The Mining Magazine

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EDITORIAL

Many books have been written on the war giving the personal experiences of the writers, but there is still room to be found on our shelves for the latest one published : "War Letters to a Wife," by Colonel Rowland Feilding. For four years, from 1915 to 1919, this gallant soldier, who is well known to many of our readers, was present on the western front in Northern France and Belgium, and his account is in the form of a vivid diary chronicling the events as they happened, with the impressions made on his mind at the time. Exigencies of space prevent us from saying much about war books, but we cannot let the publication of Colonel Feilding's diary pass without this appreciative if brief mention.

The delivery of the address by the president of the Institution of Mining and Metallurgy has been a movable function in each session recently. This year it has been found advisable for Dr. William Cullen to take the first evening of the 1929–30 session because the annual meeting in April will be disturbed by the Empire Congress in South Africa. Accordingly the meeting held on October 17 was occupied almost entirely with his address on "Modern Mining Explosives." Coming from one who has been so long associated with the manufacture of explosives his remarks were naturally of considerable value. Elsewhere in this issue extracts are made from the address, dealing with azide detonators, semi-instantaneous fuses, and non-freezing nitroglycerine explosives, which are all comparatively new features of explosive practice.

That Borax Consolidated should not be able to pay its usual dividend on the deferred shares comes to many as a surprise, seeing that the company two years ago made an important discovery of a vast deposit of a new mineral which can be worked more cheaply than the colemanite (calcium borate) which has been the chief source of borax and boracic acid during recent years. This new mineral is kernite, $Na_2 B_4 O_7 \cdot 4H_2O$, or rasorite as it is called by the company, naming it after their engineer. It differs from borax in having four molecules of water instead of ten. The reason why no dividend is being paid is that the company requires funds for equipping mines and building new refineries. During the last year or two the market price of borax has dropped considerably and it was supposed in many quarters that the discovery of the new mineral was the cause. It appears, however, that the fall is due to the Searles Lake producers selling their borax as a by-product, relying entirely on the potash content of the brine for their profit. No doubt when Borax Consolidated is working the new deposit to advantage the price will steady itself again, but at a lower figure than was customary until recently.

Periodically the marring of nature's face by mining and quarrying operations comes up for discussion among people of refinement. That the production of useful minerals should so often entail an offence to artistic feeling is, of course, to be regretted, but this drawback has been obvious from the dawn of civilization and the objection to these scars has been mitigated by the knowledge that the general advantage to mankind overbalances a local irritation. So the community has been content to view with resignation the riddling of Cornwall with tin mines and clay-pits, the spoiling of the Derbyshire ravines by limestone quarries, and the wholesale removal of Penmaenmawr. As the population and its requirements increase, so do the scale of operations. At the present time the battle of opposition to wholesale quarrying rages round the Malvern Hills, which for generations have yielded an unobtrusive supply of stone, but are now threatened, it is alleged, with total extinction. The facts cannot be denied, but the opposition is pitched in too hysterical a key. If modern methods of transport call for good roads and plenty of them, the stone must be obtained, the best and easiest quarried, and the owners of such deposits are obliged in these days of financial pressure to realize their possessions to the best advantage. There is also another point of view : Supposing the imports of stone from foreign countries increased, would there not be an outcry in various quarters and resolutions passed to the effect that the natural resources of this country should be developed and the trade thus kept within our own boundaries ? So the engineer or business man connected with mineral production suffers from onslaught on both sides and the contradictory criticisms are apt to leave him indifferent to public comment.

The Institution in Swansea

Invitations having been extended to the Institution of Mining and Metallurgy to visit the works of the Mond Nickel Company, Ltd., and of the National Smelting Company, Ltd., an enjoyable expedition to Swansea was undertaken by some sixty members, who were well repaid for having found time to break away for two or three days from their ordinary routine. A considerable proportion of the travellers also visited the new tin-plate works of Baldwins, Ltd. It is to be hoped that the Institution will in the coming years be the fortunate recipients of many like attractive summonses, for there can be no question that these journeyings and meetings of a more or less informal character are nothing if not beneficial in their consequences. Apart from the opportunities afforded of paying privileged visits to works of specific technical interest, these occasions bring about a marked increase in social intercourse in serving as meeting places of old associates and friends, wherein also many new allegiances have their beginning. It is important in this connection to compare the Institution with the Institute of Metals, the Iron and Steel Institute, the Australasian Institute of Mining and Metallurgy, and the American Institute of Mining and Metallurgical Engineers, all of which hold meetings in different mining or metallurgical centres year by year. The Empire Mining and Metallurgical Congress undoubtedly acted as a spur to the Institution in this matter, of which the first evidence was the highly successful meeting in Cornwall last year.

The latest event is especially interesting, however, in that it signalizes a departure from a policy long pursued by the Mond Company of discouraging—in fact, forbidding—the admission of visitors. This does not, of course, mean that the whole of the secrets of practice were laid bare to all and sundry, for they still had to accept the words of the guides as to the reactions occurring within certain lofty towers. Many of the party were doubtless familiar with the nickel carbonyl process, but none had previously seen the plant in which this exceptional metallurgical operation is carried out. It is hardly necessary to remind the curious that the gas content of those carefully-sealed chambers is one of the most deadly poisons known to man and that for this reason, if no other, there has been little inclination to extend the carbonyl process. It is understood, however, that certain work is being done in Germany by the I. G. Farbenindustrie on the purification of iron and cobalt by forming the carbonyls of these metals.

In the spelter works at Swansea Vale some visitors made their first acquaintance with the distillation process, while others had it borne home to them yet again how laborious is this ancient method of obtaining the metal from the flotation concentrates which are now reaching this country both from Australia and Canada. The difficulties experienced in handling these concentrates in virtue of their fine state of subdivision, and the consequent necessity for sintering furnaces to render them suitable for retorting, were made apparent. The contact acid plant was new to many and is specially noteworthy because these plants usually require sulphur or high-grade pyrites for their operation, the gases from blende and galena concentrates being too dusty, impure, and of too low a grade, and only recently has the process been improved sufficiently to admit of its use here. The tin-plate works visited by some of the party are the most modern in this country. Here the tin-plate is made from which Shell petrol tins are manufactured and the layout whereby there is an easy flow from mild steel strip to finished tinned plate in a minimum of operations is admirable.

An account of this excursion would be incomplete without some reference to the generosity of the hosts. The Mond Nickel Company entertained their guests, under the chairmanship of Mr. D. O. Evans, in their own institute. Not the least enjoyable feature of their hospitality was the musical accompaniment supplied by the works orchestra. Mr. J. L. Agnew, the vice-president of the International Nickel Company, spoke a few words of encouragement that will surely have been very welcome in Swansea when he remarked that it was not the intention of the combined nickel companies to close the Clydach works, which would continue to play their part in spite of the extensive production of the metal in Canada. The National Smelting Company were hosts to the party at dinner the same evening and Mr. Stanley Robson, who presided over this entertainment, gave a concise sketch of the process of distillation and alluded guardedly to the future technical policy of the company with regard to the treatment of concentrates at Avonmouth. While distillation is to be the method, his hearers gathered that some modification of the process may be expected.

Finally, a word of appreciation is due to the officials of the Institution and of the companies mentioned for the smooth way in which the functions were developed. In particular, Dr. Cullen is to be congratulated on the genial way in which he marshalled his party and Mr. McDermid for his efficient organization.

Boring for Oil in Kent

Statements have been made in the press that an oil-well is to be sunk on Romney Marsh, to the west of Hythe, in Kent, and the sponsors of the scheme are sufficiently optimistic to expect a supply of oil at 1,000 ft. Seeing that the surface deposits give no evidence of underground oil storage, there must be some other technical reason for the new activity. It is safe to anticipate a considerable thickness of Kimmeridge Clay at no great depth below Hythe, and as this formation is consistently associated with oil-shale the present venture is probably based on a hope of finding an oil pool in the clay or in adjacent strata. As such a hope is of the flimsiest, it is appropriate to review the question once more, so that those who may think of taking a financial interest shall know the risk involved.

The Kimmeridge Clay as an oil-bearing deposit is a well-worn theme of geological discussion, and is seldom left to rest for long. Up and down its visible outcrop it has been studied for all kinds of interests, academic and economic, while in its submerged development it has frequently been vested with the glamour of limitless resources of oil or gas, or both, to say nothing of its genuine credit as a reputable oil-shale horizon. Wherever it is met with, either at outcrop from Dorset to Norfolk or in sample from innumerable borings, it is one of the most remarkably consistent deposits with which we are familiar. As a mother-rock of petroleum it certainly once possessed great possibilities; as material it was fundamentally a good, muddy slime, extremely uniform in character and grade; as an environment for the peaceful burial of a prolific marine fauna and flora it was almost ideal; in response to the simpler stresses of consolidation it behaved much as many other bituminous rocks of similar nature and geological age have done; but somewhere in the mechanism of its formation, as we know it to-day, there was a missing part, a condition essential to the conception of free oil which it is not easy to define. The geo-chemical processes implied by the deposition and subsequent history of this clay were decidedly inimical to the segregation of quantities of fluid hydrocarbon, or even if this did form at any phase there was apparently no reservoir in the shape of sand-lenses into which the oil might be expelled and ultimately trapped, so its organic energies were directed to enriching the deposit itself, to the production of oil-shale and sporadically occurring natural gas pockets. In the face of all the evidence, it is inconceivable that, had the Kimmeridge Clay been a favourable oil-bearing rock, it would not have shown appropriate signs of such condition long ago, and that measurable yields of petroleum would have been realized in such deep borings as have in the past penetrated it; but beyond the natural gas mentioned, it has always proved singularly, or perhaps we should say inevitably, sterile of free oil, and we are unaware of any newly-discovered character which would lead to a supposition that it could behave differently.

Of the other "possibilities" under Hythe the Purbeck rocks, well-known from the Sub-Wealden borings, from outcrops in the central Weald, and from water-wells, may be ruled out, even though certain limestones and gypsiferous shales may smell strongly of No. 1 petrol, as is the case at the gypsum mines in Sussex. These are too much fractured and disturbed to form either good mother- or reservoir- rocks, and, besides, it has been shown conclusively that they have borrowed most of their bituminous (fluid) content from the Kimmeridge Clay *viâ* the intervening Portland formation, incidentally the present source of the Heathfield gas. The Purbeck beds may or may not be preserved at Hythe; similarly there is the doubt about the Portlandian, which, if present, would at least serve as a reasonable reservoir to any Kimmeridge oil or gas available. If we descend deeper, to pre-Kimmeridgian horizons, much the same scientific objections apply, whether it be to Corallian, Oxfordian, Lower Oolites, or Lias, and in any case to reach the base of the Kimmeridge Clay below Hythe—that is, practically at sea-level—would require drilling to considerably more than 1,000 ft. We cannot credit even the instigators of this contemplated oil-well with the idea that an upward migrating Palæozoic oil has been trapped at a convenient shallow horizon;

apart from the fact that we do not believe in the existence of Palæozic oil anywhere in this part of the country, any theory that involved such migration through a rock-column composed of the types known in the concealed Mesozoic would be wildly fantastic.

The Protection of Investors

The Companies Act of 1928 came into force on the first of this month, but public interest in it has waned considerably since the days of the long discussion that took place in Parliament and elsewhere a year or two ago. Already another campaign for further improving company law and protecting the investor has been launched and many of the suggestions that formed part of the propaganda of reform during past years but failed to receive general support are being revived. The case for additional action was vigorously taken up at the meeting of the Law Society held last month by that ardent protagonist, Mr. Charles L. Nordon. He pointed out that much of the recent legislation is futile in preventing fraudulent or ill-advised promotions and that penalties for gross infractions of company law do not save the investor from losses. It is no consolation to the disappointed shareholder to know that those responsible for swindles may possibly receive a term of penal servitude, and Mr. Nordon therefore pleads for laws and regulations which will kill the dangerous schemes at their inception.

One of the recommendations he puts forward is that all prospectuses should be issued in standardized form, the information being given in uniform order under headings of prominent type, and that permission to publish a prospectus should not be given without a certificate of approval from the Registrar of Joint Stock Companies, after due verification of every statement of fact. In addition the prospectus should contain copies of all material documents or full abstracts of such documents as approved by the Registrar. This would be far more useful than the present compulsory printing of the Memorandum of Association and the names and addresses of the clerks who have signed it, for this Memorandum is seldom read by intending shareholders and usually contains no useful information.

Other suggestions made by Mr. Nordon are that every director shall be required to state in the prospectus his qualifications for the position ; that no underwriting shall be referred to in a prospectus unless the underwriters have deposited with the company's bankers the amounts due on application and allotment, thus preventing "trusts" and "corporations" without adequate financial resources entering into obligations they cannot carry out should the public applications fall short of the required amount ; and that the Board of Trade should assume the duty of enforcing penalties laid down by the Act and of investigating grievances and complaints on behalf of shareholders. Among the foregoing suggestions perhaps that relating to the qualifications of directors will be the most difficult to carry out, for undoubtedly many influential men, with little or no special business aptitude but able to command capital, expect some recompense and claim a seat on the board in order to watch the interests of their financial supporters. Then again many people with experience in the technical part of a venture may not be business experts and their directorships may have disastrous results. However, the inclusion of a provision in the Act such as that suggested would effectively scatter crowds of what inoffensively may be called amateur directors. Mr. Nordon is inclined to recommend a still more drastic regulation in this connection by making it compulsory for all directors to be licensed.

One of the crying grievances of the present day is the growth of "trusts," the ostensible object of which is to enable an investor to do his business all in one transaction, at the same time giving him an opportunity of participating in favourable new flotations issued under the auspices of the "trust." Theoretically, and when the directors are experienced and trustworthy financiers, such an institution serves an excellent purpose, but nowadays there is no guarantee that the funds subscribed will be used to the advantage of the subscriber and not applied to purely speculative and indeed risky transactions. Whether Mr. Nordon has any specific cure for this unfortunate state of things is not quite clear, but one of his suggestions may possibly cover these cases, namely, that every issuing house shall be licensed by the Board of Trade and be required to make a substantial deposit to meet claims in the same way as insurance companies. Such a requirement might effectively help in regularizing the use of money subscribed in this way, but probably other provisions would also be necessary to remove one of the sinister features of current finance.

REVIEW OF MINING

Introduction. — The dullness which ushered in the autumn has continued and both the Stock Exchange and the Metal Exchange have exhibited weakness. In spite of considerable activity among tin producers with the object of stabilizing prices, tin has continued to fall. The general collapse on the New York Stock Exchange following over-speculation caused some excitement here, but the adverse effect was not so great as might have been expected. Political events in British coal circles are causing some uneasiness, for the Government, the coal owners, and the miners all seem to have different views as to the expected decrease in the hours of employment and a settlement of the new conditions appears at present to be far off. The formation of a Government committee to examine banking practice may be of eventual value in making it possible for banks to give better and cheaper facilities for industrial loans. On the other hand, some objection may be made to the Government's financial proposals for inaugurating public works for the relief of unemployment.

Transvaal.—The output of gold on the Rand during October was 853,609 oz. and in outside districts 35,081 oz., making a total of 888,690 oz., as compared with 849,553 oz. during September. At the end of October the number of natives engaged at the gold mines was 189,739, as compared with 190,567 at the end of September.

The results at Sub Nigel for the year ended June 30 last are given elsewhere in this issue. It will be seen that developments have not fully maintained the reserve of rich ore, the total reserve being estimated at 891,000 tons averaging 18·2 dwt. over a stoping width of 22 in., as compared with 986,000 tons averaging 19·7 dwt. over 24 in. the year before and 1,013,000 tons averaging 20 dwt. over 25 in. two years ago. A large amount of development work has been done, the footage being 42,367 ft., as compared with 22,559 ft. the year before. Of the footage sampled 36·7% was payable, as compared with 42·9%.

Southern Rhodesia.—The output of gold during September was reported at 45,025 oz., as compared with 46,473 oz. in August and 47,716 oz. in September, 1928. Other outputs during September were: Silver, 5,837 oz.; coal, 90,279 tons; chrome ore, 17,976 tons; asbestos, 3,674 tons; arsenic, 20 tons; corundum, 16 tons; mica, 16 tons; iron, 210 tons; scheelite, 3 tons; tin, 2 tons; barytes, 59 tons; diamonds, 17 carats.

The Gold Fields Rhodesian Development Co. made a profit of £181,604 during the year ended May 31 last and has distributed £125,711 as dividend, the rate being 10%. During the previous year the profit was £169,019 and the dividend was the same. No new interests of importance have been acquired recently, but holdings in the Wanderer, Mayfair Gold, and Loangwa Concessions have been increased.

Operations at the Wanderer Consolidated Gold Mines commenced on October 8 and from then until the 16th of last month 2,312 tons of ore averaging 5·56 dwt. per ton was treated for a yield of 567 oz., equal to 4·91 dwt. per ton. It is expected that the plant will be working at full capacity about the middle of the current month.

It will be remembered that, on the poor prospects at the Copper Queen being demonstrated by Dr. McCann, the Southern Rhodesia Base Metals Corporation decided to suspend work there and transfer the plant to the Alaska copper mine. The report now issued shows that the first unit started in the middle of September and from then until the middle of October 155 tons of high-grade concentrate was produced and is to be shipped to Europe. It is hoped that in the course of a short time this unit will reach its normal capacity and be producing 200 tons of concentrate per month.

Northern Rhodesia. — News from Loangwa Concessions is not very cheerful, as the first diamond-drill hole has registered 10 ft. of ore averaging only 0·9% copper. Those who have read the article last month on estimating ore reserves by bore-hole will realize, however, that they need not be altogether discouraged.

The Rhodesian Selection Trust and the Rhodesian Anglo American are both issuing new capital for the purpose of extending their copper operations in Northern Rhodesia, particularly in connection with the Mufulira and Chambishi mines. The Rhodesian Selection Trust is operating these properties under agreement with Bwana M'Kubwa, which company is controlled by Rhodesian Anglo American. The Selection Trust, which is the parent company of the Rhodesian Selection Trust, has also increased its capital and some at any rate of the new money will be used in developing Rhodesian copper mines.

Gold Coast.—It will be remembered that Ashanti Goldfields Corporation acquired the old Bibiani gold mine in 1927 with a view to reopening it and conducting exploratory work. At the meeting of shareholders held last month it was stated that progress has been slow owing to the dangerous condition of the workings. The shaft has been cleared and lined with steel setts to the deepest level—No. 3, at 368 ft. —opened up by the old company, and the rest of the shaft—100 ft.—is being cleared and similarly lined.

Nigeria.—Three companies of the Latilla group are to be amalgamated, with the idea of cutting expenses in face of the present low price of tin. These are the Nigerian Base Metals Corporation, the Anglo-Nigerian Tin Mines, and the Nigerian Power and Tin Fields. The latter has recently handed over its Kurra Falls hydro-electric undertaking to the Anglo-Oriental group. The chief mining properties of the three companies are in the same district and this fact, together with the expected supply of electric power, is hoped to make it possible to work them more economically.

The Ribon Valley Tinfields, a company belonging to the Latilla group, finds itself in financial difficulties owing partly to the fall in the price of tin and partly to the new plant not starting operations as early as was expected. The report for the two years ended March 31 last shows credits of £41,796 from the sale of 316 tons of tin concentrate and costs of £41,984, leaving an adverse balance on working of £187. The position is rendered unsatisfactory by an interim dividend having been paid in February, 1928, when $7\frac{1}{2}\%$, absorbing £11,500, was distributed. This amount not only absorbed the balance carried forward on March 31, 1927, but results in an adverse balance of £4,130 being shown at March 31, 1929.

India.—In the last annual report of the Mysore Gold Mining Co. it was mentioned that a new lode had been cut by bore-holes from the surface at a distance of 1,600 ft. east of the outcrop of the main lode. A pilot shaft was sunk and the news is now to hand that the lode has been cut at a depth of 280 ft., where it is 10 in. wide and assays 3 oz. 2 dwt. per ton. It will be remembered that Mr. Thomas Pryor, in his paper on the geology of the Kolar goldfield six years ago, mentioned that there are at least 26 lodes in this district and that only the Champion and Oriental lodes have been developed, the main, or Champion, lode having accounted for nearly all the gold output. The lodes all dip to the west and the Oriental is about half a mile to the west of the main lode, while the new lode now struck is to the east of the main lode. It is about four years since exploration by diamond-drill was adopted at the Kolar group of mines. So far the results published have concerned underground work and the present case is presumably the first of discovery and development from surface.

Malaya.—Kampar Malaya Tin Dredging, Ltd., was formed by the Anglo-Oriental group in 1927 to acquire from the London Tin Syndicate tin-bearing land on the Kampar River, Perak. The dredge started in May last. During June it treated 123,700 cu. yd. for 50 tons of tin concentrate and the output gradually increased until in September 227,500 cu. yd. was treated for 80 tons. During the four months 250 tons was extracted from 716,700 cu. yd., the yield per yard being 0·78 lb.

The present position of tin was discussed early this month in the Federal Council by Sir William Peel, the Chief Secretary, when making his statement relating to the finances of the Federated Malay States. He expressed himself as doubtful of any advantage to be gained by the curtailment of output on the part of existing producers, but, in response to communications made by the Chamber of Mines, he and his colleagues were considering the question of the alienation of land for mining purposes. He stressed the importance of conserving the tin resources of the country and said that the present increase in the output of tin was not helpful either to the Government or the industry.

Australia. — The West Australian Minister of Mines has agreed to advance £10,000 free of interest to Boulder Perseverance to help in the building of a new bromo-cyanide plant, which is to cost £30,000. It is believed that with this plant a saving of 6s. per ton will be effected in the cost of extraction. When the cost is reduced by 4s. or more per ton repayment of the advance is to be made by a royalty of 1s. per ton.

A noteworthy victim of the low price of tin is the Mount Bischoff Tin Mining Co., of Tasmania, which has shut down its mines and smelter awaiting better times. This company has been in operation since 1873, with never a break until now.

Owing to the continuance of the coal

lockout in New South Wales, which has caused a lower output of iron and steel and a higher cost of production, the Broken Hill Proprietory Co. has been unable to declare the usual half-yearly dividend.

Canada.—A serious fire occurred on October 28 at the Dome Mines, Porcupine, when the mill was completely destroyed.

Cornwall.—In these days of depression in Cornish tin mining owing to the low price of the metal it is pleasant to be able to record that the Geevor mine, at Pendeen, has declared an interim dividend for the half year ended September 30 last. During this period 28,562 tons of ore yielded 422 tons of concentrate, selling for £42,750. Approximately the yield per ton was worth 36s. 7d., the cost per ton 29s. 6d., and the total gross profit £10,000. The interim dividend, at the rate of 5%, will absorb £8,212. Development continues to disclose ore of a satisfactory character.

Polhigey Tin, Ltd., in its report for the year ended April 30 last, states that milling started on February 21 and from that date to the end of the year covered by the report 10,500 tons of ore was milled, the output of concentrate being 34 tons. Four lodes are being developed, the chief one being estimated to average 22 lb. of tin oxide per ton over a width of 49 in. The reserve of ore blocked out is given at 115,400 tons, sufficient to keep the mill going for 20 months.

Kent.—A year ago it was announced in these columns that the Tilmanstone (Kent) Collieries, Ltd., had obtained powers to build an aerial ropeway from the mine to Dover harbour. Last month the section of the ropeway from Tilmanstone to Pineham, two-thirds of the way to Dover, was completed and it is expected that the remainder will be at work in December, so that shipments from Dover harbour should commence early in the new year. It will be remembered that this method of transport from the mine to the sea was adopted on account of the high cost of the short railway journey. The ropeway will be 9 miles long and will carry 3,000 tons of coal per day.

Mexico.—Last month reference was made in this column to encouraging developments at the Dos Carlos mine of the Santa Gertrudis company. Since then it has been announced that on the 19th level a cross-cut has disclosed 32 ft. of ore averaging 6 dwt. gold and 50 oz. silver, of which 19 ft. was in the lode assaying 67 oz. silver and 13 ft. was mineralized hanging wall assaying 25 oz. silver.

The El Oro gold mine was closed in 1926 after a prosperous career, but the company has continued in existence, as it had a number of minor investments. To meet the altered conditions the capital was reduced a year ago from £1,147,500 to £286,875 by cancelling 15s. per £1 share. The company has by this means been able to return to the dividend-paying list, 1s. 0½d. per 5s. share now being paid, less income tax, for the year ended June 30 last. The company's chief assets at present are the railway and the La Noria silver mine. During the year the railway made a profit of £14,091 and the silver mine a loss of £2,977, other items bringing the year's profit to £25,386. At the silver mine 169,083 short tons of ore was treated, averaging 16·4 oz. silver and 0·38 dwt. gold per ton, and the yield was 3,301 tons of concentrate, selling for $1,343,722, together with 31 tons of ore realizing $3,070.

Panama.—As readers will remember, Mr. Hugh F. Marriott some time since joined the board of the Panama Corporation and subsequently visited the property. At the annual meeting on October 31 he delivered a lengthy address, which is reported in full elsewhere in this issue. Mr. Marriott corroborated the views of the engineers with regard to the value of the alluvial gold deposits in the Sabalo River, at El Mineral, and at San Jose Hill and spoke favourably of exploration work on the lode-gold deposits around the old Cana mine. The most important news he had to give, however, was in connection with quite recent developments at Mina Blanca mines and at two other properties which were not specifically named. A year ago the Mina Blanca was described as a lead-zinc deposit, but since then the accompanying gold has added greatly to its importance. The other properties contain copper and silver and the grade is described as being very high, assays over stoping width showing 14% copper and 36 oz. silver.

Norway.—The Dunderland Iron Ore Company has struggled for existence for over a quarter of a century, but it appears from the report for 1928 just published that the concentrating difficulties have been overcome and that satisfactory contracts have been made for the sale of the products. It is estimated that the deliveries during 1929 will amount to 90,000 tons and eventually an output of 16,000 to 20,000 tons monthly is expected. The management of the company is now with the Tilden Smith group.

THE MOUNT ISA LEAD-ZINC MINES
NORTH QUEENSLAND

This article is based on reports published by the Company and deals with the geology and present mining operations. In further articles to be published next month Mr. C. A. Mitke will give an account of the comprehensive method of mining to be adopted, and Mr. J. M. Callow will describe the concentration and metallurgical plant now in course of erection.

INTRODUCTION. — The lead-zinc-silver deposits at Mount Isa, North Queensland, are already sufficiently well known to readers of the MAGAZINE to make it unnecessary to give here an account of their discovery and early development. Suffice it to say that since the middle of 1927 the finance and technical management have been in the hands of the Urquhart group, that is to say, at first the Russo-Asiatic Consolidated and later the newly formed Mining Trust, Ltd. The operating company continues to be the Mount Isa Mines, Ltd., some of the shares in which are still held in Australia. With this brief introduction it is possible to proceed at once with a description of the ore-bodies and of the general geology, leaving the method of mining and the concentration and metallurgy to be described in future articles. After a period of full investigation the construction of the concentrator and smelter is at present in hand and the mill and smelter will probably be completed early next year, when the rearrangement of underground work will have progressed sufficiently to deliver regular supplies of ore to the mill. The plant provides for the handling of 1,000 tons of carbonate ore and 500 tons of sulphide ore per day, fine grinding of both classes, tabling the coarser carbonate on Deisters, and flotation in MacIntosh cells of the rest of the carbonate and the whole of the sulphide ore ; this to be followed by sintering and smelting in lead blast-furnaces, the zinc concentrate from the sulphide ore being sold until such time as a zinc plant is erected. Though the total capacity of the concentrating plant is given at 1,500 tons, it is probable that it will be capable eventually of treating 2,000 tons. Connection is already made with the Queensland railways. Coal will be obtained from Collinsville, 50 miles south-west of Bowen, and an electric power plant is being erected on the mine employing this coal in powdered form, the plant operating on the Fuller-Bonnot system. Water for the dressing and power plant and for domestic purposes will be obtained from a reservoir built 20 miles away at Rifle

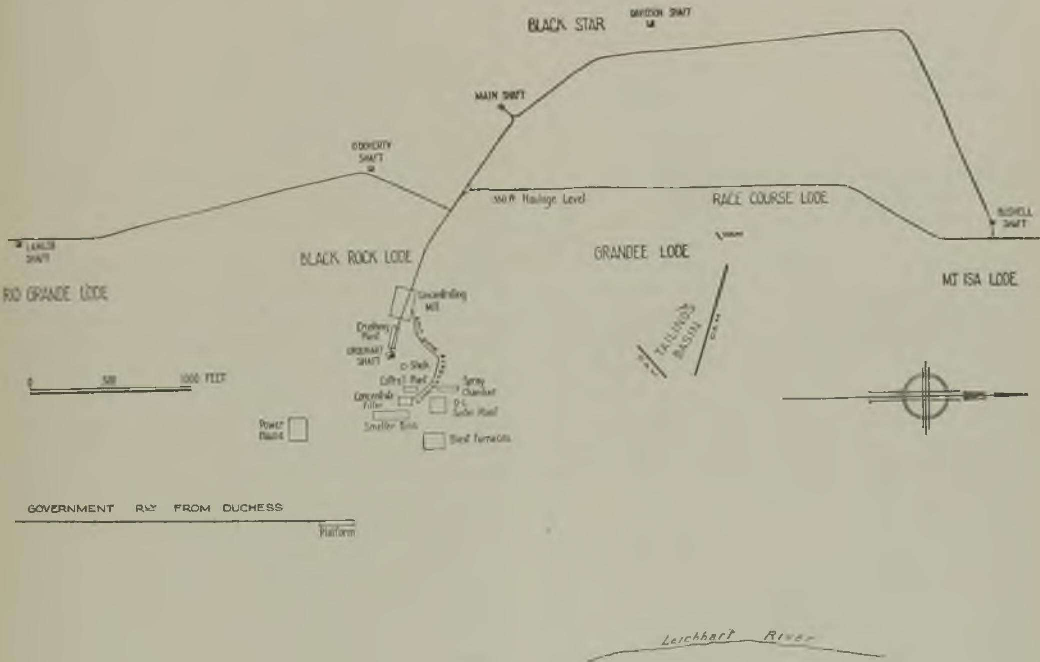


FIG. 1.—PLAN OF MOUNT ISA MINES.

Creek, and further supplies will be available from the mines itself as water has been struck in depth.

THE ORE-BODIES.—There are a number of ore-bodies on the property and of these the Rio Grande, Black Rock, and Mount Isa contain high-grade carbonate ore with sulphides appearing in depth, while the Black Star is of lower grade and the sulphides make their appearance much nearer the surface. In the first three the delimitation of the carbonates and sulphides has not yet been completed.

The following table gives an estimate of the ore reserves at the present time :—

	Tons.	Lead. %	Zinc. %	Silver. Oz.
CARBONATES—				
Rio Grande	200,000	15·8	—	9·2
Black Rock	120,000	22·4	—	10·6
Mount Isa	100,000	12·0	—	4·4
Black Star	3,100,000	8·0	—	3·0
	3,520,000			
SULPHIDES, BLACK STAR—				
Measurable to 750 ft. depth	14,700,000	6·2	8·0	3·9
Further expected to 750 ft. depth	3,000,000	6·2	8·0	3·9
In addition, approximately	500,000 of much higher assay.			

to 400 ft. depth have proved the continuation to these depths of three principal veins from 5 ft. to 22 ft. wide, while one, from which the best results were not expected, cut a 12 ft. vein, well above the average in lead, at a depth of 530 ft. Again, at 1,000 ft. depth, various veins were encountered of which one carried 20% lead and 23 oz. silver on a width of 13 ft. Although the diamond-drilling has not yet proceeded far enough to permit a statement of the sulphide ore reserves, it has nevertheless already proved persistence in depth to 1,000 ft., and has given no cause to doubt further considerable extension. Therefore, pending further exploratory work, it is permissible to apply to the sulphides the dimensions used in estimating the carbonates while introducing the specific gravity, 3·6. Thus, 150,000 tons of sulphide ore per 100 ft. depth can be counted on or, between the 160 ft. and the 500 ft. horizons, very probably half a million tons. In lead content the sulphide ore is somewhat lower than the carbonate, but the deficiency is more than offset by the higher silver tenor. Moreover, it contains 6% or more zinc.

As already mentioned, the deposits lying within the boundaries of the property are of two classes, the high-grade lodes, including the Rio Grande, Black Rock, and Mount Isa, which form a mineral belt extending north and south the full length of the property, or two and a half miles, and the second or lower grade type of lode, represented by the Black Star, lying parallel to the first, about 1,000 ft. distant to the west.

The Rio Grande mine is served by the three-compartment vertical Lawlor Shaft, from which at a depth of 175 ft. a cross-cut in the hanging wall cuts through the lode. This is here composed of four distinct veins of sulphide ore from 4 ft. to 12 ft. wide, separated by from 5 ft. to 15 ft. of country rock. Not far above this level the sulphide gives place to oxidized ore or carbonates. On the 130 ft. level two of the veins, both completely oxidized, have been opened by drives and cross-cuts and prove the so-called main vein to be 620 ft. in length and 13 ft. mean width, while No. 2 vein is 600 ft. long and averages 14 ft. wide. Allowing 160 ft. depth of oxidation and a mean specific gravity of 2·5, the main vein contains 90,000 tons of carbonate ore carrying 15·8% lead and 9·2 oz. silver per ton. No. 2 vein contains an equal amount of ore of like grade, or a total of 180,000 tons in the two veins. Bore-holes cutting the lode at 300 ft.

The Black Rock mine is opened up to a depth of 250 ft. below the outcrop by the O'Doherty Shaft, a three-compartment incline of 37°. This horizon marks closely the lower limit of the zone of oxidation, and the level which develops it is partly in carbonate ore and partly in sulphide. The ore-shoot is 350 ft. long by 20 ft. wide, and disturbances of the formation at the ends have hindered adequate exploration in both directions. Attempts to prove the ore-body in depth by means of diamond-drills have not been altogether successful. Of the three bore-holes attempted, the southernmost was stopped owing to difficult ground before cutting the ore-body, the middle bore failed to cut the ore-body at all, but at a depth of 500 ft. disclosed a vein, hitherto undiscovered, in the foot-wall, apparently 21 ft. wide and carrying 10·1% lead, 6·2%

zinc, and 6·3 oz. silver. The developed reserves of carbonate ore amount to 120,000 tons, carrying 22·4% lead and 10·6 oz. silver. It is premature to hazard a forecoast of the quantity of sulphides available.

On the Mount Isa mine, from the three-compartment vertical Bushell Shaft a cross-cut, 165 ft. in depth, intersects the ore-body at about the level of transition from carbonate ore to sulphide. Two bore-holes closely spaced prove the extension of the lode to a depth of 365 ft. where the width is 11 ft., but the difficulty of boring in such ground and the untrustworthy results discourage further attempts at diamond-drilling. So far as developed, the ore-shoot has a length of 400 ft. and a width of 20 ft., corresponding to a carbonate reserve of 100,000 tons of ore containing 12% lead and 4·5 oz. silver. Good exposures at No. 23 Shaft, 540 ft. north of the Bushell, and at No. 6 Shaft, 220 ft. still further north, promise a substantial extension of the lode in this direction. At the present time it is not intended to push development in the Mount Isa.

On the Black Star, the lode has been traced by surface and mine working and by boring over a length of 2,000 ft. and a variable width up to 250 ft., while the greatest depths thus far demonstrated by the " B " line of bores is over 800 ft. below the outcrop. (See Fig. 2.) The three-compartment vertical Davidson Shaft is in the hanging wall and at the 200 ft. level a cross-cut intersects the lode at about the permanent water level, which corresponds to the transition of the oxidized zone to the sulphide zone. Above this horizon the oxidized zone has been adequately explored by means of trenches across the outcrop, by numerous shafts and churn-drill bores and by drives and cross-cuts. The data available make it possible to determine the volume and the metallic content of the carbonate ore with sufficient accuracy. On the basis of a specific gravity of 2·3, the carbonate reserves amount to 3,100,000 tons containing 8·0% lead and 3·0 oz. silver per ton. The " A " row of bore-holes from 7 to 14 proves to this date a length of 2,000 ft. at 500 ft. depth. The " B " line of bores, cutting the lode at 750 ft. depth, demonstrates the unimpaired quality of the ore to the lowest horizon thus far attained, namely 800 ft. Bore-holes B 1, 4, and 8 are now finished. Based on the volume actually delimited at this date and applying the specific gravity 3·3, 14,700,000 tons of sulphide ore are measured, carrying 6·2% lead, 8·0% zinc, and 3·9 oz. silver.

GEOLOGY.—The following account of the geology of the district comes from Mr. H. H. Knox's report.

The mature topography of the district is characterized by low north-south trending ridges rarely attaining a height of 400 ft. above the intervening level valleys. An ancient peneplain after elevation has been

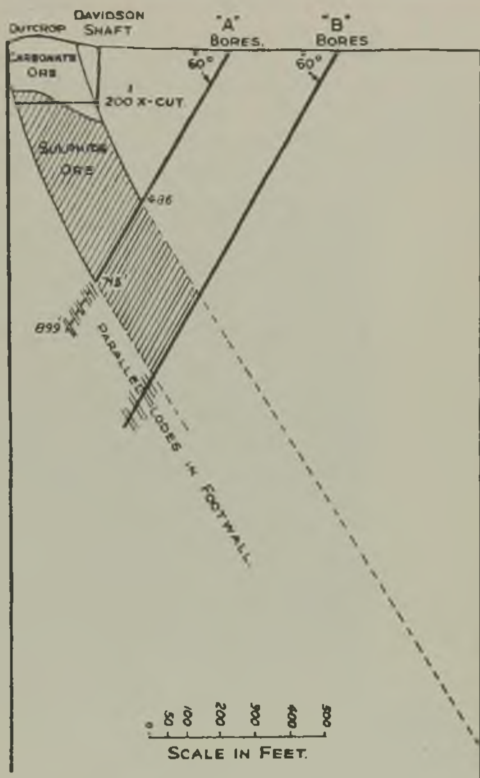


FIG. 2.—SECTION ACROSS THE BLACK STAR LODE SHOWING BORE-HOLES.

dissected down to the present level of the valleys at an altitude of about 1,200 ft. above the sea. The course of the hills and prominences conforms in general with the strike of the formation, and it is clear that the relief, save where hard igneous rocks or quartz have invaded the sediments, has been determined by the selective silicification of certain beds which thereby become highly resistant to weathering, leaving the unaffected strata an easy prey to erosion. This phenomenon of superficial silicification, so common in arid regions, is here unusually pronounced. The effect is cumulative at the surface and does not extend downward more than 8 or 10 ft.

Within a few miles both to the south and north of the mines appear bosses of coarse-grained granite traversed by dykes of ultra-basic rocks, some of which can be identified as olivine-pyroxenite or its uralitized derivative. Paralleling the granite intrusion to the north huge lenses of quartz extend for miles and as snow-white hills form a conspicuous feature of the landscape. They may reasonably be regarded as representing the ultra-acid phase, as the pyroxenite marks the extreme basic phase of the granitic magma. These occurrences harmonize with the earlier silicification and later dolomitization observed of the rocks adjoining the ore-bodies.

Westward (on the hanging wall side) of the Black Star lode a body of greenstone of aphanitic texture outcrops and has been followed downward 2,000 ft. by deep bore No. 1. This rock or series of rocks displays all stages of alteration, culminating at depth in a biotite-chlorite schist. In age it precedes the close of the dynamo-metamorphic episode. At 2,000 ft. depth it is succeeded by the normal metamorphic sediments.

The predominant rocks of the district are sedimentary and may be classed provisionally as Precambrian. Alternating thin beds of original limestone, calcareous shale, and clay shale have undergone alteration, wholly or in part, to crystalline limestone and silicified limestone and shale, while the so unaffected limestone has later to a large extent been changed to dolomite. Notwithstanding the introduction of much silica and magnesia, there is evident a nett reduction of volume manifest in unfilled solution cavities. The final alteration under the action of acid surface waters has resulted in the kaolinization of those shales which have escaped the attacks of silica, thereby rendering them extremely porous, and the low specific gravity (2·3) of the Black Star lode above water level testifies that the superficial as well as the deep metamorphic processes have abstracted more material than they have contributed.

The general strike of the stratification is north-south and the dip approximates 60° W. Compressive stresses, doubtless associated with the igneous activity, have produced zones of folding also trending north-south, and in the vicinity of the ore-bodies the plication is often severe without, however, inducing rupture save on a small scale; indeed, dislocations of more than a few inches are uncommon. Seams of iron sulphides as pyrite and pyrrhotite, introduced at the metamorphic stage, partake of the folding without apparent rupture. This generation of sulphides replaces the rock as dense aggregates of minute grains.

Fig. 3.—Headframe at Lawlor Shaft.

On the eastern ore belt a group of major folds has thrown the alignment to the right and at the extreme northern end of the property a gossan outcrop several feet wide cuts squarely across the formation. The economic significance, if any, of these phenomena is subject to later investigation.

The next stage in the history of the deposits appears to have ensued after a long time-interval. Tensional strains, acting along the old lines of weakness, opened channels for the circulation of solutions which deposited their metallic burden partly in the passages so formed and partly as a replacement of the rock and the older iron sulphides. This later movement, causing shearing and fracture, is distinguished in mode from the older, which is characterized by plication, although shearing forces have also caused local folding. Differential movement along the bedding planes of two beds which themselves remain undeformed may produce the most fantastic convolutions of a plastic stratum lying between them. And here it is worthy of note that a tendency of the folds caused by bedding faults to pitch rather flatly toward the north suggests a possible connection with the pitch of the ore-shoots. Since, however, these new shear zones do not conform strictly with the stratigraphic strike but cut it at an acute angle, the tendency of the ore-bodies is toward an alignment *en échelon*, an effect to be taken into account in exploration.

The primary economic minerals are the common sulphides of lead, zinc, and silver, with accessory copper (principally chalcopyrite with a little bornite). The gangue minerals are calcite, dolomite, and the iron sulphides, with accessory manganese mineral and carbonaceous matter in flakes resembling graphite.

The succession of events involving the deposition of ore has been as follows :—

(1) The introduction of pyrite and, somewhat later, pyrrhotite as bands from a millimetre up to several feet wide, replacing sedimentary laminæ and beds, at a period preceding or coinciding with the local folding of the strata. The pyrite is distinguished from later generations by its extremely fine grain.

(2) The second or shearing period opened passages for solutions which at first deposited fine-grained zinc blende and a coarser grained pyrite as replacements of older minerals and as veinlets in the gangue.

(3) Chalcopyrite (in places subsequently altered to bornite) slightly precedes and then accompanies the deposition of argentiferous galena. Besides replacing the older minerals and rocks and occupying minute joints, fissures, and bedding faults, the galena finds favourable lodging in saddles and troughs of sharp folds where the strain has fractured the rock.

(4) The calcium-magnesium carbonates extend throughout the whole range of ore deposition as does the quartz.

(5) From the surface to a depth of 150 to 200 ft. corresponding in a general way with the permanent water-table, the metallic sulphides have been oxidized to lead carbonate with minor amounts of sulphate and other lead salts, and to zinc carbonate, the major portion of which has been removed in solution, leaving the more stable lead and silver salts in place. Copper where present

Fig. 4.—Rifle Creek Dam from below.

appears as carbonate, oxide, and even native. The iron sulphides have become limonite, hematite, and ochre and a certain amount of manganese oxide has segregated. Cavities are often lined with gypsum and with crystallized quartz infiltrated from above and the outcrops, usually barren, are represented by silica of colloidal origin.

Consideration of the various solubilities of the minerals leads to the expectation that the lead tenor in the ozidized zone will be somewhat higher than in the sulphide zone, but such concentration is only relative; the agencies which have leached the gangue have left the lead in place. The highly soluble zinc is almost entirely removed in the oxidized zone, while the silver, occupying an intermediate place in respect of solubility has been impoverished.

In the replacement of the rocks and minerals by a later arrival there is no perceptible tendency toward selection and the control appears to be purely physical. In the walls well away from a lode stringers and veinlets of calcite or dolomite occur, containing specks of zinc blende. As the lode is approached the blende increases and galena appears. Then may follow a streak sufficient in quantity but of too low grade to be classed as ore, or else a streak of good ore too narrow to be of value. Finally appears the lode, which is an aggregate of such streaks, collectively or individually as the case may be, of profitable size and grade. The increasing alteration of calcite to dolomite as a lode is approached may possibly serve as a useful indicator in future exploration.

METHOD OF MINING. — As already mentioned the various ore-bodies have been developed separately, but the present company, acting on the advice of Mr. C. A. Mitke, has determined on a comprehensive system of mining. The Urquhart shaft is being sunk as an ore-shaft and the main shaft for men and supplies. A main haulage level is being constructed at a depth of 350ft. This system of mining will be described by Mr. Mitke in the next issue. In the meantime the plan (Fig. 1) accompanying the present article shows the position of the various shafts and the haulage level, together with that of the mill and smelter.

FIG. 5.—EXCAVATIONS FOR THE LOWER MILL.

Uganda Railways.—Early this month the manager of the Kenya-Uganda Railway introduced the railway budget for 1930 in the Kenya Legislature and gave an outline of proposed extensions. From the point of view of the mining man the extensions in Uganda were of particular interest. It was announced that the railway is to be continued to Kampala, which will involve the building of a bridge across the Nile. Afterwards the line will be extended westward to the Ruwenzori region, where it is hoped that connections will ultimately be made with the line from Stanleyville, in the Belgian Congo.

DIAMOND MINING ON THE GOLD COAST

By S. V. GRIFFITH, A.I.M.M.

The author describes the occurrence of diamonds in Gold Coast Colony and gives particulars of prospecting method and the mining and extraction of diamonds.

INTRODUCTION.—The diamond fields of the Gold Coast Colony are situated in the district of Akim Abuakwa, Eastern Province, some 90 miles inland, and were first discovered by the officers of the Gold Coast Geological Survey just after the war. Mining operations commenced in 1919 and, although at present there are only two companies producing on a large scale and although the operations are more or less confined to the region around the villages of Akwatia and Kokotintin in the Birrim valley, the industry has made rapid progress. In 1920, for instance, a total of 100 carats were produced valued at £360, whereas for the year 1927–28 the production was 501,455 carats valued at £475,000. The diamonds occur in the gravels and old marine deposits of the Colony and are known to the trade as "sand diamonds" and average 15 to 25 stones to the carat, although larger stones from ½ to 1 carat are occasionally found.

GEOLOGY.—The geology of the country may be described as follows : In the western portion of the Colony a series of ancient sedimentary and volcanic rocks occur, the former being composed, originally, of sand and gravel denuded from the land masses and deposited in the sea, and the latter of lava flows and sills of dolerite and andesite. These ancient rocks have been considerably altered both by dynamic metamorphism and contact metamorphism resulting from igneous intrusions, chiefly of granitic and allied rocks, and now comprise mica-, quartz-, graphite-schists, phyllites, slates, conglomerates, etc. This series of altered sediments is highly folded in places and strikes in a north-easterly and south-westerly direction from the coast, inland, and forms among others, the Atiawa range of hills,

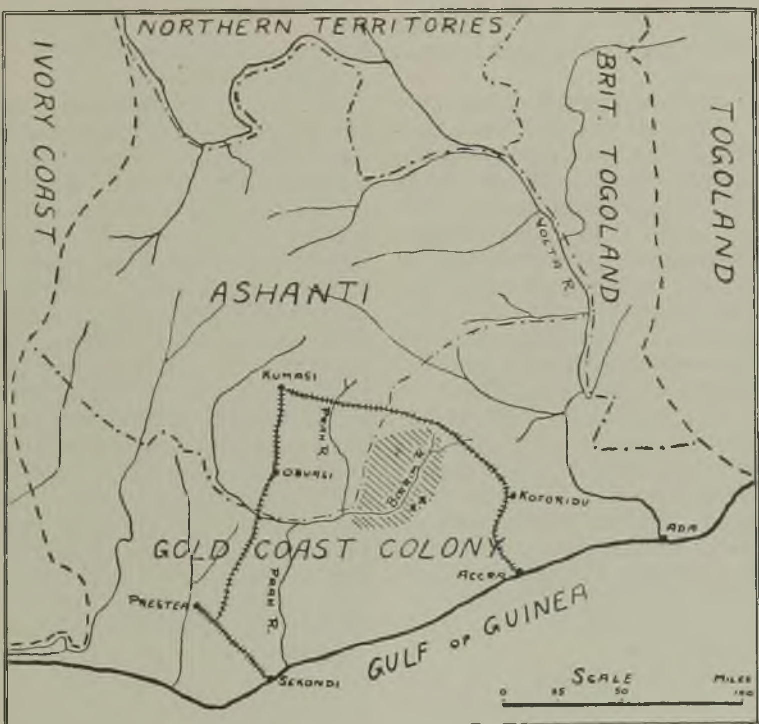


FIG. 1.—SKETCH-MAP OF THE GOLD COAST COLONY, SHOWING LOCATION OF THE DIAMOND FIELDS. SHADED PORTION REPRESENTS DIAMOND AREA AND XX DENOTES MINING CENTRES.

which lies just south-east of the diamond fields.

In the eastern portion of the Colony there exists a series of old crystalline rocks, composed of great masses of gneisses, etc., and having the same strike as the altered sediments of the west. It is quite possible that these crystalline rocks are a more highly metamorphosed edition of the altered sediments, but this has yet to be proved.

The exact age of these rocks is unknown, but they probably range from Palæozoic to Precambrian. Numerous granitic intrusions, at a later date, took place along the strike of these rocks, greatly changing their character; associated with these intrusions are pegmatitic dykes, which cut across and penetrate the adjacent rocks for great distances.

The greater portion of these rocks were deposited in a shallow sea and were subsequently uplifted by earth movements, when they suffered enormous marine erosion and denudation. The various isolated hills existing to-day in the Colony, which show signs of marine erosion, were undoubtedly islands, while some of the steep hill ranges formed cliffs bordering this sea.

The diamondiferous gravel consists of pieces of quartz—sometimes well rounded but usually quite angular—embedded in a clayey matrix, containing pieces of staurolite, black garnetiferous sand, and small grains or nuggets of gold. The gravel, which varies from 2 to 6 ft. in depth, rests on a decomposed schistose bedrock usually of a yellowish- or bluish-green colour, and is overlain by a variable thickness of overburden, consisting of a clayey alluvium.

Three types of gravel are commonly encountered, namely :—

(*a*) A red gravel of lateritic nature, poor in diamond values, usually forming the upper reaches of the valleys.

(*b*) A sandy, clayey gravel, blue in colour.

(*c*) A blue, clayey gravel, rather stiff, found bordering and extending outwards for considerable distances from the present river beds.

(*b*) and (*c*) usually carry good diamond values.

Various theories have been put forward regarding the origin of the diamond, but until more fieldwork has been done and more evidence collected, it is not possible to favour any one theory more than another. One group of theorists hold the view that some undiscovered pipe is responsible for the diamonds, while another group favour the theory that the diamonds were formed by the crystallization of the graphite in the graphitic sediments by the action of an igneous intrusion.

Sir A. E. Kitson[1] states "there is no satisfactory evidence to indicate that they (the diamonds) have any direct local association with volcanic plugs, as is the case in South Africa. The sources from which they were originally derived may have been plugs and flows of volcanic rocks or diamondiferous conglomerates derived directly from such volcanic rocks, or from later conglomerates formed from the older conglomerates, or they may have been formed by the action of pegmatite intrusions on highly carbonaceous slates, phyllites, or graphite schists."

Mr. G. Percy Ashmore[2] states: "The crystallized diamonds are generally octahedra and dodecahedra. Octahedra cleavage flakes occur in fair numbers, and many are more or less chipped, due to the action of water, having been washed to and fro on a sea beach. . . I suggest that, where the pegmatite dykes widened, heat was retained and caused the crystallization of graphitic matter to form diamond at the junction with the phyllite. . . . The question arises whether the dykes or the phyllite originally produced the diamonds. This is not yet determined, but as staurolite occurs in great abundance in the gravels, and is a mineral of contact-altered sedimentaries, the probability is that it was the graphite in the phyllite that crystallized into diamonds rather than the carbon inherent in the pegmatite."

This theory is quite feasible but the fact that cleavage flakes occur does not necessarily imply the action of water, as cleavage flakes also occur in the diamond fields of South Africa, and "owe their condition to the violent explosive outbursts which shattered country rock and kimberlite alike."[3] Also the presence of staurolite is not evidence of the diamonds having been formed by the action of an igneous intrusion on a graphitic sediment, as staurolite also occurs in some alluvial diamond fields in South

[1] Mineral Resources of the Gold Coast, by A. E. Kitson, MINING MAGAZINE, Jan., 1925.

[2] Discussion on "Description and Method of Working the Obuasi Reef of the Ashanti Goldfields Corporation, Ltd.," Bulletin No. 295 of the Institution of Mining and Metallurgy, April, 1929.

[3] "Diamond Fields of Southern Africa," by P. A. Wagner.

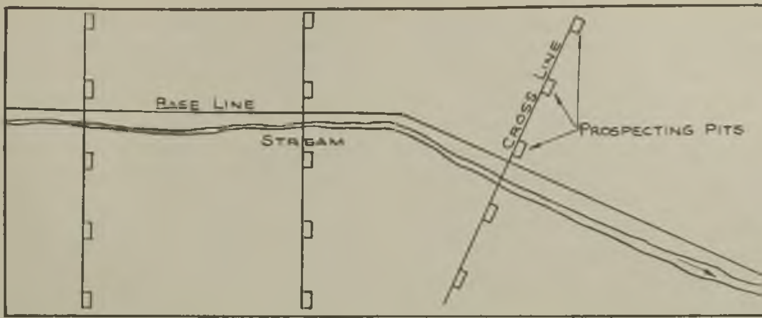


Fig. 2.—Sketch showing arrangement of Base and Cross Lines.

Africa, where the diamonds owe their origin to the presence of plugs.

On the other hand the theory regarding the presence of an undiscovered pipe is quite practicable, especially as in Southern Rhodesia diamond-bearing gravels containing none of the characteristic constituents of kimberlite are worked which are a considerable distance away from the nearest known pipe, and yet their origin is said to be due to some undiscovered pipe or plug. It is quite possible that at some remote period denudation of some undiscovered pipe took place, the diamonds, etc., being carried out to sea and deposited by the rivers and streams and then spread over the large area in which they occur by wave action. The meandering of rivers and streams may also have helped in this distribution, as at times distinct river-terraces are met with containing diamondiferous gravel.

As stated previously the crystallized diamonds are generally octahedra and dodecahedra. Maacles and borts are also fairly common, as are also cleavage flakes.

Prospecting.—A survey is made of the stream to be prospected, using a 100 ft. chain and Brunton compass, and the results plotted. From this survey a bearing of the general direction of the stream is obtained, and a path or base-line about 5 to 6 ft. wide is then cut along one bank, having a bearing equal to that of the stream; in other words the base-line is cut as nearly parallel to the stream as possible. Should the stream vary greatly in direction from one place to another, then the direction of the base-line is also changed, and made to follow the stream. (See Fig. 2.)

Cross lines are then cut, having a width of 3 ft., along this base-line at 500 ft. intervals and at right angles to it, which means that they are in turn approximately at right angles to the general direction of the stream. These cross lines are either numbered, or else designated by the letters of the alphabet.

Taking the centre of the stream as the starting point, pits are then marked out along the cross lines with pegs at 50 ft. intervals and on both sides of the stream

PROSPECTING DATA

at

C.G. *Date*

No. of Sample.	Depth Feet.		Excavation Dimensions Feet.		Volume Cubic Yards.		Diamonds.				% Gr.	% Gr. Jigged.			Remarks.
	Ov.	Gr.	Width.	Length	In Place.	Loose.	No.	Total Carats	Stones per Carat.	Carats per Cu. Yd.	+ 8 Mesh.	+ 4 Mesh.	+ 2 Mesh	+ 1 Mesh.	

Fig. 3.—Type of Data Sheet used for Prospecting Notes.

(the first pits on the right and left banks being 25 ft. from the centre of the stream), the dimensions of each pit being 5 ft. by 2 ft. For sinking purposes, two pit "boys" are usually put on together. The overburden from each pit is thrown on one side and the gravel on the other, the "gravel dumping side" having been cleared previously of bush, etc. In pit sinking it is very necessary to see that the sides of the pit, especially in the gravel, are kept vertical and also that bedrock is reached.

worked to facilitate supervision by the engineer-in-charge. The diamond washer or "shaker," as it is more commonly called in West Africa, is shown in Fig. 4; it has a bottom discharge with three coarse screens above, each one being removable. The shaker works in two bush logs, cut locally by the shaker boys, hollowed out to suit, and embedded in the ground. The screens are 8 mm., 4mm., 2 mm., and 1 mm. mesh, the 8 mm. screen being on top and the 1 mm. screen at the bottom. The shaker is worked

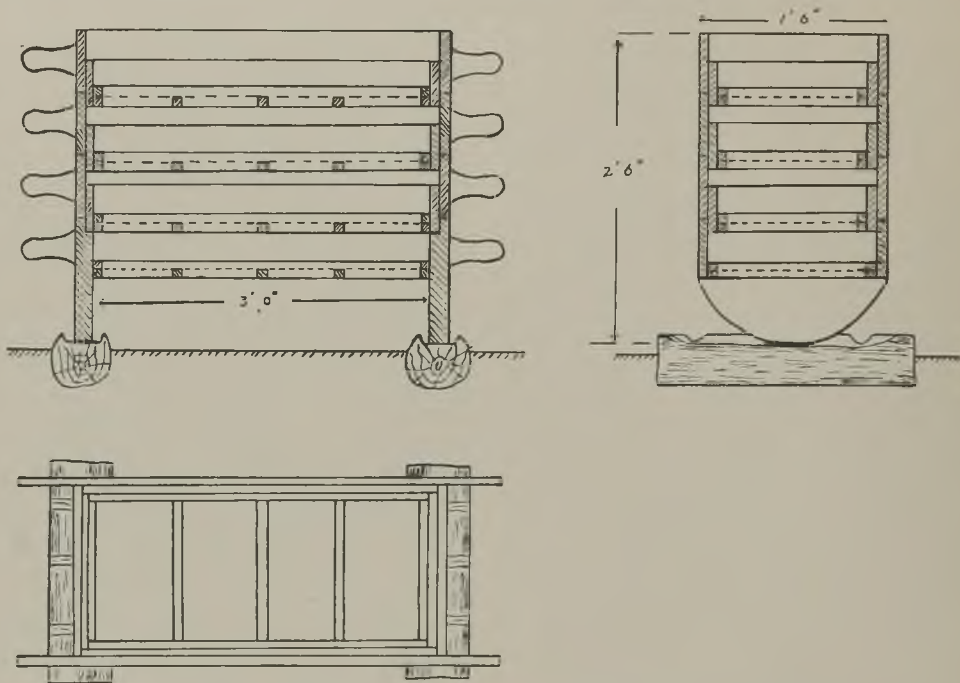


Fig. 4.—Longitudinal and Cross Sections, and Plan of West African "Shaker."

The depths of overburden and gravel are measured with a measuring rod by the native headman and turned in to the white engineer-in-charge at the end of the day's work, who books them in their respective columns in the "Prospecting Data Sheet" (shown in Fig. 3). The loose gravel from each pit is also measured up by means of a measuring box, usually of 3 cu. ft. capacity, and the number of boxes noted, from which the volume of the gravel in the loose is calculated and booked.

The gravel is carried in either head-pans or baskets to the washing-plant, consisting of diamond washers (also called rockers or shakers) and jigs, which should be as near as possible to the cross line being

by a boy standing on it at each end and rocking it from side to side by a peculiar motion of the legs, the rocking motion being terminated each time by a sudden sharp jerk to one side. Another boy stands at the side dipping up water from the stream in a pan or bucket and pouring it into the shaker. Gravel is fed to the coarse screen of the shaker and a continuous stream of water poured in and by means of the rocking motion, described above, the gravel is dashed from side to side of the shaker and grated over the coarse screen. By this means, the oversize gravel is washed clean and cleared of all clay, etc., and the undersize particles, falling through, are sized according to their respective sizes on the intermediate screens, the finest gravel or sand, which contains most of the diamonds, being found on the bottom, or 1 mm. screen.

When the shaker gets full, the oversize gravel on the top screen is removed, provided of course it is clean, measured in a 1 cu. ft. measuring box, and discarded. The top screen is then removed and the coarse gravel on the 4 mm. screen washed once, scraped up with an iron scraper into a pan, and sent to the jigs, where it is also measured in a 1 cu. ft. box and jigged. The same process is applied to the remaining products and this procedure is repeated until the entire gravel from a pit has been washed. The measurements of the various products are booked in the data sheet. In the "Remarks" column, the nature of the gravel is entered up, that is, whether it is "Sticky and Clayey," or whether it is "Free Wash," etc.

Joplin jigs, which are shown in Fig. 5 and also in Fig 6, are used for jigging the shaker products. These latter are fed to the jigs, one at a time, and jigged with frequent stoppages for scraping off the top layer of tailings; more sand is added and the process repeated until a product is obtained which consists entirely of concentrates. This is then jigged down with a short, sharp stroke, with the jig tilted, a small layer of tailings scraped off, and the remainder, consisting of clean concentrates, scraped off the jig screen, put into diamond pans with an identification tag, and sent to the diamond-pickers for picking on the spot.

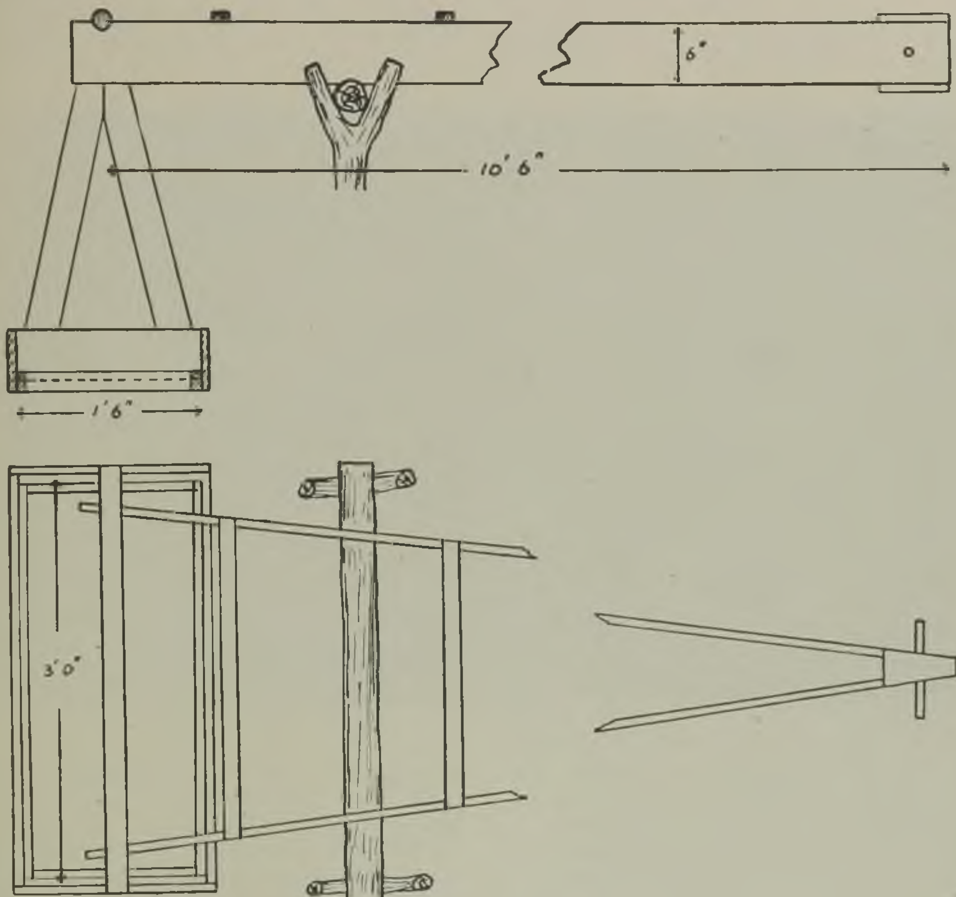


Fig. 5.—Section and Plan of Joplin Jig.

Picking is done by turning the concentrates over, under water, and finding any existing diamonds by the brightness of the stones as compared with other crystals. The diamonds from each pit are counted and weighed and put into small envelopes, specially made for the purpose, and marked with the number of the cross-line, pit, etc. All data are then entered up in the data sheet.

A prospecting gang will consist of about 60 boys, and will include a native clerk, who also acts as headman, gravel-carriers, pit sinkers, bush cutters, etc. The best labour obtainable is from the Northern Territories. Wages vary from 1s. 6d. per day for gravel-carriers, bush cutters, etc., to 1s. 9d. for pit sinkers, shaker boys, etc. The headman is paid 2s. 3d. per day.

The results obtained by prospecting are plotted on the plan and an estimation is made of the yardage and average value of the area. The area between any two adjacent lines is first calculated by means of rectangles, triangles, etc., and then the average thickness of the gravel in all payable pits (anything under 1 carat per cu. yd. is considered unpayable) on the two lines is calculated. This average thickness multiplied by the area gives the yardage between the two lines. The average value of this yardage is then calculated by multiplying the value of each payable pit on the two lines by its "gravel thickness," adding these results together and dividing this sum by the sum of the "gravel thicknesses." The average value and yardage between two lines is thus obtained and, by repeating this operation for the remaining lines, the yardage and average value of the area prospected can be obtained in the ordinary way.

MINING.—When an area has been prospected and its average value obtained and it has been decided to start mining operations, the following preliminary work is done:—

(*a*) The area is first cleared of all bush, all trees being cut down and suitable roads made over which machinery and material may be transported.

FIG. 6.—JOPLIN JIG AT WORK.

(*b*) The necessary plant is brought over to the site in sections and erected.

(*c*) A "key cut" is made. This consists of excavating a cut in the overburden, 12 to 15 ft. wide, for the full length of the area, thus exposing the gravel. All overburden should be thrown on one side of the cut only and the walls of the cut kept vertical.

When all the above operations are completed, mining may commence. A special gang of about 20 gravel boys is employed to mine the gravel, by excavating it with picks and shovels down to bed-rock and loading it into wheelbarrows for transport to the plant, which should not be more than 600 to 700 ft. from the gravel cut at any time, as this is about the limit for wheelbarrow transport. For the barrows, a track is made along the edge of the gravel exposed, consisting of planks 12 in. wide by 2 in. thick by 12 ft. long, laid end on to each other and extending from the working place to the plant. Both the overburden and the gravel in the key cut are excavated on day's pay, working a 9 hour shift, and the depths of each noted for reference for contract work out by a small portable centrifugal pump driven by a gas engine. The pump and engine are mounted on an iron framework fitted with four wheels, and can thus be moved from one working place to another as required.

It has been found by experience that an overburden boy can excavate 8 cu. yd. roughly in a 9 hour shift and a gravel boy 3 to $3\frac{1}{2}$ cu. yd. in the same time. This means that a gravel contract for a gang of 20 boys should be 60 to 70 cu. yd. which,

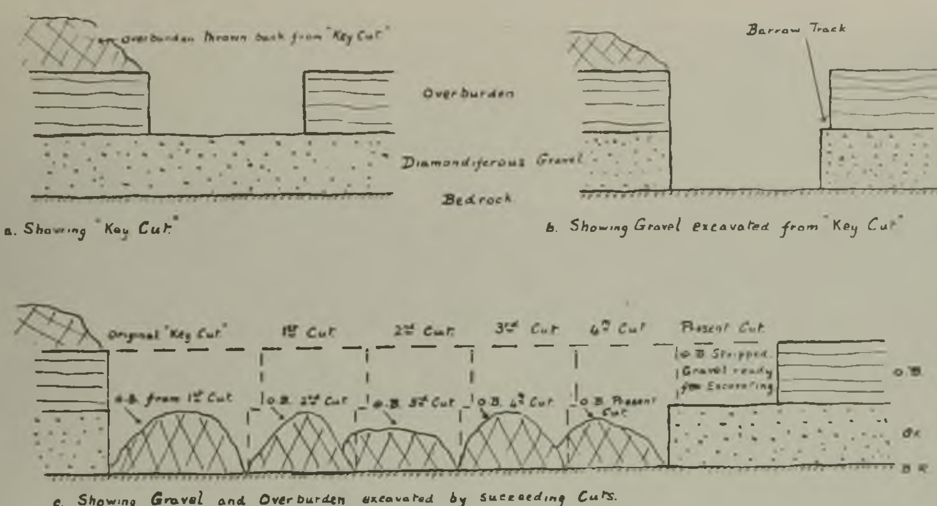


FIG. 7.—DIAGRAMS SHOWING THE DIFFERENT STAGES IN MINING THE GRAVEL.

in future. These depths vary from 3 to 6 ft. for overburden and from 2 to 6 ft. for gravel. Also it should be noted that all successive cuts are from 10 to 12 ft. in width, a width of 10·8 ft. being most convenient for measuring-up purposes, as will be explained later.

When the gravel for one day has been mined down to bedrock, an overburden gang of 8 to 12 boys is put on the following day to strip the overburden and expose the gravel alongside the excavation of the previous day, the overburden being thrown into this excavation. Fig. 7 gives explanatory diagrams. Good mining consists of throwing this overburden well back from the gravel, thus leaving a gutter between the overburden and gravel for drainage purposes, as a fair amount of water is encountered owing to the impervious nature of the bedrock. The water is usually carried off to a temporary sump, and pumped incidentally, is also the capacity of a plant, while the overburden contract should be 64 cu. yd. for a gang of eight. The necessary lengths of the contracts can be obtained from the formula $L = \frac{\text{Cu. yd.} \times 27}{B\ D}$, where B is the width of the cut and D the average depth of the gravel (or overburden), this depth being taken from the previous cut, as usually the depths of gravel or overburden do not vary to any great extent from one cut to another.

It has been stated before that a width of 10·8 ft. for each cut is most convenient; this is because on a 10·8 ft. width having a frontage of 10 ft. every foot in depth will represent 4 cu. yd., which saves time and trouble in measuring up as the yardage for each 10 ft. in length can be booked at once instead of first having to make various calculations in the office. Measurements are made daily of the gravel excavated and of the overburden stripped, and entered up in the measurement book.

For transporting the gravel excavated from the cut to the plant, twenty to twenty-five wheelbarrows are necessary, provided the distance does not exceed 600 ft. When this distance is exceeded it is necessary either to move the plant closer up to the working place, an expensive undertaking at the best of times, or else to put in truck haulage. For truck haulage, six ordinary mine-cars are required (three being loaded while three are being trammed) and a portable loading platform about 12 ft. by 12 ft. and just high enough to clear the top of the cars. The platform is placed as near the working place as possible and the gravel, which is dumped on it by wheelbarrows, is loaded into the cars and trammed to the plant. (See Fig. 8.) At the plant the cars are tipped, the gravel being dumped into a bin, from whence it is fed on to a conveyor belt for transport to the main trommel.

Fig. 8.—Loading Platform for Truck Haulage.

Milling.—Diamond milling consists of washing, sizing, and jigging, a flow-sheet of the process being shown in Fig. 9 and a view given in Fig. 10.

The conveyor belt is an endless rubber belt, 60 ft. long by 18 in. wide and $\frac{1}{4}$ in. thick; it has a linear speed of 90 ft. per minute and is set at an inclination for conveying the gravel to the main trommel, which is situated at the top of the plant 18 to 24 ft. above ground level.

The main trommel is 12 ft. long and 3 ft. in diameter, having a speed of 16 r.p.m. and a fall of $\frac{1}{2}$ in. per foot of length from the feed to the discharge end. It consists of a cylindrical shell, the first half being of unpunched metal and fitted with blades to disintegrate any clayey lumps in the diamondiferous gravel before being discharged on to the second half, which consists of $\frac{5}{8}$ in. screening. The undersize from the trommel goes to the concentrating pans, while the oversize is discharged into the washer, for further cleaning and washing.

Concentrating pans have an outside diameter of 8 ft. and an inside diameter of 2 ft. 6 in., the outer wall or rim being 18 in. high and the inside rim 12 in. high. (See Fig. 11.) The pan is fitted with eight revolving arms, each carrying five tynes, or knives, of triangular cross section, the points of which are fixed 1 in. above the pan bottom; these arms revolve at 13 r.p.m., the power being transmitted to them through a vertical shaft by bevel gears having a ratio of 4 : 1. The undersize from the main trommel, mixed with water, is fed into the pan, and is agitated by the revolving arms; by this means the lighter sands and tailings are discharged over a gate, fixed in the inside wall or rim, while the

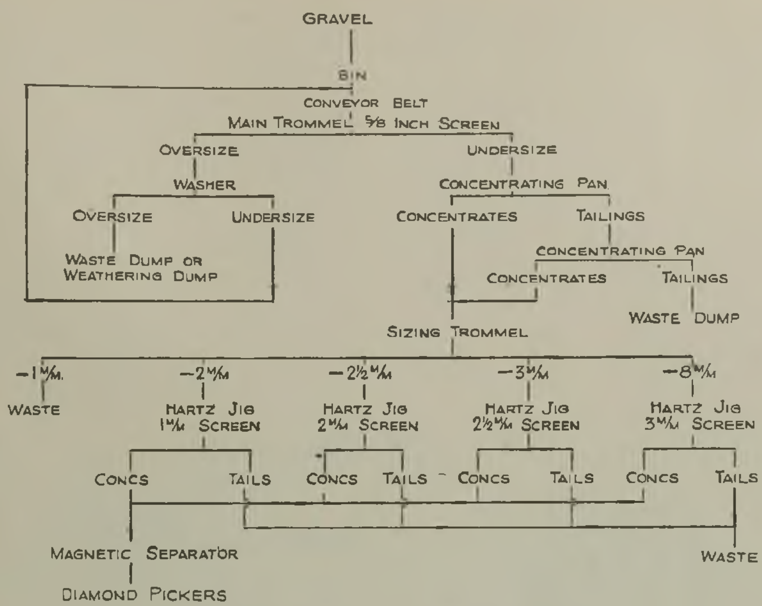


Fig. 9.—Flow-sheet of a Diamond Plant.

heavier particles, among which are the diamonds, settle on the bottom and are worked outwards to the outer rim, whence they are drawn off through a concentrate discharge pipe. Concentration is chiefly by centrifugal force.

As the tailings from the first pan contain a small percentage of diamonds, they are treated in a second pan before being discharged to waste. Actually, 90 to 97% of the diamonds recovered are obtained from the first concentrating pan.

The sizing trommel is 10 ft. long by 18 in. diameter, revolving at 18 r.p.m. It is fitted with five screens having 1 mm., 2 mm., 2½ mm., 3 mm., and 8 mm. apertures

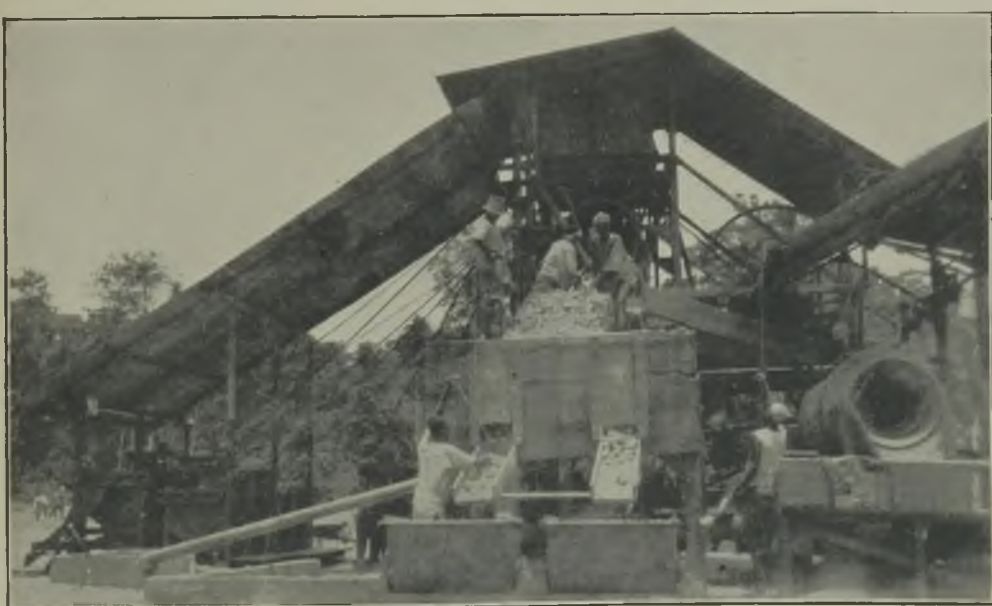


Fig. 10.—A View of a Diamond Plant.

respectively. The − 1 mm. product goes to waste, as does + 8 mm., the remaining sizes being jigged.

Jigs are ordinary two compartment Hartz jigs, the strokes of which vary from ¼ in. to ⅝ in., the number of strokes being from 170 to 150 per minute. Fine sands require a short stroke and a fast speed, while the heavier particles require a long stroke and a lesser speed. The diamonds and heavier sands settle on the jig bed, while the lighter tailings remain on top, from whence they are scraped off and discarded. The concentrates are collected from the jig beds from two to four times per day and sent to the magnetic separator. The separator separates the magnetic particles from the non-magnetic in the concentrates, after which the concentrates are sent to the pickers for picking.

The washer is a hollow iron cylinder, 12 ft. long by 3 ft. diameter, revolving at 35 r.p.m. It is fitted inside with blades to break up any clay balls, etc., that remain in the oversize discharged from the main trommel. At the discharge end of the washer, a ⅝ in. screen is fitted; the + ⅝ in. product is sent to the waste dump, if clean enough, otherwise it is trammed to the weathering dump and afterwards retreated.

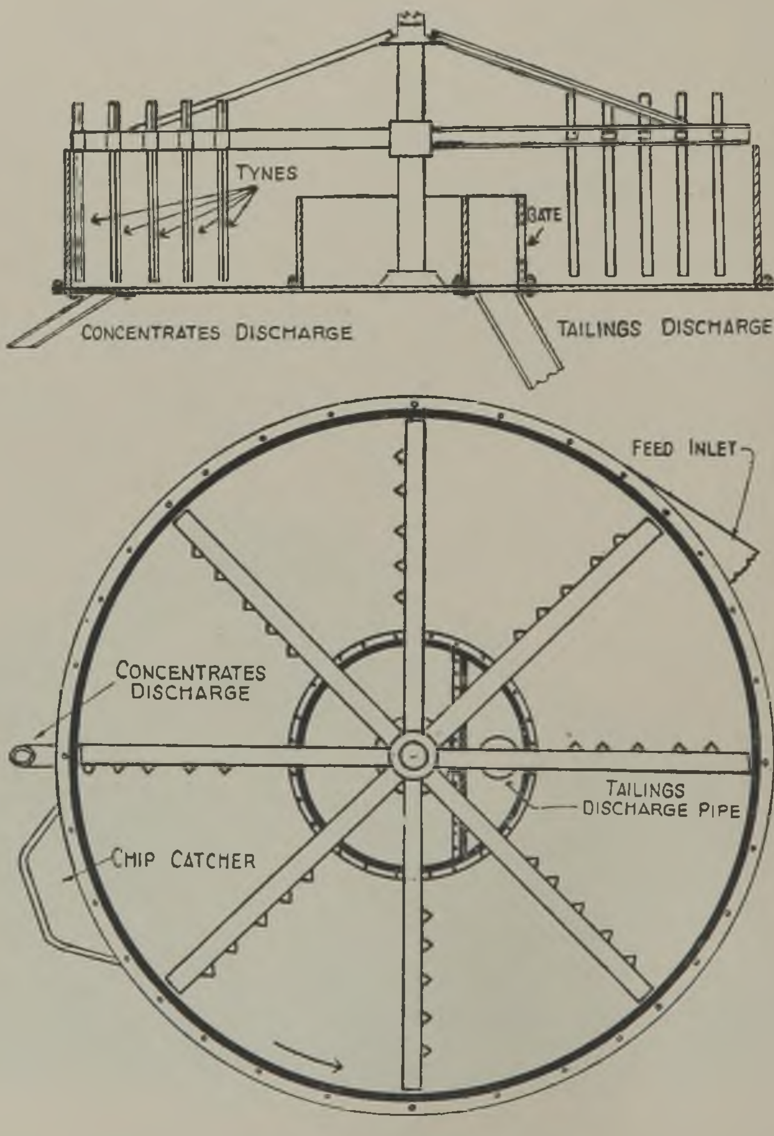


Fig. 11.—Plan and Section of 8 ft. Concentrating Pan (not to scale).

The $-\frac{5}{8}$ in. product is returned by the conveyor belt.

The whole plant is driven by a 35 h.p. portable Robey engine, using wood for fuel, six to nine stacks of wood being consumed daily, each stack costing 1s. 9d. and being 3 ft. by 3 ft. by the length of the fire-box.

The main pumping station, using an Evans' Cornish compound steam pump (double-acting bucket type), delivers 13,050 gallons of water per hour through a 6 in. pipe. The water is utilized by three diamond plants. It is pumped into two iron tanks situated at the top of the plant, and used for wash water. The waste water from each plant is drained into a sump from whence it is pumped back to the tanks by means of a small centrifugal pump.

The following table gives the average rainfall and temperatures for a normal year :—

Month.	Rainfall. Inches.	Temperature. Max.	Min.
January	0·82	89·99	67·80
February	2·08	91·15	62·85
March	4·22	92·78	69·90
April	6·44	92·50	69·17
May	8·49	90·80	71·00
June	5·42	89·55	69·55
July	6·68	85·60	69·10
August	2·15	85·40	68·80
September	4·98	86·39	68·69
October	7·37	89·60	68·60
November	6·27	91·00	69·20
December	4·85	88·50	66·80

All transport from the coast to the diamond fields is by road, motor cars and lorries being used. The roads are fairly good, but during the rains they are liable to get cut up badly if the traffic is at all heavy.

Table of Costs

Gravel excavated 1494 cu. yd. Carats produced 10,219. Working days 26.

Operation.	Total Man-Shifts.	Total Cost. £ s. d.	Cost per Cu. Yd. in Pence.
Mining (excavation of gravel, overburden, transport to plant, etc.)	1,876½	173 3 0	27·8
Milling	1,276¾	117 18 5	18·9
Power, Repairs, and Maintenance	228½	30 17 3	4·9
Overtime, etc.	97	8 17 9	1·4
Firewood, 214 stacks at 1s. 9d. each		18 14 6	3·0
Stores and Materials		31 9 0	5·0
Total	3,478¾	380 19 11	61·2d.

Labour and Costs.—The total force employed on a diamond mine varies from 100 to 120 boys, the rates of pay being from 1s. 6d. to 2s. per day. Headmen, carpenters, engine-drivers, etc., are paid from 3s. to 4s. per day. The cost, per month, of running a diamond plant is given in the accompanying table. This cost does not include the salary of the white engineer-in-charge. A carat is worth 22s.

Conclusion.—Climatic conditions are trying in West Africa owing to the great humidity of the atmosphere, although the average temperatures during the year are lower than in many tropical countries. The seasons may be divided into a wet season, extending from April to July, and a dry season from August to March, although the "small" rains occur in September and October. During January, and sometimes February, a cool wind, known as the Harmattan, blows from the Sahara desert, making the nights pleasantly cool, although the days are hot.

There is no market for the I.D.B. (illicit diamond buying) "trade" in the Colony at present.

Low-Temperature Carbonization.—A joint meeting of the Institute of Fuel and the Institution of Electrical Engineers will be held at 5.30 p.m. on November 21 at the latter society's lecture theatre, Savoy Place, London, W.C. 2, when several papers will be discussed dealing with low-temperature carbonization in connection with the production of electricity. These papers will treat the subject on the basis of experience in various countries. Messrs. E. G. Smythe and E. G. Weeks will describe practice in this country; Mr. S. McEwen will tell of systems adopted in the United States; and Professor R. Rosing will take German methods for his subject. The chair will be taken by Sir Thomas Purves, president of the Institute of Electrical Engineers.

SOUTHERN MALAYAN TIN DREDGES

Particulars are given in this short article of large modern dredges designed for working extensive deposits of comparatively low-grade tin ground; jigs are embodied in the design instead of sluice-boxes.

Southern Malayan Tin Dredging, Ltd., is a member of the Malayan Tin Dredging group and was formed in 1926 to acquire alluvial tin ground in the Tanjong Tualong district in the State of Perak, Federated Malay States. The company owns an area of 1,922 acres, which has been carefully bored and contains 170,000,000 cu. yd. averaging 0·53 lb. per yard. Four up-to-date bucket dredges, designed by Messrs. F. W. Payne and Son, each with a capacity of 200,000 cu. yd. per month, are at work, the first starting in October, 1927, the second in March, 1928, the third in December, 1928, and the fourth early this year. These are electrically driven, power being obtained from a steam generating station situated on Malayan Tin Dredging Co.'s property near Batu Gajah. The latest concentrating methods are employed and no difficulty is experienced in efficiently treating this large yardage. The following is a typical description of each of the dredges :—

Southern Malayan Dredge No. 2.

The pontoon is 194 ft. long, 55 ft. beam, and 9 ft. 6 in. deep. The buckets are made of Hadfield's "Era" manganese steel, each having a capacity of 12 cu. ft.; the bucket pins are made of nickel-chrome steel and are $6\frac{1}{2}$ in. diameter. The screen is 8 ft. in diameter, and has a total length of 44 ft., the length of the perforated section being 30 ft.

Each dredge is equipped with 16 jigs, the screening area on each jig being 16 ft. long by 3 ft. wide; 14 of these are primary jigs treating the material as it comes from the hopper under the screen, and the other two are clean-up jigs treating the hutch products from the primary jigs; the average concentrate from the clean-up jigs is approximately 30% tin oxide.

The length of the bucket ladder is 141 ft. between centres and is made on the diagonal bulkhead principle which has given excellent results in this class of ground. The maximum digging depth is 80 ft. below the surface of the water. The digging capacity is approximately 200,000 cu. yd. per month. The yardage dug depends entirely on the class of ground. It is only when in deep ground that it is possible to obtain such large yardages.

The electric current is taken on to the dredge at a pressure of 3,300 volts by means of a 3-core armoured cable which is led over a derrick projecting from the stern of the pontoon. On the dredge the voltage is stepped down to 415 volts, at which pressure all the motors are working. The lighting on the dredges is at 110 volts. An auto-synchronous motor drives one of the large pumps. This motor is for power factor correction, the power factor obtained being 0·9 to 0·92.

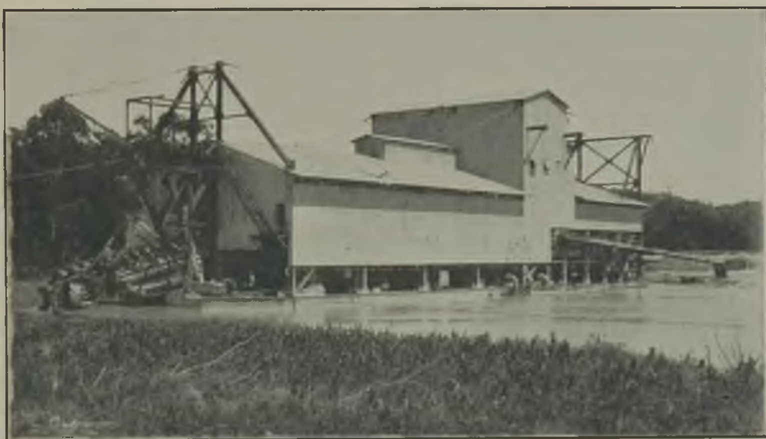
The ore-dressing shed is equipped with

one 6 cell jig which treats the concentrate as it comes off the dredge. The various products from the jig are then passed over magnetic separators and finally treated by hand.

The following is the sizing analyses of this ore by I.M.M. screens :—

Mesh.	*Percentage.*	*Mesh.*	*Percentage.*
+ 12	0·15	+ 80	48·60
+ 16	0·50	+ 90	1·30
+ 20	0·20	+ 100	7·60
+ 30	0·35	+ 120	7·25
+ 40	1·10	+ 150	5·65
+ 50	3·70	+ 200	0·50
+ 60	11·95	— 200	0·10
+ 70	9·20		

The power station at Batu Gajah is owned jointly by Malayan Tin Dredging, Ltd., and Southern Malayan Tin Dredging, Ltd., supplying power only to these two companies. There are four Babcock and Wilcox boilers each having a heating surface of 4,928 sq. ft. Each boiler is designed to give a normal output of 18,000 lb. per hour, the working pressure being 200 lb. per sq. in. The coal used is Rawang smalls having a calorific value of 8,500 B.T.U., the average coal consumption being 2·8 lb. coal per unit generated. The electric current is generated by three Brush-Ljungstrom turbo-alternators, one of 3,000 kw. and two each of 1,200 kw., each set being capable of running continuously on a 25% overload. The principal feature of this type of turbine and that to which it owes its high efficiency is the use of two rotors revolving in opposite directions and having a relative speed equal to twice the running speed. The blade rings are mounted on discs in such a manner that the rings of one disc lie between the rings of the other disc. The steam is admitted at the centre of the blade system and expands radially outwards so that the casing of the turbine is in contact with the low-pressure steam at a temperature corresponding with the vacuum at the exhaust flange. The turbine sits directly on top of the condenser which is of sufficient size to give 27 in. of vacuum with the temperature of the circulating water at 90° F.



Southern Malayan Dredge No. 2.

BOOK REVIEWS

Markscheidekunde, Part I. By Dr. P. Wilski. Large octavo, 250 pages, illustrated. Price R.M. 26. Berlin: Julius Springer.

Most mine surveyors in this country will no doubt hold that the existing literature on mine surveying caters amply for their needs and gives them all necessary information upon their subject, especially having regard to the fact that mine surveying is an art which must be learnt by practice and cannot be taught exclusively by books. They may, therefore, be inclined to question the usefulness of this latest addition to the already considerable mass of literature on the subject of mine surveying, and it may perhaps be admitted that from the strictly utilitarian point of view the present work does not contribute greatly to the stock of existing knowledge. At the same time the book contains very much interesting matter and more especially the wealth of historical information to be found in it will be prized by those who have more than a purely utilitarian interest in the subject. The book is divided into a number of relatively short sections, a list of which will probably give a good idea of the nature of the volume. After a short introduction the first section deals with measurements of length, No. 2 with the level bubble, Nos. 3 and 5 with the theory of lenses, No. 4 with the theory of the ordinary telescope, No. 6 with the theory of the Wild-Zeiss telescope (with internal focussing by concave lens), No. 7 with the theodolite, No. 8 with chain surveying, No. 9 with traverse surveying on the surface, No. 10 with traverse surveying underground, No. 11 with calculations for holing, No. 12 with triangulation, No. 13 with geometrical levelling, while No. 14 consists of the solutions of a series of problems in intersections of planes, which the author solves by various mathematical methods, not infrequently having resort to spherical trigonometry.

It will be seen that the book deals with theory rather than with practice, and indeed the author assumes considerable practical experience on the part of the reader. For example, the author does not describe the construction of the theodolite, but takes familiarity with this for granted, and definitely states that he assumes the reader to be experienced in the manipulation of the instrument, adding that such manipulation cannot be learnt from books.

It must be definitely stated that the author restricts himself to German methods, German practice, and German instruments, and it is noteworthy that in a very long list of literary references there is not a single reference to any English writer on the subject, though it must be admitted that the author would certainly have benefited had he studied some of the more modern British works on mine surveying. It may for instance be pointed out that whereas he lays down a series of conditions that a mine theodolite should fulfil, these do not always coincide with British requirements. For example, everyone would probably agree that a mine theodolite should be capable of being focussed upon an object much nearer to the instrument than is required for a theodolite to be used only on the surface, though probably the author's demand for focussing upon a point only 1 metre from the instrument is carrying this condition somewhat too far. He himself admits that it is difficult, and prefers to have a set of lenses which can be placed in front of the object glass; this method would be generally rejected by British surveyors. They will, however, agree with the author that owing to the lesser light available underground a telescope with a larger diameter of object glass and giving a larger diameter of Ramsden circle than is usual with many telescopes for use on the surface is desirable. He does not lay weight upon the shifting head which British surveyors consider indispensable in a modern mining theodolite, considers that centering under a mark in the roof is a slow operation, and prefers to attach a millimetre scale along the horizontal axis, and read off on this scale the horizontal distance between a small plumb point hung from a centre mark in the roof and the centre of the theodolite. He also desires to avoid the use of a shifting head by a system of signals exchangeable with the theodolite itself, a method which, though demanding an expensive equipment, certainly gives good results. Perhaps the gravest defect, however, in his list of requirements of a mine theodolite lies in the fact that he makes no mention of the necessity for the coincidence or at any rate the parallelism of the axes of the inner and outer cones of the body-piece. This last deficiency is possibly connected with the fact that, as already stated, he does not give any description of the construction of a theodolite. He certainly gives drawings of a large number of theodolites made by different German makers, practically all of these being apparently taken from instrument makers' catalogues. There are many other points in which he differs from accepted English practice; for example, he devotes a few pages to the method of surveying which we in this country speak of as chain surveying, and which we are in the habit of considering the least accurate method of surveying, whereas the author upholds it as the most accurate method of surveying a moderately small property. It is true that he replaces the chain by a steel tape, stating that the former measuring instrument has gone out of use in Germany for several decades, and that he looks upon an optical square or a cross-staff as a necessary part of the surveyor's equipment. A number of important problems are not discussed at all in the present book, but a circular from the Publishers states that the second part is under preparation and will contain: Shaft plumbing; tacheometry; setting out of dams, ditches, roads, railway sidings, etc.; magnetic measurements; trigonometric measurement of heights; basemetric measurements of heights; angles of depression; graphic surveying; plane table; routes; maps; mine plans. Upon the whole it may fairly be said that the present work is one which is of decided interest to the student of the history and theory of the subject, but which will not prove of any great assistance to the practising British surveyor.

H. Louis.

The Evolution of the Igneous Rocks. By N. L. Bowen. Cloth, octavo, 344 pages, illustrated. Price 23s. Princeton, U.S.A.: The University Press; Oxford: The University Press.

For more than two decades the members of the Geophysical Laboratory of the Carnegie Institution of Washington have been patiently and systematically investigating silicate and other systems, and year after year they have issued papers which have aroused the admiration and gained the gratitude of the rest of the petrological world. Dr. Bowen has played a leading part in the experimental campaign, and he has become the foremost authority on the petrological applications of the exact knowledge that has been won in this difficult field. It is therefore appropriate that he should now give us a volume which embodies "an attempt to interpret the outstanding facts of igneous-rock series as the result of fractional crystallization." The book is unquestionably the most important and the most steadfastly scientific contribution that has been made to the literature of igneous petrogenesis since the appearance of Harker's classic "The Natural History of Igneous Rocks." Bowen's discovery of the reaction principle has been hailed by Eskola as the greatest achievement of recent petrological history. It is largely the ingenious development of this far-reaching principle which gives the book its unique strength; but in recognizing this technical success we must not overlook Bowen's skilful handling and co-ordination of his material, whether gathered in the laboratory, in the field, or from the observations of others; nor must we omit to add a word of appreciation for his penetrating critical ability and the clarity and persuasiveness of his literary style.

Like Sarah Battle, Bowen is a firm upholder of "the rigour of the game." After explaining that the book is based on a series of lectures delivered at Princeton in 1927 he writes in the preface: "It was my hope that, before anything of the kind here offered was written, all of the diagrams it would be necessary to use would be determined diagrams." Fact and hypothesis, logical deduction and speculative feeler are rigidly distinguished, and the division of the book itself exhibits this admirable scientific restraint: "In Part I are given those aspects of fractional crystallization of magmas where facts determined in the laboratory are susceptible of fairly direct application to the natural problems. In Part II various problems are discussed in which the amount of extrapolation from ascertained fact is relatively great or where the diagrams used are mainly deduced. The conclusions reached in such matters are thus to be regarded as resting on a less certain foundation."

The many processes of differentiation that have been appealed to in explanation of the various natural associations of igneous rocks and the assemblages known as petrographic provinces, are:

(1) Composition gradients set up in a magma by (*a*) gravity; (*b*) temperature gradients (the Soret effect); or (*c*) pressure gradients.

(2) Separation of phases, including such processes as (*a*) gaseous transfer; (*b*) liquid immiscibility; and (*c*) fractional crystallization.

Bowen shows that only the last of these is of real importance. As a general basis for the discussion he adopts basaltic magma as the parent material, without insisting that the assumption is fundamental to his thesis. The evidences of fractional crystallization consist of a comparison of the results to be expected with the actual characters of natural rocks, and so much can already be successfully explained by this process that it is clearly the dominant control in igneous rock evolution. Variations are brought about not only by the changing composition of the residual liquid as crystallization proceeds, but also by the separation of crystals and liquid by sinking of the former or squeezing out of the latter and even in consequence of the zoning of crystals whereby the interiors are shielded from the reaction effects which would otherwise intervene. The varying degree to which reaction occurs between crystals already formed and their liquid environment, and also the nature of the resulting products make possible more than one line of descent, and thus serve to explain the basalt-trachyte association as well as the basalt-andesite or the basalt-rhyolite associations. The reaction principle is also most instructively applied to elucidating the modifications due to assimilation, that is, to contamination of a magma in any stage of descent as a result of its reaction with foreign material. Ultra-basic and other monomineralic rocks are interpreted as crystal accumulations from magmas of normal composition, and the results of a personal study of the peridotites and banded rocks of Skye are instructively presented. This first part of the book, with its authoritative description of the chief types of silicate systems and determined diagrams, will remain of permanent value as a reliable guide to the established principles of the subject.

The second part carries these principles as far as they can be reasonably pushed into the more speculative field of the problems associated with the origin of potash-granites, alkali-rocks and lamprophyres, and the effects of volatile constituents. On the whole this extension is so successful that one feels that as exact data accumulate still more will be achieved without departing from the central theme of fractional crystallization. As Bowen points out this spying out the land is justified as a preliminary to " a more serious campaign of experimental attack, concentrated upon those points where progress is most likely to be made."

The only rival hypothesis to differentiation is the doctrine of the mixing of contrasted magmas, such as was proposed long ago by Bunsen. This conception is stated by Bowen to have failed completely, but it should not be rejected so summarily, for it has recently been resuscitated by various workers to explain certain peculiarities in the rocks of Tertiary centres like Mull, Iceland, and the Deccan where the basalt-rhyolite or dolerite-granophyre association is characteristically developed. Bowen himself makes it clear that there is no objection to the view that " many granite magmas may have their immediate origin in the remelting, say by deep burial, of a granite derived in more remote times from basic material." If this happened, and at the same time basaltic magma invaded the region, or if the heat brought in by basic magma contributed to the remelting of granite, then two contrasted magmas would occur simultaneously as postulated by Bunsen. That the two magmas may have been ultimately derived from one at some more distant period is a proposition likely to be accepted by all petrologists; the controversial point is whether granitic magma has been produced on an important scale in more recent periods by the fractional crystallization of basic magma.

As to this there is one important observational fact that is generally entirely overlooked, and that is the complete absence from oceanic islands of the basalt-rhyolite assemblage. If basalt magma is capable of producing granite, granophyre, pitchstone, or rhyolite in continental regions, then surely it should do so equally abundantly in oceanic areas. Yet indubitably there is a complete lack of evidence that it does do so. There is therefore a weighty argument in favour of regarding most of the later granites (and allied rocks) of continental areas as due to the selective fusion of the older felsic differentiates which themselves constitute the *raison d'être* of the continents.

One of the most interesting chapters of the book deals with " Petrogenesis and the Physics of the Earth." In it, Bowen presents strong reasons for rejecting the conception recently advocated by Daly and Jeffreys of the existence of a basaltic layer in the glassy state. It is reasonably established by seismological work that if there be a " basaltic layer " it is not present in the gabbro facies. It may be present in the high-pressure eclogite facies, but eclogites from the diamond pipes of South and Central Africa differ so much in composition from the plateau basalts that, as Wagner has pointed out, there seems little hope of maintaining the hypothesis that eclogite is a potential source of basalt magma. Bowen shows that the selective fusion of peridotitic material like that of the stony meteorites is in the light of our present knowledge the most probable method whereby basaltic magma becomes avaliable. Petrologically, therefore, there seems to be no longer any necessity for a specifically " basaltic layer."

The reviewer ventures to suggest, however, that there are certain advantages in the alternative derivation of basaltic magma from the fractional crystallization of peridotitic material, beginning with the latter in a glassy state, and separating from it olivine by partial crystallization against the lower surfaces of the continents and ocean floors. This process would explain the early appearance of olivine-basalts in many Mesozoic and Tertiary fields; on Bowen's scheme the earliest basalts would not be expected to be usually olivine-bearing. If basalt comes from deep-seated peridotite-like material then the latter must be radioactive, since the derived basalts contain uranium, thorium, and potassium. It thus becomes difficult to understand how the peridotite shell of the earth could ever have crystallized at all except near the crust. We would expect it still to be thermally a glass, even though it be rigid in virtue of the high pressure and therefore mechanically a solid. Carrying these alternative interpretations to their limit we must find another source than basaltic magma for the primeval granites of the continents, because, if basalt be produced from the uncrystallized peridotitic shell and yet fails to generate granite or its equivalent in oceanic areas, it is hazardous to assume that it could nevertheless have generated continental granite. There is one way of escape: and that is to regard the original granite shell as having separated with the hydrosphere and atmosphere while the earth-moon system was still a fluid mass, and further, to consider the limited distribution of the continents as a consequence of the removal of much of the primeval granitic shell at the time when the moon was formed.

But now we have passed far from the primary purpose of Bowen's book, which is to build an abiding structure on an ascertained body of experimental data. Petrologists will study the more speculative chapters with sympathetic interest, but they will appreciate the chapters of Part I with the gratitude due to an unrivalled master of his subject, and they will unite in no uncertain voice in congratulating the author of the whole on a record of solid achievement of which he may be justly proud.

ARTHUR HOLMES.

Petroleum Development and Technology, 1928–29. Cloth, octavo, 620 pages illustrated. Price 30s. New York: American Institute of Mining and Metallurgical Engineers.

In its modern form the first symposium on petroleum production presented by the Petroleum Division of the American Institute appeared in 1922, and this, as the succeeding publications, aimed at giving "a timely inventory of the current state of the producing business and a forecast of indicated price and production tendencies for the immediate future." That this aim has been more than adequately fulfilled was apparent in the 1925 volume, in which the scope of the technical papers presented at various meetings of the Division for the period concerned was considerably enlarged, a policy since followed with conspicuous success, and well upheld by the present publication.

We have no means of judging what influence the periodical deliberations of the Petroleum Division exert on the purely technical evolution of the industry in America, but we believe it to be very considerable, certainly far greater than may be evident from quotations from the published papers in contemporary literature on the subject. It is possible that many oil technologists in our own country and abroad are unaware of the real value of this annual work, and of the number of important papers which it invariably contains; so much the worse for them. It is true that the weekly oil journals find in these papers a profitable source of inspiration and frequently extensive quotations therefrom may appear, thus to serve a wider public. But nothing is so satisfactory as the original and, since the Division also publishes the discussions on each paper as well, the annual volume itself is essential, nothing less.

If the reader were suddenly asked to name the three most important subjects which concerned the industry during the period reviewed by this volume, he would, if *au fait*, unhesitatingly reply "Re-pressuring" (gas-lift, etc.), "Well-Surveys" ("crooked holes" their causes and effects), and "Rising Crude Production." He would at the same time be making an accurate prediction of the main contents of the papers here involved, which intimates at once the very practical character of the work of the Division. At least six authors deal with pressure problems; underground well-surveys are considered in two excellent essays; while a third of the book is devoted to production and economics of petroleum covering the whole world. Four interesting pieces of research are also chronicled: on the relative propulsive efficiencies of air and natural gas in pressure drive operations; on oil recovery investigations of the Petroleum Experiment Station of the U.S. Bureau of Mines; on capillary phenomena as related to oil production; and on natural flow and gas-lift experiments (also Bureau of Mines).

Oil recovery factors are becoming of increasing import in practically every oilfield in the world, especially where sandstone reservoirs are involved. Operators clamour for figures and methods of assessing possibilities in their own spheres of activity, but it is a fact that this is one of the most difficult subjects to tackle with a likelihood of achieving really concrete results. The original paper (by Mills, Chambers, and Desmond) has been published *in extenso* in Technical Paper 144 of the Bureau of Mines; the salient points are given in this volume, together with results of full discussion of the data presented, both well worth reading. The associated researches are of no less merit; in fact, the whole book abounds in records of thought and progress which, although relating to a past phase, are still, in the light of current interests in the industry, singularly up-to-date.

H. B. Milner.

Earth Flexures: Their Geometry, etc. By H. H. Busk, M.A. Cloth, quarto, 106 pages, illustrated. Price 12s. 6d. Cambridge: The University Press.

". . . and draw a section across the map from *A* to *B* to show the structure." In how many cases have students been confronted with this instruction, and, presumably, will continue so to be directed in the future? The reader will probably recall, as we do, his early impressions of this demand; the preliminary construction of the ground-profile (model of refined measurement); the fixing, at the expense of much manipulation of protractor and set-square, of outcrop boundaries along that profile; the correct (?) orientation of dips; and last of all, that sally into the glorious unknown, joining up the lines *underground* to "show the structure" believed or at least hoped for. And given the opportunity with really good folded territory, spurred, maybe, by an ambitious attempt to emulate the Alpine school, the section might even be continued above the ground into space, the scroll of broken lines forming a fitting finish to this exercise of student ingenuity.

We doubt if Mr. Busk would quarrel very much with what happened above the ground-line of the section; he would probably be content to leave matters to individual imagination, though were his methods, geometrical conics as set forth in this book, followed to complete conclusion, such imagination would be severely curbed, as, in point of fact, he shows in certain examples he works out. But when it comes to what happens below the ground-line, then the author has a great deal to say, and if his beliefs and methods gain popularity, then the student of the future will find in his section-drawing a vastly different occupation than his predecessors, and, moreover, one involving no mean knowledge of geometry, especially of curves and curved surfaces.

If we start on the assumption that what we measure with the clinometer is a reasonable inference of what is happening beneath us; that such things as lateral variation and incompetent folds can be adequately allowed for; that for all practical purposes tangential circular arcs with normals to the dips as radii are the best means of constructing subsurface flexure-trends; that the day of freehand section-drawing is over; then we can follow the author practically all the way. But if our experience has, perchance, been gained in the hard school of the soft rocks; in those countries where nature abhors the nude in geology, where the mask of drift and vegetation is complete; where percentage exposure per square mile is reduced to perplexing minimum; where, in other words, subsurface sections have to be drawn largely on the basis of well-samples, what then? Or where the surface geology is definitely antipathetic to that achieved at no great distance underground: how are we to reconcile these things and to what extent may we be beholden to Mr. Busk's methods to bring about more accurate constructions on our part? These questions are obvious but fearfully difficult to answer.

The practical illustrations of the theories and applications discussed in this work are confined to the rocks of Persia, Burma, and Egypt, countries where rock-exposures constitute an *embarras des richesses*, though in at least one case, namely Persia, the geology is magnificent both as portrayed at the surface, and as an example of unconventional subterranean developments which frequently bear no resemblance to the structures determined on the ground. Were the majority of oilfields situated in latitudes conducive to the same presentation of outcrop detail, then a great vogue for the more exact methods of section-drawing here demonstrated would undoubtedly come into being. But so often the very data on which we rely for ordinary section construction are open to some doubt ; in between places where measurements can be sworn to, there must occur gaps, sometimes comparatively great distances, where evidence is uncertain or only conjectural ; if such inexactitude is contemplated on the ground, what is the use of introducing mathematically exact methods of underground interpretation ? And who, moreover, would in such circumstances take the time and trouble to make the necessary constructions ?

Against this, however, is the wider problem of greater accuracy of graphic expression of geological phenomena, and in making this demand of his brother geologists, the author is doing them and the science a service. Section-drawing is a traditional pastime in geology, one which will die hard, if it dies at all. But it must be remembered that there are many of us who refuse to see in a horizontal section more than an appeal to the elementary in geology, that to many, the map is the thing and that the reading of the map, whether in terms of surface topography or in the more hypothetical terms of subsurface tendencies, is the only convincing argument of what is really happening. If we revert to the student's lot with sections, then it is clear that, if his mind is trained on these alone, however accurate they may be, no amount of erudition will implant the desirable third dimension into his vision, to his lasting detriment. A colleague reviewing a kindred book in the MAGAZINE recently draws attention to the same thing, and all associated with the teaching of structural geology will agree that, in some circumstances, the horizontal section is nothing less than a curse to the geological mind in training.

Mr. Busk is fully cognizant of these objections, and, in fact, introduces the "solid" element into his work in the shape of some stereographic projections of various structures. Apart from the difficulty of following one or two badly executed sketch-diagrams, we are not sure whether the latter part of the book, where he breaks away from pure geometry, is not the best. At all events, his thesis is provocative in conception and in application, and no one will read this book without gaining a measure of valuable knowledge of how to proceed given certain set conditions ; the fact that such conditions may only be realized in special cases, or that problems in subsurface geology will still continue to baffle even the most expert mathematical geologist, does not in the least detract from the real merit consistently shown in its pages.

H. B. MILNER.

☞ 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

October 10.

LOW-GRADE MINES PROBLEM.—Owing to heavy losses, falling off in grade, and disappointing development for a long period, resulting in serious depletion of pay ore, the directors of the New Kleinfontein Company have decided that it is impossible to continue operations. All development is being stopped and milling will continue only so long as it is possible to make a profit. This large low-grade mine has not returned a dividend since 1924, when one of $2\frac{1}{2}\%$ was distributed. It was maintaining 400 white men and 4,000 natives in regular employment, and putting £500,000 of new money yearly into circulation. Some of the white men have already been retrenched, and soon the others will also be thrown out of employment unless something can be done to reduce the company's burdens and enable it to carry on. The Department of Mines and Industries is giving serious consideration to the position created by the company's decision, and it is hoped that the Government will now resolutely tackle the question of granting financial assistance, or relief from taxation, to all the low-grade gold mines of the Rand. As regards the New Kleinfontein, the usual departmental inquiry will be held. A full report and review of the position of the mine and its present circumstances will be made by the Government Mining Engineer, and in due course this will be submitted to the Minister of Mines for consideration and report to the Cabinet.

$5\frac{1}{2}$ TONS OF DIAMONDS.—According to a report issued by the Geological Survey, four occurrences of kimberlite are known within the limits of the Pretoria sheet of the geological map of the Union. They are situated near the Premier Mine and belong to the same group. A dyke on Franspoort and a pipe on Pienaarspoort are almost barren of diamonds, while diamonds have not been found in the pipe on Beynestpoort, and no information is available about the pipe on Louwsbaken. The Premier mine pipe is the largest kimberlite pipe known in South Africa. It is oval in plan, with the greatest diameter of over half a mile at the surface. The mine is an open-cast excavation. At present the depth of 610 ft. has been reached. The amount of material excavated since mining started in 1903 is about 100 million tons, while 27 million carats, or 5½ tons, of diamonds have been produced. The pipe rock is the "blue-ground" of the diamond mines, the upper part of which was altered to "yellow-ground" to an average depth of 37 ft. Alluvial deposits carrying diamonds occur along the minor tributaries of the Pienaars River on the farms Elandsfontein No. 85, Beynestpoort No. 520, Kameelfontein No. 166, and Roodeplaat No. 314. The streams drain the higher ground further east, and the diamonds have evidently been derived mainly by denudation of the Premier pipe. Most of these deposits have, however, been exhausted.

ALLUVIAL DIAMONDS.—The alluvial diamond output of the Transvaal is still steadily declining, and the figures for July last, just published, indicate that it is now more than 50% below those of the highest monthly production recorded during the Lichtenburg boom. The output for July was 71,831 carats valued at £198,052, a decrease of 14,902 carats and £13,064 in value. The value per carat, 52s. 7d., compares with 53s. 2d. for June and 46s. 7d. for May. Most of the diamonds registered in July were found on the recently proclaimed farm Elizabeth, in the Lichtenburg district, where the value of the production amounted to over £40,000. At Grasfontein and Uitgevonden (Lichtenburg district) the finds totalled £35,078 and £26,171 respectively. The washing plant put up by the owners of the farm Elizabeth, the Lichtenburg Diamond Estates, has now been at work for a fortnight, and is approaching its nominal duty of 500 loads a day. The first returns show that from 2,000 loads washed 207 carats were recovered, with an average value of £3 14s. 9d. per carat. The amount of ground to be washed by the company is very considerable, the present face in "A" block being 24 ft. deep.

STATE DIAMONDS SALES.—A new agreement is said to have been entered into between the Union Government and the Diamond Syndicate concerning the marketing of diamonds produced from the State diggings in Namaqualand. Two million pounds worth of State diamonds were sold to the Syndicate some months ago, on condition that any profit made on the deal by the Syndicate over 6% should be divided equally between the Syndicate and the State. The Syndicate is said to have disposed of £700,000 worth of these diamonds, and the State's share of the profit on the sales amounts to £23,000. The Government has sold approximately £1,000,000 worth of the largest State diggings diamonds to South African cutters, enabling them to compete successfully with oversea cutters.

TRANSVAAL EMERALDS.—The African and European Investment Co. announces that it has exercised its option over a block of 480 emerald-bearing claims, situated 2½ miles north-east of Gravelotte railway station, in the Leydsdorp District of the Transvaal. It is understood that the results disclosed during six months' prospecting, combined with the reports received from London in regard to the value of the emeralds despatched for examination and cutting, are so favourable that active recovery operations will be commenced shortly. There is reason to believe that eventually a subsidiary company will be formed to work the property.

BERYLLIUM SUPPLIES.—Advices from Great Britain indicate that there is a definite desire to investigate and apply beryllium, but it is not known where adequate supplies of ore can be procured. Probably when people in Great Britain have studied Professor Kavaloff's report on the beryl occurrence in Namaqualand, mentioned in my last letter to the MAGAZINE, they will be convinced that no doubt need be entertained regarding supplies. It is stated that £20 per ton is offered and has been paid in London for small consignments of Madagascar beryl.

JADE.—Some years have elapsed since the discovery of jade in the Pretoria district was announced, yet apparently little or nothing has been done in the direction of finding a market for the stone, which is described by the Geological Survey as "a massive garnet (grossularite)". Outcrops are found on the farms Buffelsfontein No. 205 and Turffontein No. 310, near Wolhuterskop Station. The colour of the jade ranges from deep sea green to pink with many intermediary shades, while the varieties may be translucent to opaque, with or without spots of magnetite. The bulk of the material consists of massive grossularite, while zoisite and chromite also occur in places. The hardness is from 7 to well over 8 and the specific gravity is between 3·33 and 3·52. On account of its superior hardness, capacity for taking polish, translucency, freedom from parting planes, and artistic range of colours, the jade has been claimed a semi-precious stone.

MANGANESE DEVELOPMENTS.—South African Manganese, Ltd., has granted an option to the Becker's Trust Company which gives the latter the right for the period of six months to acquire all the right, title, and interest of South African Manganese, Ltd., in and to that company's farms on behalf of a new company to be formed with a capital of £500,000. Operations on the properties of South African Manganese, Ltd., are to be commenced immediately under the direction of an engineer, who is collaborating with Professor Kaiser, the geologist, whose favourable report upon the company's areas in the initial prospecting stages was published some time ago. The object of the prospecting and development work is to prove on one or two of the company's farms a solid unbroken deposit of from 5 to 10 million tons of good-grade manganese ore. At the same time the engineers will form definite conclusions as to the cost of mining, or rather quarrying, the ore, which the directors are confident will be highly satisfactory.

Manganese Fields, Ltd., has been registered at Pretoria with a capital of £100,000, for the purpose of amalgamating Postmas Manganese Fields, Ltd., and Gamagara Manganese Corporation (Postmasburg), Ltd. The Postmas Manganese Fields was registered in February, 1927, with a capital of £40,000, and the Gamagara Manganese Corporation, Ltd., was registered in May of the same year with a similar amount as capital. The new company will take over these two companies.

FALSE BAY FORMATION.—Dr. E. C. N. van Hoepen, Director of the National Museum at Bloemfontein, has made an interesting discovery in regard to the geology of Zululand. Some weeks ago he visited Zululand with members of the International Geological Congress and studied several formations there, but nothing was found that appeared to affect the theory that the Cretaceous formations of Pondoland were the highest or youngest ever discovered. Dr. van Hoepen, however, had all along an inkling that a younger formation existed somewhere in Zululand, and with a view to ascertaining the truth, he stayed two days after the other members of the excursion had left. The result was that he discovered fossils which definitely proved that the Cretaceous formation in the vicinity of False Bay is the youngest on record. The theory about the age of the Pondoland formation is, therefore, finally exploded, and it will undoubtedly be news to the visiting geologists to hear that they actually passed right over the formation without noticing it. The formation was at once christened the "False Bay formation" by the discoverer.

BRISBANE

September 16.

QUEENSLAND OIL PROSPECTING.—Queensland, particularly the Roma district, has hitherto been regarded as the State offering the most favourable prospects for oil in the Commonwealth. Two important reports published to-day, however, are of a nature by no means encouraging to the score or so of companies operating in the Roma district, and will certainly check future investment of money in oil prospecting. The first of these reports is by the directors of two Elbof geophysical survey groups, Messrs. Bein and Rittershausen. One of these groups began operations in Queensland in December and the other in March last. Although the report specifically relates only to two petroleum prospecting permits (No. 67 and 128), held respectively by the Queensland Roma Oil, Ltd., and the Australian Oil No. 1, Ltd., and situated about 35 miles north-westerly from Roma, it has an important bearing on oil prospecting over the whole district. The sites for both bores were selected towards the end of last year by Dr. H. I. Jensen, consulting geologist, who based his selection on the assumption that definite anticlines traverse the areas. The geological theory, which is backed up by other geologists who know the district, is that what are geologically known as the Lower Walloon series of the whole Roma district should be considered as the origin and carrier of economical oil accumulations, to be reached by comparatively shallow boring on suitable structures, and this theory is substantially based on the encouraging oil-gas evidence of the boring that has been carried on at Roma. The report now issued, however, states that this theory cannot "be supported any longer in the light of definite information meanwhile obtained by further boring, as well as by recent geophysical survey and geological considerations. Furthermore, certain previous contentions in proof of the theory mentioned must, it is added, be considered as erroneous. It is asserted that there is abundance of evidence that the Lower Walloons at Roma are neither oil producers nor suitable as oil carriers to favourable structures. Bedrock in granite has been met with in two or three bores, and Messrs. Bein and Rittershausen affirm that to continue boring when such bedrock is encountered is not only technically difficult and uneconomical, but also without the remotest chance of success.

The geophysical report, while having a general application to the whole district, excepts a very limited area at Hospital Hill, at Roma, on account of the evidence there of oil-gas. The origin of this, it is asserted, is not yet established, but that it does not come from the Lower Walloons is considered certain. More promising areas are considered to exist in other parts of Queensland, but it is recommended that a search for oil there should be preceded by scientific exploration, and that further exploration on Hospital Hill should be carried out at Government expense.

Dr. Woolnough's Report.—The second report relating to oil prospects in Queensland is one by Dr. Woolnough, Commonwealth Geological Adviser, which was made public on the same day as that referred to above. The conclusion arrived at by this authority is that the operations on Hospital Hill showed the existence of an important gas field, but have proved fairly conclusively that the small quantities of light oil obtained along with the gas are not likely to be derived from a local oil reservoir of considerable dimensions. In his opinion, however, the gas field alone is worthy of development, as there is a decided possibility that gas even richer in petrol than that at present flowing may be encountered. He also recommends that a thorough geological survey of the district should precede boring.

Coal from Abroad.—The principal coal mines in New South Wales, which were closed down by the owners over six months ago because the miners would not accept a reduced wage, are still idle, and no further move for a settlement of the trouble has been made in the past month. London papers lately to hand indicate that many people in England, qualified to give sound opinions, refuse to believe that this trouble is entirely responsible for the development of an Australian export trade from Great Britain. They consider that, even though the miners here may yield to the owners' demands, Australian coal will still be too dear to use anywhere except in the immediate vicinity of the mines. On this side of the globe, however, facts do not bear out the view of these authorities. When the South Australian Government was first compelled to go to Britain for coal supplies, reduced freight charges were stated to have contributed to the low price at which these supplies were obtained. Even under these conditions, the Australian coal owners were fully satisfied that, if the scheme then proposed to reduce the cost of production by 4s. or 5s. a ton was agreed to, the Australian trade would be regained. When later the Victorian Railway Department were forced to order 40,000 tons of high-grade British coal, at a cost of about £100,000, the price they had to pay was stated to be 30% more than that of New South Wales Maitland coal. More recently it was reported that the Victorian Railway Department, having arranged for supplies from the south coast at a price considerably lower than the latest British quote, had decided not to give more orders overseas. Moreover, as many orders as can be filled are now being shipped from Queensland to the southern States and New Zealand, presumably because the coal can be more advantageously obtained from this State than from Great Britain.

Mount Isa Mines.—The number of men employed at the Mount Isa mines has now reached about 1,200. Mr. Leslie Urquhart, in Brisbane, after his recent visit to the field, said that he and his colleagues who accompanied him were very well satisfied with the progress that had been made since he saw the property last year, when the programme of mine development now being carried out was inaugurated. The ore reserves are now estimated at 25,000,000 tons, of a commercial grade. The magnitude of the Mount Isa undertaking is indicated by the fact that to complete the first section of the programme mapped out for the treatment of 2,000 tons of ore a day will involve an expenditure of £2,000,000 ; while an additional plant, to provide for dealing with 5,000 tons daily and to include a zinc treatment plant, will cost another £3,000,000. The 20-mile pipe line, to convey water from the Rifle Creek dam to the works at Mount Isa, is now being laid. The storage capacity of the dam (about 600,000,000 gallons) is more than ample for initial requirements on a 2,000 tons per day basis; but in the meantime the bores and wells being put down to largely supplement the supply of water will, with mine water, guarantee all needs against the possibility of a sequence of dry years. In order to ensure a further supply, however, for the intended increased operations up to a 5,000 tons basis, several other water schemes are being studied, with a view to putting this work in hand at once.

Broken Hill Mines.—Owing to the then declining price of metals, the lead-zinc mines of the Broken Hill Proprietary Company, Ltd., and the Broken Hill Proprietary Block 14 Company, Ltd., were closed down in September, 1927, and have been idle since. The extraction of ore from these properties, however, is now expected to be resumed shortly. Arrangements have been made for ore from both mines to be crushed and concentrated at the Central mine mill of the Sulphide Corporation, Ltd., which is extending its plant and installing a new power unit. This will allow the average cost of production to be reduced, from which the three companies will benefit. About 1,200 men will be employed in the B.H.P. and Block 14 mines when full capacity is reached.

A Big Central Power-Plant.—Contracts have been let by the North Broken Hill, the Broken Hill South, and the Zinc Corporation for the manufacture of machinery for the proposed central power station at Broken Hill. The order for the six sets of Diesel-electric generators needed, each of 3,000 h.p., has been placed with Sulzer Bros., of London, who are to have them constructed by the British Thomson-Houston Co., Ltd., of Rugby; the four Diesel compressors, as well as the whole of the switch-gear and electric accessories, will be manufactured by Mirrlees, Bickerton, and Day, Ltd., and the air-compressors by Belliss and Morcom, both British engineering firms.

VANCOUVER

October 9.

Alice Arm.—The Britannia Mining and Smelting Company has added considerably to the properties it either has located or taken under lease and option in the Alice Arm district. It recently has taken leases and options on the Dolly Varden, Wolf, and Kitsol groups, and it has moved its drilling outfit from the Toric mine, which is controlled in London and under option to Britannia, to the Wolf, which evidently is to receive first attention of the properties recently optioned. No information has been given out as to the result of diamond-drilling at the Toric, but the fact that the company has located 18 claims adjoining and is following up the diamond-drilling by extending the bottom tunnel and by sinking a winze from it, would seem to indicate that the result of the drilling has been favourable. Of the new properties bonded the Dolly Varden is the only one that has any record of production. During 1919, 1920, and 1921 the Taylor Mining Company, now defunct, took more than 1,300,000 oz. of silver from the property, without doing any development, and, as a result, it has been impossible to get any development company interested in the mine since it was closed, in 1922, until now.

Kitsault Eagle Silver Mines has opened a promising vein of silver-lead-zinc ore at 1,200 ft. from the portal of its tunnel and at a depth of about 500 ft. The width of the vein has not yet been determined, but an interesting feature of the development is that, whereas on the surface the mineralization was chiefly zinc-blende, at depth the vein carries silver associated with grey copper and galena and only a small amount of blende. At the surface the vein was 30 ft. wide.

Boundary.—The Granby Consolidated Mining, Smelting, and Power Co. is not shipping concentrate from its Allenby mill to Tadanac, as I erroneously stated last month. It made a five-year contract for the treatment of the concentrate with the Tacoma Smelter which will not expire until the end of August, 1933. Granby is, however, shipping blister copper from Anyox to Tadanac, and will continue to ship as much as Canada can absorb in the form of rods and bars, which is about 1,200 tons per month. Previously this was refined at New Jersey.

John F. Guest and associates recently made their first clean-up from the consolidation of placer mining leases they acquired on the Tulameen River, about three miles below Coalmont. From approximately 8,000 cu. yd. of gravel they recovered nine ounces of coarse platinum, twenty ounces of coarse gold, and some thirty tons of black sand that assays $50 in gold and platinum per ton.

A group of Vancouver mining and financial men has acquired the Sally mine, on Wallace Mountain, near Beaverville, and intends thoroughly to explore for the downward extension of the shoots of rich silver ore that characterized the upper workings of the mine. The vein is much faulted and difficult to follow.

THE KOOTENAYS.—Reeves-McDonald Mines, which is controlled by Victoria Syndicate, of London, has struck another body of ore, 28 ft. wide, by diamond-drilling. It will be some time before the extent of the deposit can be determined. The ore is of the same character as the other large bodies that are being developed on the property. The drill also penetrated 3 ft. of almost clean galena, an unusual occurrence in this district of low-grade zinc ores.

Galena Farm Consolidated Mines, another property in which Victoria Syndicate, of London, is interested, has nearly completed its new 100-ton mill, on the shore of Slocan Lake, and the plant will be in operation before this letter is in print. The company is a consolidation of the Galena Farm and Hewitt mines and the properties between, which gives the company about 2¼ miles on the shear zone. A main haulage adit is being driven a little above the mill, from which ultimately all properties will be operated. In the meantime, an aerial tramway has been erected to carry ore from the Hewitt to the mill.

Lucky Jim Lead and Zinc Co., still another concern controlled by Victoria Syndicate, has found a new shoot of ore between No. 5 and No. 6 levels—700 ft. apart—by diamond-drilling and is now opening it up for stoping. The shoot is 240 ft. long with a maximum width of 30 ft. Colonel H. H. Yuill, general manager for the Syndicate in British Columbia, states that the mine is looking better than at any time since the Victoria Syndicate acquired control. The new shoot is appreciably higher in zinc than any previously mined.

The Ruth-Hope Mining Co. has developed a good tonnage of ore between No. 5 and No. 6 levels on both the extension of the Silversmith shear zone and the Ruth vein. The company is milling 50 tons daily, and the mill feed runs about 25 oz. of silver, 6% of lead, and 6½% of zinc.

Noble Five Mines has developed a large tonnage of ore between the 1,600 ft. and 1,800 ft. levels on the Deadman vein; the shoot is 350 ft. long and ranges up to 20 ft. in width. The company also is developing a 5 ft. to 6 ft. shoot on the Noble Five vein, between the 800 and 600 ft. levels, and it is driving a cross-cut to open at greater depth the old Surprise mine, which it has acquired, through Noble Five. This development, which Mr. Paul Lincoln, the general manager, considers more important than production, leaves power sufficient to operate the mill at only about 800 tons daily. Returns from this, however, provide funds to pay for all development and operating expenses and leave something over for a dividend fund. It was expected that West Kootenay Power and Light would have completed a transmission line into the Slocan before now, and provide the company with ample power for all purposes, but, owing to shortage of electric current at the smelter, this line has been held up. The West Kootenay company had expected to have started construction on an 80,000 h.p. hydro-electric plant on the Pend d'Oreille River, near the international boundary, before now, but the development of this power station has provided engineering difficulties that have not yet been surmounted. The company has, however, been given the power rights of the Adams River, which is expected to develop 30,000 h.p., and as soon as surveys have been made, work on this plant will be pushed to completion.

PORTLAND CANAL.—Premier Gold Mining Co. has paid the customary dividend of 6%, covering operations for the third quarter of this year. The dividend amounted to $300,000 and brought the total disbursement up to about $14,050,000. The company is developing a body of ore between No. 5 and No. 6 levels, but the only information with regard to this ore-body that has been made public is that it will appreciably lengthen the life of the mine. The company has nearly completed the 6¼ mile aerial tramway from the Prosperity and Porter-Idaho mines to the mouth of the Marmot River, and by stringing temporary cables over the unfinished part has been able to take up supplies that will assure the continuation of development during the coming winter. While the supplies were going up some 2,000 sacks of high-grade ore were brought down.

L. M. Lynburner, president of Mountain Boy Mining Company, who recently reached Vancouver after inspecting the property at American Creek, stated that the tunnel has cut the high-grade vein, which has been traced for 1,500 ft. on the surface, at its junction with the vein worked by Sir Donald Mann and associates, 15 years ago, and at a depth of about 500 ft. The Mann vein, he said, is 50 ft. wide and assays $37.50 in silver and lead per ton, at the point of intersection. A trial shipment of four tons from the high-grade vein to the Tacoma smelter yielded a return of $541.50 per ton. Development will be continued through the winter, and it is expected enough ore will be proved to warrant the erection of a concentrator in the spring.

Vancouver Island.—Consolidated Mining and Smelting Co. has acquired an option on a controlling interest in the Kinman group, near Kimpkish Lake, which was described in a recent newsletter, and is making a road from the lake to the property and constructing a camp. As soon as this work is finished and machinery has been taken to the property exploration by both underground work and diamond-drilling will be started and pushed vigorously until the downward continuation or discontinuation of the remarkable showings at the surface has been proved.

Yukon Territory.—Ores and concentrates shipped over the White Pass and Yukon River route from the Mayo district during the present season amounted to approximately 8,000 tons, valued at $2,600,000, as compared with 4,500 tons, valued at $1,500,000, in 1928, according to a statement made by Mr. S. J. Farr, British Columbia representative for the railway company.

TORONTO

October 19.

Sudbury District.—Work on the new smelter of the International Nickel Company at Copper Cliff is making steady progress. The chimney 510 ft. in height has been completed and operations are being pushed forward rapidly in order to get the plant into working order as soon as possible. Underground operations at the Frood mine show that the ore is improving in grade at depth with an increased proportion of copper. The Garson branch of the Canadian Pacific Railway to the Falconbridge mine has been completed, so that machinery for the new smelter can now be brought in over it and the completion of the work hastened; it is expected that the furnace will be blown in about January 1. The ore reserves down to the 550 ft. level are estimated at 5,000,000 tons, the deposit continuing to the 1,000 ft. level where it shows an increased value of about 20%. The branch line of the Canadian Pacific Railway from Chelmsford to the Errington property of the Treadwell Yukon has nearly been completed and will be in operation next month. A new ore-body 150 ft. in width has been discovered on previously unexplored ground north of the present workings. The Lake Geneva, which has 70,000 tons of ore in sight carrying zinc and lead, will instal a mill with an initial capacity of 50 tons of ore a day. The Mormac is carrying on active development on a discovery made last year and has recently encountered another promising ore-body. Nickel Range Syndicate, Ltd., which owns a property comprising 1,500 acres about 600 of which underlie a shallow lake where a mineralized zone had been indicated by a radiore survey, will carry out a campaign of diamond-drilling during the winter. A large deposit of chromite has been discovered at Obonga Lake 25 miles south from the Collins station on the Canadian National Railways. A number of claims have been staked, and the Golden Centre Mines, Ltd., has let a contract for 2,000 ft. of diamond-drilling.

Porcupine.—The output of the eight producing mines of the Porcupine area during September was valued at $1,564,582, as compared with $1,736,523 during August. Development work at the McIntyre Porcupine mine has for the past year been almost entirely confined to maintaining production from the older workings and getting the lower levels into shape for intensive development for ore. According to a preliminary estimate the mill has handled approximately 410,000 tons of ore during the first nine months of 1929, producing about $3,200,000 with an average recovery of about $7·80 per ton. The ore reserves are estimated at a value of $17,000,000. A new process for the reduction of gold ore is being tried out in a 100 ton pilot mill equipped for the purpose, which will be operated for six months. Should the process prove successful it will be adopted in connection with the plans for the new mill. It is claimed that it will effect important economies, reducing the operating costs by one half and the capital cost of mill construction by 60%. The Hollinger Consolidated during the nine months ended September 30, according to preliminary estimates, produced gold to the amount of $6,400,000 from the treatment of about 1,120,000 tons of ore, with an average recovery of around $5·75 per ton. During the past month, however, the average grade of ore going to the mill has been considerably increased. The comparatively low recovery during the nine months was due to the policy of the management of conserving the high-grade so as to prolong the life of the mine. The output of the Dome Mines during September showed a decrease from the previous month, being valued at $301,184 as compared with $317,727. Production for the first nine months of the year totalled $3,210,358, as against $2,313,120 for the corresponding period of 1928. The mill continues to run steadily on a production basis of 1,500 tons of ore daily. It is stated that latterly development operations in the greenstone formation have not been as successful as was anticipated by the management. At the West Dome the mill is operating steadily treating about 100 tons a day, with millheads ranging from $6 to $7 per ton, the revenue from production being sufficient to cover operations. The mill at the Vipond is treating 300 tons of ore a day, and millheads show improvement. Production during the first nine months of the year amounted to $620,000 according to preliminary estimates. Developments have disclosed additional ore in the central part of the mine, and a vein coming in from the Hollinger is yielding good ore on the 400 ft. level.

Kirkland Lake.—The six producing companies operating in this field during September had a total output of bullion valued at $1,120,096, as compared with $1,063,999 in August. The net profits of the Lake Shore gold mine for the year ending June 30 was $2,504,000 compared with $1,681,000 for the preceding year. Total production amounted to $5,504,858 from 367,000 tons of ore treated, being an average recovery of $15 per ton. The installation of a new tube-mill has brought the mill capacity up to 1,400 tons a day. Very high values have been encountered in driving on the 2,000 ft. level, where the best ore yet found on the property has been disclosed, averaging $35 per ton over a width of 9 ft. The downward extension of this ore has been discovered on the 2,200 ft. level. The position of the Wright Hargreaves has been considerably improved by the opening up of a large tonnage of ore on the 2,125 and the 2,250 ft. levels. Work on the upper levels is also proving satisfactory and adding to the ore reserves. At the Teck Hughes a new ore-shoot has made its appearance on the 19th level, continuing downward to the 26th level, where it showed a width of 20 ft. of high-grade. Work on the lower horizon shows that mineralization is well maintained at depth, with high gold content. The deeper mining campaign of the Kirkland Lake Gold mine is meeting with encouraging success. Diamond-drilling from the 3,600 ft. level has proved rich ore at a depth of 200 ft. The Amity Copper in the Boston Creek area of the camp has encountered some good ore-bodies. A vein came in at the shaft on the 600 ft. level covering the entire width. The shaft is being put down to 1,000 ft. The Patterson Copper mine in the same area is steadily developing high-grade ore for shipment to the Noranda smelter.

Rouyn.—The Noranda smelter is handling ore at the rate of 1,200 tons of ore a day and the construction of the second unit which is expected to be completed in November is well advanced. The concentrating plant is now treating 250 to 300 tons per day. Its present capacity of 500 tons per day is being doubled and before Christmas a steady rate of production of about 2,200 tons is expected to be reached and maintained for some time to come. The value of the ore reserves is roughly estimated at not far from $100,000,000, and the deepest level at 975 ft. appears to be the richest so far opened.

Manitoba.—Construction work is making rapid and satisfactory progress on the Flin Flon and Sherritt-Gordon properties in Northern Manitoba. At the former the erection of the smelter and other buildings is well advanced, and an all-steel fire-proof shaft is being installed capable of raising 3,000 tons of material in an eight-hour shift. The Sherritt-Gordon is sinking its main incline shaft at the extreme west end of the deposit. This is now down 400 ft. on the way to its objective of 1,500 ft. at a vertical depth of 1,000 ft. The estimated output of the concentrator now under construction is 27,000,000 lb. of copper a year in addition to zinc and precious metals. A series of tests have been completed at the Bernic Lake property of the Jack Nutt Mines, Ltd. The results show good tin values and development is being actively continued.

CAMBORNE

November 5.

UNEMPLOYMENT AND A PROPOSED REMEDY.—In August last a round-table conference of representatives of the Cornish mining industry was held at the Council Chambers, Camborne, to discuss schemes of work for the relief of unemployment, it having been thought that a way might be found whereby proposals could be tabulated with a view to obtaining Government assistance in resuscitating the mining industry, at the same time relieving unemployment.

The conference was attended by representatives of the Cornish Chamber of Mines, the Cornish Institute of Engineers, local mine managers, and representatives of the Camborne and Redruth Urban District Councils. A decision was arrived at to invite the Chamber of Mines and the Institute of Engineers to prepare a scheme, or schemes, of development of the county's mineral wealth.

The councils of these two institutions subsequently appointed a special committee, which met several times during the last few weeks, and, as a result, a well-considered scheme has been forwarded for the Government's investigation, care having been taken in the preparation of the scheme to make it specially applicable to those districts in which unemployment has been most severe and prolonged. Naturally first consideration was attracted to the Dolcoath Company's late efforts to establish a mine from the new Roskear Shaft as a centre. Potentialities of that and other mining areas in west and central Cornwall were carefully examined.

Finally the scheme, which was recently submitted to the Government for their investigation, embraced :—

(1) Camborne and Illogan (North). A closer unity of interests among mines now in operation, especially with regard to a system of central drainage. The sinking of two new shafts, with the object of developing the lodes known to exist to the north of the Roskears, South Crofty, East Pool, and Agar. The Setons and Old North Pool, with the intervening and adjacent setts, would be included. Ultimately, the linking-up of both new shafts with the Roskear shaft, from which the interrupted plans for the development of the lodes discovered immediately north and south of it would be resumed, and extended.

(2) Camborne and Illogan (South). The extension of the existing deep adit system, which served Old Dolcoath and Carn Brea with the intervening mines, southward through Great Condurrow to the Flat Lode mines, the first object being to exploit those lodes which were worked at shallow depths in South Condurrow, the Bassets and other mines to the south of Carn Brea Hill and Camborne Beacon Hill, before the Flat Lode was discovered, just over half-a-century ago. Such an extension of the deep adit would give 400 to 450 ft. of free drainage on the lodes referred to.

(3) St. Just. The extension of operations at Levant below the depth now accessible, and the exploitation of additional ground southwards to Cape Cornwall.

(4) Lead and Zinc. Deeper sinking—below 400 ft.—at Lambriggan, with the object of augmenting the work now in hand at 400 ft. and above, with a view to establishing the continuation of the old Chiverton productive lead and zinc deposits in a westerly direction towards St. Agnes.

The scheme is comprehensive and well-designed. Any one part can be proceeded with separately. Care has been taken in its preparation to ensure that the scheme embraces only those areas in which unemployment is, and has been, most acute. Dolcoath, a year ago, employed over 200 hands in the Roskear developments. The plant, including pumping, remains intact, just as it was on the suspension of operations. Employment can be given at once to a number of men which can be rapidly increased. During the last six or seven years the tin mining industry in the West has undergone steady, progressive resuscitation from a state of absolute suspension caused by the post-war adverse conditions, but progress has not been sufficiently rapid to absorb all those seeking employment in mines, especially all young men who were inclined to take up mining as an occupation. Hence a considerable number of miners, and would-be miners, still remain out of work.

THE PRICE OF TIN.—With tin at the lowest price for six years past, the present situation of the mines in operation is serious—indeed, a cause for anxiety to "one and all" in the West, for the welfare of the mining industry closely touches many who are not miners! From a total Cornish output of black tin amounting to only just over 500 tons, six or seven years ago, the measure of resuscitation established since then is sufficient to make the present year's output about ten times as much.

Current prices of £180 to £190 per ton for tin metal, however, render existence difficult at the moment; but, nevertheless, not impossible. South Crofty and Geevor have cash reserves of £30,000 to £40,000 each. The former pays its way, and the latter has just paid a 5% interim dividend on the first six months of the financial year.

East Pool and Levant, though less fortunate in cash reserves, possess substantial underground reserves, and have maintained a steady increase in output in order to meet requirements of a falling market.

Jantar, Polhigey, and others of the newer mines have, so far, kept going at full pressure, in the hope that a turning-point was in view; but they are now either adopting the undoubtedly wise course of curtailing production and working on a smaller scale till the market rights itself, or are contemplating the adoption of such a course. The policy is a commendable one of self-preservation, and it, incidentally, helps somewhat towards the prevention of over-production. Indeed, it is an example that bigger companies in foreign tin-fields might advantageously follow.

PERSONAL

E. G. Banks, late Superintendent of the Waihi Gold Mine, New Zealand, has been in London and has returned to Malaya.

Sydney Bray has left for Cyprus.

G. W. Campion has left for West Africa.

Stanley W. Carpenter has left for Nigeria.

L. Maurice Cockerell has left London for Texas and California.

P. C. Delaitre has returned from Oubangui.

Daniel Gibson has returned to Panama.

Maurice Gregory has left for Abyssinia.

H. C. Hannay has returned to Malaya.

S. O. Hatton is home from West Africa.

Sydney Higham has returned from the Sudan.

N. R. Junner was here from South Africa on his way to Sierra Leone.

Sir A. E. Kitson is home from the Gold Coast.

Rex Lambert has left for Egypt.

Deane P. Mitchell has returned from Australia.

C. A. Mitke has returned from Australia.

A. E. Northey has left for New York and Havana.

A. Livingstone Oke has left for Portugal.

W. S. Robinson has left for Australia.

R. de H. St. Stephens has returned from India.

Blamey Stevens has been in London and has returned to Mexico.

G. Gordon Thomas left Capetown on November 1 on his return to England.

D. A. Thompson is home from West Africa.

David M. Thomson has returned to Canada.

Scott Turner left Washington on October 12 for Tokio to attend the World Engineering Congress.

Leslie Urquhart has returned from Australia.

Louis A. Wright is now in London as consulting engineer and foreign representative for Mayflower Associates Inc., his address being c/o Messrs. Wilkens and Devereux, Stone House, Bishopsgate, E.C. 2.

TRADE PARAGRAPHS

The Morse Chain Co., Ltd., of Letchworth, Herts, issue a booklet giving details of their standardized chain drives for all classes of power transmission.

Head, Wrightson, and Co., Ltd., of Stockton-on-Tees, issue a new edition of their catalogue of elevators, belt conveyors, and screens, the latter including rotary screens with shaft or roller drives.

Daniel Adamson and Co., Ltd., of Dukinfield, Manchester, manufacturers of turbines and boilers, inform us that they have purchased the goodwill and drawings of J. Carmichael and Co., boiler makers and steel plate workers of Dundee.

Crosby, Lockwood, and Sons, of Ludgate Hill, London, E.C. 4, issue their quarterly announcement of new and forthcoming books, among which we notice a new textbook on Metalliferous Mine Surveying by Thomas Hanton of the University of Sydney, which is in preparation.

Mond Nickel Co., Ltd. (Bureau of Information on Nickel), of Imperial Chemical House, London, S.W. 1, send us their bulletin devoted to nickel alloy steels in high performance internal combustion engines. They also send us the October issue of their nickel bulletin.

British Geophysical Survey, Ltd., of 3-4, Clements Inn, London, W.C. 2, have issued a copy of the report submitted to their annual general meeting held last month, in which it is disclosed that the company have decided to remain independent and have accordingly rejected offers of amalgamation with other geophysical operators. They also issue a booklet which aims at showing the practical application of geophysics in mining and prospecting for minerals. It is illustrated with various types of apparatus for this purpose.

Babcock and Wilcox, Ltd., of Farringdon Street, London, E.C. 4, send us a complete list of their leaflets devoted to pulverized fuel plant, which include the following: A Bailey furnace wall, which is a special type for insuring maximum efficiency in boiler heating; a unit coal pulverizer; turbulent pulverized coal burners, specially designed for firing through a water cooled furnace wall; a Bailey pulverized coal feeder for controlling feed of coal from mill to burner; a Fuller-Kinyon transport system for conveying the pulverized material through standard size pipelines, working on a screw conveyor principle, and finally a Fuller-Bonnot pulverizer mill and a Lehigh pulverizer mill both being special types of coal crushing mills. The power station of Mount Isa Mines referred to elsewhere in this issue is equipped with Babcock and Wilcox plant.

Ransomes and Rapier, Ltd., of Ipswich, give us particulars of the following orders recently executed for Marion excavators. Union Minière du Haut Katanga have bought 3 British, type 7, 1-yd. electric shovels recently and 2 large 3-cu. yd.

heavy duty, quarrying shovels of a new type known as 5120, the latter having been supplied direct from the Marion company's works in America, production in England of this type not yet having commenced. Minas del Rif, Morocco, have ordered 6 type 490, $2\frac{1}{2}$-cu. yd. Marion shovels, Bwana M'Kubwa Copper Mining Co., Ltd., recently bought a large, type 7, 1-cu. yd. steam shovel, a duplicate of that previously supplied to the Roan Antelope Copper Mining Co., and a repeat order has just been received from the Roan Antelope themselves. A type 7, 1-cu. yd. electric shovel has been supplied to the Mount Lyell Mining and Railway Co., Ltd., of Australia, a type 7 Diesel-electric 1-cu. yd. to the Alquife Mines and Railway Co., Ltd., of Spain, and a type 7, steam shovel to the United Steel Companies, Ltd., and also a type 460 $1\frac{1}{2}$-cu. yd. shovel is on order for the Sungei Besi Mines, F.M.S. These sales are in addition to numbers of excavators supplied to contracting and quarrying companies and to irrigation and public works authorities.

Sullivan Machinery Co., of Salisbury House, London, E.C.2, issue a number of bulletins describing different types of their core drills. These include the following: Type 20, engine driven, rig is a diamond drill recently developed to meet the requirements of mineral prospecting in which the depth does not exceed 1,000 to 1,200 ft. It has a capacity of 1,000 ft. equipped with $1\frac{3}{8}$ in. core fittings or 1,150 ft. with [illegible] in. core fittings and can be equipped with hydraulic head or screw feed swivel head as required by the conditions of the ground where the machine is to be used. A hoist of new design has been mounted with this rig and two speeds are provided for both hoisting and rotating the drill rods. Type 40 mounted diamond drill is driven by a direct-connected petrol engine and is mounted complete with power plant and pump and hoist carried on a heavy steel wheel truck for convenience. This will drill to a depth of 1,200 ft. with fittings making a 3 in. hole and removing a 2 in. core and to a depth of 2,200 ft. when removing a core of $1\frac{1}{4}$ in. diameter. While developed primarily for oil-field prospecting it is made adaptable for other types of drilling, particularly where maximum portability and fuel economy are important. The hoist built for this machine is set transversely so that the rope will spool on the drum no matter how far the drill is drawn back from the hole. There are 4 hoist and 4 rotating speeds. The engine is a Buda 29 h.p. 4 cylinder 4 cycle unit. "Bravo" and "Bravo 300" are described in the other two bulletins, the former being a hand driven drill for shallow holes and the other a petrol engine driven type for taking cores at 300 ft. in depth.

METAL MARKETS

Copper.—Sentiment fluctuated somewhat on the standard copper market during October, but the tendency, on balance, was easier, as was also the case on the electrolytic copper market in New York. Electrolytic there fell from 18 cents to 17·95 cents per lb. Consumers did not display much fresh interest as they were fairly fully supplied by reason of heavy purchases made earlier, but producers are generally reckoning upon larger buying before the end of the year. Copper stocks in the United States appear, however, to be increasing and the crash in Wall Street would scarcely appear to be a favourable factor.

Average price of cash standard copper: October, 1929, £72 17s. 2d.; September, 1929, £75 6s. 9d.; October, 1928, £65 11s. 4d.; September, 1928, £63 11s. 3d.

Tin.—Prices slumped further during October and confidence was obviously shaken pretty badly. At the low level at which prices now rule, however, fresh speculative interest is almost certain to be aroused, while consumption should also be stimulated. In addition, output will be curtailed, so that eventually things should work themselves on to a sounder basis again. Meanwhile, although world consumption is excellent it is insufficient fully to absorb all the supplies coming forward. The statistical position, therefore, is not developing too favourably. The present low quotation should, of course, offset much that is adverse in the position.

Average price of cash standard tin: October, 1929, £190 17s. 7d.; September, 1929, £204 18s. 9d.; October, 1928, £222 2s. 1d.; September, 1928, £215 15s. 7d.

Lead.—The market was easy last month, anticipations of heavier arrivals in the near future, a subdued consuming demand, weaker advices from America, and the easiness on other metal markets all contributing to the downward tendency. The metal resisted these factors fairly well for some time, but was eventually forced to give way. The Lead Producers' Association, which seems temporarily to have lost control of the situation on this side of the Atlantic, is likely, however, to do its utmost to regain it, and its efforts may perhaps be assisted by buying on the part of dealers and consumers to whom the metal now looks an attractive investment at current price levels.

Average mean price of soft foreign lead: October, 1929, £23 4s. 9d.; September, 1929, £23 11s. 5d.; October, 1928, £21 18s. 9d.; September, 1928, £21 18s. 2d.

Spelter.—This market remained in the doldrums during October, and prices receded further. Demand was dull and despite all the measures taken by the Cartel to curtail output, there was too much metal about for market or industrial needs. It looks as if somethng further will have to be done, unless a better demand springs up, if even the present low prices are to be maintained.

Average mean price of spelter: October, 1929, £23 2s. 6d.; September, 1929, £24 8s. 11d.; October, 1928, £24 3s. 3d.; September, 1928, £24 11s. 2d.

Iron and Steel.—The Cleveland pig iron market has assumed a distinctly less favourable aspect during recent weeks. Continental competition is growing and makers are finding themselves handicapped in the struggle for fresh business by the firmness of production-costs. It would not be surprising if the rate of output at the North-East Coast blast-furnaces declines in the near future. No. 3 Cleveland G.M.B. remained during October at 72s. 6d. per ton, but this figure was shaded by merchants. Hematite was a fairly good market, although makers complained that they could not cover production-costs; East Coast Mixed Nos. realized between 76s. 6d. and 77s. per ton. In finished iron and steel, the British mills reported a rather better demand, thanks possibly to fears

LONDON DAILY METAL PRICES

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

	COPPER				TIN.		ZINC (Spelter).	LEAD.		SILVER.		GOLD.
	Standard.		Electrolytic.	Best Selected.				Soft Foreign.	English.			
	Cash.	3 Months.			Cash.	3 Months.				Cash.	Forward.	
Oct.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	d.	d.	s. d.
11	73 18 9	74 11 3	84 10 0	78 5 0	194 12 6	198 11 3	23 7 6	23 7 6	24 15 0	22 15/16	23 1/4	84 11½
14	73 16 3	74 3 9	84 7 6	—	189 16 3	194 6 3	23 5 0	23 7 6	24 15 0	23 1/16	23 3/16	84 11½
15	73 8 9	73 13 1½	84 7 6	77 10 0	191 3 9	195 16 3	22 15 0	23 5 0	24 15 0	23 3/16	23 1/4	84 10
16	72 18 9	73 6 3	84 7 6	—	189 16 3	194 7 6	22 16 3	23 0 0	24 10 0	23 1/8	23 3/16	84 10
17	72 9 4½	73 1 3	84 5 0	—	187 16 3	192 2 6	22 17 6	23 6 3	24 10 0	23	23 1/16	84 11½
18	72 3 9	72 15 7½	84 5 0	77 0 0	184 17 6	189 2 6	22 12 6	23 7 6	24 15 0	23 1/16	23 3/16	84 11½
21	71 3 1½	71 11 10½	84 5 0	—	181 11 3	185 11 3	22 2 6	23 2 6	24 10 0	22 15/16	23	84 11½
22	71 12 6	71 16 10½	84 2 6	76 0 0	182 2 6	186 2 6	22 2 6	23 1 3	24 10 0	22 15/16	23 1/16	84 11½
23	73 1 10½	73 9 4½	84 2 6	—	189 12 6	193 17 6	22 7 6	23 11 3	24 15 0	23	23 1/16	84 11½
24	72 8 9	72 15 7½	84 2 6	—	188 17 6	192 18 9	22 10 0	23 11 3	25 0 0	23	23 3/16	84 11½
25	72 1 10½	72 9 4½	84 2 6	76 10 0	186 17 6	190 17 6	22 12 6	23 12 6	25 0 0	23 1/8	23 5/16	84 11½
28	72 3 1½	72 3 1½	84 0 0	—	183 12 6	187 12 6	22 2 6	23 7 6	25 0 0	22 15/16	23 1/8	84 11½
29	71 5 7½	71 5 7½	84 0 0	75 10 0	184 7 6	188 7 6	22 0 0	22 17 6	24 10 0	22 15/16	23 1/8	84 11⅜
30	70 6 10½	70 6 10½	83 15 0	—	184 7 6	187 12 6	22 1 3	22 7 6	24 0 0	22 7/8	23 1/16	84 11⅜
31	71 1 3	70 9 4½	83 15 0	—	189 2 6	192 2 6	22 1 3	22 10 0	24 0 0	23	23 3/16	84 11½
Nov.												
1	71 10 0	70 18 4½	83 15 0	75 10 0	185 12 6	188 12 6	22 0 0	22 3 9	24 0 0	22 15/16	23 1/16	84 11½
4	70 8 1½	70 6 10½	83 15 0	—	181 17 6	185 2 6	21 17 6	22 3 9	24 0 0	22 15/16	23 1/8	84 11½
5	69 8 9	69 8 1½	83 0 0	74 15 0	178 2 6	181 17 6	21 13 9	22 1 3	24 0 0	22 7/8	23	84 11½
6	66 5 0	66 3 9	83 0 0	—	176 7 6	179 17 6	21 5 0	22 1 3	24 0 0	22 13/16	23	84 11½
7	68 6 3	68 7 9	83 0 0	—	178 17 6	182 1 3	20 17 6	21 5 0	23 0 0	22 3/4	23	84 11½
8	68 5 0	68 5 0	83 0 0	74 5 0	178 7 6	181 12 6	20 12 6	21 12 6	23 0 0	22 5/8	22 7/8	84 11½

on the part of buyers that prices might be advanced. The Continental steel market, however, was in a wretched condition. In an effort to improve things, the European Raw Steel Cartel recommended its members to curtail output by 10 per cent.

Iron Ore.—New business was quiet but deliveries against contracts already placed were on a full scale. Best Bilbao rubio was quoted nominally at 24s. 6d. per ton c.i.f.

Antimony.—At the end of October, English regulus was quoted at about £45 to £52 10s. per ton, business being of a hand-to-mouth nature. Chinese regulus was dull, with spot material priced at £31 10s. to £31 15s. ex warehouse, while for shipment from the East the value was around £30 per ton c.i.f.

Arsenic.—Prices are unaltered since our last report at £16 per ton, f.o.r. mines for 99% Cornish white and £17 10s. c.i.f. Liverpool for high-grade Mexican.

Bismuth.—Sellers continue to quote 7s. 6d. per lb. for merchant quantities.

Cadmium.—Business has not been very active but prices are steady at about 3s. 10d. to 3s. 11d. per lb.

Cobalt Metal.—The market remains quite a good one with the official quotation maintained at 10s. per lb.

Cobalt Oxides.—Prices are unaltered at 8s. per lb. for black and 8s. 10d. for grey oxide.

Platinum.—Conditions have been rather easier and at the close of October refined metal was quoted at £13 5s. to £13 10s. per oz. The expected seasonal demand has been slow to mature.

Palladium.—The market has been easy and the price closed the month at about £6 15s. to £7 per oz.

Iridium.—The price is about £43 to £45 for sponge and powder.

Tellurium.—The quotation remains nominal around 12s. 6d. to 15s. per lb.

Selenium.—The market is steady at 7s. 8d. to 7s. 9d. per lb. ex warehouse for 99% black powder.

Manganese Ore.—The market assumed a slightly better undertone owing to the fact that the pressure of supplies has slackened. The Russians, having concluded big contracts, are less eager to press ore on the market, and the cheaper Indian sellers also seem to have been satisfied. Prices were virtually unchanged during October at 1s. 0¾d. per unit c.i.f. for washed Caucasian and 1s. 1¾d. for best Indian.

Aluminium.—Trading conditions were not especially brisk during October but values were maintained at £95 per ton delivered, less 2%, for ingots and bars.

Sulphate of Copper.—The quotation remains at £27 to £27 10s. per ton, less 5%.

Nickel.—An excellent consumption is reported and makers adhere to their former quotation of £175 per ton for both home and export sales.

Chrome Ore.—There is no lack of supplies. Rhodesian, basis 48%, is quoted between £4 and £4 14s. per ton c.i.f., according to quality.

Quicksilver.—The market has remained quiet, with spot material priced at £23 per bottle, and forward metal at £22 10s. to £22 12s. 6d., c.i.f.

Tungsten Ore.—There was a tug-of-war between buyers and sellers during October, the former being disinclined to pay more than 35s. per unit c.i.f. for forward shipment while sellers were reserved and asked 36s. upwards. A certain amount of business took place between these figures.

Molybdenum Ore.—The market is quiet with the quotation firm around 37s. 6d. to 42s. 6d. per unit c.i.f. for 80 to 85% concentrates.

Graphite.—There has been a good demand. Good 85 to 90% raw Madagascar flake is priced at £25 to £28 per ton c.i.f., and good average 90% Ceylon lumps around £25 to £26 c.i.f.

Silver.—Opening firm on October 1, with spot bars quoted at 23 5/16d., the silver market subsequently eased to 22 15/16d. on October 8. During the remainder of the month the price fluctuated between 22 7/8d. and 23 3/16d., closing on October 31 at 23d.

STATISTICS

PRODUCTION OF GOLD IN THE TRANSVAAL.

	Rand.	Elsewhere.	Total.
	Oz.	Oz.	Oz.
October, 1928	858,945	38,775	897,720
November	832,461	40,023	872,484
December	821,582	38,179	859,761
January, 1929	840,344	36,108	876,452
February	778,559	36,725	815,284
March	830,829	35,700	866,529
April	836,474	35,649	872,123
May	858,991	38,607	897,598
June	821,352	34,677	856,029
July	853,370	36,110	889,480
August	850,952	38,649	889,601
September	814,707	34,846	849,553
October	853,609	35,081	888,690

TRANSVAAL GOLD OUTPUTS.

	September.		October.	
	Treated Tons.	Yield Oz.	Treated Tons.	Yield Oz.
Brakpan	84,000	£138,545	88,500	£144,369
City Deep	80,500	23,590	91,500	25,084
Cons. Main Reef	57,300	21,562	59,600	22,434
Crown Mines	227,000	72,087	232,000	74,181
D'rb'n Roodepoort Deep	40,400	13,845	41,800	14,237
East Rand P.M.	145,200	38,844	149,000	40,258
Geduld	83,500	26,758	85,500	27,526
Geldenbuis Deep	63,400	14,694	67,500	15,570
Glynn's Lydenburg	6,100	1,790	6,300	1,960
Government G.M. Areas	194,000	£370,322	210,000	£297,626
Kleinfontein	50,600	10,315	53,800	12,614
Langlaagte Estate	78,000	£107,470	83,000	£112,830
Luipaard's Vlei	22,800	5,946	23,000	6,237
Meyer and Charlton	16,800	£19,649	17,300	£20,390
Modderfontein New	146,000	70,789	152,000	73,119
Modderfontein B	69,000	24,511	71,000	25,160
Modderfontein Deep	42,800	22,743	45,900	24,308
Modderfontein East	66,000	20,188	70,500	20,882
New State Areas	71,000	£133,616	78,000	£142,969
Nourse	56,000	16,933	62,000	17,860
Randfontein	212,000	£210,474	220,000	£220,297
Robinson Deep	75,500	20,715	78,100	21,325
Rose Deep	58,000	11,922	60,500	12,383
Simmer and Jack	76,000	18,894	76,400	19,499
Springs	66,900	£136,949	73,000	£146,738
Sub Nigel	25,200	20,831	25,800	20,890
Transvaal G.M. Estates	14,170	4,910	13,600	4,877
Van Ryn	40,000	£39,954	40,500	£40,370
Van Ryn Deep	59,000	£102,007	65,000	£106,122
Village Deep	57,700	15,513	60,000	15,661
West Rand Consolidated	87,000	£96,744	90,000	£97,980
West Springs	63,500	£77,455	70,000	£83,128
Witw'tersr'nd (Knights)	53,000	£48,665	55,000	£50,614
Witwatersrand Deep	42,000	9,094	42,000	9,381

COST AND PROFIT ON THE RAND, Etc.

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

	Tons milled.	Yield per ton.	Work'g cost per ton.	Work'g profit per ton.	Total working profit.
		s. d.	s. d.	s. d.	£
August, 1928	2,580,700	27 11	19 7	8 4	1,079,152
September	2,485,700	27 11	19 7	8 4	1,040,368
October	2,612,500	27 9	19 5	8 4	1,092,162
November	2,539,700	27 9	19 7	8 2	1,041,713
December	2,505,500	27 10	19 8	8 2	1,024,654
January, 1929	2,627,320	28 1	19 9	8 4	1,095,070
February	2,403,720	28 6	20 3	8 3	990,942
March	2,581,600	28 3	20 0	8 3	1,062,331
April	2,606,420	28 1	19 11	8 2	1,068,103
May	2,694,610	28 0	19 10	8 2	1,100,461
June	2,543,550	28 3	19 10	8 5	1,065,191
July	2,649,560	28 1	19 8	8 5	1,112,246
August	2,661,800	28 1	19 9	8 4	1,111,834
September	—	—	—	—	1,056,839

NATIVES EMPLOYED IN THE TRANSVAAL MINES.

	Gold Mines.	Coal Mines.	Diamond Mines.	Total.
October 31, 1928	193,147	16,767	4,807	216,362
November 30	190,870	16,803	4,889	216,628
December 31	187,970	16,059	4,444	208,473
January 31, 1929	192,526	15,845	50,56	213,427
February 28	196,150	15,940	5,635	217,725
March 30	197,646	16,065	5,787	219,498
April 30	197,412	15,900	5,554	218,866
May 31	195,733	15,852	5,473	217,058
June 30	192,595	15,928	5,029	213,552
July 31	190,031	15,914	4,845	210,790
August 31	190,062	15,857	5,071	211,000
September 30	190,567	15,733	4,814	211,114
October 31	189,739	15,533	4,555	209,827

PRODUCTION OF GOLD IN RHODESIA.

	1926	1927	1928	1929
	oz.	oz.	oz.	oz.
January	48,967	48,731	51,356	46,231
February	46,026	46,461	46,286	44,551
March	46,902	50,407	48,017	47,388
April	51,928	48,290	48,549	48,210
May	49,392	48,992	47,323	48,189
June	52,381	52,910	51,762	48,406
July	50,460	49,116	48,960	46,369
August	49,735	47,288	50,611	46,473
September	48,350	45,838	47,716	45,025
October	50,132	46,752	43,056	—
November	51,090	47,435	47,705	—
December	48,063	49,208	44,772	—

RHODESIAN GOLD OUTPUTS.

	September.		October.	
	Tons.	Oz.	Tons.	Oz.
Cam and Motor	24,200	11,167	24,400	11.440
Globe and Phœnix	6,002	4,966	6,016	4,794
Lonely Reef	5,300	4,150	5,600	4,197
Rezende	6,400	2,890	6,400	2,874
Shamva	40,000	£20,391	—	—
Sherwood Starr	5,000	£9,353	4,800	£9,640

WEST AFRICAN GOLD OUTPUTS.

	September.		October.	
	Tons.	Oz.	Tons.	Oz.
Ariston Gold Mines	—	£3,444	—	
Ashanti Goldfields	9,121	10,794	9,425	11,110
Taquah and Abosso	8,010	£13,325	8,510	£14,038

AUSTRALIAN GOLD OUTPUTS BY STATES.

	Western Australia.	Victoria.	Queensland.	New South Wales.
	Oz.	Oz.	Oz.	Oz.
October, 1928	36,565	2,632	820	256
November	31,466	3,111	865	550
December	36,097	—	493	208
January, 1929	27,384	—	260	445
February	28,177	1.997	117	474
March	25,848	2,974	816	—
April	39,166	—	617	—
May	28,026	3,018	493	467
June	33,139	2,368	465	8
July	28,086	1,421	1,203	—
August	37,032	2,178	567	—
September	32,751	—	—	—
October	35,445	—	—	—

AUSTRALASIAN GOLD OUTPUTS.

	September.		October.	
	Tons	Value £	Tons	Value £
Associated G.M. (W.A.)	4,767	7,870	—	—
Blackwater (N.Z.)	2,995	5,227	3,050	5,565
Boulder Persev'ce (W.A.)	5,936	15,706	5,887	12,887
Grt. Boulder Pro. (W.A.)	9,302	27,304	9,176	27,335
Lake View & Star (W.A.)	7,353	17,169	—	—
Sons of Gwalia (W.A.)	13,640	11.959	13,772	10,970
South Kalgurli (W.A.)	8,585	16,439	—	—
Waihi (N.Z.)	18,146	6,633* 35,910†	18,110‡	6,395* 44,018†

* Oz. gold. † Oz. silver. ‡ 4 weeks to October 19.

GOLD OUTPUTS, KOLAR DISTRICT, INDIA.

	September.		October.	
	Tons Ore	Total Oz.	Tons Ore	Total Oz.
Balaghat	3,900	2,753	4,050	2,744
Champion Reef	8,415	5,931	8,010	6,023
Mysore	18,327	8,325	17,505	8,431
Nundydroog	10,847	6,682	11,090	6,681
Ooregum	13,865	6,187	13,500	6,645

MISCELLANEOUS GOLD, SILVER, AND PLATINUM OUTPUTS.

	September.		October.	
	Tons	Value £	Tons	Value £
Chosen Synd. (Korea)	9,260	12,653	9,480	12,930
Frontino& Bolivia (C'lbia)	1,810	6,284	1,960	7,191
Lena (Siberia)	—	16,296	—	—
Lydenburg Plat. (Trans.)	3,370	737	3,600	665*p*
Marmajito (Colombia)	760	3,389	1,020	£4,248
Mexican Corp. Fresnillo	90,657	135,951*d*	—	—
Onverwacht Platinum	2,384	434*p*	2,715	438*p*
Oriental Cons. (Korea)	19,244	88,913*d*	—	97,500*d*
St. John del Rey (Brazil)	—	46,600	—	44,500
Santa Gertrudis (Mexico)	49,052	103,186*d*	—	—

d dollars. *p* Oz. platinoids.

PRODUCTION OF TIN IN FEDERATED MALAY STATES.

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

January, 1929	5,840	July, 1929	5,802
February	4,896	August	5,610
March	5,236	September	5,332
April	5,433	October	5,966
May	5,405	November	—
June	5,523	December	—

OUTPUTS OF MALAYAN TIN COMPANIES.

In Long Tons of Concentrate.

	August.	Sept.	Oct.
Batu Caves	31	30	24
Changkat	120	100	56
Chenderiang	30	27	26¾
Gopeng	80	86	80
Hong Kong Tin	42	50½	50½
Idris Hydraulic	32¾	32¾	35¾
Ipoh	37	43¼	39½
Jelapang	42	36	36
Kamunting	83½	84	103
Kent (F.M.S.)	36	39	42
Kepong	34	34	31
Kinta	30	30	31
Kinta Kellas	38¾	32¾	44¾
Kramat Pulai	19¼	13¾	14¼
Kuala Kampar	120	105	110
Kundang	—	23	24
Lahat	11⅛	12¼	14
Larut Tinfields	81	76½	82
Malaya Consolidated	70½	53¼	58¼
Malayan Tin	125	143	119
Meru	27	27¼	—
Pahang	222	222	222
Pengkalen	86	77½	77½
Petaling	202½	226	210
Rahman	53½	53½	59½
Rambutan	11	10	10
Rantau	43	32	56
Rawang	50	40	40
Rawang Concessions	—	100	170
Renong	49¾	44¾	57¼
Selayang	17¼	20¼	22
Southern Malayan	184½	172½	172½
Southern Perak	65¼	59½	65½
Southern Tronoh	18	21	41
Sungei Besi	45	45	45
Sungei Kinta	42¼	68½	50
Sungei Way	89¼	83¼	77¼
Taiping	40	31	35
Tanjong	27	30	38¾
Teja Malaya	18¼	5	5¼
Tekka	46	45	45
Tekka-Taiping	39	27	24½
Temoh	43	35¾	34
Tronoh	133	99	112¼

OUTPUTS OF NIGERIAN TIN MINING COMPANIES.

In Long Tons of Concentrate.

	August.	Sept.	Oct.
Amari	14	11	—
Anglo-Nigerian	40	35	—
Associated Tin Mines	250	278	256
Baba River	6	4	—
Batura Monguna	2½	2½	—
Bisichi	90	92	95
Daffo	10	10	—
Ex-Lands	55	60	—
Filani	11¼	8	7¼
Jantar	45	40	47
Jos	19	19¾	22½
Juga Valley	20	20	20
Junction	2½	2½	2½
Kaduna	51	48	—
Kaduna Prospectors	32½	25	—
Kassa	26	27	—
London Tin	—	—	245
Lower Bisichi	9¼	8¼	7¼
Mongu	60	50	50
Naraguta	76	44¾	45
Naraguta Durumi	20	20	24
Naraguta Extended	25	25	22
Naraguta Karama	38½	37	—
Naraguta Korot	20	20	—
Nigerian Base Metals	46½	39	—
Nigerian Consolidated	20	20	20
N.N. Bauchi	120	150	—
Offin River	5¼	4	5¼
Ribon Valley	23	19	—
Ropp	105	105	—
South Bukeru	8	7½	8¼
Tin Fields	8	6¾	5¼
Tin Properties	20	33	22
United Tin Areas	29¾	23	—
Yarde Kerri	10	9	—

OUTPUTS OF OTHER TIN MINING COMPANIES.

In Long Tons of Concentrate.

	August.	Sept.	Oct.
Anglo-Burma (Burma)	30¼	30¼	30½
Aramayo Mines (Bolivia)	332	449	351
Bangrin (Siam)	76½	69¼	57½
Berenguela (Bolivia)	31	41	—
Consolidated Tin Mines (Burma)	200	150	104
East Pool (Cornwall)	88¼	87¼	—
Fabulosa (Bolivia)	120	145	167½
Geevor (Cornwall)	72	69	68
Jantar (Cornwall)	24	21	—
Kagera (Uganda)	28	28	28
Polhigey (Cornwall)	30	35	35
San Finx (Spain)	37¼*	37¼*	—
Siamese Tin (Siam)	159¼	143¼	145
South Crofty (Cornwall)	69	68¾	69½
Tavoy Tin (Burma)	41	50	45
Theindaw (Burma)	9	7	8
Tongkah Harbour (Siam)	97	100	93
Toyo (Japan)	—	—	—
Wheal Kitty (Cornwall)	36	40	39
Wheal Reeth (Cornwall)	—	—	—

* Tin and Wolfram.

COPPER, LEAD, AND ZINC OUTPUTS.

		Sept.	October.
Broken Hill South	Tons lead conc.	5,947	5,969
	Tons zinc conc.	5,236	5,086
Burma Corporation	Tons refined lead	6,502	6,750
	Oz. refined silver	600,837	607,000
Bwana M'Kubwa	Tons copper oxide	605	699
Electrolytic Zinc	Tons zinc	4,036‡	4,102†
Indian Copper	Tons copper	175	214
Messina	Tons copper	557	590
Mount Lyell	Tons concentrates	4,100*	—
Namaqua	Tons copper	188	180
North Broken Hill	Tons lead conc.	8,000	—
	Tons zinc conc.	6,190	—
Poderosa	Tons copper ore	1,020	1,392
Rhodesia Broken Hill	Tons lead	—	—
	Tons slab zinc	1,125	1,253
San Francisco Mexico	Tons lead conc.	3,097	2,853
	Tons zinc conc.	4,036	3,461
Sulphide Corporation	Tons lead conc.	1,738	1,851
	Tons zinc conc.	2,313	2,545
Tetiuhe	Tons lead conc.	427	1,073
	Tons zinc conc.	920	1,967
Union Minière	Tons copper	12,800	—
Zinc Corporation	Tons lead conc.	5,283	—
	Tons zinc conc.	4,322	—

* Four weeks to Oct. 9. † Four weeks to Oct. 16.
‡ Four weeks to Sept. 18.

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

		August.	Sept.
Iron Ore	Tons	576,166	530,338
Manganese Ore	Tons	29,908	27,257
Iron and Steel	Tons	255,192	229,082
Copper and Iron Pyrites	Tons	25,298	31,350
Copper Ore, Matte, and Prec.	Tons	2,611	3,318
Copper Metal	Tons	14,565	9,785
Tin Concentrate	Tons	8,433	8,358
Tin Metal	Tons	1,111	537
Lead Pig and Sheet	Tons	29,268	25,127
Zinc (Spelter)	Tons	13,830	12,051
Zinc Sheets, etc.	Tons	1,891	2,009
Aluminium	Tons	1,[illegible]	2,568
Quicksilver	Lb.	49,423	133,339
Zinc Oxide	Tons	913	1,072
White Lead	Cwt.	13,742	12,413
Red and Orange Lead	Cwt.	2,530	3,003
Barytes, ground	Cwt.	57,415	46,889
Asbestos	Tons	3,117	2,489
Boron Minerals	Tons	—	1,723
Borax	Cwt.	22,477	27,383
Basic Slag	Tons	997	4,360
Superphosphates	Tons	2,224	3,340
Phosphate of Lime	Tons	33,462	41,957
Mica	Tons	433	296
Sulphur	Tons	7,768	7,022
Nitrate of Soda	Cwt.	10,550	22,556
Potash Salts	Cwt.	429,696	596,048
Petroleum: Crude	Gallons	43,866,394	34,629,875
Lamp Oil	Gallons	19,632,199	17,216,805
Motor Spirit	Gallons	85,539,434	74,508,827
Lubricating Oil	Gallons	10,788,760	8,077,891
Gas Oil	Gallons	6,919,791	9,401,359
Fuel Oil	Gallons	44,545,546	31,350,101
Asphalt and Bitumen	Tons	13,492	16,241
Paraffin Wax	Cwt.	134,705	112,119
Turpentine	Cwt.	65,318	69,028

OUTPUTS REPORTED BY OIL-PRODUCING COMPANIES

In Tons.

	August.	Sept.	Oct.
Anglo-Ecuadorian	16,085	14,961	15,012
Apex Trinidad	34,200	34,610	36,060
Attock	7,329	5,429	4,781
British Burmah	5,930	5,648	5,613
British Controlled	34,547	34,430	—
Kern Mex	835	891	832
Kern River (Cal.)	5,021	4,702	4,849
Kern Romana	6,013	5,170	3,527
Kern Trinidad	4,521	5,095	4,868
Lobitos	27,805	26,954	28,768
Phœnix	44,271	42,276	42,291
St. Helen's Petroleum	13,333	12,091	9,690
Steaua Romana	83,480	78,970	78,320
Tampico	3,076	3,226	3,084
Trinidad Leaseholds	33,550	31,450	31,700
Venezuelan Consolidated	4,224	3,845	5,220

QUOTATIONS OF OIL COMPANIES SHARES.

Denomination of Shares £1 unless otherwise noted.

	Oct. 9, 1929			Nov. 8, 1929		
	£	s.	d.	£	s.	d
Anglo-American	3	1	3	3	1	3
Anglo-Ecuadorian	1	0	0		18	3
Anglo-Egyptian B	2	12	6	2	7	6
Anglo-Persian 1st Pref.	1	5	6	1	6	3
,, ,, Ord.	4	5	6	4	2	6
Apex Trinidad (5s.)	1	8	9	1	5	0
Attock	2	14	6	2	11	3
British Burmah (8s.)		7	0		6	9
British Controlled ($5)		5	6		4	9
Burmah Oil	4	5	0	4	1	3
Kern River, Cal. (10s.)		6	6		6	6
Lobitos, Peru	2	1	9	1	18	9
Mexican Eagle, Ord. (4 pesos)		16	9		18	0
,, ,, 8% Pref. (4 pesos)		16	6		16	9
Phœnix, Roumania		11	0		10	9
Royal Dutch (100 fl.)	37	6	3	33	7	6
Shell Transport, Ord.	4	18	9	4	13	9
,, ,, 5% Pref. (£10)	9	6	3	9	10	0
Steaua Romana		10	6		10	0
Trinidad Leaseholds	4	5	6	4	1	3
United British of Trinidad (6s. 8d.)		8	6		7	6
V.O.C. Holding	3	10	6	2	18	9

PRICES OF CHEMICALS. November 8.

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

		£	s.	d.
Acetic Acid, 40%	per cwt.		16	6
,, 80%	,,	1	16	0
,, Glacial	per ton	66	0	0
Alum	,,	8	10	0
Alumina, Sulphate, 17 to 18%	,,	6	15	0
Ammonia, Anhydrous	per lb.			10
,, 0·880 solution	per ton	15	10	0
,, Carbonate	,,	27	10	0
,, Nitrate	,,	24	0	0
,, Phosphate	,,	40	0	0
,, Sulphate, 20·6% N.	,,	9	14	0
Antimony, Tartar Emetic	per lb.			10¾
,, Sulphide, Golden	,,			7
Arsenic, White	per ton	16	0	0
Barium Carbonate, 94%	,,	5	10	0
,, Chloride	per ton	10	10	0
,, Sulphate, 94%	,,	5	0	0
Benzol, standard motor	per gal.		1	8
Bleaching Powder, 35% Cl.	per ton	6	15	0
,, Liquor, 7%	,,	3	5	0
Borax	,,	14	0	0
Boric Acid	,,	25	0	0
Calcium Chloride	,,	5	10	0
Carbolic Acid, crude 60%	per gal.		2	6
,, ,, crystallized, 40°	per lb.			8
Carbon Disulphide	per ton	24	0	0
Citric Acid	per lb.		2	0¼
Copper Sulphate	per ton	26	10	0
Cyanide of Sodium, 100% KCN	per lb.			7
Hydrofluoric Acid	,,			6
Iodine	per oz.		1	0
Iron, Nitrate	per ton	6	0	0
,, Sulphate	,,	1	15	0
Lead, Acetate, white	,,	40	0	0
,, Nitrate	,,	33	5	0
,, Oxide, Litharge	,,	37	10	0
,, White	,,	38	0	0
Lime, Acetate, brown	,,	7	10	0
,, ,, grey, 80%	,,	16	10	0
Magnesite, Calcined	,,	9	10	0
Magnesium, Chloride	,,	6	15	0
,, Sulphate	,,	3	5	0
Methylated Spirit 64° Industrial	per gal.		1	5
Nitric Acid, 80° Tw.	per ton	21	0	0
Oxalic Acid	per cwt.	1	13	0
Phosphoric Acid	per ton	29	15	0
Potassium Bichromate	per lb.			4[illegible]
,, Carbonate	per ton	25	0	0
,, Chlorate	per lb.			2¾
,, Chloride 80%	per ton	9	0	0
,, Hydrate (Caustic) 90%	,,	32	5	0
,, Nitrate, refined	,,	20	10	0
,, Permanganate	per lb.			5⅜
,, Prussiate, Yellow	,,			6¾
,, ,, Red	,,		1	9
,, Sulphate, 90%	per ton	11	5	0
Sodium Acetate	per ton	20	5	0
,, Arsenate, 45%	,,	26	0	0
,, Bicarbonate	,,	10	10	0
,, Bichromate	per lb.			3⅜
,, Carbonate (Soda Ash)	per ton	6	0	0
,, ,, (Crystals)	,,	5	5	0
,, Chlorate	per lb.			2½
,, Hydrate, 76%	per ton	14	10	0
,, Hyposulphite	,,	9	0	0
,, Nitrate, 96%	,,	9	14	0
,, Phosphate, comml.	per cwt.		10	9
,, Prussiate	per lb.			4¾
,, Silicate	per ton	9	10	0
,, Sulphate (Salt-cake)	,,	2	15	0
,, ,, (Glauber's Salt)	,,	2	5	0
,, Sulphide	,,	9	10	0
Sulphur, Roll	,,	10	10	0
,, Flowers	,,	12	0	0
Sulphuric Acid, 168°	,,	6	5	0
,, ,, free from Arsenic, 144°	,,	4	0	0
Superphosphate of Lime, 35%	,,	3	0	0
Tartaric Acid	per lb.		1	4½
Turpentine	per ton	44	15	0
Tin Crystals	per lb.			6½
Titanous Chloride	,,			10
Zinc Chloride	per ton	12	0	0
Zinc Dust	,,	32	0	0
Zinc Oxide	,,	42	0	0
Zinc Sulphate	,,	9	0	0

SHARE QUOTATIONS

Shares are £1 par value except where otherwise noted.

GOLD AND SILVER:	Oct. 9, 1929. £	s.	d.	Nov. 8, 1929. £	s.	d.
SOUTH AFRICA:						
Brakpan	4	4	6	3	18	9
City Deep		10	6		8	6
Consolidated Main Reef		18	6		18	6
Crown Mines (10s.)	3	4	6	3	2	6
Daggafontein	1	2	6	1	2	6
Durban Roodepoort Deep		11	3		10	6
East Geduld	1	18	9	1	16	3
East Rand Proprietary (10s.)		12	0		11	3
Ferreira Deep		6	3		6	3
Geduld	3	6	3	3	6	3
Geldenhuis Deep		4	9		5	0
Glynn's Lydenburg		2	6		2	6
Government Gold Mining Areas (5s.)	1	17	0	1	16	3
Langlaagte Estate	1	0	6	1	0	0
Meyer & Charlton		10	0		9	6
Modderfontein New (10s.)	4	16	3	4	13	9
Modderfontein B (5s.)		14	6		14	6
Modderfontein Deep (5s.)	1	7	0	1	6	3
Modderfontein East	1	5	6	1	7	6
New State Areas	1	12	6	1	12	0
Nourse		8	9		9	6
Randfontein		6	9		6	3
Robinson Deep A (1s.)		13	9		13	0
" " B		8	6		8	6
Rose Deep		5	6		5	3
Simmer & Jack (2s. 6d.)		3	6		3	3
Springs	3	2	6	3	5	0
Sub Nigel (10s.)	1	15	6	1	13	9
Van Ryn		7	6		6	6
Van Ryn Deep	1	15	0	1	13	9
Village Deep		6	0		6	0
West Rand Consolidated (10s.)		7	3		6	0
West Springs		18	0		17	0
Witwatersrand (Knight's)		7	6		8	6
Witwatersrand Deep		5	0		4	3
RHODESIA:						
Cam and Motor	1	6	3	1	1	3
Gaika		4	9		4	3
Globe and Phœnix (5s.)		10	3		10	0
Lonely Reef	1	0	0		18	9
Mayfair	1	0	0	1	0	0
Rezende		16	3		15	0
Shamva		5	6		3	9
Sherwood Starr	1	5	0	1	3	9
GOLD COAST:						
Ashanti (4s.)	1	3	0	1	1	0
Taquah and Abosso (5s.)		2	0		1	9
AUSTRALASIA:						
Golden Horseshoe (4s.), W.A.		1	9		1	9
Great Boulder Proprietary (2s.), W.A.		2	0		2	0
Lake View and Star (4s.), W.A.		13	0		11	6
Sons of Gwalia, W.A.		2	0		1	9
South Kalgurli (10s.), W.A.		13	9		13	9
Waihi (5s.), N.Z.		13	0		12	0
Wiluna Gold, W.A.	1	0	6		18	6
INDIA:						
Balaghat (10s.)		5	0		4	9
Champion Reef (10s).		9	6		9	9
Mysore (10s.)		12	0		12	9
Nundydroog (10s.)		17	6		16	3
Ooregum (10s.)		8	0		8	0
AMERICA:						
Camp Bird (2s.), Colorado		2	3		1	9
Exploration (10s.)		8	9		8	6
Frontino and Bolivia, Colombia		7	6		7	6
Mexican Corporation, Mexico		15	0		13	0
Mexico Mines of El Oro, Mexico		2	9		2	6
Panama Corporation		18	0	1	0	0
St. John del Rey, Brazil		17	0		16	9
Santa Gertrudis, Mexico		10	3		11	9
Selukwe (2s. 6d.), British Columbia		6	9		5	0
MISCELLANEOUS:						
Chosen, Korea	1	5	0		13	9
Edie (5s.), New Guinea	1	4	0		18	9
Lena Goldfields, Russia		3	0		2	0
COPPER:						
Bwana M'Kubwa (5s.) Rhodesia	1	8	3	1	5	0
Esperanza Copper, Spain	1	2	3	1	1	6
Indian (2s.)		2	6		2	3
Loangwa (5s.), Rhodesia		10	9		6	6
Luiri (5s.), Rhodesia		5	9		5	3
Messina (5s.), Transvaal		18	9		17	6
Mount Lyell, Tasmania	2	1	6	2	0	9
Namaqua (£2), Cape Province		17	6		16	3
N'Changa, Rhodesia	2	16	3	2	0	0
Rhodesia-Katanga	1	13	9	1	11	3
Rio Tinto (£5), Spain	53	7	6	45	18	9
Roan Antelope (5s.), Rhodesia	2	3	9	1	13	9
Tanganyika, Congo and Rhodesia	2	16	3	2	3	9
Tharsis (£2), Spain	6	1	3	4	18	9

LEAD-ZINC:	October 9, 1929. £	s.	d	Nov. 8, 1929. £	s.	d.
Amalgamated Zinc (8s.), N.S.W.		14	6		13	0
Broken Hill Proprietary, N.S.W.	1	7	9	1	4	6
Broken Hill North, N.S.W.	5	15	0	5	1	3
Broken Hill South, N.S.W.	3	7	6	3	5	0
Burma Corporation (10 rupees)		17	9		17	0
Electrolytic Zinc Pref., Tasmania	1	15	0	1	12	6
Mount Isa, Queensland	1	15	0	1	7	6
Rhodesia Broken Hill (5s.)		4	0		3	6
San Francisco (10s.), Mexico	1	16	6	1	13	0
Sulphide Corporation (15s.), N.S.W.		19	6		18	0
ditto, Pref.	1	6	9	1	4	6
Zinc Corporation (10s.), N.S.W.	2	8	9	2	3	9
ditto, Pref.	4	13	9	4	2	6
TIN:						
Aramayo Mines (25 fr.), Bolivia	2	15	0	2	7	6
Associated Tin (5s.), Nigeria		6	9		6	6
Bangrin, Siam	1	11	3	1	6	3
Bisichi (10s.), Nigeria		8	3		8	0
Chenderiang, Malay		9	0		9	0
Consolidated Tin Mines of Burma		9	9		8	6
East Pool (5s.), Cornwall		1	3		1	3
Ex-Lands Nigeria (2s.), Nigeria		2	0		2	0
Geevor (10s.), Cornwall		7	0		6	6
Gopeng, Malaya	2	3	9	2	0	0
Idris (5s.), Malaya		11	6		11	0
Ipoh Dredging (16s.), Malay	1	4	0	1	1	6
Kaduna Prospectors (5s.), Nigeria		9	6		8	9
Kaduna Syndicate (5s.), Nigeria		15	0		12	6
Kamunting (5s.), Malay		13	3		12	0
Kepong, Malay	1	5	0	1	5	0
Kinta, Malay		12	0		12	3
Kinta Kellas, Malay	1	15	6	1	13	9
Kramat Pulai, Malay	1	5	6	1	7	6
Lahat, Malay		13	6		13	6
Malayan Tin Dredging (5s.)	1	5	3	1	3	0
Mongu (10s.), Nigeria		7	0		5	3
Naraguta, Nigeria		15	0		11	3
Nigerian Base Metals (5s.)		2	6		2	0
N.N. Bauchi, Nigeria (10s.), Ord.		17	6		18	0
ditto (10s.), Pref.		18	9		17	6
Pahang Consolidated (5s.), Malay		9	3		9	3
Penawat ($1), Malay		2	3		2	0
Pengkalen (5s.), Malay		19	6		19	3
Petaling (2s. 4d.), Malay		12	9		12	6
Rambutan, Malay		15	0		15	0
Renong Dredging, Malay	1	10	6	1	6	0
Siamese Tin (5s.), Siam		13	6		12	0
South Crofty (5s.), Cornwall		3	6		3	3
Southern Malayan		15	3		14	0
Southern Perak, Malay	2	8	9	2	2	6
Southern Tronoh (5s.), Malay		10	6		10	9
Sungei Besi (5s.), Malay		13	3		11	9
Sungei Kinta, Malay	1	1	0	1	0	6
Tanjong (5s.), Malay		14	6		14	6
Tavoy (4s.), Burma		8	6		7	0
Tekka, Malay	1	1	6	1	0	9
Tekka Taiping, Malay	1	2	6	1	0	3
Temengor, Malay	1	11	3	1	6	3
Toyo (10s.), Japan		8	6		8	0
Tronoh (5s.), Malay		19	6		19	9
DIAMONDS:						
Consol. African Selection Trust (5s.)	1	8	0	1	6	3
Consolidated of S.W.A.	1	4	6		14	3
De Beers Deferred (£2 10s.)	11	12	6	11	0	0
Jagersfontein	2	5	6	2	6	3
Premier Preferred (5s.)	5	12	6	5	10	0
FINANCE, ETC.:						
Anglo-American Corporation	1	15	0	1	12	6
Anglo-French Exploration	1	2	6	1	0	0
Anglo-Continental (10s.)		8	3		10	3
Anglo-Oriental (Ord., 5s.)		7	0		7	0
ditto, Pref.		15	0		14	6
British South Africa (15s.)	2	0	0	1	17	0
Central Mining (£8)	17	10	0	16	3	9
Consolidated Gold Fields	2	11	3	2	2	6
Consolidated Mines Selection (10s.)		19	3		18	9
Fanti Consols (8s.)		13	9		13	9
General Mining and Finance		18	9		18	0
Gold Fields Rhodesian (10s.)		9	9		10	0
Johannesburg Consolidated	2	4	9	2	3	0
London Malayan		13	0		11	0
London Tin Syndicate	2	1	3	2	0	0
Minerals Separation	5	10	0	5	5	0
National Mining (8s.)		3	0		2	6
Rand Mines (5s.)	2	18	9	2	17	6
Rand Selection (5s.)		16	9		15	3
Rhodesian Anglo-American (10s.)	2	1	3	1	16	3
Rhodesian Congo Border	9	1	3	8	0	0
Rhodesian Selection Trust (5s.)	3	15	0	2	15	0
South African Gold Trust	1	8	9	1	6	3
Southern Rhodesia Base Metals		17	6		10	0
Tigon (5s.)	1	7	6	1	4	3
Tin Selection Trust		19	9		17	3
Union Corporation (12s. 6d.)	3	17	6	3	11	3
Venture Trust (10s.)		6	6		7	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.

THE SEISMIC METHOD IN GEOPHYSICS

In February last we quoted W. H. Fordham's account of the seismic method of prospecting invented by Dr. Mintrop. A later description of this method was given at the Second International Drilling Congress held in Paris in September by E. H. Neville, managing director of the Geophysical Co., Ltd., of London.

The important advantage of the application of the seismic method is that it provides a means of determining, with close approximation, the depth at which underground beds are to be found. The method is based on the fact that rocks with different elasticity or density transmit mechanical and acoustic waves with different velocities. The velocity in various strata differs from a few hundred yards per second in loose sands to more than 7,000 yards per second in certain hard and compact or crystalline rocks.

A number of small and transportable seismographs are placed along a straight line, a charge is exploded at one end of the line, and the seismic waves proceeding from the resultant artificial earthquake shocks are recorded by the seismographs. Fig. 1 shows the arrangement of the instruments used for such a reception. Each seismograph is combined with a photographic recording apparatus containing an electric lamp and a drum of photographic paper which travels round or from the drum at a definite speed, means being provided by a pendulum, of known frequency, in the recording apparatus by which recording marks at equal time intervals are made upon the photographic paper. The vibrations which reach the seismograph are registered on the paper by means of a reflected beam of light. The exact moment of explosion is also recorded on the same photographic paper by the interruption of an electric circuit, the effect of which is transmitted either by wire or by wireless (see Fig. 1). A number of such seismograph records known as "seismograms" are obtained from each explosion. A sketch of such a seismogram is given in Fig. 2. The time which has elapsed between the initial mark *b* and the appearance of the first oscillation *c*, is called the

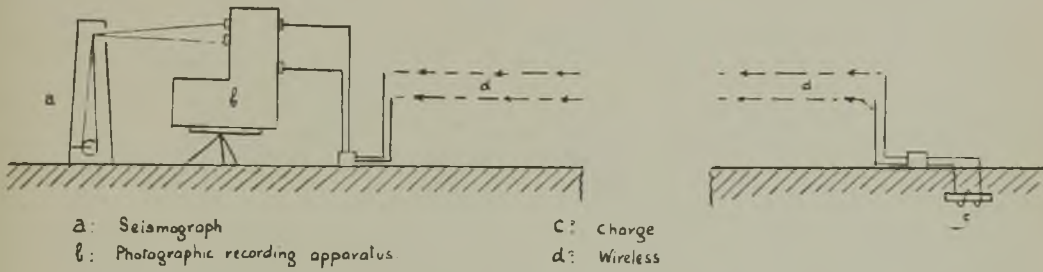


FIG. 1.

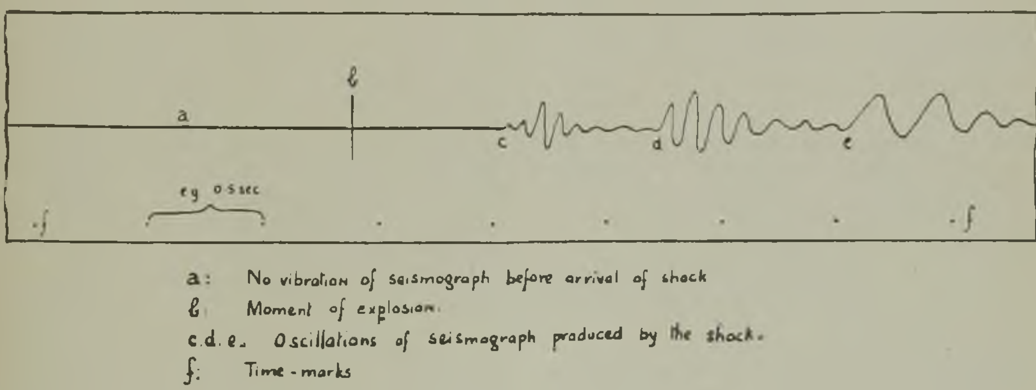


FIG. 2.

travelling time of the elastic wave. A number of subsequent waves or oscillations due to the same shock are also recorded on the seismogram and each has its specific meaning.

For the present explanation it is sufficient to regard only the first sharply defined wave *c*. The travelling time *t* of this first vibration thus recorded represents the time taken by the wave to travel by the quickest route from the point of origin to the seismograph. Travelling times and respective distances are shown by a diagram or graph in which the ordinates represent the times and the abscissae the distances between the explosion travelling in loose sand, enter the highly elastic limestone. At that point the time-curve suddenly shows a sharp change of direction (see *b* in Fig. 3). The distance at which the sudden change occurs is shown marked *d*. Thus in the example given in Fig. 3 at the distance e_3, e_4, e_5 and e_6 the first vibration will not arrive at the times t_3, t_4, t_5 and t_6, but at the times t^x_3, t^x_4, t^x_5 and t^x_6. The distance *d* at which the sudden change in the direction of the time-curve occurs is the indication of the depth of the more elastic stratum below, for it is clear that this change will occur at a shorter distance from the zero point (representing the place

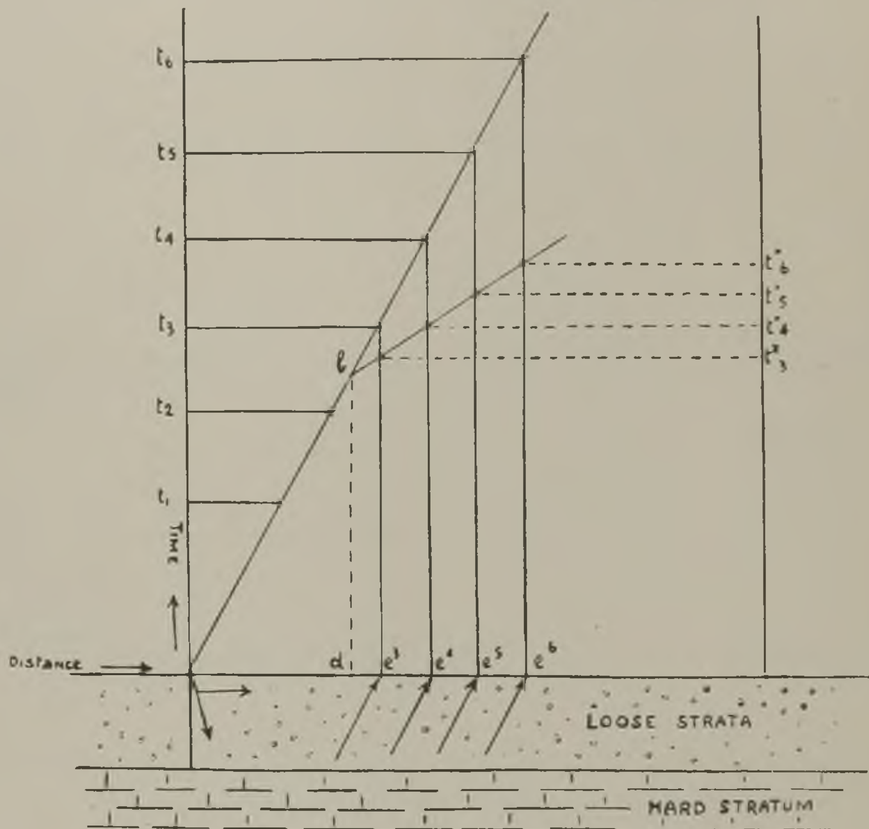


FIG. 3.

point and the observation stations of the seismographs. In ground without changes of petrological conditions a straight travelling time-curve will be obtained, that is, the speed of the waves will be constant and therefore from shocks produced at the distances e_1, e_2, e_3, e_4, e_5 and e_6 the travelling times t_1, t_2, t_3, t_4, t_5 and t_6 will be respectively observed.

So far reference has only been made to the case of a more or less homogeneous medium without a change of elasticity or density, but should there be a sudden change in the formations, for instance, limestone underneath sand or clay, the time-curve will show quite a different and very distinct character from that described above. The travelling speed, instead of being constant, increases abruptly from the point at which the elastic waves, formerly and time of the explosion) the nearer the more elastic formation is to the surface, and at a longer distance the deeper the more elastic formation is from the surface. While the speed derived from the first part of the time-curve shows the travelling speed in the upper loose stratum, the portion of the curve following the change of direction gives an indication of the propagation speed in the lower more elastic stratum. In cases where there are several formations following each other with more or less abrupt changes of density and elasticity, the time-curve will show several changes of direction, the distances of which from the zero point will depend on the respective depths of such formations and the relation between the respective travelling speeds of the waves. The calculation of such depths is carried out by formulæ deduced for the purpose. The speeds of the waves in all kinds of rocks are now known to the geophysicist, and he can from the time-curve not only calculate the depths of the more elastic formations underneath a loose overburden, but from the observed speed of the waves taken from the time-curve he will also obtain information about the petrological character of the hidden formations.

Furthermore, upward or downward inclinations of the rocks, faults and displacements, swallow-holes and other irregularities in the lower formations have all characteristic effects on the time-curves, for they directly affect the travelling times of the waves and result in distinct types of diagrams. In each case a correct geological interpretation can be arrived at by a suitable system of observation lines and observation points selected by geophysicists and geologists.

ELECTROLYTIC ZINC AT ANACONDA

(Concluded from October issue, page 243)

The overflow from the neutral thickeners following the first, or neutral, leach contains copper and cadmium, which must be removed prior to electrolysis. This is accomplished by agitating the solution with atomized metallic zinc, or zinc dust. To effect the complete removal of cadmium, a large excess of zinc dust is required, resulting in production of a purification residue high in zinc and requiring re-treatment for recovery of its zinc content. The amount of zinc dust required varies from 3·5 to 4·5% of the weight of zinc produced, the amount depending largely upon the copper content of the solution to be purified.

Solution purification is carried out in batches in mechanically agitated tanks, each batch being tested for copper and cadmium before being discharged to a thickener. Thickener overflow is filtered through Shriver presses, filtered solution being pumped to storage tanks for the electrolysing division. The thickener spigot product is sent to an American filter, the filter cake and Shriver residue, containing copper, cadmium, and zinc, being sent to the purification residue re-treatment plant for recovery of the three metals.

The residue resulting from copper-cadmium purification contains metallic zinc, copper, and cadmium, in addition to any slime contained in the neutral thickener overflow. To convert the metallics into oxides, the residue is subjected to a low temperature roast. Roasted residue is leached with spent electrolyte from the zinc electrolysing division, adding sufficient residue completely to neutralize all free acid. Most of the copper, cadmium, and zinc are extracted in this leach, giving a solution high in copper and cadmium. The leaches are discharged to a thickener, the overflow going to a mechanically agitated tank, where most of the copper is precipitated on metallic zinc, giving a high-grade copper precipitate and leaving a solution of zinc and cadmium sulphates. This solution, after removing the copper residue, is treated with additional metallic zinc to remove most of the cadmium as a high-grade cadmium product, which becomes the feed for the electrolytic cadmium plant. The solution, purified of copper and cadmium, is returned to the main zinc leaching plant for final cadmium purification. The residue resulting from leaching of the purification residue, and the high-grade copper precipitate, are shipped to the Anaconda copper plant. Purification residue from the Anaconda plant is shipped to Great Falls for re-treatment, avoiding duplicating this small auxiliary department.

Only a small part of the zinc used in purification of solution is finally lost in the copper residues sent to Anaconda for smelting, and most of the cadmium dissolved from the roasted concentrate is recovered as a high-grade cadmium residue. Fractional precipitation of copper and cadmium from zinc sulphate solution rich in both impurities may be carried out very closely, as freshly precipitated cadmium is immediately available for copper precipitation.

The high-grade cadmium residue obtained from purification residue re-treatment is dissolved in sulphuric acid and the resulting solution is purified of the last traces of copper and filtered, giving a solution rich in cadmium and zinc. This solution is then electrolysed, using lead anodes and aluminium cathodes, keeping the cell voltage under the decomposition voltage of zinc sulphate to avoid deposition of zinc with cadmium. The cadmium deposit is stripped from the cathode blank and melted under caustic or oil, and then cast into shapes for market. Formerly, practically all cadmium was marketed in pencil-like form, but in recent years the uses of cadmium for electroplating have increased so rapidly that a large part of present production is marketed in various anode forms. Very high-grade cadmium is produced as a byproduct of electrolytic zinc operations, and production from such sources is now a major factor in the cadmium market, though no production from these sources was made ten years ago. Anaconda company production in 1928 amounted to 891,000 lb.

As successful electrolytic deposition of zinc from a sulphate solution is primarily dependent upon the purity of the solution fed to the cells, every effort is made in the leaching and purification plants to produce a solution entirely free from metals electronegative to zinc, and materials entering into electrode and tank construction are carefully selected to avoid contamination from these sources. Although much study has been devoted to the effect of a number of impurities on the electro-deposition of zinc from a sulphate solution, and fairly accurate limits have been established for single impurities, comparatively little is known regarding the combined effect of these impurities in varying proportions. Also, a great deal of effort has been spent in an attempt to develop a suitable addition agent to lessen the effect of certain impurities, and some success has been had for a given set of conditions, but when a new variable is introduced it immediately establishes a new set of conditions and requires a new form of treatment. Given a pure solution and pure materials in contact with solution, high ampere efficiency is easily and consistently obtained, but with either impure solution or impure materials erratic results are obtained; therefore, the highest possible standard of purity is maintained, and occasional small amounts of impurities which may get by the established precautions have very much less effect than if addition agents were relied upon.

The Great Falls electrolysing division is divided into eight electrical circuits, each containing 144 cells, arranged in cascades of six cells each. In addition there are twelve cells connected so that they may be cut in on any circuit to replace those taken out of service for cleaning. This gives a total of 1,164 cells, of which 1,152 are continuously in service. Each circuit, or unit, is supplied with current from a rotary converter having a capacity of 10,000 amperes at 580 volts. The Anaconda plant has four such units, each connected to a motor-generator set of the same capacity as the Great Falls rotary converters. Motor-generator sets were installed at Anaconda on account of their greater stability under the electrical conditions existing there, this factor being considered sufficient to offset their small loss in conversion efficiency compared with rotary converters.

No material change in the construction of the cells and electrodes has been made since the details were published in the 1921 paper. Spacing of electrodes is being changed from 4 in. from centre to centre of anodes, to 3 in. centres, resulting in a material reduction in power requirements. Current density remains at approximately 30 amperes per square foot of cathode area.

The solution is distributed from storage tanks through lead pipe lines to individual cascades of cells and is taken from header lines through iron pipes to the individual cells, flow to each cell being regulated so as to maintain practically a constant acid and zinc concentration in each cell. Acid strength is determined by measurement of the electrical resistance of the electrolyte, readings so obtained being occasionally checked against a standard chemical method. The feed to the cells averages about 110 grammes of zinc per litre, and the cell discharge averages about 105 grammes of sulphuric acid per litre. Spent electrolyte is collected by a system of launders and delivered to storage tanks, from which solution is drawn as needed for the leaching plant and purification residue re-treatment plant. Each cell is cooled by circulating water through a lead coil placed in the cell. Cell temperatures vary from 40 to 50° C., depending upon atmospheric and cooling-water temperatures. The amount of water used for cooling purposes varies from 8,000 to 15,000 gallons per ton of cathodes produced.

Cathodes are removed and the zinc deposit is stripped at 24 hour intervals. For several years the stripping interval was 48 hours. The change from the 48 to a 24 hour interval has been an important factor in increasing and stabilizing ampere efficiency; the resulting saving in power and increased production more than offsets the increased labour cost. With absolutely pure solution, little improvement in ampere efficiency is gained through establishing the shorter stripping interval, but the sensitiveness of the zinc cell to the effect of impurities in solution increases rapidly with the length of the period of deposition, and a solution of sufficient purity to give high ampere efficiency for 24 hours may be sufficiently impure to give a very low efficiency at end of a 48 hour period. Shortening the period of deposition makes the cell much more resistant to the effect of occasional temporary imperfections in purification of solution and brings about a much more rapid recovery from the effects of an abnormal amount of impurity. With a 24 hour stripping interval, changes in ampere efficiency are normally very gradual, and the stability of cell operation has been greatly improved. One man removes cathodes, strips the deposit, brightens contacts, and replaces the cathodes from twelve cells each day, against nine per day with the 48 hour stripping interval. He also delivers his load of zinc to the scales for weighing and then to the melting furnaces. Cathode production averages about 7,000 lb. of zinc per stripper per day.

Each group of cells is taken out of service at six months' intervals for a thorough overhauling. The sludge deposit is removed, the cell repainted, insulation is renewed, anodes are cleaned and straightened, and any other needed repairs are made. No ill effect has been noted from the mist given off from the cells, either on the health of the workmen, some of whom have been continuously employed as strippers for fourteen years, or on the building steelwork. The original I-beams carrying the trolleys and hoists used in stripping and placed directly over the cells, are still in service and in good condition after nearly thirteen years of steady service.

The zinc cathode sheets from the electrolysing division are stacked as stripped in piles of approximately one ton each on small cars; these cars, carrying four piles each, are delivered to the melting and casting department, where each pile is lifted by an electric hoist, using an iron fork slipped under the pile, to an inclined charging platform above the furnace. A door in the roof of the furnace is opened and the pile of cathodes slides into the furnace. Charging, melting, and casting are carried on simultaneously and continuously for sixteen hours each day. At the end of this period, the furnace is cooled down, dross is skimmed, and the furnace is again brought up to melting temperature. Approximately 150 tons of molten zinc is constantly kept in each furnace, so a considerable part of the melting of fresh cathodes is done under the surface of the zinc bath.

Three furnaces are installed at Great Falls and two at Anaconda, each furnace having a normal melting capacity of 100 tons of cathode zinc per day. Those at Great Falls are gas-fired; those at Anaconda are oil-fired. Coal-firing was used at Great Falls for several years before either oil or gas was available. The character of the fuel makes little difference in dross production, the quality of cathodes and rate of melting having a much greater effect. A certain minimum amount of dross seems to be formed per square foot of bath area, independent of the tonnage treated, so it is advisable to keep the tonnage up to the maximum that can be melted in each furnace without overheating. From 3·5 to 4·5 % of the zinc in the cathodes melted goes into dross. A drop in ampere efficiency, insufficient in severity to cause a marked difference in appearance of the zinc cathode sheet, will nearly invariably be reflected in an increase in the amount of dross produced. If the furnaces are not overcrowded, the volatilization loss from the furnaces and from reworking dross will not exceed 0·25 % of the cathodes melted.

Dross, as formed in the furnaces, is a pasty mass high in metallic zinc. Some ammonium chloride is worked into the dross in the furnace, freeing much of the metallic zinc and generating heat. The partially worked dross is then skimmed from the furnaces through side doors into concrete buggies and transferred to heated, revolving drums, where more ammonium chloride is added and the drum is revolved until metallics and dry dross are separated. Normal consumption of ammonium chloride for both furnace and drum treatment of dross is slightly less than 1 lb. per ton of cathodes melted. The metallics, in molten condition, are drained from the drum and returned to the melting furnaces. After removing all metallics, the resulting dross is either sold to plants desiring a high-grade zinc material of high purity, or is re-treated through the roasting and leaching plants at Great Falls. During periods when concentrate supply is inadequate to keep both plants operating at capacity, dross is re-treated; when an ample supply of concentrate is available, dross is sold.

Each furnace is equipped with two casting wells, surrounded by muffles to prevent air leakage into the furnaces, from which zinc is dipped by hand ladles suspended from trolleys running on over-head I-beams, and the zinc then cast into stationary moulds arranged in rows parallel to the long axis of the furnace. As soon as the zinc slabs have solidified they are stamped with a lot number for identification, and the moulds are dumped and replaced for the next pouring. Water sprays are placed underneath the moulds for cooling. The slabs of zinc are stacked in rows until the day shift, when they are check-weighed and loaded for shipment. Shot samples are taken during the casting period. These samples are made up to represent each day's production from each furnace, to correspond with the lot number stamped on the zinc slabs, and are analysed for lead, cadmium, and iron.

One man can dip from the furnace and cast into slabs 30 tons of zinc in an eight-hour shift. Various schemes to improve upon this method of casting zinc have proved unsuccessful. For instance, a casting wheel, with the moulds placed on the periphery of the wheel, was installed. The cooled slabs were removed from the moulds by a vacuum lift and stacked at one side of the wheel. No appreciable money saving was made and the appearance of the slabs was damaged by the movement of the wheel before the zinc had solidified. As the slabs weigh only 50 lb. each, and the rate of casting is limited by the rate of melting, it is improbable that machine casting will replace hand casting until a system of melting is devised whereby a large tonnage of zinc can be cast in a comparatively short period of time.

An electric furnace, heated by a resistor of crushed carbon placed in a trough along the sides of the furnace, was tried in an attempt to reduce dross production, but was not successful either in reducing the amount of dross or the cost of melting.

For making zinc dust, molten zinc is transferred from the melting furnaces to graphite crucibles having carbon rods, tapped with $\frac{1}{8}$ in. holes, placed in the bottoms. As the molten zinc falls from one of these openings it is caught in a jet of compressed air from an atomizing nozzle and is blown into a settling chamber. Air from this chamber is exhausted through bags to avoid dust loss. The atomized zinc, or zinc dust, is removed into cars to be transported to the purification division for use in removal of copper and cadmium from solution.

CASSITERITE DEPOSITS IN UGANDA

In the Annual Report of the Geological Survey Department for the year 1928, E. J. Wayland, Director of the Department, writes on the cassiterite deposits of Mwirasando, which are being worked by the Kagera (Uganda) Tinfields, Ltd.

Mwirasando Hill is formed of thinly bedded and unbedded soft silver-grey, grey, blue-grey and pink schistose phyllites of the Karagwe-Ankolean System folded into a sharp syncline, at a point where a large pitching fold is rolling out and the strata merging into the normal uninterrupted succession. The dip of the phyllites varies from 55° to vertical and the strike from N. 65°W. to N. 55°W. The ore deposits consist of (*a*) irregular dyke-like occurrences of quartz, (*b*) irregular masses of the Mwirasando pegmatite mostly along the edge of quartz deposits and sometimes in them, and (*c*) veins of the Mwirasando pegmatite and muscovite-kaolin veins independent of the quartz occurrences. As far as the mine has been developed, the most important source of cassiterite has been from a muscovite-kaolin vein of the last group.

(*a*) *The Quartz Deposits.*—On the main or No. 1 Mwirasando Hill, there are six larger outcrops of quartz and several smaller ones. The main quartz bodies have an irregular dyke-like form which as a whole trends with the general strike of the phyllites, but in smaller detail parts of them cut across the strike. One quartz mass, the downward continuation of that exposed in No. 10 working, which is part of the main quartz dyk forming the highest part of No. 1 Hill to the north-west of No. 10 working, according to sections exposed in cross-cuts on the 50 ft. level, cuts across the strike of the phyllites at a large angle. This quartz mass, however, curves in large undulations both along the direction of strike and the dip. The behaviour of the quartz deposits in depth is as yet unknown.

The quartz deposits vary in thickness up to 25 ft., and in length, as far as is known at present, up to 420 ft. The dips are mostly high, that is from 70° up to the vertical and across those of the phyllites. The contacts are generally sharp and well defined. A characteristic feature of the quartz deposits is the occurrence of flat offshoots branching from them which cut across the dips of the highly inclined phyllites at, or nearly at, right angles, and they appear to have been intruded along flat fracture planes and joints. Beyond the ends of the flat offshoots, a fracture plane containing a thread of quartz continues, this finally merging into a strong joint plane which gradually fades out.

On the top of Mwirasando Hill there is an irregular outcrop of quartz approximately 130 ft. by 85 ft. which, if the section exposed in the trench of No. 8 working had not been seen, would be regarded as a large irregular high dipping pipe-like mass, but actually it is a large flat off-shoot from a high dipping dyke-like mass. This offshoot forms the present day land surface and it is just sitting on the hill top.

The quartz of these deposits is mostly of a grey close-grained glassy variety, but it is sometimes coarsely crystalline. No tourmaline or sulphide minerals have been observed in it. It is cut by closely spaced joints without any regular arrangement and in places it is much shattered by later movements. Along the joint planes there are usually skins of muscovite, and sometimes at the intersection of joint planes the muscovite occurs as masses varying from small aggregates to large patches, and in the latter case it forms the Mwirasando pegmatite, which may, however, sometimes occur in the quartz without any connection with joint planes. In the quartz deposits the cassiterite occurs as coarse blebs, aggregates, and crystals, usually very irregularly distributed. Most of the quartz appears to be barren but certain outcrops are known in which the cassiterite forms numerous masses up to six inches in diameter. When occurring in quartz it is usually associated with a skin of muscovite or with small aggregates and patches of the mica, and only occasionally does it occur in the quartz itself without such association, and it is usually cut by threads and small veins of muscovite which do not pass beyond the limits of the cassiterite into the quartz.

(*b*) *Pegmatites Associated with the Quartz Deposits.* —The pegmatites of this group form irregular masses and lenticular vein-like masses along the edge of the quartz bodies between the quartz and the phyllites, and sometimes as a mere thread. They are usually composed wholly of an aggregate of closely packed flakes of muscovite, but in parts of them the vein or mass consists largely of kaolin and a kaolin-sericite aggregate through which the coarse muscovite occurs as bunches or scattered flakes. These veins which vary up to four feet in width are later than the quartz, and in one case one of them cuts across it. The cassiterite in them is again very irregularly distributed, but in places they contain very rich ore deposits, while some of them appear to contain little or no cassiterite. In a S.E. drive off the S.W. end of No. 2 adit in one of these deposits the tinstone occurs as frequent and numerous slugs and lumps up to 150 lb. in weight. The all-muscovite pegmatite is also found underneath some of the flat offshoots of quartz either as an irregular vein or irregular masses with an increased thickness in hollows and undulations along the base of the quartz. Some of the muscovite aggregates along the edges of the quartz bodies seem to be differentiates in place of the siliceous pegmatitic magma solution.

(*c*) *The Veins of Mwirasando Pegmatite and Muscovite-Kaolin Veins Independent of the Quartz Bodies.*—The best example of this group is that exposed in No. 10 working, from which to date the greater part of the production of cassiterite has been obtained, and which vein has now been stoped down to the 50 ft. level. This vein or dyke varies in composition from a coarse aggregate formed wholly of muscovite (the Mwirasando pegmatite) but sometimes containing small patches of kaolin and sericite, to a kaolin-sericitic aggregate through which muscovite occurs as large aggregates and scattered flakes. The cassiterite is again irregularly distributed as coarse crystals, blebs, slugs, and irregular masses. The writer observed *in situ* one mass 2 ft. 8 in. in length, 2 ft. in breadth, and 8 in. in thickness, and in that particular section there were several other masses not quite so large. Almost all of the cassiterite is cut by threads and veinlets of muscovite as noted above. The whole of this vein from the surface to the 50 ft. level was very rich, and sections were observed where it must have carried 30% of cassiterite. No tourmaline, sulphide, or other minerals have as yet been seen in it, and no data were observed regarding any controlling factors in the localization of the cassiterite. The strike of this vein generally coincides with that of the enclosing phyllites, but in places it cuts slightly across the dip. On the surface this vein outcrops over a length of approximately 130 ft., but on the 50 ft. level there are indications that it is of greater length. The vein is known to extend downwards to the level of No. 2 adit a depth of 100 ft., but between the 50 ft. level and No. 2 adit it seems to have split into three veins. In width the vein varies from 1 ft. 6 in. to 3 ft., with local bulges to over 6 feet.

At the north-west end of No. 10 working the vein is exposed in cross section, dipping at an angle of 80° to the south-west, in contact with a quartz body on the south-west side and phyllites on the north-east which dip at 65° to the north-east. This quartz dyke forms the highest part of Mwirasando Hill and in a south-east direction from the above end of the open cut it pitches below the surface for a length of 90 ft., and then rises again and over this section the top of the quartz is covered by from 5 to 16 ft. of phyllites standing in a vertical position. The quartz over this part dips to the south-west at an angle varying down to as low as 45°. In places over the pitching section of the quartz body the muscovite-kaolin vein is in contact with it at depths varying from 10 to 20 ft., and from these points there is a branch of the muscovite-kaolin vein over the cap of the quartz, and thus between the quartz and overlying vertical phyllites. This vein varies up to one foot in thickness and much of it contained over 50% of cassiterite. From the points where the muscovite-kaolin vein is in contact with the quartz it continues both upwards and downwards in the phyllites independent of it; but at one place in the N.W. drive on the 50 ft. level, the quartz again almost meets it. In No. 2 adit, that is at the 100 ft. horizon, the quartz body is 87 ft. away from the direct downward continuation of the main muscovite-kaolin vein. On the evidence of structural relationships the muscovite-kaolin veins seem to be of a later date than the quartz bodies and most likely they were formed immediately after the quartz had solidified.

In the main muscovite-kaolin vein of No. 10 working and in another one in a S.E. drive off the S.W. end of No. 2 adit there are large patches of white kaolin in which there are aggregates of sericite. The origin of the kaolin is not clear, but it suggests a derivation from orthoclase felspar, in which case the pegmatite veins would be of two types, an all-muscovite type and an orthoclase-muscovite type. However, it still remains to be proved whether the kaolin represents a weathered or altered orthoclase. The sericite is certainly suggestive of that, but in some specimens the muscovite seems to have broken down into a kaolin-sericite mixture.

The quartz and pegmatite deposits are invariably associated with phyllites and sandstones which have been tourmalinized to a greater or lesser degree and in some cases completely replaced by fine tourmaline needles, but there is no tourmaline in any of the deposits themselves. Even the smallest stringer of quartz is associated with tourmalinization, and it is a significant fact that in the phyllites completely free from tourmaline there is not even the smallest quartz stringer. The above evidence indicates that the tourmalinization took place at the same time as the formation of the quartz and pegmatite deposits.

In some of the phyllites that have been almost or completely replaced by tourmaline, muscovite occurs as horizontal threads and small gash veins. Many of the threads are only a few inches in length and not in any way connected with joints, fracture planes, or bedding. This suggests an intimate relationship between the tourmalinization and the formation of the pegmatites, and also that the quartz bodies, which are always associated with the tourmalinized rocks, represent the siliceous end of a pegmatite series.

The period of crystallization of the muscovite and cassiterite overlapped, as is evidenced by their intimate association in the quartz deposits and by the constant threading and veining of the cassiterite with muscovite in both the quartz and pegmatite. In places adjacent to the quartz and pegmatites, the phyllites pass gradually into a soft white sericite aggregate, which is often difficult to distinguish from some of the more altered parts of the pegmatite-kaolin veins. This alteration, together with the formation of the sericite in the veins themselves, seems to have been caused by later ascending solutions. The writer does not think that there are enough data as yet to decide whether the kaolin has been formed by surface weathering, or by alteration of the orthoclase by ascending magmatic waters.

The quartz and pegmatite bodies seem to have made room for themselves after the manner of intrusion of igneous dykes and only partly to have followed any pre-existing lines of weakness or fracture zones. Many sections are exposed in which the quartz and pegmatite veins cut across the dip of the phyllites, with the dips on each side in the same direction but at different angles. These sections examined in themselves, suggest that the veins were injected along fault planes, but the apparent displacement of the phyllite beds is a result of the rocks accommodating themselves to the supposed forced injections of the veins. The main muscovite-kaolin vein of No. 10 working, which is nearly vertical, close to the surface cuts across the dip of the beds, but on the 50 ft. level and at 100 ft. in No. 2 adit it is conformable with the beds, which there stand in a vertical position. Many other examples can be cited of the accommodation of the phyllites to the supposed injected veins.

There are inclusions of phyllite in the pegmatites, but there is no evidence of metasomatic replacement of the phyllites, the inclusions apparently representing torn-off fragments of the rocks through which the veins were injected. In several places, notably in the trench of No. 8 working, flat veins of the Mwirasando pegmatite from 1 ft. to 3 ft. in thickness cut across the tourmalinized phyllites which dip at 80° to the S.W. These veins seem to have forced their way across the beds almost at right angles to the bedding, like a sill. In these flat veins there are inclusions of phyllite, and irregularities in the edge of the intruded rocks appear to be the places from which the inclusions were torn off. Again in the flat veins there are constrictions down to an inch in thickness and beyond which the vein may bulge to over 3 ft. The intruded rocks adjacent to these bulges show distinct evidence of having accommodated themselves to the increased thickness of injected material; the constrictions most likely represent points where the injected solutions were obstructed in their passage. There have been movements of later date than the formation of the quartz and pegmatite veins, but these were of the nature of a slipping and rubbing along bedding planes resulting in the formation of numerous smooth slickensided faces on which there are varying amounts of soft mush. In places on the edges of some of the quartz bodies these movements have produced a fault breccia in which quartz has been rolled into subangular and rounded lumps. These movements which are for the most part along the bedding planes become less intense and gradually leave the bedding, cut across it on a curve, and finally die out along a flat joint cutting across the dip of the beds.

The ore deposits were formed after the second period of folding in the Karagwe-Ankolean rocks which resulted in the formation of the large pitching folds, at a period when the granite had almost completely cooled and crystallized out, and only residual magmatic solutions and volatile constituents remain. These residual solutions were in the main highly siliceous and with them there was a large volume of volatile boron compounds. As far as the Mwirasando area was concerned a siliceous solution containing only a small proportion of potash and alumina was the first to be injected into the phyllites to form the quartz deposits with the associated small patches of muscovite. After the injection of the highly siliceous solutions there still remained a residual magmatic differentiate rich in alumina and potash and containing abundant volatile boron compounds and possibly fluorine and which were injected into the phyllites along much the same courses as the siliceous solutions were, but in some places along partly independent courses to form the all-muscovite and the muscovite-orthoclase pegmatite (on the assumption that the kaolin represents a decomposed orthoclase felspar).

The cassiterite is believed to have come along during both the formation of the quartz deposits with their associated small bunches of muscovite, and the muscovite and muscovite-orthoclase pegmatite veins, the greater part of it with the latter. The writer believes that the quartz deposits were injected in the form of aqueous solutions under high pressure and the pegmatite veins in the form of an aqueous magma.

In future prospecting underground for tin-bearing pegmatites, there seems to be no other course open than to follow the edges of the quartz bodies or any pegmatite veins or stringers found during the course of prospecting operations. From what can be seen of the nature of the quartz deposits it is most likely that others will be found that do not reach the surface.

The writer emphasizes the fact that it is impossible to make a sampling of such ore-bodies that could pretend to be even moderately accurate and any estimate of the tin reserves underground would be the merest guess. The mine is still in a very early stage of development and there is no reason why further rich deposits should not be found similar to those already known.

MODERN MINING EXPLOSIVES

At the October meeting of the Institution of Mining and Metallurgy. the president, Dr. William Cullen, gave an address on Modern Mining Explosives, from which extracts are given herewith.

The Rapid Fuse.—The "cordeau detonant", or instantaneous fuse, is a recent introduction which is not well known to mining engineers generally, though quarrymen in America, and to a lesser extent on the Continent, realize its great economic significance. This is a form of instantaneous, or at least semi-instantaneous fuse, the velocity of detonation being roughly 7,000 metres per second. It consists of a thin lead pipe having a diameter of 0·23 in., filled with high-quality crystalline trinitrotoluene. It is employed exclusively for quarrying or open-cast work carried out on a large scale, that is where anything from 30,000 to 1,000,000 tons of rock are brought down in one blast. The technique is very simple and, provided certain precautions are taken, there is little room for failure. Holes 5 in. to 8 in. in diameter are made by well or churn drills back from the face, either in line or staggered to suit the circumstances, and these are charged with explosives but not necessarily in a continuous column. Any number of shots can be set off by one detonator.

Detonators.—Until recently the fulminate detonator with its copper tube held the field, as indeed it still does in America, but the lead azide detonator is rapidly taking its place, not only in this country but throughout the Empire and Europe. The fulminate detonator has had a run of over 60 years, and it was never patented. Its one failing is its tendency to absorb moisture, with consequent decrease in strength. Indeed, this drops off considerably with extremely small percentages of moisture. The lead azide detonator marketed at the present time has an aluminium tube and the charge is made up in two parts. The bottom portion of the charge, generally known as the main charge, consists of tetryl (trinitro-phenyl-methyl-nitramine), and the top or priming charge of a mixture of lead azide and lead styphnate (lead trinitro-resorcinate), with a small percentage of aluminium powder. This detonator has two distinct advantages over the old fulminate detonator. First, it is much stronger as regards its initiating or boosting power, and, secondly, it can withstand the action of moisture much better. One point should, however, be mentioned in regard to this type of detonator. Owing to the extra heat generated through the oxidation of the aluminium tube, its use is prohibited in certain classes of coal mines both in this country and elsewhere.

In an appendix Dr. Cullen gives further information relating to detonators as follows:

The capsule containing the ordinary mercury fulminate-chlorate mixture is not copper, but an alloy of 95% of copper and 5% of zinc, which is stronger than copper. Strength is necessary, for the detonating composition, after it has been loaded into the capsules, is submitted to considerable pressure. Fulminate alone will not bind well, but the chlorate addition improves it in this respect. When pressed, the mixture remains in position and cannot be tapped out or, indeed, easily removed. Moreover, it does not readily adhere to the punches when they are withdrawn after pressing. Not all fulminate crystals are suitable for detonator manufacture. A definite form of crystal is necessary as is also a definite grist of chlorate.

Within the past 20 years there have been many varieties of detonator introduced, but, whereas the fulminate was what might be called a straight detonator, inasmuch as the charge was fulminate-chlorate throughout, all the others might be called composite. That is, the main charge was one of a variety of bodies here mentioned, but an initiating charge of fulminate was necessary in each case. Picric acid—$C_6H_2OH(NO_2)_3$—detonators have still a vogue in France. The capsule must, however, be made of pure copper otherwise dangerous picrates are formed. Trinitrotoluol—$C_7H_5(NO_2)_3$—has also been employed to a considerable extent and is still employed on the Continent, but, though it is cheaper than fulminate to manufacture, the consensus of opinion is that it is not so satisfactory. Tetryl (trinitro-phenyl-methyl-nitramine) has also been tried out and, as it has an extra NO_2 radicle, is very powerful and is distinctly better than the previous two.

The ideal initiating explosive should have the following properties: (*a*) It should run easily through a loading machine, that is, it should be of a crystalline nature so as not to clog in the small apertures of the loading plates. It should also not adhere to the punches of the press. (*b*) It should bind well and not become loose after pressing. (*c*) It should be as insensitive as possible to shock and friction. (*d*) It should ignite every time, without fail, from the spit of the safety fuse. (*e*) It should detonate even when damp. (*f*) It should be chemically stable under extreme climatic conditions and should not form dangerous compounds with the metal of the container. (*g*) It should not become insensitive (dead) through excess of pressure.

Hydrazoic acid (HN_3) was discovered about forty years ago. The azides of the heavy metals are all powerful explosives, while those of the alkali group are only inflammable. As already mentioned the lead salt (PbN_6) is more powerful than fulminate and much less easily affected by moisture. It has been made in this country for a number of years by mixing together solutions of calcium azide (CaN_6) and lead nitrate, when a double decomposition takes place. Lead azide has, however, a high ignition temperature and does not become readily ignited by the spit of a safety fuse, neither does it bind well. These are serious objections and it required years of patient research both in Germany and in this country to overcome them. It was, however, eventually found that by incorporating a proportion of lead styphnate and aluminium with the azide the difficulties could be surmounted. Lead styphnate is the lead salt of styphnic acid or trinitro-resorcin. The azide-styphnate detonator is now a well-established article of commerce and in South Africa, for instance, it has nearly replaced the old type. The main charge however is tetryl, the azide-styphnate-aluminium mixture being the initiator. Reference has already been made to the fact that crystals of fulminate of mercury for the loading of detonators must have a definite form. Precisely the same holds for azide and styphnate

Non-freezing Explosives.—All mining engineers realize the dangers attached to the handling of frozen nitroglycerine explosives. They are not only very sensitive to frictional effects when in this condition, but they are extremely insensitive to detonators; consequently all manufacturers issue detailed instructions regarding the precautions to be taken during thawing or softening. This has undoubtedly militated against the more extensive use of nitroglycerine explosives in the past, but the difficulty, after years of patient research has been overcome in two ways. When glycerine is polymerized, that is, when the size of the molecule is increased, a very slight change takes place in its actual constitution, one molecule of water disappearing. This polymerized glycerine behaves like ordinary glycerine on nitration, but the resulting nitroglycerine does not freeze. When, therefore, a proportion of this modified nitroglycerine is blended with the ordinary product, the resulting mixture, either alone or in the form of explosives, will not freeze or harden in winter. The second method consists of the additions of dinitro-glycol to the nitroglycerine explosives. Ethylene glycol—$C_2H_2(OH)_2$—only a very few years ago was known as a somewhat rare and apparently useless chemical. Now its annual production amounts to thousands of tons, for it has many applications outside of that which is now being considered. There are several ways of producing it, but the following might be mentioned. Ethane (C_2H_6) occurs in many natural gases. When this is cracked, ethylene (C_2H_4) is produced, and this by simple chemical processes is transformed into glycol which on nitration yields dinitro-glycol. This behaves just like the polymerized product already described and seems to give what is called better propagation in the explosive sense. Explosives designated "low freezing", "polar", or "arctic" have all an admixture of one or other of these two nitrates, and their introduction has largely freed users from the necessity of providing warming pans, thawing houses, and the like. They have also meant a saving in life by their reduction of thawing accidents.

TIN MINING IN BANKA

The Netherlands East Indies rank as important tin producers, and the most important islands in this respect are Banka and Billiton, which lie to the south-east of Sumatra. Observations on a visit to Banka in 1926 were read before the Malayan Tin Dredging, Mining and Research Association by J. B. Scrivenor on July 4.

The author first gave an account of the granites in the tinfields. He showed that situated to the north-north-west were Lower Burma and Lower Siam, in both of which countries tin-bearing granites occur. In Malaya further outcrops of tin-bearing granites occur on the west and east of the Peninsula, forming two well marked belts, converging towards the south. If these belts are carried on southwards, they pass through a number of small Dutch islands and the east coast of Sumatra, and one of the islands, Singkep, is well known as a tinfield. If the trend of the belts is produced farther still they enter Banka. Thus far the strike of the rocks cut by the granite is parallel to the continuation of the two peninsular tin-belts, but in Banka the strike of the bedded rocks older than the granite swings round towards the east-south-east. If these strike-lines are followed on the map they reach Billiton, and when the strike across the Strait of Karimata is continued it leads to West Borneo where a few occurrences of tin ore are reported. On the east coast of Borneo and adjacent country inland the strike of rocks that are of the same age as those in Banka, the islands between Banka and Malaya, and Malaya, swings towards the north, and it is probable that G. Kinabalu, in British North Borneo, formed of hornblende-granite, is related to the granites of Billiton, Banka, and Malaya.

A few unimportant occurrences of tin ore are known on the east coast of Sumatra, which may mark a continuation of the western Malayan tin-belt. The only other tin ore recorded in the Netherlands Indies is on the west coast of the same island, so that all the important occurrences of tin ore in this part of the world lie on an arc passing down the Malay Peninsula through the Lingga Archipelago to Banka and then swerving eastward to Borneo. In late Mesozoic time the crust of the earth was intensely folded, one fold, coinciding with this arc, raising the old bedded rocks and allowing tin-bearing granite to rise. The bedded rocks in Banka, Lingga Archipelago, Singapore, and parts of the Peninsula, lie on the same line of strike. That they are contemporaneous has been proved on palæontological and lithological data, and they are believed to be Triassic.

It has been shown how Banka fits into the arrangement of the tinfields in the Middle East. It is not a small island, as it is about 140 miles long, and its area is about the same as the States of Selangor and Negri Sembilan together. The scenery is very like that of Johore. There are no very large mountains, but occasional granite hills occur. The island, with its capital at Muntok, is inhabited by Malays. It has no railway, but there are good roads.

The total production of tin concentrates in the Netherlands Indies is about 40,000 tons per year, and of this Banka is the biggest producer. Tin mining began in Banka about A.D. 1710, the mines being worked by Malays. In 1718 the Dutch East India Company obtained their first supplies of tin from this island through the Sultan of Palembang. A point of great interest about tin mining in Banka is that it is carried out by a Government Department, the "Bankatinwinning." The Government of the Netherlands East Indies has a group of Government Industries. These are:—State Railways and Tramways, Posts and Telegraphs, Telephones, a Hydro-electric Station, Coal Mines at Ombilin (W. Sumatra), P. Laut (S.E. Borneo), B. Asam (Palembang), gold mines in Sumatra, a salt monopoly, and tin mining in Banka. In 1927 all previous production of tin in Banka was exceeded, the total being about 21,000 tons. The profit made in that year was 49,279,270 guilders. The staff in February, 1928, numbered 333, including 12 mining engineers, and 8 electrical engineers. There were 20,112 workmen on contract in 1927, of whom 19,783 were Chinese, 329 natives of the Netherlands Indies; and 2,667 non-contract workers of whom 1,552 were Chinese.

This 1927 production was one-seventh of the world's total production, an important contribution. It was less, however, than half that of the total F.M.S. production, although larger than that of Selangor, Negri Sembilan, and Pahang added together.

In 1926 there were no dredges in Banka. Now there is one suction-cutter and two bucket dredges. On Singkep the Singkep Tin Maatschappij has the same number of dredges, two being bucket dredges, the other a suction-cutter.

Comparing the financial results in 1927 for Banka and for the Malay States, the profit in Banka was 49,279,270 florins which in Straits dollars is $34,495,489. The export duty on tin for the Malay States in the same year was $17,704,590. The figures placed together are interesting :—

	Production.	Profit. To the Government.
F.M.S. .	876,620 piculs	$17,704,590
Banka .	354,270 ,,	$34,495,489

So Banka with much less than half the Malayan production, had nearly double the profit. There is an obvious objection to this statement, namely, that it does not take into account indirect revenue and land-revenue and land-sales in Malaya. What the indirect revenue from mines is in the F.M.S. would be very hard to estimate, but the total land-revenue and land-sales in 1927 was $6,656,724. Moreover, against this must be reckoned revenue in the way of customs and taxes derived from the Banka mining community, which in 1927 numbered 22,779. In the F.M.S. the mining labour-force was 122,888.

The organization by the Netherlands Indies Government of the State mining is interesting. The head of the Government is the Governor General of the Netherlands Indies, residing in Java. Under him are various technical departments, one being the Department of Government Industries. One section of this is Dienst van den Mijnbouw. Under the Director of the Mijnbouw, whose headquarters are at Bandoeng, is the Bankatinwinning Department, the Director of which resides at Muntok. His staff is distributed among the various tin mining centres in the island, where the mining engineers superintend the workers, but as there are no quarrels between neighbouring lessees over water-rights and disposal of tailings, their work is not so arduous as that of the officers of the F.M.S. Mines Department. Details of dredging procedure are not to hand but in the case of the open-cast mines the procedure is as follows. The Bankatinwinning does the prospecting, and as the alluvium rests on a fairly level bottom, limestone being absent, it is possible to get a fairly close valuation of the ground. Chinese then proceed to work the mine on contract. Kongsi-houses are built for them and electric power is supplied if necessary from a central station at Mantoeng, with water and monitors, hoes, etc. They are then told that there are 5,000 piculs of tin ore in the particular area. If more than 5,000 piculs are obtained the surplus is bought at full market rates. The gamble in the transaction is attractive: it stimulates very careful boring on the one hand and efficient extraction on the other. The ore is smelted in 5 modern smelting-works distributed through the island, excepting some ore more difficult to treat, which is sent to the Straits Trading Company. The tin is sold and the proceeds paid into the Government Treasury. During the years 1923–1927 214,300,000 florins were paid in.

On a visit to Banka in 1925, the writer after landing at Koba, on the east of the island, was shown two alluvial mines near by. Both showed peaty and granitic alluvium. In one, the bedrock of black contorted phyllites was exposed. In the second numerous buried tree-stumps were causing trouble, but on the whole the tin-bearing ground was sandy and easy to work. There was abundant water and the tailings found their own way into the sea.

Near Pangkal Pinang another mine was visited, No. 14, in coarse granitic alluvium. More interesting was No. 24 which is in a " drowned valley " in the sea. Vast accumulations of ice at the poles during the Pleistocene glaciation caused the sea-level to fall and Sumatra, the Malay Peninsula, Borneo, Java, and the small islands in between, were united by dry land drained partly by rivers that flowed out into the China Sea north of what are now Sarawak and British North Borneo. In tin-bearing areas, alluvium with tin ore was deposited. When the severe glaciation came to an end the sea-level rose again, the Peninsula and islands were separated and some of the valleys containing tin-bearing alluvium were submerged under the sea. In Malaya there are no well marked valleys with tin ore submerged in this way. In Singkep and Banka, however, tin is won from these " drowned valleys." Prof. H. A. Brouwer has pointed out that on one of the Singkep rivers the lowest part of the alluvium worked was 17 metres below the present sea-level, and that stream-deposits 1,300 metres from the shore are about 10 metres thick, the sea above being 7 metres deep. The mine near Pangkal Pinang, No. 24, extended roughly half a mile out to sea. The tin-bearing ground was alluvium, no bedrock being visible. The sea is shallow here for a long way out and walls of coral and mud had been constructed to prevent the sea-water flooding the mine at high tide. Monitors were used to cut the alluvium. Farther out to sea a line of prospecting bores was being put down, stages of scaffolding being used for the work. On the coast near by was a raised beach. From Pangkal Pinang the writer proceeded to Sungei Liat, another mining centre farther north. Mine 36 at the latter place had a bedrock of granite and abundant large quartz boulders. The alluvium consisted of stiff white clay, sandy clay, red clay, and coarse granitic sand. A more interesting mine was No. 27 which was on the junction of aplite carrying tin ore, and phyllites, and was similar to several mines in Malaya.

Non-detrital tin ore occurs in quartzite at Bukit Sambonggiri, but there are no deposits in the parent rock that are of great value in Banka. Apart from the quartzite at Bukit Sambonggiri there are stanniferous granitic rocks other than the aplite at Mine 27. In one near Blinjoe 0·13% of cassiterite has been found. Veins of kaolin, derived from a granitic rock, are found carrying quartz, zircon, tourmaline, and cassiterite. In a granitic rock on the S. Belami metallic sulphides were found, including galena with 17·63 oz. of silver to the ton. Wolfram is not common in Banka. Scheelite, has not been recorded, and a favourable feature of the tin-ore concentrates is that " amang " is not abundant. Only in one place does ilmenite occur in large quantity with the ore.

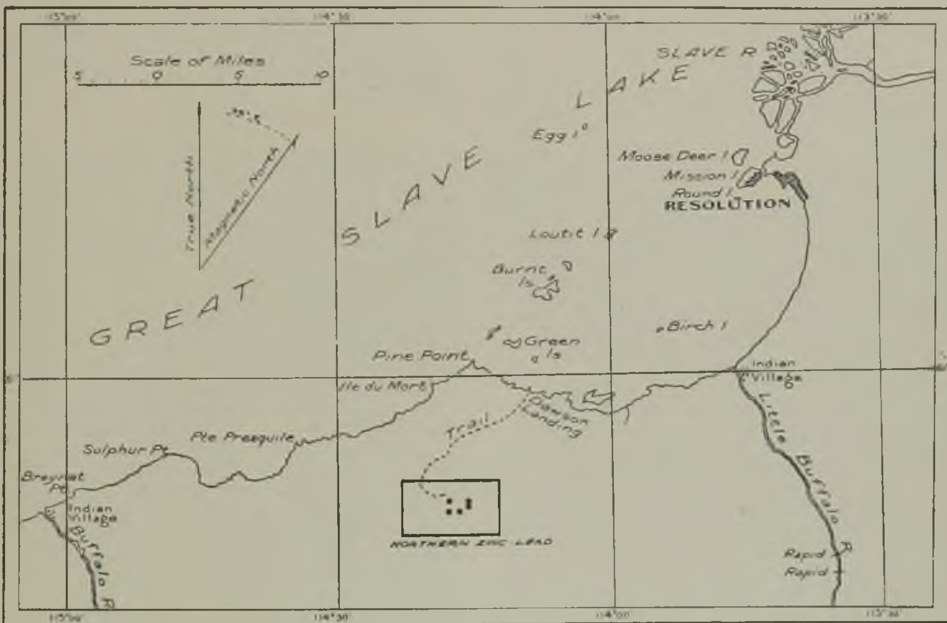
Three favourable factors for winning the ore in Banka are :—no irregular limestone bedrock, the amount of heavy impurity in the concentrates smaller than in Malaya, and generally the alluvial tin-bearing ground is sandy and more easily concentrated than the stiff clays above the limestone in Malaya.

LEAD-ZINC DEPOSITS ON GREAT SLAVE LAKE

The *Canadian Mixing and Metallurgical Bulletin* for October contains a paper by Dr. J. Mackintosh Bell on the lead-zinc deposits on the south side of Great Slave Lake, North-West Territory, Canada. These deposits have been known for 30 years or more and were tested by prospectors who had attempted to get to Yukon by the Slave and Mackenzie Rivers. Owing to the ores containing little silver attempts at development were not made until 1928, when a company called Northern Lead-Zinc, Ltd., was formed for the purpose by Consolidated Mining and Smelting of Canada, Ventures, Ltd., Atlas Exploration Co., and a Boston Syndicate. This company has not yet done a great deal of work but the importance of the deposits has been established and Dr. Bell's account is worthy of record.

the irregular nature of the pre-Glacial surface upon which it was deposited. Near the deposits, the greatest depth at which solid rock was first encountered in test-pitting was about 15 ft.

Up to the present, five deposits of lead-zinc ore have been found. While these are apparently distinct, exploration has not proceeded sufficiently far to prove that they may not all be surface expressions of a single ramifying occurrence. Three of the deposits lie on what is known as the northerly line, two close together, and the third about three-quarters of a mile distant. The remaining two are situated on the southerly line, which parallels the northerly line and is about a quarter of a mile from it. The deposits on the southerly line are separated by about a quarter



SKETCH MAP SHOWING LOCATION OF NORTHERN ZINC-LEAD PROPERTY.

The solid rocks in the neighbourhood are of Middle Devonian age and have been divided into three formations named, in ascending order, the Pine Point Limestone, Presqu'ile Dolomite, and Slave Point Limestone. The Pine Point rocks comprise soft grey shaly limestone, blue to black thin-bedded hard limestone, and grey to brown shaly limestone. The Presqu'ile Dolomite formation is composed mainly of crystalline, in places cavernous, dolomite and dolomitic limestone. There are also minor beds of shaly or arenaceous limestone. The Slave Point formation consists of grey, shaly limestone. Above the Pine Point formation are the various formations of the Upper Devonian. The ores are contained in the crystalline portions of the Presqu'ile Dolomite.

Shrouding the solid rocks almost everywhere, in greater or lesser amount, are boulder clays of Glacial age, and the sands and gravels deposited thereon during the retreat of the water of Great Slave Lake. The thickness of this unconsolidated material varies from place to place, depending upon

of a mile of boulder-clay plain. Judging by the exposures, three of the deposits are roughly circular in shape and about 250 ft. in diameter. The smallest showing is about 123 ft. by 80 ft., and the largest extends for a length of 900 ft. and has a maximum width of 200 ft.

The two lines along which the deposits occur are considered to be eroded shattered axes of low anticlinal folds. Their outcrop is characterized by sink-holes, which, in the case of three of the deposits, almost surround them and appear to mark their surface limitations. The visible sink-holes are obviously post-Glacial in age. They are thought to be due to the dissolution of the ore minerals, more particularly pyrite, and the consequent collapse of overlying mineralized dolomite beds, and the surface covering of glacial and lacustrine material.

Where the deposits are capped by barren dolomite or dolomite containing negligible amounts of lead and zinc minerals, or by unconsolidated débris, the surface, apart from the sink-holes, gives no indication to betray the occurrences of mineral deposits beneath ; it shows merely the characteristic flat country covered by coarse grass and occasional trees. Where, however, the ore actually outcrops, there is little vegetation ; the soil is occasionally rusty, reddish, or greyish, with commonly considerable detrital material, consisting of the ore minerals mixed with dolomite fragments and glacially transported material. The best natural sections of ore are those shown on the cliff edges of the sink-holes.

The metallic minerals in the lead-zinc deposits are galena, sphalerite (blende), and pyrite, together with the oxidation products of each. Generally, the galena is coarsely crystalline, showing the characteristic cubical cleavage ; but again it is more fine-grained and associated intimately with sphalerite. The latter mineral frequently exhibits a botryoidal form, suggesting a secondary formation ; but, as stated, it is in places fine grained and associated with galena, and it also occurs coarsely crystallized. Pyrite, generally fine-grained, is found with both the other sulphides, more particularly when mineralization appears to weaken.

Of the oxidation products, those of iron are much the most conspicuous. In many places the dolomites are merely stained with brown and red iron oxides, but elsewhere there are beds, 3 to 4 ft. thick, of gossanous material of this character. Zinc carbonate is apparently rare, and white and yellow oxides of lead have been found. The gangue of the ore is chiefly dolomite, which, in the richer material, crumbles rapidly on exposure to the air. Calcite occurs both as inter-metallic mineral filling, or as large crystals in cavities. Though low silver assays have been found in all of the deposits, the quantity of this element present may be regarded as negligible.

Though lead and zinc minerals occur in greater or lesser amount throughout the deposits, beds of barren or nearly barren material are interstratified with others containing a high metallic content, which diminishes or increases laterally. Apart from this mineralization of favourable beds, the ore occurs in vertical or inclined masses of highly irregular shape, as fairly closely-spaced small lenses in crumbly dolomite, and as the cementing material of dolomite fragments, thus forming a sort of breccia. The strength of the mineralization would appear to be greatest along lines parallel to the principal joint planes and to weaken outward therefrom in favourable beds. Thinly stratified beds of relatively impervious nonporous dolomite are un-mineralized or contain only occasional crystals of the sulphides. Certain features suggest a roughly zonal arrangement of the three metallic elements, with lead more conspicuous towards the centre of the deposits and zinc and iron in turn towards the peripheries.

The deposits show evidence of considerable oxidation to the greatest depth reached by any prospecting shaft (55 ft. on August 1, 1929), the oxidation naturally being most apparent where iron minerals are present. Highly oxidized beds occur in places below those which show no obvious oxidation. Open caverns surrounded by gossanous material have been encountered in test-pitting in ore and in barren dolomite.

The deposits possess a general similarity to those of the same elements occurring in the Tri-State region of the Mississippi valley. The quantity of ore would appear to be considerable, but it remains to be proved, by the exploration now in progress, whether the amount is sufficient to warrant early intensive development as a mining enterprise. The quality of the ore is generally good, in places unusually so. Its character in this respect may be judged by the following 55 ft. section, from surface to the bottom of the shaft :

Footage.	Lead.	Zinc.
	%	%
0—18	43·29	16·87
18—30	20·65	26·25
30—42	6·90	4·65
42—55	9·01	5·60

A correct diagnosis of the mode of formation of the lead-zinc deposits of Great Slave Lake would probably aid in directing their exploration, and might assist in gauging their probable extent, but the amount of exploration so far done is insufficient to warrant, at this stage, the advance of a theory which could be regarded as other than mere speculation.

British Somaliland Minerals.—The Colonial Report on British Somaliland for 1928 contains brief references to mineral investigations. In quoting these it is appropriate to refer readers to the article on the geology and minerals of this protectorate written by R. A. Farquharson in the MAGAZINE for May and June, 1926.

As a result of the discovery of gold in the residues of a gum sample sent to an English confectionery firm in December the director of the Geological Survey made a preliminary investigation into the possibility of the occurrence of the metal in the area from which the gum was obtained. An examination was made to determine its geological structure and composition, and to ascertain whether quartz reefs, quartz veinlets, acid dykes, or lode were present in it, and whether alluvial gold existed in the "tug" sands. A "tug" is a sandy river bed, dry except during rains. Most of the area consists of more or less metamorphosed sedimentary slates from light-grey to nearly black in colour, dipping chiefly vertically and striking uniformly north and south. The whole of the slate series is seamed with quartz reefs, quartz veinlets, and aplite and granite dykes. Some of the quartz and veinlets and reefs were distinctly "favourable" and samples were collected and sent to the Imperial Institute for assay. From what was seen, it is advisable that all foothills from Dabgadot to Ershida should be examined in the near future.

The holders of the mica concession, referred to in report for 1927, sent out during the year their own mining engineer to examine the property in the light of the development work done, the amount of saleable mica obtained, and the comparative figures for results and expense. The report of the examining engineer being unfavourable to the prospects of the syndicate—though some good mica was obtained—the concession was abandoned.

In November a party including two geologists and a surveyor began work on the petroleum concession granted to the Anglo-Saxon Petroleum Co. The preliminary operations of the geological survey are not yet completed.

A concession for the production of salt from brine springs and pans at Zeilah was granted during the year and early work on the concession is expected.

SHORT NOTICES

Rio Tinto.—The October *Bulletin* of the Institution of Mining and Metallurgy contains notes by H. R. Potts on converting low-grade matte at Rio Tinto. Extracts from a paper on smelting at Rio Tinto, by the same author, were given in the MAGAZINE for September.

Cinnabar.—*Economic Geology* for September–October contains an article by John T. Lonsdale on an underground placer cinnabar deposit in Texas. An open sink-hole in limestone has been filled with clay containing limestone and cinnabar fragments.

The Growth of Magnetite Crystals.—Results arising from an investigation of the mineral composition and structure of iron-ore sinter are described by G. M. Schwartz in *Economic Geology* for September–October. Information on the growth of magnetite crystals has been obtained.

Anthracite.—In *Technical Publication* No. 234 of the American Institute of Mining and Metallurgical Engineers H. G. Turner continues his description of work on the constitution and nature of Pennsylvania anthracite. Comparisons with bituminous coal are made.

The Microscope in Ore-dressing.—Results of microscopic studies of mill products are given by H. S. Martin in *Technical Publication* No. 255 of the American Institute of Mining and Metallurgical Engineers. Actual examples show that such studies have been an aid to operation at the Utah Copper Mills.

Copper Queen.—Concentrating operations at Copper Queen are outlined in *Engineering and Mining Journal* for October 12 by Charles W. Tully.

Nova Scotia.—The Geological Survey Branch of the Dominion Department of Mines at Ottawa has published Memoir 156 by Dr. Wyatt Malcolm, dealing with the Gold Fields of Nova Scotia. The work has been compiled largely from the results of investigations by Dr. E. R. Faribault.

Inspiration.—*Engineering and Mining Journal* for October 19 and 26 contains an article by Harold W. Aldrich and Walter G. Scott on the practice employed in leaching mixed oxide and sulphide copper ores at Inspiration.

Flour Gold.—The recovery of flour gold from river sand in California is described by Edwin A. Sperry in the *Engineering and Mining Journal* for October 12.

Flotation of Zinc Blende.—In *Technical Publications* Nos. 247 and 248 issued by the American Institute of Mining and Metallurgical Engineers, O. C. Ralston, C. R. King, F. X. Tartaron, and W. C. Hunter discuss the reason why sulphate of copper acts as an activator in the flotation of sphalerite, and give the results of investigations relating to the action of other salts of copper. They show that the copper sulphate forms an invisible but physically detectable film of cupric sulphide on the surface of the sphalerite particles, and that no other salt is as active in this way as the sulphate.

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.*

6,077 of 1928 (288,250). BOZEL-MALÉTRA SOCIÉTÉ INDUSTRIELLE DE PRODUITS CHEMIQUES, Paris. The thermal disintegration of chrome ores in stationary hearth furnaces, using agitation by rotating arms. The ore may be mixed with fuel or the heating may be totally external.

6,509 of 1928 (303,055). BALZ-ERZROSTUNG GESELLSCHAFT MIT BESCHRÄNKTER HAFTUNG, Gleiwitz, Germany. A process for calcining zinc blende and similar ores in which the ore passes downwards through a series of roasting chambers arranged zig-zag fashion, while the roasting air passes upwards.

10,302 of 1928 (318,301). EDGAR ARTHUR ASHCROFT, Ashburton. Chlorination methods in the metallurgy of base metal ores.

16,340 of 1928 (318,314). THOMAS JAMES TAPLIN, BRUCE TAPLIN and METALS PRODUCTION LIMITED, London. Treatment of oxidized copper ores in which the ore is mixed with solid carbonaceous matter and heated in the presence of a halogen or halogen compound.

19,413 of 1928 (317,952). HENRY EDWIN COLEY, London. A method of internally heating ore-reducing furnaces which will obviate the use of excess air.

19,565 of 1928 (317,953). THE BRITISH ROPEWAY ENGINEERING CO., LTD., and H. F. H. SHIELDS, London. Means for conveniently removing buckets from an aerial ropeway and for replacing them.

20,928 of 1928 (317,961). THOMAS TWYNAM, Redcar. A cheap method of separating magnesia in a fairly pure state from dolomite.

21,136 of 1928 (294, 541). ERNST KELSEN, Vienna. A new process for electrolytically manufacturing metal sheets and tubes, particularly of iron, by means of rotating cathodes.

21,840 of 1928 (318,355). FREDERIC LOUIS WARD, Oakland, Michigan. The excavation of sand or similar material from subaqueous deposits by suction methods.

22,203 of 1928 (318,359). MICHAEL GEORGE CORSON, New York. New nickel alloys consisting mainly of copper and nickel with silicon, beryllium and various other metals in small amounts.

31,683 of 1928 (305,458). ALUMINIUM INDUSTRIE A.G., Neuhausen, Switzerland. Improvements in the electrolytic production of aluminium.

33,520 of 1928 (318,431). VEREINIGTE ALUMINIUM-WERKE A.G., Lausitz, Germany. Improved cathode and anode in electrolytic aluminium furnaces, electrolytically active areas of the electrodes being kept in a proportion of practically 1 : 1.

36,487 of 1928 (318,067). GIAN ALBERTO BLANC, Rome. During the treatment of leucite and similar silicates by hydrochloric acid for the recovery of potash, ferric chloride must be removed from solution. In this patent the leach liquor is handled in such a way that ferric chloride is deposited and can be separated.

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.

A Preface to Mining Investment. By F. W. H. CAUDWELL. Cloth, octavo, 60 pages. Price 7s. 6d. London: Effingham Wilson.

Tin Companies' Position. Paper backs, pocket size, 149 pages. Price 2s. 6d. London: W. H. Rickinson and Son.

Sierra Leone. Report of the Geological Department, 1927–28. Paper folio, 17 pages. Freetown: Government Printing Office.

Tin. By Dr. C. L. Mantell. Cloth, octavo, 366 pages, illustrated. Price $7.00. An American Chemical Society Monograph. New York: The Chemical Catalog Co.

The Structure of Asia. Edited by Prof. J. W. Gregory. Cloth, octavo, xi + 227 pages, illustrated. Price 15s. London: Methuen and Co.

Mines: Year 1928. List of Mines in Great Britain and the Isle of Man. Prepared by H. M. Inspectors of Mines. Paper backs, 393 pages. Price 18s. 6d. London: H.M. Stationery Office.

The Mining Laws of the British Empire and of Foreign Countries. Vol. V. Australia. Part I. New South Wales. Prepared for the Board of Governors of the Imperial Institute. Paper boards, 378 pages. Price 21s. London: H.M. Stationery Office.

Province of Nova Scotia. Report on the Mines, 1928. Part 2. Paper backs, 238 pages. Halifax: Department of Public Works and Mines.

Kootenay District, British Columbia. Slocan Sheet. Map on scale $\frac{1}{63{\cdot}360}$. Paper, price 25 cents. Ottawa: Department of Mines.

Bulletin of the Imperial Institute. Vol. xxvii. No. 3. 1929. Paper backs, pp. 277–440. Price 3s. 6d. London: John Murray.

Tanganyika Territory. Land Development Survey, First Report, 1928 – 1929. Iringa Province. Paper backs, 95 pages, with map. Price 5s. London: The Crown Agents for the Colonies.

Tanganyika Territory. Geological Survey Annual Report, 1928. Paper backs, 48 pages, illustrated, with sketch map. Price 4s. Dar Es Salaam: The Government Printer.

British Guiana. Report on the Lands and Mines Department for the year 1928. Paper folio, ix + 17 pages. Georgetown, Demerara: The Government Printers.

Western Australia. Report of the Department of Mines for the year 1928. Paper folio, 119 pages + 78 pages statistics, illustrated. Perth: The Government Printer.

Permissible Junction Boxes. By L. C. Ilsley and R. A. Kearns. Paper backs, 19 pages, illustrated. Price 10 cents. Technical Paper 454, Washington: Bureau of Mines.

Fluorspar and Cryolite in 1928. By Hubert W. Davis. Mineral Resources of the United States, 1928—Part II (pp. 13–30). Price 5 cents. Washington: Bureau of Mines.

Gold, Silver, Copper, Lead and Zinc in Nevada, in 1927, Mine Report by C. N. Gerry. Mineral Resources of the United States, 1927—Part I (pp. 509–525). Price 5 cents. Washington: Bureau of Mines.

Gold and Silver in 1927. By J. P. Dunlop. Mineral Resources of the United States, 1927—Part I (pp. 599–636). Price 10 cents. Washington: Bureau of Mines.

Civilization in Britain, 2000 B.C. By Dr. T. F. G. Dexter. Paper backs, 40 pages, illustrated. Price 2s. Perranporth, Cornwall: The New Knowledge Press.

Coal Measure Plants. By Dr. R. Crookall. Cloth, octavo, 80 pages, illustrated by 39 plates. Price 12s. 6d. London: Edward Arnold.

Comparative Tests of Various Fuels when Burned in a Domestic Hot-water Boiler. By E. S. Malloch and C. E. Baltzer. Paper backs, 92 pages, illustrated. Price 20 cents. Canada: Department of Mines Report No. 705.

COMPANY REPORTS

Sub-Nigel.—This company belongs to the Consolidated Gold Fields group and was formed in 1895 to work a gold property in the Far East Rand. Additional properties have since been acquired, all situated in the Heidelberg District. The report for the year ended June 30 shows that 656,828 tons was mined and, after waste had been sorted above and below ground, 291,400 tons was sent to the mill. The output of gold was 261,107 oz., worth £1,107,342, or 76s. per ton, and the working cost was £616,183, or 42s. 3d. per ton, leaving a working profit of £491,159, or 33s. 9d. per ton. Dividends absorbed £375,000 equal to 50%. The ore reserve is estimated at 891,000 tons averaging 18·2 dwt. over 22 in., as compared with 986,000 tons averaging 19·7 dwt. over 24 in. the year before. The percentage of payable footage developed during the year was 36·7% as compared with 42·9% in the previous year. The Betty Shaft was sunk 2,812 ft. during the year and was connected in June with the workings from No. 1 Shaft on the 28th level. This has greatly improved the ventilation of the mine.

Glynn's Lydenburg.—This company, controlled by the Central Mining—Rand Mines group, was formed in 1895 to work a group of gold properties in the Lydenburg district of the Transvaal. The report for the year ended July 31 shows that 75,300 tons of ore averaging 8·2 dwt. gold per ton was sent to the mill where 25,064 oz. of gold was extracted valued at £106,153 or 28s. 3d. per ton. In addition silver to the value of £170 was recovered. The working cost was £98,711, or 26s. 3d. per ton, leaving a working profit of £7,612, or 2s. per ton. The amount of ore treated was 700 tons more than in the previous year, and the yield 2d. per ton more. Working costs have decreased by 6d. per ton to 26s. 3d. No dividend has been paid since 1921. The ore reserve at the end of the year was estimated at 233,200 tons averaging 8·4 dwt. over 19·1 in., as compared with 185,788 tons averaging 8·2 dwt. a year ago.

Zaaiplaats Tin Mining.—This company was formed in 1908 to work tin-mining properties in the Transvaal. The report for the year ended July 31 last shows that 25,915 short tons of ore were crushed, and that 673 tons of middlings, 171 tons of sands and 10 tons of slimes were treated, recovering 266 long tons of concentrates averaging 74·4% metallic tin. In addition 19·45 tons of concentrates were purchased from tributors. Of the ore treated 23,718 tons came from the adit, which is in impregnated granite, and 2,197 tons was from No. 5 pipe. The working profit for the year amounted to £9,771, of which £8,925 was absorbed as dividends equal to 10%. Developments in the adit workings are proceeding favourably, a new ore-body having been encountered near the adit entrance, while a body of ore 3 ft. by 2 ft. averaging 2·5% black tin is being followed in the No. 5 pipe. Little work was done during the year on the valley alluvial which is approaching exhaustion, and no mining or milling was done on the Stavoren mine.

Cam and Motor.—This company was formed in 1910 to work gold-mining properties in the Hartley district of Southern Rhodesia. It was reconstructed in 1919. The report for the year ended June 30 last shows that 280,000 tons of ore was milled, an increase of 20,000 tons over the previous year. By amalgamation and cyaniding £508,871 was produced and £75,697 was made by the blast-furnace unit, where antimonial concentrates are treated, making a total output of £584,568, which is less than the previous year by £30,214. The nett working profit was £234,965 and the working costs were £320,376. Dividends absorbed £150,000, equal to 20%. The ore treated averaged 51s. 8d. per ton and the total extraction was 41s. 9d. per ton. The working cost per ton was 22s. 11d., the royalty 2s. 1d., and the working profit 16s. 9d. The ore reserves are estimated at 1,026,500 tons, valued at 51s. 2d. per ton, as compared with 1,093,000 tons averaging 53s. 8d. the year before. The reserves are distributed as follows:—Motor lode, 472,833 tons; Cam lode, 283,733 tons; and the Petrol lode, 269,934 tons.

Sherwood Starr.—This company was formed in 1923 to work gold deposits eight miles north of the Globe and Phoenix mine in Southern Rhodesia. Milling of oxidized ore started in 1924, and a complex sulphide plant started in 1926. The report for the year ended June 30 shows that 56,200 tons of ore averaging 47s. 1½d. per ton was milled, as compared with 38,200 tons in the previous year. At the concentrator 6,694 tons of concentrates was recovered, of which 1,961 tons was treated by the Cam and Motor Co. The cyanide plant recovered £61,721, and amalgamation £8,489; the concentrate treated at the Cam and Motor yielded £19,432, and the re-treatment of slime £7,952. The total gold output was £97,594 equal to 32s. 11d. per ton, a recovery of 70%. Working costs amounted to £59,494, and the B.S.A. Company royalty was £4,880, leaving a working profit of £33,221, out of which £15,000 was distributed as dividends. The ore reserves are estimated at 113,000 tons averaging 13·7 dwt., as compared with 128,000 tons averaging 13·25 dwt. at the end of the previous year.

Yarde Kerri Group Tin Mines.—This company which works alluvial tin properties in Northern Nigeria has issued the report for the year ended March 31. Tin concentrates amounting to 140 tons was produced, as compared with 155 tons the year before. The working profit for the year was £1,029, which was carried forward. The proved reserves are calculated to contain 1,502 tons of tin concentrates. The new dam and the pipe line which had been constructed to increase output were not entirely successful, chiefly owing to an exceptionally low rainfall, but better results are expected in the current year.

Juga Valley Tin Areas.—This company, formed in January, 1927, works alluvial tin properties in Northern Nigeria. The report for the year ended February 28 last shows that 98¾ tons of tin concentrates was produced, an increase of 46¾ tons over the previous year. The year's working resulted in a loss of £8,042, but although output for the current year shows 100% increase in the first six months it is not considered economical further to increase production.

Nigerian Base Metals Corporation.—This company was formed in 1920 to acquire tin and other properties in Nigeria. The report for the period January 1, 1927, to June 30, 1928, shows that sales of tin concentrates brought in £113,133, and that during the period under review a profit of £68,131 was made, of which £60,000 was distributed as a dividend, equal to 10%. The company proposes an amalgamation with Anglo-Nigerian Tin Mines, Ltd., and Nigerian Power and Tin Fields, Ltd. The advantages of this amalgamation of adjoining properties will be more economical working, and cancellation of inter-held capital.

Naraguta Karama Areas.—This company, formed in 1926, took over alluvial tin-bearing properties in Northern Nigeria from the Naraguta Tin Mines, Ltd. In March, 1927, the Sho areas on the Bauchi plateau were acquired. The report for the year ended December 31, 1928, shows that 285 tons of tin concentrates was produced, of which 208 tons came from the Sho areas. The ore won on the Karama areas was produced mainly by tributers. The result of the year's working showed a profit of £5,032, and there was a net profit of £3,701 which has been carried forward.

Kagera (Uganda) Tinfields.—This company was formed in 1926 to work alluvial tin property in Uganda. The report for the year ended December 31, 1928, shows that 266·2 tons of tin concentrates was produced, which realized £41,997. The output in the previous year was 139 tons. The net profit for the year amounted to £23,198 and £20,000 was distributed as dividends, equal to 20%. For the current year the output to the end of September shows an increase of 50 tons over the corresponding period of last year, and the proved reserves are equal to six years' output at the present increased rate. The company holds a 10% interest in 1,800 square miles in Uganda and Tanganyika, which are being prospected by the Billiton Tin Group.

Temoh Tin Dredging.—Formed in 1927, this company took over alluvial tin-bearing property in Malaya from Ipoh Tin Dredging, Ltd. The report for the year ended June 30 shows that the dredge treated 620,450 cubic yards of ground, which yielded 163 tons of tin concentrates. The area worked out amounted to 9 acres. The year's working resulted in a net profit of £6,416, of which £4,200 was distributed as dividends. The company has acquired a further 10 acres of ground on tribute, and the dredge is now working this area.

Eastern Siam Tin Dredging.—This company was formed in 1925 to acquire alluvial tin properties in the province of Surasthradhani, Siam. The report for the year ended December 31, 1928, shows that the dredge started work in the previous March and up to the end of the year it had treated 505,000 cubic yards of ground, recovering 102·43 tons of tin concentrates. The revenue from the sale of tin ore amounted to £13,735, but the year s working resulted in a loss of £9,212, which is attributed mainly to difficulties met with in working the ground. During the current year alterations were made to the dredge to overcome working troubles, but the dredge sank in April and has had to be salvaged. It is now ready to start work again, but an issue of £30,000 debenture stock is being made to provide working capital.

Chosen Corporation.—This company was formed in 1923 as the Chosen Syndicate to take over a gold-mining concession in Korea. The actual mining is done by three Japanese companies, all the shares of which are held by the Corporation. The report for the year ended June 30 last shows that at the Great Nurupi mine the milling plant treated 93,571 tons of ore producing bullion worth £125,072. The ore treated was 310 tons less than in the previous year, and this was due to lack of sufficient power. Work was commenced in November, 1928, on the erection of 115 miles of high tension transmission line from the plant of Chosen Denki Kaisha at Pyeng Yang and power was turned on on June 1, 1929. The success attained during the last month of the year under review when the previous monthly average tonnage was exceeded by 1,100 tons augurs well for future operations. Ore reserves at the end of the year were estimated at 198,850 tons averaging 7·16 dwt. gold, as compared with 154,102 tons averaging 7·57 dwt. the year before. Now that more power is available it is expected that development in the deeper levels of the mine will be expedited. Another feature is that owing to the embargo on the exportation of gold by the Japanese Government it has not always been possible to sell the gold output at the most favourable price. This embargo is expected to be lifted in 1930. The operating costs on the 93,571 tons treated was 19s. 6d. per ton as compared with 19s. 7d. in the previous year, and an overall extraction of 85·39% was obtained. The unwatering of the East Nurupi mine has been commenced, and a geological survey of the concession completed. The working profit on the Great Nurupi mine was £32,838, and the net profit of the Corporation £10,113, which was carried forward.

Jantar (Cornwall).—This company was formed in December, 1927, and commenced operations at the Porkellis mine on January 1, 1928. The report for the period ended March 31 last shows that 25,217 tons of ore was milled, yielding 208 tons of black tin. The overall working costs were 22s. 8d. per ton, and the 15 months working have resulted in a loss of £6,085. It has been decided to scrap the old power units and electrify the plant, a further sum of £4,205 having been written off for this purpose, and when funds are available a slimes plant will be erected. The ore reserves at March 31 are estimated at 71.000 tons of ore of an extractable value of 19·5 lb. of black tin per ton. Since the new compressor was installed in August, 1928, development work has progressed favourably on the Wheal Cock lode, where 1,025 ft. have been driven averaging 28·54 lb. black tin over 6·05 ft., and on the Old Man's lode, where 957 ft. have been driven averaging 28·56 lb. black tin over 4·94 ft.

DIVIDENDS DECLARED

American Smelting and Refining.—$1, less tax, payable November 1.

Anaconda Copper.—$1.75, less tax, payable November 18.

Aramayo Mines.—5%, less tax, payable November 1.

Changkat Tin Dredging.—1s., less tax, payable October 31.

Chicago-Gaika Development.—1s., less tax, payable October 12.

Consolidated Gold Fields of South Africa.—15%, less tax.

El Oro Mining and Railway.—1s. 0½d., less tax, payable November 9.

Fresnillo.—25 cents, less tax, payable November 21.

Gaika Gold.—6d., less tax, payable October 31.

Geevor.—6d., less tax, payable October 31.

Gold Fields Rhodesian.—6d., less tax, payable November 14.

Kent (F.M.S.) Tin Dredging.—5%, less tax, payable December 4.

Kinta Kellas Tin.—1s., less tax, payable October 15.

Lampa Mining.—3½%, less tax.

Mazapil Copper.—5%, less tax.

Mining Corporation of Canada.—12½ c., less tax, payable Dec. 19.

Mount Lyell.—2s. 9d., payable December 18.

Mount Morgan.—3s., less tax, payable January 15.

North Broken Hill.—2s., and bonus 1s., less tax, payable December 9.

Pahang Consolidated.—Pref. 11½%, Ord. 15%, less tax, payable December 4.

Petaling Tin.—15%, less tax, payable October 30.

Premier (Transvaal) Diamond.—Pref. 6s. 3d., less tax, payable October 31.

St. John del Rey.—Pref. 1s., tax free; Ord. 6d., less tax, payable December 6.

Sungei Way.—5%, payable October 28.

Tekka-Taiping.—3d., less tax, payable October 31.

Temoh Tin.—9d., less tax., payable November 8.

Union Corporation.—2s., less tax, payable November 21.

United African Exploration.—1s. 4·4d., less tax, payable November 1.

United Explorations.—2⅜d., less tax, payable November 2.

Wallarah Coal.—1s., payable December 6.

West African Diamond Syndicate.—4½d., less tax, payable October 11.

Zinc Corporation. — Preference, 3s. 6d.; Ordinary, 1s. 6d., less tax, payable January 2.

NEW COMPANIES REGISTERED

Ameib Tin Mining.—Registered as a private company October 19. Nominal capital: £25,000 in £1 shares. Objects: To acquire in South-West Africa or elsewhere mining rights, etc. Directors: R. H. Philips (chairman), J. L. Behrend, C. B. Harwood, D.Sc. (London), M.I.C.E., L. Portman, J. M. du Mont (director of Whitworth Mines). Office: 73, Basinghall Street, E.C. 2.

Anglo-Canadian Zinc.—Registered as a private company October 7. Nominal capital: £100 in £1 shares. Objects: To acquire from H. A. A. Van Someren an option to acquire any exclusive licence to manufacture zinc in Canada by a process known as the Coley Process.

Manganese Corporation, 1929 (British Sales).—Registered October 4. Nominal capital: £5,000 in £1 shares. Objects: To carry on the business of brokers of, agents for, and dealers in ores, minerals, metals, and metallic alloys, etc.

Palestine Potash.—Registered with a capital of £400,000 divided into 230,000 £1 seven and a half per cent. Preference, 150,000 £1 shares, to be issued either as Preference or Ordinary' and 400,000 1s. Ordinary shares. Objects: To operate the concession granted by the Governments of Palestine and Transjordania for the extraction of salts from the Dead Sea. Directors: Lord Lytton, Israel B. Brodie, B. Flexner, E. Friedman, E. W. D. Tennant, F. M. Warburg, Major T. G. Tulloch, Moise Novomeysky, and David Lyell.

Puruni Syndicate.—Registered October 26. Nominal capital: £100 in 2s. shares. Objects: To acquire and work mining rights. Negotiations are proceeding with the view of acquiring an interest in a mineral property in British Guiana. Office: 11, Duke Street, W.C. 2.