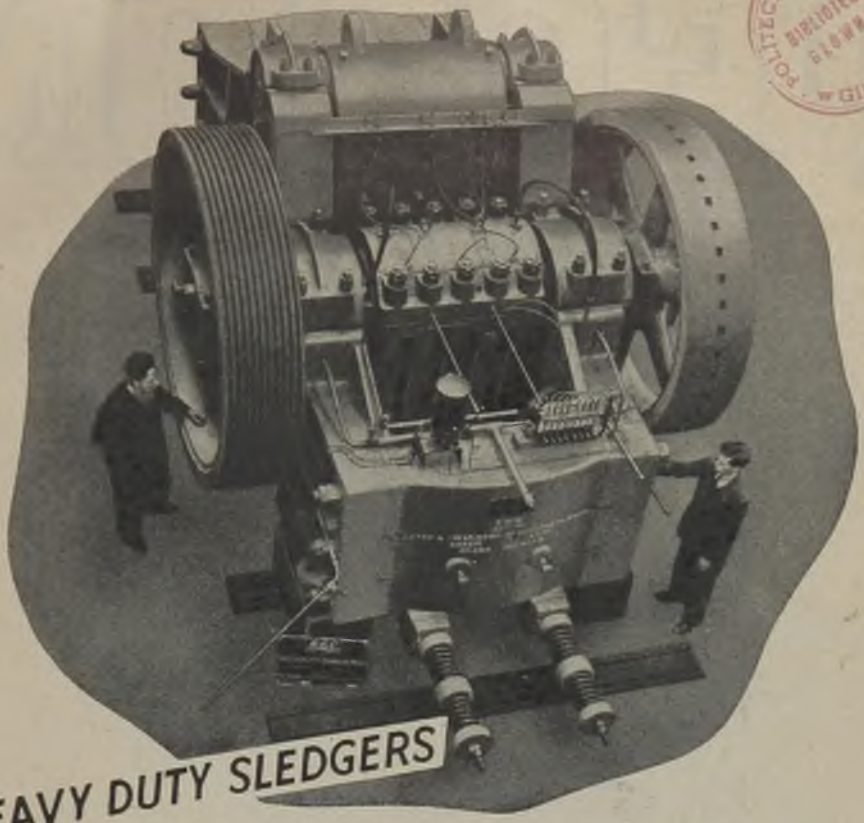
The Mining Magazine

VOL. LXXV. No. 1. LONDON, JULY, 1946. PRICE ONE SHILLING



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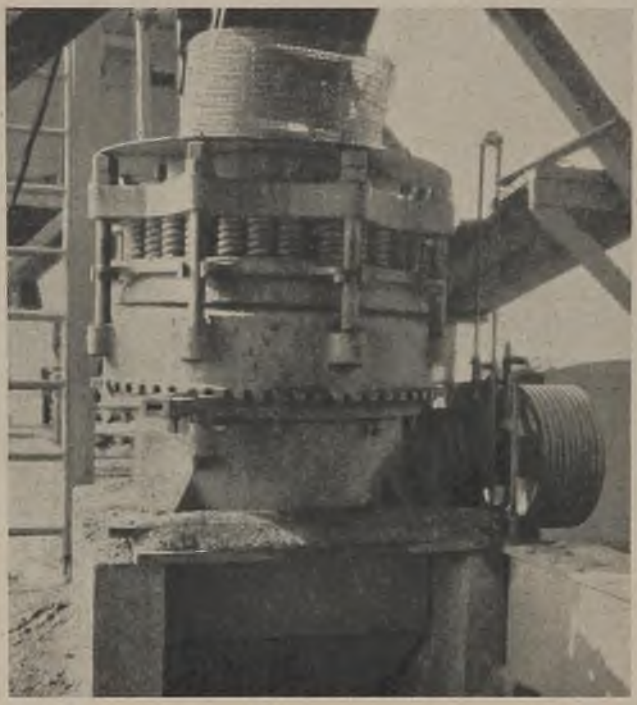

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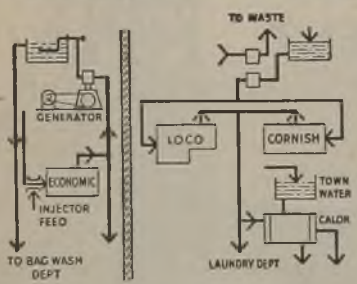
THERMAL LINKAGE SAVES LAUNDRY 23% OF COAL BILL



LAUNDRY'S BIG ECONOMY

BEFORE *Thermal Linkage —A laundry, in two sections (with separate boiler plants), one each side of a road, used* 5,550 *lb. of steam per hour and consumed* 41 *tons of coal weekly.*

AFTER

Thermal Linkage

The Laundry maintained the same output on a reduced coal consumption of only 31½ *tons per week. Replacement of a condemned boiler was also rendered unnecessary, saving* £6,000 *of new plant.*

More plants, of all types, adopt proved production-economy technique

Thermal Linkage saves fuel. Thermal Linkage cuts production costs. Thermal Linkage increases output. Those are the three proved reasons why progressive factories everywhere are adopting Thermal Linkage.

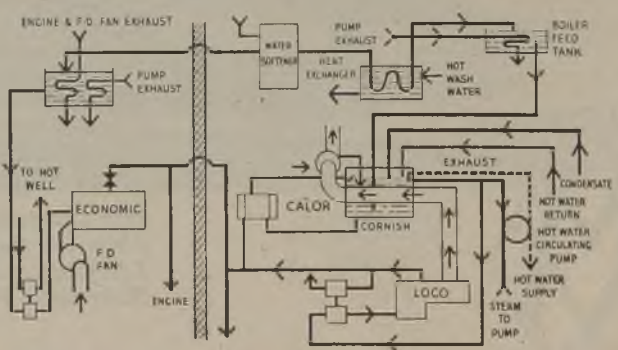
Thermal Linkage means integrating your various heat-using processes and, as far as possible, operating them as a single co-ordinated heat-using unit. Instead of being independently supplied to several separate points of consumption and the surplus going to waste, heat is circulated and re-circulated from point to point so long as there is work for it to do.

URGENT ACTION NEEDED

Fuel efficiency and improved production will remain a pressing need. How much could your existing plant benefit from the application of these principles? No scheme of reconstruction or plant conversion should commence without Thermal Linkage being considered.

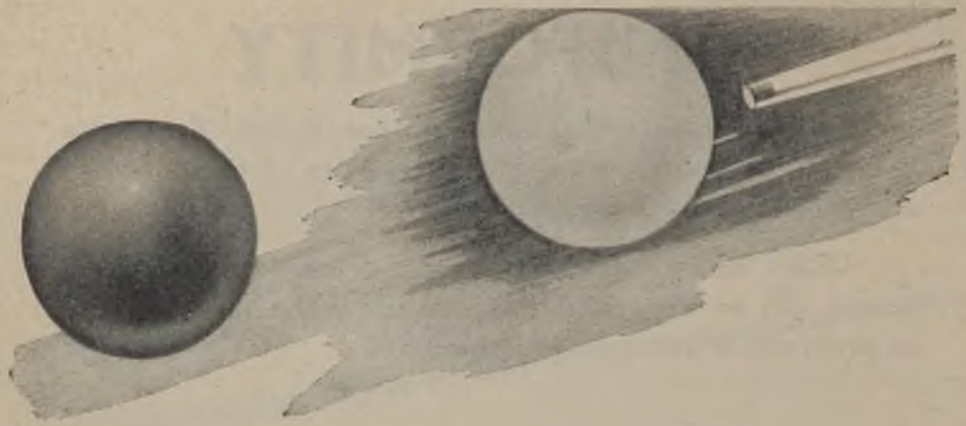
FOR GENERAL INFORMATION see Fuel Efficiency Bulletin No. 21 (The Construction of a Factory Heat Balance).

FOR SPECIFIC ADVICE and guidance contact your Regional Office of the Ministry of Fuel and Power.



METHOD · *One boiler equipped to supply a further* 3,000 *lbs. of steam per hour, and coupled by a* 6-*in. steam main across street to steam range previously fed by separate boiler plant. Steam-driven feed pump installed; exhaust returned to hot water tank. Turbine fan, exhausting to hot tank, added for supplying forced draught to boiler. Hot waste gases from the locomotive boiler put through the redundant boiler, now used as hot water storage calorifier. Several further refinements in steam-using plant carried out. Incoming town water raised in temperature by* 15°*F. by using dirty hot wash water in simple heat interchanger. For complete details see "Fuel Efficiency News," December,* 1945.

ISSUED BY THE MINISTRY OF FUEL AND POWER



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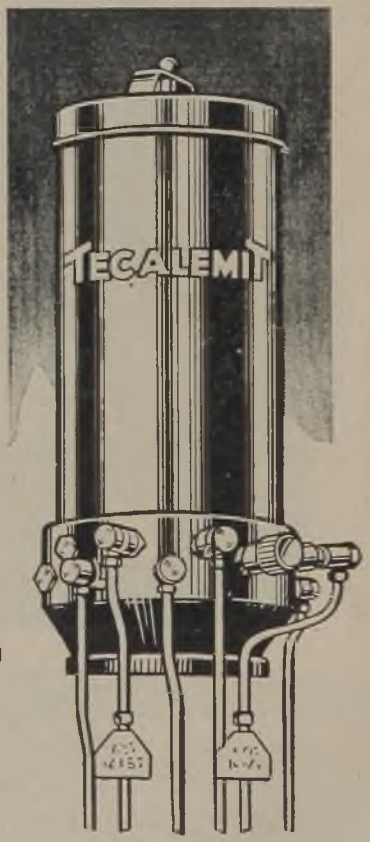
The Radial Pump illustrated is one of a series designed to meet most of the lubricating requirements of Industry.



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HARDINGE CONICAL BALL MILLS

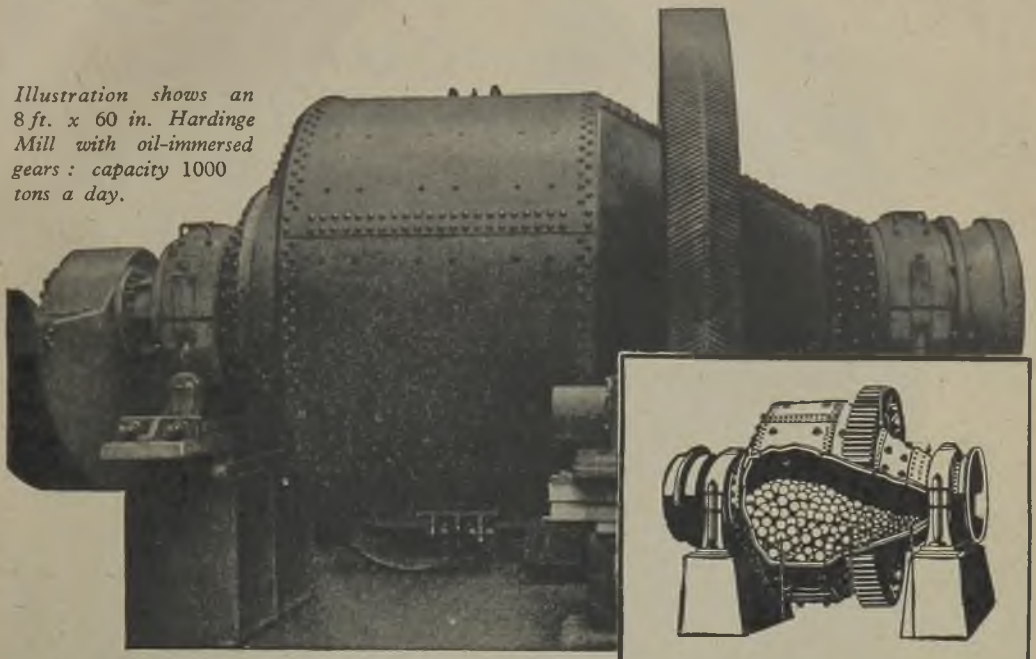

Illustration shows an 8 ft. x 60 in. Hardinge Mill with oil-immersed gears : capacity 1000 tons a day.

Sectional View

1 ton a day to 1200 tons a day capacity

Hardinge Mills are operating throughout the world, grinding a larger proportion of minerals than any other make of mill.

No fewer than 34 sizes are actually installed and in use, grinding felspar, ores, minerals and synthetic compounds.

Hardinge Mills are designed for wet or dry dustless grinding, the size of the finished product ranging from 10 mesh to 95%—10 M.U.

The Technical Staff of International Combustion Ltd. are always ready to bring their exceptional experience to any grinding problem.

34 SIZES ACTUALLY INSTALLED AND IN USE

ft.	in.	ft.	in.	ft.	in.
3	× 8	6	× 22	8	× 30
3	× 18	6	× 36	8	× 36
3	× 28	6	× 48	8	× 48
4½	× 13	6	× 54	8	× 54
4½	× 16	6	× 72	8	× 60
4½	× 24	7	× 22	8	× 72
4½	× 36	7	× 36	10	× 36
5	× 22	7	× 48	10	× 48
5	× 36	7	× 54	10	× 60
5	× 48	7	× 60	10	× 72
6	× 16	8	× 22	10	× 84
				10	× 96

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CONTENTS

EDITORIAL

A DEPLETION allowance of 50% for tax purposes on all operating mines in Canada, together with exemption from corporation tax for new mines for a three-year period, are the recommendations of the Senate Committee on Natural Resources which has been studying the economic value of the mining industry in the Dominion.

IT has been common knowledge for some time that the Government intends to set up a committee of inquiry into the metalliferous mining industry in this country. Matters were advanced a stage further on July 9 when, in answer to a question in the House of Commons, it was stated on behalf of the Minister of Fuel and Power that Lord Westwood had accepted an invitation to act as chairman and that the Minister hoped shortly to announce the full constitution of the committee and its terms of reference. Lord Westwood, who hails from Northumberland, has a long experience of industrial and labour questions.

FURTHER rises in the prices of three base metals were announced last month by the Ministry of Supply effective July 1. It will be recalled that as recently as April last changes were made in the prices then ruling for copper, lead, zinc, and zinc products. In the Control of Non-Ferrous Metals (No. 24) Order, 1946, the maximum prices are respectively increased as follows: Copper by £12 per ton; copper rods by £12 10s.; lead by £10; zinc by £10; zinc sheets by £10, and zinc oxide by £8 10s. On this occasion the Ministry have stated their reasons for the adjustments as being made "in order to bring the selling prices of copper, lead, and zinc in the U.K. more closely into line with current purchase costs." Additional remarks by our Metal Markets' correspondent will be found elsewhere in this issue.

IN the Birthday Honours list published last month appear a number of names of interest to mining men. Knighthoods are awarded to Dr. W. T. Griffiths, chairman and managing director of the Mond Nickel Co., Ltd., to Dr. C. C. Paterson, Director of the Research Laboratories of the General Electric Co., Ltd., and to Mr. A. J. G. Smout, a director of Imperial Chemical Industries, Ltd., and a Member of Council of the Institution of Mining and Metallurgy. Among awards in India are the C.S.I. to Mr. J. B. Harrison, Deputy Coal Commissioner and Chief Mining Engineer, Railway Board, and the C.I.E. to Mr. H. Crookshank, Superintending Geologist, Geological Survey of India. In the Dominions and Colonies lists the O.B.E. goes to Mr. B. Lightfoot, Director of the Geological Survey of Southern Rhodesia, and Mr. F. B. Higgins, Chief Inspector of Mines, Gold Coast, while Mr. N. A. Middlemas, Director of Surveys, Land Officer, and Commissioner of Mines, Uganda, receives the C.M.G. Another recipient of the O.B.E. is Mr. H. E. Fern, chairman of Mining Publications, Ltd., who has been associated with THE MINING MAGAZINE since its inception in 1909.

SPEAKING at the annual meeting of the Chamber of Mines of Rhodesia held in Bulawayo recently Mr. B. W. Durham, the president, suggested that the Government mining settlement scheme for ex-Service men would unquestionably play an important part in arresting the decline in the Colony's mining industry. Mr. Durham said of 94 mines being re-opened under the scheme it appeared that production was certain on 29, probable on 29, and possible on 33. Only three mines had been abandoned after exploratory work. The results were considered extremely satisfactory and the prospects distinctly encouraging, particularly as nearly all the ex-Service men placed under the scheme had shown themselves enthusiastic, energetic, and capable. With regard to the position of the industry the president suggested that progress would be retarded, especially in respect of the introduction of capital for opening up new ventures of any size, until the Government policy in regard to taxation and other matters had been clearly and definitely outlined, so that investors and operating companies might know where they stood. If the new Government granted the relief that the position demanded he had no fear for the gold-mining industry and was confident that other large mines would come into production to replace those which by the nature of mining were approaching their end.

British Coal Reserves

For the past 25 years the Coal Survey Office of the Fuel Research Organization of the Department of Scientific and Industrial Research have been engaged upon a systematic physical and chemical examination of the coals of this country. Such reports as have been issued from time to time, however, have lacked a quantitative basis. This, however, has recently been rectified, for, as a direct result of the transfer of the ownership of all unworked coal to the Nation, the Department has now issued Survey Paper No. 58 [1] which comprises a first appraisal of the results of a rapid survey of coal reserves and production. The report does not attempt to assess total reserves, but concentrates on those readily-available reserves that will probably support output for the next 100 years. For the first time some data are available on the relative proportions of anthracite, coking coal, gas coal, etc., in the immediately available resources.

This rapid survey deals with the properties of 20,000,000,000 tons of coal as yet in the ground and certain references are made in passing to a further 15,000,000,000 tons that have been noted whilst collecting the main data. This means broadly that so far as the classification of reserves is concerned we can to-day see our way clearly for 100 years and for a further 75 years somewhat less clearly. The report tells us what the Nation is to receive under the Coal Act of 1938. The reserves of coal dealt with are those which formed the basis of purchase from the coal owners by the Coal Commission on behalf of the Nation under that Act.

The general position revealed by the report shows that the reserves of the various kinds or types of coal appear to be adequate to meet the demands, barring any revolutionary changes. Attention is called, however, to the approaching depletion of the reserves in certain special areas. For instance, in the section dealing with Durham the report says: "The area with the shortest life—less than 50 years—is almost exclusively confined to West Durham, which produces coking coals" —*i.e.*, medium-volatile metallurgical coking coal. However, regarding Durham as a whole, it is stated that "long after the medium-volatile coals of Durham have been exhausted, the field will produce coals similar in type to the best coals now used in coke ovens in the Midland areas." Attention is also called to the remarkably wide range of coal types produced and available in South Wales. Some of these types are found in Kent as well, but apart from those two coalfields the low-volatile coking and steam coals cannot be obtained elsewhere. The reserves in Kent are very conservatively estimated, but the position there is discussed in some detail. Three-quarters of the reserves classified consist of general-purpose coals—such as, those mined in Lancashire, the Midland area, Northumberland, and Scotland. To quote the report: "The great virtue of these coals lies in their adaptability . . . the whole range is suitable for domestic use, gas making, steam raising, and for general industrial purposes." This answers the question which is often raised regarding supplies of particular types of coal. Commenting on the present position the report says: "At times of low output . . . the shortage of coal is felt by the carbonizing industries, in common with others, even though the output of gas and coking coal is still more than adequate."

The findings of this rapid survey will be of value, it is considered, in planning for some years ahead, but beyond that it will be necessary to have reliable information about the reserves that will remain after the next 100 years. Among other things this will be of importance in deciding to what extent the decline in planned outputs can be made good by mining the reserves not scheduled to be worked in the 100-year period. To obtain this information a survey of all workable coal reserves has been undertaken by the Geological Survey and the Fuel Research Coal Survey, in co-operation with the Ministry of Fuel and Power and the Coal Commission. Work upon this survey has already been begun, but it will be some years before results will be available for all coalfields. As the first step officers of the Geological Survey are engaged in revising and preparing new maps of the coalfields and of individual seams, while Coal Survey Officers are to contribute data relating to the properties of the seams in different parts of the coalfields. In preparing these maps account is being taken of the latest information available from existing collieries and other sources, but for the concealed coalfields and virgin areas, as well as for the lower seams in parts of the present production areas, for which reliabi

[1] London: H.M. Stationery Office. Price 9d.

information is scanty, a comprehensive programme of boring is necessary. In planning to put this programme into operation the possibility of discovering new coalfields by boring outside the limits of known coalfields has not been overlooked.

Empire Mineral Resources

In concluding a review in the last issue of the MAGAZINE of the recent presidential address given before the Institution of Mining and Metallurgy by Mr. G. F. Laycock it was suggested that it is " urgently necessary that an assessment of world [mineral] resources be undertaken at as early a date as possible and that legislation be framed in all countries to help mineral exploration forward. . . ." Mr. Laycock's thesis lay, of course, in his suggestion that we moderns are living largely on our mineral capital at the present time and that there was a necessity for discovering new ore-bodies, but, as was also mentioned in the last issue, the Empire Scientific Conference assembled recently in this country under the auspices of the Royal Society has equally had this matter of mineral resources in mind. At a meeting held in Cambridge on June 24 the Conference discussed the need for a co-ordinated survey of the mineral resources of the Empire. It was resolved that the need for such co-ordination was of paramount importance and detailed recommendations are now being prepared.

On the occasion referred to speakers from the Dominions and Colonies were insistent that geological staffs are at present totally inadequate. In some parts of Australia, for example, there is only one state geologist to 100,000 square miles, while some of the Colonies have not a single government geologist, which means that over large parts of the Empire the mineral resources are unknown. This contrasts very strongly with what happens with some mining companies; for example, in Northern Rhodesia private companies employ about 80 geologists. They had proved the existence of one of the largest copper fields of the world and at that time there was not a single government geologist in Northern Rhodesia. There is at present a great shortage of trained geologists and it would take at least five years to make up this shortage even under the most advantageous circumstances. As was stressed by Mr. Laycock mineral deposits in former days were discovered on the surface by the old-time prospector, but henceforward it will be the concealed deposits missed by the untrained prospector which will contribute to the Empire's prosperity. These can only be discovered by scientific and systematic investigations based on the geological map. The Conference reached the same conclusion as Mr. Laycock had previously that there is at present a shortage of some metals in the Empire, the situation with regard to lead being serious; its price is about four times what it was a few years ago. Even more grave than a temporary shortage is the fact that within 20 years the Empire's proved lead resources will not be able to meet the demand at the present rate of consumption and the same is true of zinc. It is probable that intensive geological work would reveal the presence of hitherto unknown deposits and thus amply repay the cost. The Conference also noted that active research is also necessary to enable processes for the treatment of what are now regarded as unworkable deposits to be developed for the recovery of their useful contents.

One of Mr. Laycock's suggestions was that exploration companies should be formed to investigate virgin areas thought to have potentialities and in this connexion it is probable that aerial surveying will come into its own. The Empire Scientific Conference has also had this matter under discussion and at a meeting held in Oxford on July 1 it was pointed out, for instance, that radar can now be used for making reasonably accurate maps. Further work is required to give the method its maximum effectiveness both for civilian and military purposes, but already other developments are rapidly coming along. In South Africa, for instance, it has been suggested that attention should be given to the development of airborne methods of magnetic surveying. If this work could, in the first instance, be done from the air it would be invaluable in regions where lack of surface water and of roads makes ground magnetometric prospecting difficult. It is evident, then, that mineral exploration will not lack the new tools required for the job. It is to be hoped that governments can be persuaded to take an interest in mineral resources and encouraged to act. It is surely better that something be done now than that serious metal shortages should take us unprepared.

MONTHLY REVIEW

Introduction.—By the time these notes appear in print it is probable that the result of the loan debate in the United States House of Representatives will be known. Meanwhile industry in this country remains steadily firm and the past month has seen a fresh rise in prices for the principal non-ferrous metals.

Transvaal.—The output of gold from the Rand mines for May was 1,026,007 oz. and from outside districts 23,188 oz., making a total of 1,049,195 oz. for the month. The number of natives employed in the gold mines at the end of May was 309,190, as compared with 310,923 at the end of the previous month.

The accompanying table gives the dividends declared by the Rand mining companies for the past half-year. Figures for the three preceding half-years are added for comparison, the denomination of shares being £1 unless otherwise stated.

	2nd half, 1944	1st half, 1945	2nd half, 1945	1st half, 1946
	s. d.	s. d.	s. d.	s. d.
Blyvooruitzicht (10s.)	—	—	—	1 0
Brakpan (5s.).....	0 7½	0 6	0 7½	0 6
City Deep	1 6	1 6	2 0	1 6
Consolidated Main Reef ...	1 9	1 9	1 9	1 9
Consolidated Murchison (5s.)	0 3	0 6	0 6	0 6
Crown Mines (10s.)	4 3	4 3	4 3	4 0
Daggafontein (5s.)	1 2¼	1 1½	1 2¼	1 3
Durban R'd'poort D p (10s.)	1 9	1 9	1 9	1 9
East Champ d'Or (2s. 6d.) .	0 4	0 3¾	0 3	0 3
East Daggafontein (10s.) ...	1 4½	1 3	1 4½	1 6
East Geduld	5 6	5 3	5 6	5 9
East Rand Prop. (10s.)	1 6	1 3	1 3	1 0
Geduld Prop.....	5 0	5 0	5 3	5 3
Government Areas (5s.)	1 3	1 3	1 1½	1 0
Grootvlei Pty.....	2 9	2 9	3 0	3 3
Lupaards Vlei (2s.)	0 4	0 4	0 4	0 4
Marievale Consolidated (10s.)	0 5	0 5	0 5	0 6
Modderfontein B (5s.).....	0 6	0 6	0 6	0 6
Modderfontein East	3 0	3 0	3 0	3 0
New Kleinfontein	1 0	1 0	1 0	1 0
New Klerksdorp Gold (5s.).	—	—	0 1½	0 1·8
New Modderfontein (10s.) ..	0 3	—	—	—
New State Areas	1 6	1 6	1 6	1 6
Nigel Gold (10s.)	1 3	1 3½	1 1½	0 10½
Nourse Mines	1 6	1 6	1 6	1 3
Rand Leases (10s.)	1 7½	1 7½	1 6	1 6
Randfontein	1 1½	0 9	0 9	0 6
Rietfontein Cons. (5s.)	0 7½	0 7½	0 7½	0 7½
Robinson Deep, B (7s. 6d.) .	1 0	0 9	0 9	0 4½
Rose Deep	1 0	0 9	1 0	0 9
Simmer and Jack (2s. 6d.)..	0 2	0 1	0 3	0 2
South African Land (3s. 6d.)	2 0	1 7½	1 7½	1 6
Springs Mines (5s.)	0 3¾	0 3¾	0 3¾	0 3¾
Sub Nigel (10s.)	4 6	4 6	4 6	4 6
Van Dyk Cons. (10s.)	0 3	0 3	0 3	0 3
Venterspost (10s.).....	0 5	0 5	0 6	0 6
Vlakfontein (10s.).....	0 3	0 3	0 3	0 3
Vogelstruisbult (10s.)	0 7	0 7	0 7	0 6
West Rand, Ord. (10s.)	1 0	0 9	1 0	0 9
West Springs	0 7½	0 6	0 6	0 6
Western Reefs (5s.)	1 3	1 0¾	1 1½	0 5½
Witwatersrand Gold	1 9	1 4½	1 3	1 6†

† Including 6d. bonus.

The liquidator's report to shareholders of Modderfontein Deep Levels for the six months ended March 31 last shows a profit of £8,476. In the period the value of the gold, silver, and osmiridium recovered from the 218,900 tons of ore milled was £286,715. The report states that payable ore from the Main Reef was exhausted at the beginning of the current year, but operations are being continued on a reduced scale on ore obtained from the Black Reef.

At an extraordinary meeting of Transvaal Gold Mining Estates to be held following the annual meeting next month it is to be proposed that the capital of the company be increased to £850,000 by the creation of 210,000 new £1 shares. Of the new shares 115,281 are to be offered to existing holders, together with 35,775 now in reserve. The company proposes a capital expenditure of £24,000 on increasing its forest reserve, of £20,000 on re-opening the Vaalhoek and Willemsoord West mines, and of £50,000 on a systematic programme of prospecting recommended by the company's technical advisers.

At the recent annual meeting of the Associated Manganese Mines of South Africa the chairman stated that there was an unprecedented demand for all grades of the company's ore from the United States of America and other consuming centres. Long-period contracts for considerable tonnages of ore have been arranged for shipment to the United States, where the company's deliveries during the War period are said to have given great satisfaction.

The accounts of the General Mining and Finance Corporation for 1945 show a profit of £376,685 and a total of £508,897 available for appropriation. Dividends totalling 25% require £316,145 of this amount and after setting aside various sums for taxation and other items a balance of £142,238 was carried forward.

Henderson's Transvaal Estates, Ltd., reports a profit of £41,237 for the year to March 31 last, the accounts showing a total of £97,420 available, of which a dividend equal to 12½% requires £38,737.

The report of the African Land and Investment Company for the year ended March 31 last shows a profit of £26,013, making with

the sum brought in an available total of £41,731, of which £16,125 is required for dividends equal to 1s. 2d. on the ordinary shares.

A circular to shareholders of the West Rand Investment Trust issued last month contained details of an offer of 396,783 new 10s. shares at 42s. 6d. per share to existing holders. At the annual meeting of the Trust held in Johannesburg in April last it was stated that it would be called upon in due course to provide funds for financing West Witwatersrand flotations.

The accounts of the Northern Transvaal Lands Company for 1945 show a profit of £4,590 and £5,218 available, of which £4,421 is required for a dividend equal to 6d. a share.

Diamonds.—It was reported last month that extensions are being made to the De Beers' treatment plant on the alluvial diamond fields at Kleinzee, Namaqualand.

Orange Free State.—The Free State Development and Investment Corporation recently reported two new bore-hole results. A deflection in bore-hole E.V.1 intersected Basal Reef at 5,729 ft., the core assaying 51 dwt. over 7·5 in., while bore-hole K.K.5 intersected the same reef at 5,948 ft., the core here assaying 9·5 dwt. over 6 in.

At the recent annual meeting of H.E. Proprietary it was announced that arrangements were being made to enable the company to participate with New Union Goldfields in new ventures in the Orange Free State—notably, in New Free State Gold Estates, Ltd.

Speaking at the annual meeting of the Union Corporation held in Johannesburg the chairman referred to the registration of St. Helena Gold Mines. This company, in which the Corporation has a substantial interest, is to begin active exploratory work immediately. While admitting that much surface equipment and underground development had to be done before the decision to erect a reduction plant could be taken, the chairman thought there were many favourable features to be borne in mind. These include encouraging bore-hole results, a large area to be taken over, and the shallow depths of the reefs discovered. In addition to the St. Helena area, which lies some eight miles south of Odendaalsrust the Corporation is interested in mineral rights and options in various other parts of the Orange Free State. It will be recalled that the issued capital of the Corporation has recently been increased to £1,017,500, in order to provide capital for the development of established ventures and to participate in new.

Southern Rhodesia.—At the recent annual meeting of Rezende Mines held in Salisbury the chairman reported encouraging bore-hole results from the Redwing reef. The company is considering an increase of capital for expansion operations.

Northern Rhodesia.—A circular recently issued to shareholders of Nchanga Consolidated Copper Mines stated that the board had decided to take steps greatly to increase production. Subject to the approval of the Capital Issues Committee it is proposed to offer shares to existing holders sufficient to produce about £4,000,000. At an extraordinary meeting held on July 4 last a resolution proposing an increase of capital to £7,500,000 by the creation of £2,150,000 new £1 shares was approved. It is estimated that an initial expenditure of approximately £2,625,000 would enable copper production to be raised to 64,000 long tons per annum.

Gold Coast.—The report of Konongo Gold Mines for the year ended September 30 last shows a profit of £129,906 and a total of £152,561 available, of which £34,059 is required for a dividend equal to 10%. During the year 113,849 tons of ore was treated and 52,674 oz. of gold recovered. The ore reserves at September 30 last were estimated to be 292,243 tons, averaging 12·63 dwt. in value over 44 in.

The accounts of Lyndhurst Deep-Level (Gold and Silver) for 1945 show receipts totalling £26,628, of which £25,000 was required for a dividend equal to 10% and £1,628 applied in reduction of prospecting and development expenditure.

Nigeria.—It was rumoured from Lagos earlier this month that the Government has had under consideration the question of granting mineral concessions to approved parties, a practice that has been in abeyance for some years.

Angola.—The Angola Diamond Company recently announced that it had obtained the authority of the Portuguese Ministry of Finance to pay coupons to shareholders resident abroad who were unable, on account of the war, to present them for payment within the term of five years required by Portuguese law.

Australia.—Shareholders of the Zinc Corporation were informed earlier this month that a new industrial agreement between the miners' unions and the Broken Hill mining companies had been concluded as from

July 8. The agreement is to be in force for a period of three years.

With the recent dividend announcement shareholders of Great Boulder Proprietary Gold Mines were informed that the profit for 1945 was £93,261, as compared with £95,757 for the previous year.

The net profit of Boulder Perseverance for 1945 has been announced as £14,947, subject to audit, this figure comparing with £14,288 for 1944.

The Western Mining Corporation announced last month that the option over leases 330 and 337 Hampton Plains, five miles east of Coolgardie, had been exercised.

A recent circular issued by Ora Banda United Mines suggests that the estimated capital needed to put the mine into production at a rate of 4,000 tons monthly amounts to £36,000 and states that the directors' recommendations in this connexion are to be submitted to shareholders. The reserves on the Wilson's lode and elsewhere are estimated at 514,000 tons averaging 4·35 dwt. in gold.

Hampton Plains Development, Ltd., is offering for subscription 300,000 shares of 2s. at 2s. 6d.

The accounts of Golden Horse Shoe (New), Ltd., for 1945 show a profit of £5,563 and a total of £6,569 available for appropriation, of which £5,042 is required for dividends amounting to 2d. a share. Operations at the Great Boulder No. 2 dump were continued until October 31 last, when a start was made on the Lake View No. 3 dump. The 279,010 short tons from Great Boulder No. 2 yielded a working profit of 9½d. a ton, while the 120,920 tons from Lake View gave a realized profit of 3½d. per ton.

Malaya.—The report of Tanjong Tin Dredging for 1945 shows a loss of £642, which reduced the credit brought in £4,150, increased in turn by old bank balances now brought in to £5,337.

The accounts of Kinta Tin Mines for 1945 show a profit of £642. With the sum brought in and other items there was £16,693 available, of which £5,000 has been transferred to reserve.

Shareholders of Kamunting Tin Dredging were informed last month that No. 1 dredge reached the production stage on May 15 last.

Selayang Tin Dredging reports that its dredge had its trial run on April 16 and that to the end of the month it had recovered some five tons of concentrates. The output for May was 20 tons.

Tribute production at Rahman Hydraulic Tin commenced in April, the outputs for April and May being 18 tons and 17 tons of ore respectively.

India.—With the recent dividend announcements shareholders of three of the Mysore gold-mining companies were given preliminary profit figures for 1945. Mysore Gold Mining reports £112,050, against £126,808 for 1944, Nundydroog Mines £61,447, against £77,194, and Ooregum Gold Mining £60,209, against £48,331.

Burma.—An interim report issued by Consolidated Tin Mines of Burma, Ltd., shows that for the time being the company is concentrating on the restoration of mining operations on a modest scale from those areas likely to yield the quickest return.

Brazil.—The report of St. John d'el Rey Mining for 1945 shows a profit of £173,516 and a total of £230,245 available, of which £64,616 is required for dividends, equal to 10% free of tax, and £108,000 for taxation, leaving £57,619 to be carried forward. In the year a total of 345,400 tons of ore was crushed and 147,274 oz. of gold recovered. At the end of the year the reserves of mineral at the Morro Velho mine are estimated at 5,918,000 tons of an average value of 8·7 dwt., while at Espirito Santo the reserves are estimated at 2,533,000 tons at 5·9 dwt., in addition to reserves at Faria and Bicalho totalling 290,000 tons, with an average grade of 6·4 dwt.

African and European Investment.—The accounts of the African and European Investment Company for 1945 show a profit of £404,675 and an available total of £550,728, of which £324,501 was required for dividends totalling 2s. 6d. a share.

Associated Mining and Finance.—The liquidators of the Associated Mining and Finance Company have announced that a final distribution of 2¾d. per share is to be paid on July 19, making a total of 12s. 2¾d. per share and completing the distribution of assets.

Base Metals Mining Corporation.—Shareholders of the Base Metals Mining Corporation were informed that a reduction in capital had been effected by a repayment of 20 cents Canadian per share on June 20.

Central Mining.—The report of the Central Mining and Investment Corporation for 1945 shows a profit of £679,832, making with the sum brought in an available total of £869,527. Dividends, equal to 13s. 3d., and a bonus of 4s. 9d. on the ordinary shares, require £249,187, while £175,000 has been

placed in reserve, and £260,000 provided for taxation, leaving £185,340 to be carried forward.

National Mining Corporation.—The National Mining Corporation announces that Treasury consent has been received in respect of a proposed issue of 1,676,894 shares of 2s. 6d. each at 4s. a share.

Oceana Development.—The accounts of the Oceana Development Company for 1945 show a profit of £14,304 and £23,979 available. A dividend equal to 6% has been declared.

Selection Trust.—The report of the Selection Trust for the year ended March 31 last shows a profit of £378,603 and a total of £557,427 for appropriation. Of this amount £177,500 is required for taxation and £165,917 for a dividend equal to 1s. 6d. a share, while £20,000 has been placed to reserve, leaving £194,010 to be carried forward.

Zambesia Exploring.—The Zambesia Exploring Company reports a profit of £42,965 for 1945, which, with the sum brought in, gave an available total of £84,699, of which dividends and bonuses totalling 8% require £36,760.

DIVIDENDS DECLARED

* Interim. † Final.

(Less Tax unless otherwise stated.)

†**African Investment Trust.**—9d.

***Amalgamated Collieries of South Africa.**—1s., payable Aug. 15.

***Anglo American Corporation of South Africa.**—Pref. 3%.

***Anglo American Investment Trust.**—2s., payable Aug. 15.

†**Anglo-Huronian.**—10 cents, payable July 31.

†**Anglo-Transvaal Collieries.**—4%, payable Aug. 16.

†**Anglo-Transvaal Consolidated Investment.**—2s., and 2s. bonus, payable Aug. 16.

***Apex Mines.**—1s. 6d., payable Aug. 15.

***Apex (Trinidad) Oilfields.**—10½d., payable July 24.

***Associated Manganese Mines of S.A.**—8%, payable Aug. 16.

Associated Mining and Finance.—Final liquidation distribution, 2¾d., payable July 19.

†**Boulder Perseverance.**—6d., payable July 27.

†**British New Guinea Development.**—6%, payable July 31.

***Cam and Motor Gold Mining.**—Ord. 1s. 3d., payable Aug. 12.

***Cape Asbestos.**—3s., payable July 13.

***Consolidated Co., Bultfontein Mine.**—3¾%, payable Aug. 1.

***Consolidated Diamond Mines of S.W. Africa.**—Pref. 4½d., Ord. 2s.

***Consolidated Gold Fields of South Africa.**—Pref. 3%, payable July 1,

†**Consolidated Tin Smelters.**—Pref. 3½%, Ord. 2½%, payable Aug. 16.

***De Beers Consolidated.**—Pref. 10s., Deferred 15s.

***Dome Mines.**—30 cents, payable July 30.

†**Gloucester Manganese Mines (Postmasburg).**—15%, payable Aug. 16.

***Gold Coast Selection Trust.**—9d., payable July 3.

†**Great Boulder Proprietary.**—3d., payable Sept. 2.

***Griqualand West.**—2%, payable Aug. 1.

†**Hodbarrow Mining.**—2%.

***Hollinger Consolidated.**—10 cents, payable June 29.

†**Johnson, Matthey and Co.**—3% and 6% bonus.

†**Lace Proprietary Mines.**—6d., payable Aug. 15.

***Lower Bisichi (Nigeria).**—2d.

***Lyndhurst Deep Level (Gold and Silver).**—5%, payable July 25.

***Middle Witwatersrand (Western Areas).**—6%, payable Aug. 16.

***Mount Malcolm Gold.**—30%, payable Aug. 7.

†**Mysore Gold Mining.**—6d., free of tax, payable Aug. 30.

†**Natal Navigation Collieries.**—1s. 6d., payable Aug. 14.

***New Era Consolidated.**—6d., payable Aug. 15.

***New Jagersfontein Mining.**—6d., payable July 31.

***New Zealand Crown Mines.**—2d., payable June 22.

†**North Kalgurli (1912).**—1s. 3d., payable Aug. 12.

†**Nundydroog Mines.**—9d., free of tax, payable Sept. 18.

†**Ooregum Gold Mining.**—Pref. 20%, and Ord. 10%, payable Aug. 9.

***Patino Mines and Enterprises.**—1s. 9d., payable July 25.

***Peel River Land and Mineral.**—5%, payable July 25.

***Rand Mines.**—2s. 6d., payable Aug. 15.

***Rhokana Corporation.**—Pref. 2¾%.

***Rooiberg Minerals Development.**—1s., payable Aug. 15.

***Sherwood Starr Gold Mining.**—Ord. 3d., payable Aug. 13.

***South African Coal Estates.**—1s. 6d., payable Aug. 15.

†**South African Torbanite.**—3d., payable Aug. 16.

†**Transvaal Nigel.**—8%, payable Aug. 16.

***Vereeniging Estates.**—1s., payable Aug. 15.

†**Village Main Reef.**—6%, payable Aug. 16.

***West Rand Consolidated.**—Def. 42s. 6d., payable Aug. 15.

***Zinc Corporation.**—Pref. 2¾%, Ord. 1s. 6d., payable Aug. 8.

Industrial Training

By J. B. Richardson, A.R.S.M., M.Inst.M.M.

A summary of the war-time use of industrial training and of its present development and aims, together with a brief review of its application to metal mining.

Introduction

Training is yet another managerial function that the complexity of modern industry demands. It should be staffed, where the size of the establishment allows, by specially-appointed officials who have been taught to train and not become just an appendage of the efficiency or welfare departments. During the war thousands of black-coated workers became expert pilots in the R.A.F., tens of thousands of unskilled labourers skilled soldiers in the most highly-mechanized army of all time, hundreds of thousands of women and girls—shop assistants and domestic servants—and many others who had never before worked in a factory, quickly acquired the skill necessary to perform high-precision jobs. A casual labourer learnt to control an intricate chemical process and a shop girl to rifle expertly and accurately the barrels of big guns.

How did this happen ? In a single phrase, by specialized vocational training.

In this connexion the Services were in advance of industry, because they took for granted that every man and woman should not only be trained for their job but that training should be a continuous process. Managements of factories on war work were forced to experiment with organized training schemes because of the war-time necessity of adapting millions of new entrants, without previous industrial experience, to new conditions. Every large factory in the munitions and aircraft industries had a training scheme that strove to make the newcomer competent in the least possible time. Their methods of training were as varied as the jobs in hand. To some training meant a group of operatives gathered round an assembly bench and to others foremen attending a technical institute, but because the manufacture of munitions and aircraft called for a high degree of care and precision many studied the principles of specialized training and put a scheme in hand as complete as war conditions, the nature of the work, and available equipment allowed.

Everywhere training courses received an enormous fillip, but perforce were intensely practical. Carefully graduated apprenticeship was swept away. Time was the essence of the contract and urgency the keynote ; background study was almost eliminated, principles and theory cut down. Paradoxically, although on more active service, the Armed Forces had more time for training and industrialists looked upon post-entry training as a new and untried instrument which failed to gain as wide an acceptance as development, efficiency, progress, and planning, and welfare. There was, however, a lively realization that it must be the best way to overcome the effects of war-time dilution of workers and supervisors.

T.W.I.

Among the systems adopted was an importation from America called " Training Within Industry " which was started there before Pearl Harbour. Between 1940 and the autumn of 1945 some 2,500,000 individuals had received certificates of training. It was studied on the spot by officials of the British Ministries of Labour and Education and its development here was sponsored by the Minister of Labour. The latest report states that it is training a thousand people a week and over 30,000 have had some training in job instruction.

T.W.I. is a system of selecting and training junior officials to act as instructors. Briefly it consists of specially-trained inspectors visiting a firm on invitation and after careful study choosing the best supervisors available to be trained as instructors. They are taught and practised in the art of breaking down jobs by examining the individual tasks that compose them and laying emphasis on the key points, of which safety is one. Essential conditions are that the workpeople must be properly placed, everything be in readiness, the amount of material, supplies, and skill expected known, and the time to acquire that skill determined. The worker under instruction is put at his ease, the job explained and how much he knows about it found out. Interest is aroused and after

placing the individual in the correct position he is told, shown, and has illustrated to him each important step, one at a time, always stressing the key points. While the worker does the job himself, he is made to explain the key points, the instructor making sure that he understands them as he does so. This is continued until the instructor knows that he knows. Then the worker proceeds on his own after being told to whom to go for help and advice. Check-up is frequent until extra coaching is tapered off and follow-up eased. If the worker hasn't then learnt, the instructor hasn't taught. The essence of success is the thorough training of the instructor !

The problems encountered are those of production, safety, quality of work, and human idiosyncrasies. They range from poor planning, congestion of the working space, and excessive wear and tear on equipment to the worker's dissatisfaction in his own progress and his being at loggerheads with his supervisor.

T.W.I. originated in the United States and that country must get full marks for its development and for the enormous success it achieved there. It is peculiarly suited to the American industrial economy and was adopted without modification, first in Canada and then in Britain. It is possibly not so well suited to our workshops, where a wider diversity of methods has been adopted and, as already shown, the number of individuals trained in this system here is relatively small.

A Comprehensive Training Scheme

In this country, during the war, when hundreds of new entrants were engaged at a single factory each week, often at establishments where high explosives were handled, or delicate dangerous operations performed, and a high standard of efficiency essential, it became apparent, with supervisors and operatives new to the job, that the hazard of putting untrained people to dangerous work was too grave to be faced. Therefore some form of organized training was imperative to build up production rapidly. Starting by all new entrants receiving initial training as an insurance scheme against injury to individuals, it rapidly developed in many factories into a properly-organized department, which not only gave technical instruction to all grades, but taught policy and the functions of all branches of the family tree. It played a large and important part in turning huge scattered factories into highly-organized industrial units.

Detail of the experiences at one such establishment will give a measure of the work done by a training department. Hundreds of workshops were scattered over as many hundred acres with a population of over 10,000 workers, mainly women, who handled explosive and incendiary compounds of many kinds.

When production started less than a dozen supervisors had had previous experience of the work. Fortunately a few of the newly-recruited staff were drawn from the ranks of the teaching profession and had already had a short practical training at an older similar factory. They formed the nucleus of the training department and their first task was to receive all newcomers and set them to work on various processes exactly as in the production shops, but using inert material. Each new entrant passed through the hands of several instructors, who reported on his or her physical qualities—such as, tall, medium, or short—and mental characteristics—such as, process-minded, normal, or unmethodical. On the results of the analysis of the several reports each individual was allocated his or her job—*e.g.*, a clumsy, irritable, careless girl would not be chosen to fill detonators.

During this initiation period talks were given on safety precautions, rule books were handed out, and questions were encouraged. Discussions were held on the effects of cleanliness, waste, and absenteeism on ever-increasing production. At the same time those never in industry before were smoothly introduced to factory life. The general results were keener discipline and the encouragement of the team spirit.

At first supervisors were sent to other factories to learn various processes, but, as soon as the Training Department was recognized as such, a properly-formulated scheme was started and post-entry training as apart from initial training commenced. For the junior supervisory grades, who were released from production responsibilities for a full week, classes of a dozen or more received general as well as technical instruction. Later courses were held for managers and senior grades on similar lines.

To eliminate the taunt of favouritism, the promotion of operatives to charge hands followed a procedure that insisted on the publication of vacancies, all applications in

writing, and the formal interview of applicants by a board of three senior departmental officials, none of whom was the immediate supervisor of the applicant. The successful candidates proceeded to the training centre for a course devoted to their special duties and instruction in factory procedure. They had to pass that course before being confirmed in their rank.

Assistant foremen, foremen, and their women equivalents had more-advanced courses. In giving background talks to junior staff the matter was modified according to their grade, but the subjects covered were the same—*i.e.*, the principles of administration and organization, planning and production, labour management, and the elements of costs. For these grades the length of talks was normally limited to half an hour to avoid boredom, leaving a quarter to half an hour for discussion, during which the shy ones were dug out by going round the class. Senior grades could stand a lecture lasting three-quarters of an hour.

The next step was to introduce courses for special groups of workers. Shop stewards, men and women members of councils, and committees were a problem, in that they were prone to talk "chalk" while the management talked "cheese," wasting much time and some heat with little result. Authority was sought and given to hold a special discussion group, where the factory set-up, departmental functions, Factory Act, Defence Regulations, and safety and special regulations relating to the particular industry were explained and discussed.

Firemen were taught how best to tackle fires, involving a wide range of types of explosive and incendiary compounds with practical demonstrations. Storekeepers were taught correct stacking and storage methods, simple book-keeping, and good housekeeping. Clerical workers were encouraged to make conducted tours so that they could appreciate the effect of their often monotonous tasks on the production of essential war stores.

With few exceptions the lecturers were found amongst the senior staff and only occasionally were outsiders from universities and other bodies brought in to talk on some subject of special interest to the factory population. On every section of the factory the Training Department had its lecture room and practical workshop, equipped with duplicates of production machines. Right to the end of the factory's productive life these were necessary to cope with the large numbers transferred from section to section in dealing with the ever-changing production programme.

As already seen selection and allocation preceded training and thus avoided the waste in training round pegs to fit square holes. The original method of selection took the best part of a week for each person and wasted too much precious time. Subsequently selection, allocation, and initiation took only a day and was placed rightly in the hands of the Labour (Personnel) Department, while the training staff took over the newcomers for general instruction in factory life and the particular job to which they were allocated.

An obvious fault in the system of training described is that, initially, operatives were trained before junior staff and the latter before managers. At that stage of the war in a huge factory of mushroom growth it was "Hobson's choice," as the safety of the individual performing a dangerous operation was at stake. In an established concern, though newcomers must still be trained on entry, a properly-planned scheme will take care of the training from top to bottom of the supervisory grades and post-entry training of operatives over a predetermined time period.

Among the special courses the outstanding success was that for workers' representatives. Nearly all re-elected councillors and stewards after the annual ballots chose to rejoin the fresh course, even though they sacrificed bonus by so doing. Women members attending this course made especially constructive contribution and were most realistic in their outlook.

As regards physically training women workers for tasks previously performed by men little was done. At a few factories where of necessity women replaced men in heavy work a belated attempt was made by calling in qualified physical training instructors to counteract aches, sprains, and strains. Unimaginative managers, who would not think twice about going to a golf professional to improve their stance and action in a game, seemed slow to appreciate that the application of the same principles would improve the performance, especially of women workers. However, a number of firms are beginning to realize the value of purposeful physical training and to understand the vital importance of correct movement, proper co-ordination, and physical control as a valuable aid in accident prevention and the reduction of absenteeism.

War-time training permitted a large variety of operations usually performed by men to be done by women, whose limbs and muscles are differently proportioned to men's, so that special guidance is essential if they are to do similar work continuously. In lighter tasks women were found both in industry and the services to excel men. On inspection women were taught to perform in half an hour what had previous to the war occupied a skilled man half a day.

The rehabilitation treatment of the factory's own injured workers was under the joint control of the Senior Medical Officer, the Senior Labour Officer, and the Chief Instructor. Remedial exercises were devised and dictated by the Medical Department, the patients selected by the Labour Department, but the training staff ran the centre, taught the exercises, and carried out the policy of not only restoring quickly a lost function of part of the body, but speedily restored a normal outlook in the injured worker's mind.

As the war proceeded industry generally was robbed of skilled men of all trades either for the Services or for such special jobs as " Mulberry " and it became necessary to create, with Trades Union agreement, a grade of female mechanical assistant.

In the successful training of these women there were many striking parallel experiences with the training of women for mechanical work at the Central Ordnance Factory in South Africa. In both cases the training was specialized to the fullest extent possible. The course lasted two months in South Africa and six weeks in England. The candidates were carefully pre-selected and on entry equipped with regulation clothing and instructed in safety. Follow-up was keen. In both countries Government training centres were found to be unsuitable for the specialized requirements of the factories concerned, although the instructors were transferred from the Government training centres because they had both mechanical knowledge and training experience. It was found essential at both places for the training to be on the factory premises under the complete control and in closest contact with the factory, so that working conditions and discipline were the same. The women were trained on machines transferred from production for the purpose in both South Africa and England. A difference was that in South Africa inspectresses were specially chosen after careful observation by the instructors, whereas in Britain inspection was carried out usually by special branches of the three Services.

Quality Control

Quality control had a great vogue in engineering factories of all kinds, Government and otherwise, directly or indirectly connected with the war effort. Men and women were selected on account of mathematical knowledge and conscientiousness and were usually trained in the shops to keep performance charts with the duty of drawing rapid attention to anomalies. It was sponsored in high circles as a sort of cure-all, but its application proved to be limited.

Training Supervisors

The training of foremen and other supervisors was carried out in a number of ways. In our large cities Government-sponsored courses in foremanship were held. Many firms had their own foremen's discussion groups and association meetings and as already mentioned, T.W.I. or comprehensive training schemes were carried out in many factories.

Some of the courses set out to train the foremen in his executive duties—such as, setting an example, how to instruct, correct, praise, use speech and demonstrate, as well as how to do all these wisely and effectively. Others sought to guide him on moral problems ; the danger of a loose tongue or of touching a worker, male or female, and how and when to refer a trouble with a worker upwards to doctor, nurse, labour officer, senior official, or police. He was taught to tread like Agag in his conduct towards workpeople or else lawyer's letters to the firm would result with a packet of trouble both for him and the firm.

In some of the papers written and discussed, even before the war, and in the syllabuses of courses the qualifications necessary for a good foreman made a formidable list. In one such he had to possess—a positive character, decision, initiative, leadership, discretion, aggressiveness, self-confidence, poise, dignity, resourcefulness, integrity, honesty, dependability, adaptability, co-operativeness, self-discipline, conscientiousness, ability to organize, and judgment. In fact, he had to be a cross between an archangel and the Admirable Crichton.

Naturally, in all types of factories technical instruction was given to foremen on new

methods, processes, and equipment. Views differ as to whether the training on management and conduct should be imposed on special technical training or given in separate courses. Foremen cannot teach until they are taught what to teach and that must be directed from above. Exactly what to expect from a worker under every circumstance cannot be taught and must be left to experience. Training cannot turn a muddler into a good organizer, but it can increase the organizing ability of the average man and teach him to lead and stay with his men when they are in trouble.

Some foremen are difficult to train ; the old-timer feels he's too old to go back to school and some look on training as yet another device to diminish their prestige and authority though they know in their own hearts their own practice is rule of thumb.

Behind the training of foremen should be the underlying principle of improving their status and enhancing their prestige. The first step must be to bring them right into the policy picture as they are that part of management in constant direct touch with the workpeople who interpret the firm's intentions largely through their foreman's attitude. They must not be allowed to think of themselves as " the forgotten men." During courses the usual experience was that with foremen groups the response and discussions were excellent, but the difficulty was to judge the results, as the effect is indirect and not directly measurable in terms of productivity as in operative training.

Booklets of many kinds were usefully issued in many war industries, ranging from ordnance factory rules and regulations to health hints to girl operatives. Safety hints, outline illustrations of named tools, and duties of a foreman were valuable. Many were clear, concise, well-paragraphed, and excellently produced ; most of them were of a convenient size to fit the pocket of working clothes and acted as a constant aid to memory.

Technique of Training

Training in conjunction with selection and allocation seeks to develop the human being so that the best use may be made of his efforts for the community in which he works. Selection and allocation must precede training. Many firms have played with short psychological tests on the same lines as those used in the Services with the laudable intention of saving time in putting the square peg in the square hole, but the Senior Psychologist to the Admiralty views with apprehension the application of these Service tests to industrial organizations as " they are not wide enough in their sweep." Previous experience and present ambition must be taken into account and a point not always observed is that psychological tests should only be used by a qualified psychologist. It may not be generally remembered that as far back as the middle of the 1914–18 war, the American Army made experimental use of selection tests on a vast scale.

Post-entry training during the war was largely unscientific, but it satisfied an urgent need as it was obviously a cruel waste to leave the individual to pick up facts without knowing whether they were valuable or worthless and to discover well-known methods by trial and error. Now, in peace-time, there ought to be some way of gathering into one net all the war-time experiences, to examine closely and to compare them in order to produce better and more scientific training methods.

Training in industry is unlike general education in that it must be a step in advance of normal practices. The technique is different from teaching the child, the university student, or the worker, who finds time after his day's work is done to attend classes. The average worker is not used to textbooks and primers but to posters, snappy paragraphs, comic strips, cinema, and wireless. Therefore industrial training must illustrate to attract and make use of films, gramophone, models, epidiascope, attractively-drawn pictures and charts, and practical demonstrations. There were a number of attractive instructional Service films made during the war, full of humour and charm, even on the subject of training itself.

Training Staff

Whether recruited from the teaching profession or industry, the training staff, as well as possessing special gifts and aptitudes, must be re-trained. Even technical teachers are rarely able to break down a job to demonstrate each step, duly underlining safety, economy, and speed. The head of the training staff should not be promoted from the junior staff, nor be a production official who has failed to make the grade. If he is to be an effective departmental chief he must have the authority and standing to teach all grades.

An advanced writer on the subject suggests that there should be continual interchange between production and training staffs, as "this constant osmosis keeps both fresh" and gives the lie to Shaw's "those who can do, those that can't teach."

Individuals with a teaching degree already in industry and getting on well were the most successful training officials and are likely to remain so, as teaching is both an art and an applied science. Such people will still be rare birds until training becomes an integral part of industrial life and the reward offered to the chief trainer of a firm is well above the Burnham Scale. During the interim the posts must be filled by recruits from industry with special inclinations, willing to be properly trained to train. Manifestly they must have sufficient practical knowledge of the work to command respect and carry conviction to their classes. In every firm the senior members of all departments should be persuaded to take classes and give talks, for until a senior official stands up before an interested class to try to impart his particular piece of industrial knowledge he does not realize his deficiencies in matter, method, and procedure. A manager lacks an essential qualification if he is no wiser after half an hour's discussion with a class on a subject of interest to them all.

The trainee, it must never be forgotten, is the important person and the sole reason for the existence of the department, so that the first principle is to find out how much has been learnt. Fundamentally close attention of the class must be attracted to the most boring subject—a matter of educational skill. Prof. Smith, of Leeds, tells a good story of a young teacher with a class of noisy unruly hobbledehoys about to be instructed in the principles of surface tension. Out of his desk he produced a bowl of soapy water and a clay pipe and soon had every eye rivetted upon the bubbles he blew. Then he gave his talk and spent the last ten minutes finding out how much the class had learnt. How different from the university lecturer, not so rare as he should be, who, turning his back on his students, covers several blackboards with intricate diagrams and figures, mumbling incoherently to himself meanwhile.

Conditions for Success

Training may be defined as a branch of education that affords the opportunity to the worker to function better in the pursuit of his livelihood. It can never be a substitute for experience, but it helps people better to use the experience they gain. Experience itself is a function of opportunity, not time.

Like all subjects training is based on general principles and the best results are got by skilfully applying them to the particular needs of the industrial unit concerned. Courses to be successful must be given in working hours for operatives and supervisors alike and the individuals attending should be for the duration of the course completely divorced from the responsibilities of production. If not they fail to concentrate and are constantly distracted, with disastrous results to the process of learning.

Training must be an integral part of the firm's activities; not just a tonic dose given once to the limp, lame, and lazy, but a continuous process at every level to open up the way to further advancement—equal opportunities for all. All grades must be included in a complete training scheme and scrappy ill-arranged time-tables and syllabuses should be deemed as evil as unpunctual workmen's transport, bad canteen meals, or poor shop conditions.

The trained worker is given a sense of responsibility in his job and an attempt is made to instil pride and pleasure in his work, difficult enough with the specialization and mechanized production of modern industry. He is told "why" as well as "how" the job must be done. Some of the workers are future foremen and one cannot expect an atmosphere of goodwill throughout a factory if the employees are denied the means of knowing the breadth of their responsibility. In other words operative training should strive to produce the hundred per cent. co-operator.

The Training Staff must keep themselves right up-to-date in factory methods; in fact, the introduction of new methods and machines is best done through the Training Department, which should be always a little bit in front of normal factory procedure and practice. If a new method is put across properly many a slip can be caught up before introducing it into the production line and save teething troubles. Also British workers in the main are distrustful of new things. If employees have heard of them and been properly instructed, opposition vanishes and strife is avoided.

Courses should recur for the individual worker at regular intervals, not greater than two years, and every step in promotion should

be accompanied by fresh training appropriate to the grade. Short frequent courses are better, as they keep pace with the constant changes in details of process methods. Probably a big firm should take more than two years to evolve and establish a complete training scheme to cover all grades and groups. A small firm can telescope all the functions of its training department into one person, provided always it is the right person.

Training, like the processes themselves, must be ever open to improvement. It means a more scientific approach to many industrial problems and more freedom from the domination of the rule of thumb foreman. During the war training had to sell itself to all ranks, from the senior administrative official to the operative and maintenance mechanic. Naturally it succeeded best where it had the enthusiastic backing of the heads of the concern.

Opposition

In peace-time training will inevitably meet all the difficulties that any new activity does. Higher management, unless it takes a long view, will take a poor one when two per cent. of the operatives are taken away from production. It is unlikely in many cases to spare the best people and conditions for the new venture and a training centre will not thrive hidden in a dark corner equipped with out-of-date machinery.

There will always be opposition from the self-made manager who never was trained and cannot see the use of it. The busy section of a firm, already understaffed, will not want to spare a soul for training and the slack department will fear training may mean demotion, transfer, or even dismissal for some. Other managers will prefer to train their own people their own way in their own shops and in any case all their people know their job and are already perfectly trained. Serious opposition is unlikely from the unions or shop stewards, as they gave little trouble in this respect during the war, especially in the training of women to replace men, where opposition might have been expected.

A firm that has instituted systematic training and persisted must be gaining a rich reward because labour scarcity means the end to any firm skimming the cream of the labour market and the certainty that each firm must look after a cross-section of the working community, including disabled, rehabilitated, ex-Service men.

Aim is Increased Efficiency

The war has emphasized the need for greater efficiency in industry. It is now generally recognized that there is plenty of room for improvement, but the technique for achieving it is by no means completely worked out. That work-people to produce efficiently must be reasonably contented with their hours, wages, conditions, and bosses will not be contested by practical industrialists. In a "happy ship" workers with a real incentive are capable of enormous productivity, as witness the munitions turned out by women and girls here after Dunkirk, when they beat men's records even in the assembly of gun ammunition, compared with the low efficiency, now under examination, of Hitler's cosmopolitan fear-driven slave labour. The epic tale of British women's part in winning this war has yet to be told.

The trend in Britain seems to be an attempt to take labour into a sort of junior partnership, not co-partnership or profit-sharing, but by the ever-increasing adoption of joint committees on production, safety, absenteeism, and other matters where joint action is an obvious advantage to all concerned. This system allows the workers, through representatives, to play a part in some phases of the management of their own factory and to influence to some degree the policies and actions of the management.

The success of management and workers sitting round a table together depends on the creation of mutual confidence and the observance of the unwritten rule that both sides keep faith—the workers' representatives by giving fairly the views of management to the workers and the views of their fellow workers fairly and clearly to the other side. Management, the senior partner, must take the initiative and realize that the workers' representatives are employees still not because they have less brain but that lack of drive, ambition, opportunity, or all three, have kept them in the ranks. Management must never forget that the other side of the table is frequently handicapped by lack of knowledge of industrial history, the problems of administration, economic problems, and the policies of the department they represent, not to mention procedure in committee. This is a prime opportunity for the Training Department to render good service and provide, through talks and discussions, the chance to explain to the councillors and committeemen the functions and limits of

responsibility to production of the various ancillary departments, often so puzzling to the workers, the ladder of approach, the structure, policy, and outlook of the company, and, of course, procedure. Such background talks will sweep away misunderstanding and turn obstruction into constructive criticism.

The Training Department should also be a valuable medium of propaganda and take care of the ever-changing position in the workshops. The safety chord may have been played too long and be deadening production, so pull out the production stop and soft-pedal safety. Co-operation and avoidance of waste can similarly be stressed.

A further aid to management is that a training centre is a good shock absorber in the inter-departmental movement of workers; it makes the transition smooth and accelerates the competence of the worker in his new task. Training brings all grades together and forces them to share knowledge and morale is improved by learning about each other's jobs. A self-respecting training department won't go on training the wrong people and as it is unbiased and impersonal the advice on its reports should lead to better selection, allocation, and promotion and keep at bay the bogy of favouritism that darkens the steps of promotion in so many firms.

Too much competition between departments of a firm can cause friction and too much friction an explosion, but a little gives a nice polish to production. The sounding board of factory opinion and feelings is the training centre, which by listening to the undertones can best advise when and where to act to relieve the human strains.

There are plenty of new ideas on Industrial Training; the difficulty is to separate the grain from the chaff and then to sow the grain. Industry must examine for itself what steps are necessary to get a training department started and the cost of making practical use of the new tool. That it must look after its own specialized training is already being insisted on by the Ministries of Labour and Education.

The position of Industrial Training to-day is not unlike that of "welfare" at the end of the last war, when it was recognized that the care of the worker's body was a managerial responsibility. Now it is becoming understood that care of the mind must be added. Training, like welfare, has come to stay.

Metal Mining and Training

British-controlled metal mines are operated in all five continents, usually as isolated communities, with their only near neighbours mining camps like their own. Often they are in unhealthy climates and frequently in countries where the native standard of living is primitive and the social life of the miners undeveloped or neglected. Some were overrun by the enemy and the labour forces of others disturbed and depleted by the war.

Although in many lands the scarcity of labour will not compare with that of industrial labour at home, the turnover will have been considerable before normal conditions are restored and the low efficiency of the fresh and returned labour a headache for the managements of many properties.

In spite, or perhaps because, of isolation some British mining communities abroad have developed a high standard of social responsibility as regards the health of their workers and their families, the education of their children, and care of the dependants of killed and injured workers. In many countries such duties have been forced upon them as they cannot look to any competent local authority to relieve them of the burden and all amenities become a charge on the company. The managements find themselves obliged to manage and control towns and villages and provide food and water supply, sanitation, medical, educational, and even religious facilities. For 24 hours a day they are serving their workers' interests, in striking contrast to home industries, which have no right to interfere in their workers' lives once they have left the factory and, except for sports and entertainment, little opportunity to do so if they would.

The metal-mining industry generally, governed by geographical and social conditions, has thus perforce developed some phases of industrial activity in advance of home industry. For example, industrial medicine is in its infancy in this country but a special kind of industrial medicine has been practised for decades at many metal mines from the sheer necessity of keeping both the European and native staffs fit for work.

Together with most producing industries, metal mining has changed since the beginning of the century from employing a minority of completely skilled men with a large attendant force of unskilled to a labour

force nearly entirely of semi-skilled specialists, owing to the ever-increasing mechanization of underground operations, so that the old craftsman-miner, who not only broke the ground and set the timbers but first found the ore, is almost extinct.

The outstanding difference of mining from other industries, including other branches of engineering, is that, except for temporary war-time surface intrusions, it has not yet been seriously invaded by women either in professional circles or amongst the ranks of the underground workers, so that, except in primitive places where the old order changeth not, the "bal maiden" has not reappeared.

British mining men from the middle of last century lived through a lively period when new mineral discoveries and new inventions went hand in hand. New mines were being exploited all over the world, dynamite was replacing gunpowder, the rock-drill the hand hammer, and electricity steam. These pioneers had to train raw natives of many lands the hard way, by picking up the lingo and getting down to learn the job themselves, before demonstrating and teaching their miners the new ways. Even the older generation of living mining engineers, when the world lay at their feet and they could choose where they worked, literally from China to Peru, trained men of many races to perform all the operations necessary to win the ore, concentrate it, and assemble and operate machines of many kinds. In more settled mining communities newcomers were left to pick up haphazard the knowledge required for work in mine or mill. More often than not this just meant putting the learner with an old hand to pick up his bad habits as well as one way of doing the job. These ways of training by the pioneer, the mining engineer, and the old hand were crude, unsystematic, and obviously wasteful by modern standards.

In the "Bad Old Days" many English foremen and engineers served abroad in unhealthy camps for one contract only, lasting perhaps from two to three years. They had no future interest in the job to keep them keen, their chief hobby was marking off the days on a calendar, so that their value as trainers was small and the standard of work achieved by the men under them low. Labour, however, was cheap and plentiful then and there was little or no legislation to protect it.

To-day as high a standard of discipline is essential as in a battleship. Not only because of the hazards of misfires, pressure of ground, falls of rock, poor lighting, and other adverse conditions of underground work, but because the wide dispersal of personnel makes direct and constant supervision impossible. Underground rules and regulations must be strictly enforced and penalties inflicted on the defaulter on the grounds that he is endangering the lives of his fellow workers.

Of Special Value to Mining

A central training scheme is the medium to inculcate and ensure that a uniformly-high standard of conduct is observed and that there is equal knowledge and appreciation of the hazards and the precautions to defeat them throughout the whole population of the mine.

The same basic needs for training apply as in any other industry. Within the limit that does not destroy initiative, the section bosses, shift bosses, and foremen, as well as the miners, should be trained to tackle their duties in the same way in order to avoid differences of behaviour in different parts of the workings or on the transference of officials or workers. Specialization, with increasing mechanization, calls for training, as well as careful selection and allocation on entry or promotion. Co-operation is of equal, if not greater, importance than elsewhere. Methods similarly are constantly becoming changed and modified; propaganda is as essential to counteract the insidious growth of bad practices. In times of trouble on changing systems of working the training centre eases up the transfer and speeds up the efficiency of workers. Job responsibility is more important than in other industries if costs are to be kept down, waste avoided, and the cycle of operations tightly maintained.

To-day many underground operations are becoming so highly mechanized that the miner as well as the engineer must acquire a good mechanical sense to give efficient service and keep his machine, however rugged, in continuous work. Drilling, mucking, scraping, loading, hauling, blasting, pipe-fitting, ventilation, track-laying, and now diamond drilling, are all becoming miners' specialized jobs and making the underground workers less interchangeable. Even in drilling the tendency is for some to become experts in tunnelling and driving and others in rising and stoping. Under-

ground labour is much less fluid and less flexible than formerly and this in turn demands more organizing ability and administrative skill on the part of underground officials, who have the responsibility of maintaining the grade and quantity of ore sent to the hoisting shaft.

New machines and new methods are more easily introduced, with less teething trouble and less obstruction in production, if they are explained and demonstrated beforehand by a department that is free to concentrate, unhampered and uninterrupted by production problems, on the proper and skilful teaching of the new things uniformly with the ability to check whether its training has been effective or not.

The miner is mostly an independent type of worker liable to do things his own accustomed way and disliking a change in his pet habits ; above all classes of workers the miner must be told why as well as how the work should be done. The training staff is there to enlist his reason and to focus attention on giving him understanding of his work and pride in doing it well. The Services did no less and often with worse material. The withdrawal of a very small percentage of workers from full production for training will be amply paid for by the formation of good habits and methods, the avoidance of an unnecessary variety of ways of doing the same job, elimination of sketchy instruction, and in counteracting subversive obstruction causing costly delays in changing over to better methods. Recent discussions on technical papers have disclosed the fact that sometimes there wasn't time or opportunity to change a method on introducing a new machine, although the author knew it should, and wished it could, have been done. A training department would have helped.

A mine official must know the best way to perform each task, or he will not be able to check his men when they depart from the right method and the tail will begin to wag the dog. He must be trained and taught the most effective way to perform a wide variety of operations before promotion, so that he can conform to the standard set by the management. When he changes his mine, even if it is a neighbouring one, he has to meet a new set of problems, as no mine has exactly the same conditions as another. If he goes from one type of mine to another it may be months before he is competent to take complete charge of his duties unsupervised, especially if he has to pick them up on his own. A training department will speed up this man's education and increase his value.

In opening up a new property or reopening an old one speed is essential in crystallizing the best procedure for winning the ore or making the ground safe. It is not easy for a manager with many administrative duties speedily to work out and lay down the details of operation. A training centre is an ideal place for open discussion to hammer out the solution of such problems. Thus for technical matters, as well as conduct, administration, organization, costs, and safety, the basic principles of training are as valuable as in any other producing industry. The instruction should be continuous and start with the higher officials just as elsewhere.

One particular subject on which nearly all officials and drillers need training is the ability to think and see quickly in three dimensions. More people find this difficult than is commonly supposed, a fact well recognized in teaching art subjects. A simple way of finding out in a class is to give each member six matches and tell them to make four equilateral triangles of equal size. Few, unless they know the trick, will think immediately in terms of solid geometry. The making of mine models for teaching purposes is an old art and excellent examples were exhibited many years ago at the Science Museum, South Kensington. It was thus refreshing recently to hear a senior member of the profession state how much information had been gained by studying a recently-made model of an old mine—an excellent proof of the value of visual aids in training. The hole-director, introduced between the wars on the Rand, first for stoping and then for driving, was another good example of visual aid, especially the vertical wooden screen with broomsticks to represent the drill-holes of a full round.

Except in mine workshops and laboratories T.W.I. does not seem to apply to mining as well as the comprehensive training centre because the latter can give close attention to explaining "why" as well as "how" on which T.W.I. tends to concentrate and it is not easy to interlard background talks while teaching this way, nor are the instructors trained to do so. Where the miners are literate booklets are useful and already widely used on such subjects as the duties of a shift boss, hints to drillers, safety precautions, blasters' guide, and so

forth. These are best composed by the training staff, who will know the points to stress.

Training in isolated camps can occasionally be given an entertainment value and attract a larger audience—such as, the display of applied physical education given by one of our largest iron and steel firms to its workers and their families. The showing of technical films give a similar popularity to training.

A good example of successful formal occupational training in another sphere is the teaching at the Police Motor Driving School at Hendon, where the instruction is based on an analysis of the psychology of car control and mechanical, anatomical, and mental factors are all taken into account, so that drivers trained there could challenge and beat a team of racing car drivers in dexterity of car handling.

The debatable question of whether such instruction as operative and supervisor training should be given within or outside working hours is answered in one country by the following extract from the U.S. Wage Hour Law, May, 1939 (Wage Hour Interpretative Bulletin, No. 13): "Time spent in attending meetings and lectures sponsored by the employer (whether or not attendance is voluntary) should be considered time worked if such meetings and lectures are related to the employee's work—as, for example, meetings and lectures for the purpose of teaching the employee the use of new types of machinery on his job, mine rescue, fire prevention, and control. In addition, time spent in attending any meetings and lectures should be considered hours worked if attendance is not wholly voluntary."

It is perhaps unnecessary to point out that attendance outside working hours must be voluntary so that much of the value of the lecture or meeting is lost by absenteeism. Moreover, miners and officials coming off shift or about to go on the "graveyard" shift are poor learners; they are either physically tired and mentally dulled or inclined to be resentful at having their leisure broken into.

Time-tables must be carefully planned to give effective instruction and yet interfere as little as possible with production. Spasmodic lectures and discussions at irregular intervals do little good. Balanced syllabuses and time-tables are best made by those accustomed to make them or boredom, mental indigestion, or lack of interest will result. Training is a special branch of education and is best left in the hands of those qualified to carry it out. The average mining engineer is not necessarily gifted in such matters; in fact, the technical Press have sometimes taunted him with not being able to express himself in writing and not being taught to do so. Much less is he taught to train.

Mining engineers with teaching degrees must be as rare as white blackbirds and until the big companies adopt systematic training as an integral part of their organization they will remain so. Meantime among the staff of large companies the best and most senior man with special inclination and aptitude should be chosen. The pre-requisites are a practical knowledge of mining, as wide experience as possible, good personality, a knowledge of the language of the country he works in, and a willingness to be trained to train.

This presupposes a good well-paid type of man but not greatly dissimilar to the type of senior man employed by a few American machinery companies between the wars, who were college graduates who had spent several years in the works, with a knowledge of the language of the country to which they were posted sufficient to be able to jolly the miners at the face, to whom they were teaching a new machine, and afterwards discuss the theory in the mine manager's office.

The training on the technical side must be highly specialized and occupational. While it would be absurd to teach the varieties of square-set timber joints in a narrow lode mine, nevertheless the range of information required is usually much greater than anticipated, causing surprise and sometimes even repudiation of a scheme.

It is claimed that post-entry training is important and the man in charge as much a factor for successful operation as the mine efficiency engineer, safety officer, or personnel manager. If no suitable person exists within the organization it is better to seek one outside than promote a "near-miss." The lecturers in most cases will be the mine staff and it will do them good to learn how to impart knowledge and to clarify their ideas and speech.

Present Training Uneven

In some mining areas, as mentioned above, a high standard of industrial human relationship has been attained, but apart from

safety little is published on organized continuous labour training. On the Rand the principle of continuity of training is clearly understood in safety matters, because the certificate held by officials is valid only for three years, after which they have to take a refresher course to obtain a new certificate; similar conditions apply to rescue workers. At the Consolidated Mining and Smelting Co. of Canada the sons of workers are taught a trade, with mathematics and general science as background subjects—a sound form of initial training. Elsewhere in a British mine a scarcity of drillers decided the management to select three foremen with previous knowledge of machine demonstration and instruction to start a school, where miners who had applied to the mine office to become drillers were trained in the use of drifters, stoper, and jackhammers as well as blasting with electric delays and safety fuse. The course lasted ten weeks, during which time they were under all three instructors in turn. If a trainee passed a senior official's test at the end of his course he became a driller and each instructor got 30s.

A most successful Canadian mine mechanical engineer, before he did a major changeover in the mill at Easter or Christmas, held classes with a blackboard for all the tradesmen concerned to discuss and work out a close time-table for each man.

At another British mine all the shift bosses met regularly during the winter months to discuss the merits and snags in different methods of stoping, rising, and drilling rounds in drives as well as safety precautions. The Rand hole-director wooden screen and broomsticks were copied and used successfully for instruction in many places. During this war the same device was used to teach sappers to make a good clean cut in their tunnel rounds at Gibraltar.

The Anglo-Iranian Oil Co., though not a mining company, is a similar isolated British community. It takes training seriously for both boys and adults and has established a training school that is almost a university.

In that most highly organized British metal mining community, the Rand, the South African Government Training School trains young men in the general principles of mining and up to the practical standard of gaining a blasting certificate. This is exceptional as few British mining centres can look for local, or central, governmental aid in vocational training.

In some ways and in some places British mining lags behind. A fair example is the use of the hoe for the collecting and loading of ore and waste in common use from the Iberian Peninsula, through Asia, to Japan. It is easy to prove that the miner's shovel is a more efficient tool, using less worker's energy and shifting more material. This conservatism can be overcome by education and continuous practical training, because the African, who is no more teachable than the Southern European or Asiatic, has been taught to use the shovel.

In Japan between the wars some American mining men did make a valiant effort to turn from hoe to shovel. As related in the *Engineering and Mining Journal* some years ago they built bins on the surface, brought ore from underground, and even engaged a golf professional from the States to teach the natives stance and the proper co-ordinated movements for shovelling.

A misdirected effort was the mine workshops manager's decision to replace the springy wooden shaft of the hoe by scrap 1-in. iron piping to reduce cost and increase the life of the handle. No one foresaw the sore hands and jarred elbow joints, but the miners threatened to strike and the management had to back down. A training department properly run would have tried out the idea and discussed it with users and thus avoided the strife.

These brief notes of various happenings at different places tend to show that labour-training in metal mines is in just the same uneven state as in industry at home.

Good Labour Relationship Vital

Recently in the Press of other nations the British have been violently attacked for neglecting the minds and bodies of Far Eastern races with whom they live and work, with the accusation that they made no attempt to improve their standard of living or education. Even so the conduct of British mining companies compares well with that of other Europeans. Pope Pius XI in his memoirs, after relating a visit to some gold mines under British control, remarks how the English, with their practical ability and characteristic courage, are to be praised " because of the liberality with which they ensure the safety of our (Italian) workmen, who elsewhere are often sacrificed to a murderous economy."

The British, in spite of traditional snobbishness, have a genius for co-operation in sport

and also, it would appear, in joint committees in industry, shown by their rapid growth in the home country and some of the Dominions, probably because of their ingrained sense of fair play, ability to compromise, spirit of tolerance, and dislike for violence.

The interests of management and men are more closely identified in metal mining abroad than in almost any other industry, as all conditions and hazards of climate and workers' conditions are shared and the British tradition demands that the senior official goes at once where danger threatens and takes charge or for ever loses the respect of his fellow-workers.

The logical effect of training tends to bind the total population of a mining camp into a more closely-knit community and should be an asset in these days of rising wages, loss of flexibility of labour force, and the low efficiency of fresh labour on specialized jobs, as it is increasingly desirable to maintain a steady and contented body of workers.

Closer relations between management and men envisages educating the workers in company aims and policies, with the management standing up to critical discussion. Industry at home is recognizing that this step gains more in co-operation than it loses in authority. " Monty " kept all ranks in the picture and was singularly vindicated, yet he unquestionably held the reins of management. The late S. G. Blaylock, a great humanitarian and a great mining engineer, through the creation of his Co-operative Committee at Consolidated, gave an outstanding example of an intimate exchange of views between management and men creating a contented and friendly community which had previously been a centre of strife.

In metal mining it is natural to turn to the United States for comparisons and there the mining engineer is less shut away from the influences of other industries because of a much tighter national industrial economy. They can observe at first hand the trends in the widening of managerial functions and responsibilities. In similar British circles distance and isolation prevents this too often, so that the tendency is to become introspective and parochial.

Headquarters' engineers are probably not often called upon to report on general social trends in home industry, as it would perhaps be deemed to interfere with the authority of local managements, and they tend to look upon industry here at home as little more than a source of supply of machines and material. Should this be so ? Would it not be healthier for the industry at large if a suitably-chosen headquarters' official kept the many distant managements concerned up to date in the rapid changes in human relationships in other industries—just to put ideas in their heads on this vital subject ?

Gravimeter Test in a British Oilfield

An account of a recent demonstration of the use of the Nørgaard Gravimeter staged in Nottinghamshire.

Introduction

Representatives of the MAGAZINE were recently afforded the opportunity of witnessing a test demonstration of the Nørgaard gravimeter, a brief description and illustration of which appeared in the April issue. This was arranged through the courtesy of the Anglo Iranian Oil Co., Ltd., and took place on May 8 at three stations in the Eakring area of Nottinghamshire, between 6 and 10 miles west of Newark-on-Trent. The three stations at which readings were to be taken had been used as bases for previous gravimeter surveys by the company and their relative gravity values were therefore well known. The distances by road between the stations are approximately as follows :—Kirklington-Southwell, 3½ miles ; Southwell–Oxton, 4½ miles, and Oxton–Kirklington, 5 miles. The stations were located by the roadside and the readings taken during the test were in some instances delayed on account of passing traffic. All these places lie in the neighbourhood of the Eakring oilfield and the nature of the structure in the Carboniferous Limestone of the area is indicated in the accompanying map (Fig. 1).[1] In charge of the demonstration was Mr. H. Hedstrom, of the Electrical Prospecting Company of Stockholm, who took the various readings referred to later.

[1] LEES, G. M., and TAITT, A. H., *Q.J. Geol. Soc.*, Vol. CI, Parts 3 and 4, Feb. 28, 1946.

The Nørgaard Gravimeter

In the description of the Nørgaard gravimeter already mentioned reference was made to the essential feature of the instrument—*i.e.*, a nearly horizontal quartz pendulum supported on a horizontal torsion fibre of fused quartz fixed in a quartz frame. This system, diagrammatically shown in Fig. 2, is immersed in a liquid and completely enclosed in a thick copper casing, protected against outside temperature variations by thick insulation. The casing is provided with a small glass window through which movements of the pendulum can be observed by means of a microscope by way of a system of mirrors. The construction is clearly shown in the accompanying cross-section of the gravimeter.

The complete instrument weighs approximately 25 lb. and its tripod 13 lb., the overall dimensions being: Width 8½ in., length 12 in., and height 16 in. It is a light and compact unit which does not require batteries and charging sets. It is easy to transport

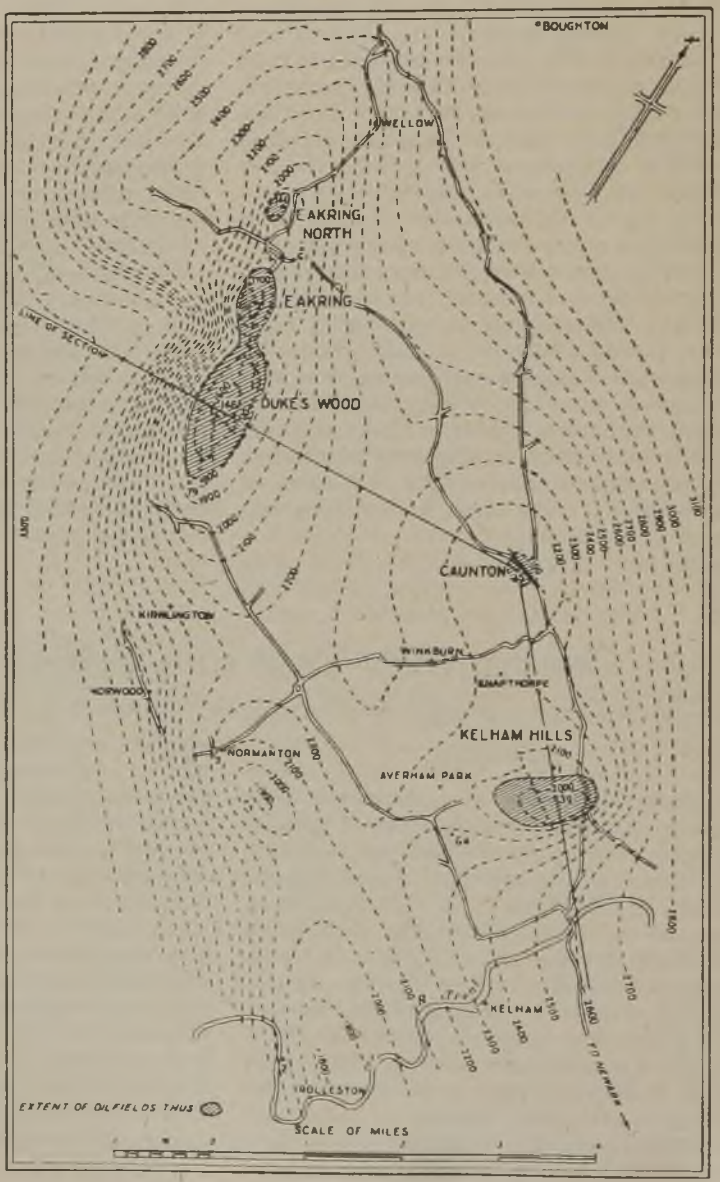


Fig. 1.—Structural Contour Map of the Eakring Oilfield (*after Lees and Tatt*).

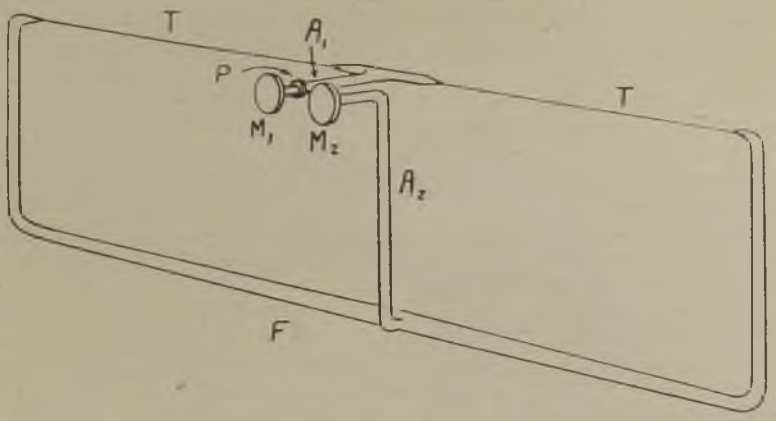


Fig. 2.—Diagrammatic Representation of the Quartz System in the Nørgaard Gravimeter.

and unaffected by normal usage, although the quartz pendulum is never clamped. The instrument has a small and steady drift and a small and simple temperature correction, so that it is well suited for use in place of pendulums for long-distance and geodetic surveys. The need for determination of "scale value" is eliminated, since the scale value is a function of the angle measured. The time for setting up, taking observations, and moving out from the station is four to five minutes.

Observations taken with the instrument consist in measuring the angle of displacement from the horizontal of the quartz system about an axis parallel to the torsion fibre when the torque exerted by the pendulum due to gravity is balanced by a predetermined torque in the fibre. This angle is measured by micrometer (micrometers are shown in Fig. 3) with an accuracy of approximately 0·3 to 0·4 seconds of arc, which corresponds to an accuracy in gravity determination of about 0·03 to 0·04 mgal. for one observation. In field work an accuracy of $\pm$ 0·014 mgal. (expressed as the probable error of the mean of three determinations) has been obtained in the determination of the gravity difference between stations half a mile apart.

Eakring Test Conditions

On the occasion of the test in the Eakring field observations were taken between 12 noon and 1.30 p.m. in bright sunny weather, with a fresh easterly wind. The air temperature, which had been approximately 10° C. in the morning, rose to approximately 20° C. in the early afternoon. At the commencement of the test the instrument temperature was about 13·5° C. and rose to nearly 17° C. some three hours later. Observations were taken without protection from the sun and no special windscreen was used. The instrument was carried by hand and transported between the three stations on the seat of a car.

The gravimeter had recently left the factory

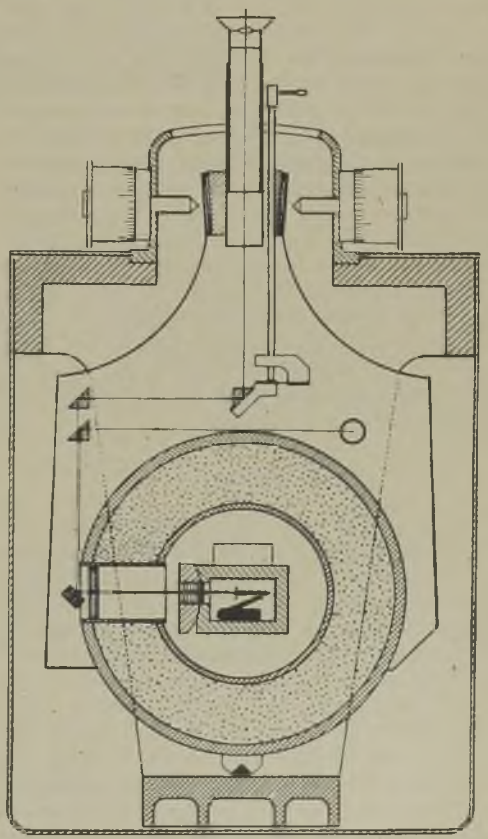


Fig. 3.—Cross-Sectional View of the Nørgaard Instrument.

and there was therefore no accurate information on its average hourly rate of drift during field work. The particular quartz system had been under observation in the laboratory and showed a drift of 1·75 mgal. per day.

Before departing for London Mr. Hedström had himself re-set the instrument to a gravity value of about 670 mgal. A reading taken in Stockholm at 11 a.m. on May 2 gave a figure of 671·6 mgal. and a reading taken at the National Physical Laboratory at Teddington at 4.40 p.m. on May 6 gave 22·8 mgal.—a difference between Stockholm and Teddington of 648·8 mgal. The gravity at the reference point in Stockholm is given as 981·847 cm./sec.^{2}, based on several pendulum connexions with Helsinki (g = 981·915), which in turn has been connected with Potsdam through a good many measurements from 1896 to 1935. From the difference between the gravimeter readings in Stockholm and Teddington the gravity in Teddington would be 981·198, assuming no drift at all for the instrument during the four days' journey from Stockholm. The most probable value for the gravity in Teddington, relative to the old absolute measurements at Potsdam, is, however, 981·1953, as determined through indirect connexions *via* British and other reference points. The most probable value for the drift of this Nørgaard Gravimeter during the journey from Stockholm to Teddington would therefore be 3 mgal., equal to 0·7 mgal. per day, which checks very well with field experience when working with other gravimeters of the same type—such as the one now being used by the Geodetic Institute in Stockholm for the gravity survey of Sweden.

Theory

In a report on the Eakring test Mr Hedström points out that the relative gravity values measured by means of this gravimeter are referred to a "g_o" value, at which the moving beam of the instrument would be horizontal in the coincidence position at a predetermined "working temperature." At a gravity value g_1, larger than g_o, the coincidence position is obtained when the casing containing the quartz system is tilted by a certain angle α_1 from its horizontal position, about an axis parallel to the torsion wire. In this position the moving beam forms the same angle α_1 from the horizontal, because coincidence is always obtained with the beam in the same position relative to the casing. It follows that :—

$$g_o = g_1 \times \cos\alpha_1.$$

$$\text{Thus } g_1 = \frac{g_o}{\cos\alpha_1}$$

$$= g_o \times \sqrt{1 + \tan^2\alpha_1}$$

$$= g_o (1 + \tfrac{1}{2} \tan^2\alpha_1)$$

The relative gravity value referred to above is thus :—

$$g_r = g_1 - g_o = g_o \times \tfrac{1}{2} \times \tan^2\alpha_1.$$

The value of tan α for the up and down tilt of the casing containing the quartz system in the instrument is determined by means of two micrometer screws (Fig. 3) working horizontally against opposite sides of a vertical lever attached to the casing. The distance D from the centre of the bearing (at the bottom of the instrument), about which the casing is tilted, to the centre of the micrometer screws is (in the particular instrument) 263·02 $\pm$ 0·01 mm. The horizontal displacement m of the vertical lever along the common centre line of the two micrometer screws (generally 3 to 6 mm.) is measured to 0·0005 mm., corresponding to one-tenth of a scale division on the micrometers. Then tan α is equal to the ratio m : D (with a small correction factor C due to the thickness of the lever against which the two micrometer screws bear). It follows that :—

$$g_1 - g_o = g_o \times \tfrac{1}{2} \times m^2 \times \frac{C^2}{D^2}$$

For the instrument used at the test this expression can, Mr. Hedström points out, be written for all practical purposes :—

$$g_1 - g_o = 7{\cdot}00 \times m^2 \text{ mgal. (m in mm).}$$

The scale value of the micrometer divisions for a micrometer reading M is therefore :—

$$\frac{dg \text{ mgal}}{dM \text{ scale div.}}$$

$$= \frac{dg}{dm} \times \frac{dm}{dM}$$

$$= 14\,m \times 0{\cdot}005$$

$$= 0{\cdot}07 \text{ m mgal/scale div.}$$

In order to obtain the value of m from the micrometer readings a correction has to be applied equal to the reading on the two micrometers when the lever is in the vertical position. With the instrument used this reading was 0·4725 mm., which has to be subtracted from all micrometer readings in order to obtain the m value. This value squared is then multiplied by 7·00 and the resulting relative gravity value is referred to "working

Fig. 4.— Gravimeter in Use at Kirklington.

temperature" by applying a temperature correction.

In taking readings T_1 is the temperature in degrees Centigrade at the interior surface of a horizontal cylindrical casing (outside diameter $5\frac{5}{16}$ in., inside diameter $3\frac{1}{16}$ in.), which contains the heavy parallel piped copper casing enclosing the quartz system. The cylindrical casing has a $1\frac{1}{4}$ in. thick thermal insulation (cork in this case). T_2 is the temperature of the heavy copper casing (cross-sectional area $1\frac{3}{4}$ in. $\times$ $1\frac{1}{4}$ in.) in which the quartz system is mounted. Between this copper casing and the inside of the cylindrical casing there is an additional layer of thermal insulation. The T_1 and T_2 values, which are read to 0·05° C. (divisions at every 0·5° C.), are plotted against the time to give curves showing the temperature changes in the instrument during a day's field work. Because these temperature changes are comparatively slow, owing to the thick thermal insulation of the instrument, the curves must be smooth and without breaks. By reading the correction temperature, t_c, off the T_2 curve, at the time corresponding to each gravity determination, it is thus possible to obtain a greater accuracy in the determination of t_c than that obtained by visual reading with an error of $\pm$ 0·05° C. R is the reading in micrometer scale divisions (of 0·005 mm.) on the right-hand micrometer and L is the corresponding reading on the left-hand micrometer.

Test Readings

Sample readings taken at the Kirklington station are given in Table 1. Here the two mean values differ by 0·075 scale divisions, which is equal to about 0·026 mgal., although the difference between the first two R values indicates difficulty of observation, probably due to wind gusts. Mean of observations

$$= 5{\cdot}0 \text{ mm} + 90{\cdot}71 \text{ scale divisions.}$$
$$= 5{\cdot}4535 \text{ mm.}$$
$$\text{Correction} \quad -0{\cdot}4725 \text{ mm.}$$
$$m = 4{\cdot}9810 \text{ mm.}$$
$$m^2 = (5{\cdot}0 - 0{\cdot}0190)^2 = 25{\cdot}0 - 0{\cdot}19$$
$$7{\cdot}00\, m^2 = 175{\cdot}0 - 1{\cdot}33 = 173{\cdot}67 \text{ mgal.}$$

Correction temperature t_c read off the T_2 curve for the time 12·085 hours was 13·55° C.; temperature correction is thus:

$$-0{\cdot}0202\,(19{\cdot}8 - 13{\cdot}55)^2$$
$$= -0{\cdot}79 \text{ mgal.}$$
$$g_r = 172{\cdot}88 \text{ mgal. at } 12{\cdot}09 \text{ hours}$$

Similar observations were taken at Southwell and Oxton and a summary of the results obtained is given in Table 2. The resulting gravity values are: Kirklington, 172·92 mgal. (mean); Southwell, 167·58 mgal. (mean),

Table 1

Kirklington.	*Time.*	T_1	T_2	R.	L.	*Mean of R and L.*
Arrival at Station	12·01	—	—	5·0 mm.	5·0 mm	—
Temperature reading	12·04	13·8°	13·55	—	—	—
1st Observation	—	—	—	97·4	83·5	90·675
,, ,, completed	12·07	—	—	98·8	83·0	
2nd Observation	—	—	—	100·6	81·0	90·75
,, ,, completed	12·10	—	—	100·3	81·1	

Table 2

Station.	*Time.*	*Relative gravity.*	*Correction for drift (0·07 mgal. per hr.)*	*Corrected relative gravity value.*
Kirklington	12·09	172·88 mgal	Nil	172·88 mgal.
Southwell	12·25	167·63 ,,	− 0·02 mgal	167·61 ,,
Oxton	12·51	162·44 ,,	− 0·05 ,,	162·39 ,,
Southwell	13·13	167·61 ,,	− 0·07 ,,	167·54 ,,
Kirklington	13·33	173·05 ,,	− 0·10 ,,	172·95 ,,

and Oxton, 162·39 mgal. (mean). Therefore the difference Kirklington–Southwell is 5·34 mgal. and Southwell–Oxton, 5·19 mgal.

The drift correction figure of 0·07 mgal. per hour is the mean of the rate of drift between the two observations at Kirklington and the two observations at Southwell obtained by weighting the apparent rate of drift in proportion to the lapse of time between the first and second observations in each case. The difference between the two Kirklington determinations was 0·16 mgal. in 1 hr. 24 min., or 0·12 mgal. per hour. The difference between the two Southwell determinations was 0·02 mgal. in 0 hr. 48 min., or 0·025 mgal. per hour. The ratio between the times is :—

$$\frac{1\cdot4}{0\cdot8} = 1\cdot75$$

and thus the weighted mean will be

$$\frac{(0\cdot12 \times 1\cdot75) - (0\cdot02 \times 1)}{2\cdot75} = \frac{0\cdot21 - 0\cdot02}{2\cdot75} = 0\cdot07.$$

After the test, when the value of the above differences had been reported, the values obtained by many previous determinations by the Anglo Iranian Oil Co. were given as :—Kirklington–Southwell, 5·46 mgal., and Southwell–Oxton, 5·19 mgal., with a probable error of about ± 0·05 mgal.

After the test the instrument was demonstrated and members of the party were given the opportunity to take observations, the instrument remaining in the same position all the time. An illustration of the instrument in use at Kirklington is given in Fig. 4.

Precipitation of Gold by the Merrill-Crowe Process

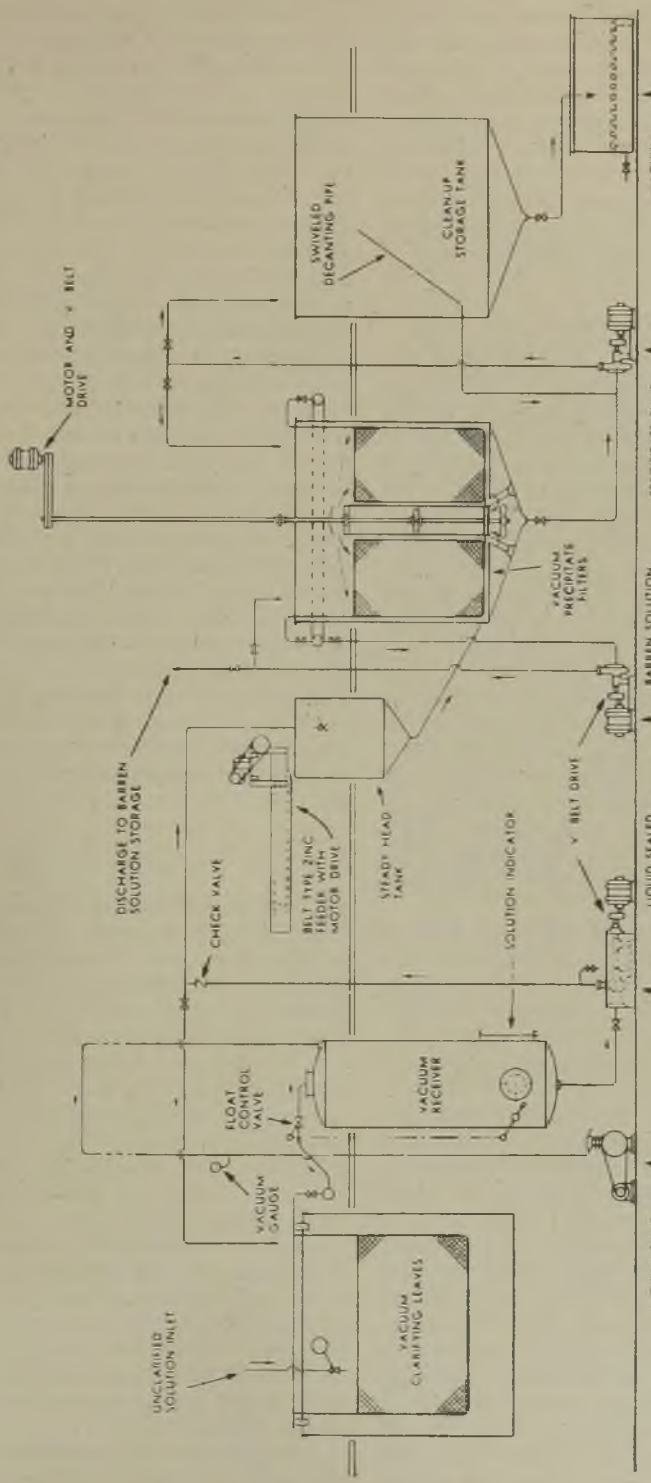
By J. G. Vivian

The author, until recently in charge of a gold mill in West Africa, gives some operating hints.

Introduction

The precipitation of gold from cyanide solutions by zinc dust in the Merrill-Crowe precipitation plant has almost entirely replaced the older method using zinc shavings in zinc boxes. The present short article is written entirely from a practical point of view. A few tips are given, which it is hoped may be useful, but the chemistry of the subject has not been touched on, since full details have already been given in many textbooks.

The Merrill-Crowe plant looks complicated at first sight, although its object is quite simple. First, the gold solution is filtered and its oxygen content is removed by a vacuum. The next step is intimate contact with zinc dust and, finally, the zinc-gold precipitate is collected for further treatment



Diagrammatic Flow-Sheet of a Merrill-Crowe Precipitation Plant of the Radial Vacuum Filter Type.

which ends in the production of gold bars. A small quantity of a lead salt, generally lead nitrate, is used, because a lead-zinc couple is a more efficient precipitant than zinc by itself. Diatomaceous earth (Trade Name "Hyposupercel") may be used to coat the precipitate filter leaves and forms an almost perfect filtering surface. It is composed of extremely finely-divided silica and acts as a flux when smelting after a clean-up.

Flow-Sheet

The following is a short description of the flow of the plant. Referring to the accompanying figure, a dry vacuum pump, connected by a barometric leg to the top of a vacuum receiver, maintains a vacuum in the receiver and draws solution through the filter leaves in the clarifier tank. The receiver is fitted with a solution indicator (a float connected by a rod to a float control valve) as shown; solution is discharged from the bottom of the receiver by a liquid-sealed centrifugal pump. The float value is adjusted so that the intake and discharge to the receiver remain constant and the level of the solution is maintained about half-way up the solution indicator. The receiver is fitted inside with wooden grids and weirs, so arranged that the solution is divided into thin layers and drops. The vacuum acting on the solution as it falls to the bottom of the receiver removes practically all the contained oxygen.

The liquid-sealed centrifugal pump delivers to a small steady-head tank, into which the requisite quantity of zinc dust is fed throughout the 24 hours. Combined with the belt-type zinc feeder, there is often a wet re-agent feeder, feeding a solution of lead nitrate to the same tank.

The de-aerated gold solution, carrying the correct amount of precipitant, gravitates to the bottom of a circular tank with conical bottom (precipitate filter tank) in which filter leaves are immersed; this tank is fitted with a stand pipe and a slow-speed impeller agitator. A small barren-solution pump is connected to the filter-leaf manifold and draws solution through the filter leaves, delivering it to barren solution storage for further use. Owing to the gentle agitation the zinc dust is kept in suspension until it forms an evenly-distributed cake on the filter leaves and as the solution is drawn through this cake practically all the gold is precipitated.

A centrifugal precipitate pump is connected with the bottom of the cone of the precipitate filter tank and at clean-up time delivers the solution and precipitate to a clean-up storage tank; when the former tank is empty the leaves are washed and the washings sent to the same pump. A clean-up storage tank is not absolutely necessary—if a small filter-press is available the precipitate pump can deliver direct to it; the only disadvantage is that the clean-up takes a little longer.

Alternative flows are provided for in case of imperfect clarification or imperfect precipitation; cloudy solution can be returned to the clarifier, from the vacuum receiver, by the liquid-sealed pump. If precipitation is imperfect and the so-called barren solution carries gold the barren-solution pump can return it to the precipitate filter tank instead of sending it to storage and it is circulated until the gold is all precipitated.

In addition to the filter-leaf type of plant shown small plants can be provided with bag-type filters and in large plants the precipitate is accumulated in a filter-press instead of on leaves.

The Merrill-Crowe precipitation plant is very efficient and with careful supervision the barren solution should only carry a trace of gold and should never exceed 0·05 dwt. per ton.

Process Troubles

Troubles do occur and their cause is sometimes difficult to find. Fortunately faulty precipitation can be spotted at once by carrying out regular colorimetric tests for gold in the barren solution. This test is too well known to need description. It is simple and sensitive and it can be carried out by an intelligent lab. boy, who should be checked at intervals, making sure that he is not using tin solution in which the stannous has all oxidized to stannic chloride.

The following are some of the causes of faulty precipitation:

Imperfect Clarification.—The gold solution should be crystal clear after passing the clarifier. It should be very carefully examined for the slightest sign of material in suspension. If it is at all cloudy, precipitation will not be efficient and there will be an increase in the bulk of precipitate to be dealt with at clean-up time.

Sand clarifiers are very satisfactory. There should be at least two of these, so that precipitation can continue when it is necessary

to change the sand in one of them. The sand used is often the under-flow from a cone classifier, which is included in the circuit for this purpose.

Two leaf clarifiers in series give good clarification, provided the leaves are removed and washed at regular intervals.

Faulty Zinc Dust.—The formation of lumps in the zinc dust, due to moisture entering containers in transit, will affect precipitation. The dust on the feed belt should be examined; it should be of the consistency of flour and there should be no feel of roughness to the touch. Dry grinding the dust in a laboratory ball-mill will often put matters right; care must be taken to stop grinding before too much heat is developed or the zinc may become oxidized.

Irregular Feeding of Zinc Dust, or Feeding Too Small a Quantity.—If the shift-boss in charge of the plant has forgotten to place dust on the feed belt and the plant has been running for some time without zinc, the value of the barren solution will, of course, rise. The same applies, to a less extent, to the lead nitrate feed. The quantity feed is in the metallurgist's hands and should be detailed in the Instruction Book.

Insufficient Cyanide Strength.—If the gold solution is low in cyanide, its strength can be increased by adding solid cyanide to the clarifier, or better, by a drip of strong solution to the steady-head tank to which the zinc dust is fed.

Ordinary cyanide solutions in use are generally quite strong enough for satisfactory precipitation. When periods of circulation within the plant are necessary, the cyanide strength may fall considerably and when precipitation is resumed the barren solution may carry gold.

Air Leaks in the Circuit.—The plant should be carefully examined for air leaks, especially in connexion with the liquid-sealed pump. Any oxygen entering the circuit at this point will cause trouble.

Leakage through Precipitate Filter Leaves.—If any of the filter leaves are faulty and precipitate is being drawn through them by the barren solution pump, it will be dissolved in excess cyanide solution and increase the value of the barren solution. Leaves should be examined at clean-up time and any doubtful ones replaced. The use of "supercel" will help to prevent leakage.

Height of Solution in Vacuum Receiver.—Unless this is correct and the solution can be seen in the indicator de-aeration will be imperfect and this will affect precipitation. If the solution level is not correct, the connexion between the float and float control valve requires adjustment, or the float may be leaking, in which case it will have to be removed and repaired.

Conclusion

There are, of course, other causes of faulty precipitation, especially when dealing with solution from, say, the treatment of flotation concentrate. In such cases the solution may be foul and the trouble may be entirely of a chemical nature. In some cases solutions may have to be discarded and an entirely fresh solution made up throughout the plant.

The quantity of zinc dust used varies and may be as high as 0·13 lb. per ton of solution. The quantity of lead nitrate, to give good precipitation, is usually about 10% of the weight of the zinc; "supercel," when used, is about 10% of the wet precipitate produced. The last-mentioned material is added to the precipitate filter tank when it is filled after clean-up; circulation of the solution then takes place for about two hours before any addition of zinc dust.

In addition to frequent colorimetric tests of the barren solution, drip samples from both this and from the gold solution are assayed daily. All solution leaving the plant is metered. From these the theoretical quantity of gold which should be recovered can be estimated.

Ore-Dressing Notes

(1) *General.*

War-Time Progress

A recent "progress report" on ore treatment in the United States during the war years, made by E. H. Rose,[1] makes interesting reading. War secrecy and restriction of travel have at times made accurate reporting in these Notes difficult—impossible, indeed, in some developments. For instance, the part played by mineral dressing in the production of uranium is not generally known. As with so many treatments to-day, however, the later stages of purification in

[1] *Min. Met.*, Feb., 1946.

this case must be chemical. Indeed, the suggestion that this column should be renamed " Ore-Processing Notes " made some years back was more factual than prophetic. The author named, quoting Taggart's definition of mineral dressing as, " the art of treating the crude mineral crust of the earth to produce therefrom primary-consumer derivatives," comments that :—

> The chemical engineering trend has forced (his) review to follow the facts . . . into the chemical engineering of minerals, rather than to cling futilely to the narrower definition of a bygone day. To draw fine distinctions between milling and mineral dressing and include a definitive limitation that no feed constituent shall undergo a change of state is no longer valid in 1945. . . .

The old boundaries between ore-dressing and pyro-metallurgy, electro-metallurgy, or hydro-metallurgy are gone. If there is enough bulk in a low-grade deposit to make cheap bulk handling possible, then it is up to the ore-dresser to devise a production-line process to extract the value, whatever may be its initial or final chemical combination. He has the whole field of physical, chemical, and electrical technology to exploit, providing only that he shows a final profit adequate to the risk.

Some of the new techniques cited in the article reviewed here have already been discussed in these Notes. For instance, the recovery of tungsten from a manganese-iron ore by something akin to the old Oxland process technique—that is, by crushing, sanding, pelletizing with suitable salts, sintering, and leaching out a soluble tungstate for precipitation with acids. The amphoteric minerals—vanadates, chromates, molybdates, stannates, and aluminates—are all capable of this type of handling.

In the war years flotation has gone ahead and is becoming controllable with increasing scientific precision. Non-metallic and oxidized ores are commercially floated and new collecting and modifying agents continue to be developed ; even cassiterite is reported to have been floated on an experimental scale. Spodumene, felspar, potash, sillimanite, ilmenite, garnet, pyrophyllite, oxidized copper and lead, lithium, and phosphate are among those rising in response to suitable conditioning. In addition flotation has ranged beyond mineral dressing into sugar-beet processing, brewing, and rubber work. Tannin derivatives are in increasing use as depressing agents, being specific to silica, calcite, and pyrite.

In comminution perhaps the most important trend is toward the use of the rod-mill as an intermediary between fine dry crushers and the secondary ball-milling circuit charged with 1-in. balls or even $\frac{3}{4}$-in., the reported effect being increased capacity with less dust, slime, and steel consumption. Small forged balls are being produced by the hot-shearing of square bar, followed by pressing to round the resulting cubes. Alternatively to rod-milling some flow-sheets use low-discharge primary ball-mills, grates or diaphragms for this purpose being increasingly favoured.

In connexion with circuit control the Haultain infra-sizer is selling well to mill laboratories. Automatic control makes steady headway, two plants now leaving all water adjustments to the instruments. Among new machines of which few details have yet reached England is a sink-float machine in which the ore forms its own selecting medium in the space between a fixed outer cone and a riffled inner one which revolves at 15 r.p.m. A complex of forces is brought to bear on the feed and field trials are in progress on some iron mines.

Among automatic controls that of the *p*H value is extending its use. One mill controls the addition of xanthate automatically. In pumping, constant head and automatic adjustment of speed to load have been developed. Microscopic examination of particles is aided by the use of slides mirroring the underside. Reading the review from which the foregoing points have been noted, one is increasingly impressed by the revolution which has occurred in milling methods and the increasing importance and technical skill of the modern mill superintendent in North America.

(2) *Filtration.*

" Home-Made " Clarifier

By simple adaptation, a Canadian mine has converted a spare thickener into an efficient sand clarifier. The raking mechanism was removed and a wooden grid put in, covered with coir matting underlying canvas. Sand was then run in to form a moderately-coarse bed 3 ft. thick. A scraping mechanism was next installed above this, actuated by the original thickener drive, and this is used intermittently to scrape off the uppermost layer of $\frac{1}{16}$-in. of sand and trapped sediment for discharge through the central

opening. The sand-filter cleans water for use as a wash on the filters.[1]

(3) *Crushing.*

Unblocking a Jammed Crusher

One tedious job that may have to be done after an event such as a failure of the power supply is the unblocking of a cone-crusher which has stopped under load. Describing the Hollinger method of dealing with this contretemps I. M. Gordon [2] points out that usually an hour or two is lost in emptying the crushing space by hand, the starting torque of the average motor being insufficient for it to free the trapped rock by reversal. An 8-ft. wrench was made to fit on to the end of the countershaft *via* a 22-in. diameter special wheel, which was substituted for the standard set collar. Normally this wheel does the work of the collar, but when the crusher is jammed the lever, weighing 400 lb., can be connected to it and worked by means of a 1½-ton chain block until it has turned the crusher back 30°. This process is repeated until the machine has been turned a half-circle, when the wedged-in fines can run free. In 44 shut-downs under load during the past three years an average of 23 minutes was lost, against 82 minutes for 27 stoppages cleared by the old method.

(4) *Sink-Float.*

Chance Sand Flotation

In a recent Note the consideration of quiet settling conditions, typically employed in ore-dressing, led us to forget one strongly established sink-float method employing hydraulic currents. The Chance process, used in coal preparation, works with a quicksand of controlled density and this density is maintained at the desired figure by a rising current of water. The effective density of this quicksand, or teeter-bed, depends on the extent to which the rising water is able to disperse it. For example, Gaudin shows that a suspension of quartz in water in the solid/liquid ration of 40/60 has a density of $(2{\cdot}65 \times 0{\cdot}4) + (1 \times 0{\cdot}6)$ or 1·66, if the sand used is of s.g. 2·65, and further that the hindered-settling ratio of any two minerals with respect to this teeter-bed is in accordance with their densities relative to that of the suspension and not

[1] *Can. Min. Journ.*, Feb., 1946.
[2] *Can. Min. Met. Bull.*, Aug., 1945.

Gold Dredge in West Africa.

of the liquid phase of the suspension. Coarse sand—such as is typically used in maintaining such a teeter-bed—follows the Newtonian law of settlement, not that of Stokes. The formulation and discussion of the mathematical principles involved are detailed in Gaudin's "Principles of Mineral Dressing."

In the commercial application now discussed the separating device forming the heart of the process is a cone in which sand is hydraulically agitated, this agitation being assisted by paddle stirrers. Raw coal, probably de-dusted, is fed to the cone, where it meets the quicksand, maintained by vertical currents of water introduced at three horizons. The fraction of the feed insufficiently heavy to penetrate the quicksand overflows to the discharge screens, where it is washed free of adhering sand, screened into sizes, and dispatched. The "sinks" capable of falling through the teeter-bed are either removed as a middling or allowed to sink to the refuse chamber. This is periodically cleaned, pneumatically-operated gates closing the top of the refuse chamber and then allowing the accumulated shale to run off *via* sand-reclaiming screens to waste or further treatment. The sand recovered from the overflows is trapped and recirculated.

The process is economical of power, flexible in that adjustment of teeter density within working limits is easily and quickly made, and has the further advantage that it uses a cheap and widely-available material—sand—as the separating medium. It is said to work down to the commercial screening limits of fine coal and, since density is the determining factor in separation, the upper size limit depends only on handling problems and the liberation size of coal from its associated impurities.

(5) *Panning.*

A New Technique ?

What appears to be a novel method of concentration, either batch or continuous, is reported from America.[1] The Gyro concentrator imitates mechanically the motions used in panning by hand. From a screen the feed works down over three screens in series or parallel, which are gyrated by a small motor. The 1-h.p. size is said to handle 7 cu. yd. of $\frac{1}{2}$-in. ore hourly with 72 gallons per minute of water and to have possibilities for other ores beside gold, on which it has been used exclusively to date.

Engineering Log

Scientific development of the flying bomb was not confined to Germany. Discussing American and German methods,[2] a group of United States workers observe that the structural strength of the bomb limits the launching strain which may be used, the United States tentative limit being an accelerative force of 18 g., or, better, 483 ft. per sec. per sec. This needs a 150-ft. ramp, a launching speed of 250 miles/hour, $\frac{3}{4}$ second on the ramp, and 55,000 h.p. being developed with 15,000 cu. ft. per min. of gas at 850 lb. per sq. in. at the moment of becoming airborne. It is not surprising that the German bombs constituted a considerable menace at and near the launching sites, when it is considered that these tremendous forces had to be built up from zero in less than one second and that in that short period a heavy projectile had to receive aiming guidance.

* * *

If mining can be defined as the extraction of desired elements from their natural deposits then the operation of extracting oxygen from the atmosphere must by now rank as a large-scale mining industry. Even before the war America alone took out 215,500 tons of oxygen annually. This sort of " mining ", like the extraction of magnesium from sea-water, has no trouble with ore reserves and dumps. A square mile of air at sea-level underlies some 20,000,000 tons of nitrogen and America, by using 500,000 tons annually in fertilizers, chemicals, etc., is hardly likely to start any new centres of atmospheric depression. Each 1,000 cu. ft. of air carries 9 cu. ft. of argon, used as an inert filling gas for lamps, and $\frac{3}{10}$ cu. ft. of neon, which, in the advertising signs of modern industry, appears far from inert.

* * *

Testifying before the Senate Special Committee on Atomic Energy, P. Morrison gave evidence [1] of the effect of the Japanese bombing which should be studied by every thinker who is interested in the survival of mankind :

> One plane roared down the runway, took off, and set course for the cities of the enemy . . . One plane, with one bomb . . . destroyed many square miles of a city . . . even more thoroughly . . . than the 1,000-plane strike. . . . War can now destroy not cities, but nations. . . . I remember vividly the lunch we had . . . in Hiroshima. The Japanese officials came there to . . . describe their experiences. . . . The chief medical officer of the district . . . had been pinned in the wreckage of his house for several days after the explosion. He had lived a little more than a mile from the point of impact and was still wearing splints. . . . Of 300 registered physicians more than 260 were unable to aid the injured. Of 2,400 nurses, orderlies, and trained first-aid workers more than 1,800 were made casualties in a single instant. . . . There were about 33 modern fire stations in Hiroshima. Twenty-six were useless after the blast and three-quarters of the firemen killed or missing. The military organization was destroyed ; the commanding general and all his staff were killed, with some 5,000 of the garrison of 8,000. Not one hospital in the city was left in condition to shelter patients from the rain. The power and the telephone service were both out . . . debris filled the streets and . . . thousands of fires burned unchecked among the injured and the dead . . .
>
> The atomic bomb is a weapon of saturation. It destroys so quickly and so completely such a large area that defence is hopeless. Leadership and organization are gone.

[1] *Chem. Met. Eng.*, Oct., 1945.
[2] *Ind. Eng. Chem.*, Feb., 1946.

[1] *Ind. Eng. Chem.*, Feb., 1946.

Loading Sulphur in Louisiana:

Crude material, some 99½% pure, being taken from a storage vat of the Freeport Sulphur Co.

When the bomb is detonated . . . it is as though a small piece of the sun has been instantly created . . . a hot, glowing mass something about one-third of a mile across, with a temperature of about a hundred million Fahrenheit in the centre of it. . . . The air, shocked into motion . . . moves dust like a blast wave. . . . Behind the wave of pressure there come great winds, 500 to 1,000 miles per hour, winds which damage and destroy all structures. . . . Even more striking than the damage to buildings is the great number of casualties. . . . Virtually all the people in the streets within almost a mile were instantly and seriously burned. . . . People inside buildings . . . were for the most part killed or seriously injured by falling walls and beams . . . many were burned to death by the secondary fires . . . after hundreds of stoves had been overturned. . . . Perhaps 5 or 10% escaped death from blast or burn. . . . But they died anyway . . . from the effects of radium-like rays emitted in great number from the bomb at the instant of explosion.

This is ugly reading, but it seems necessary. There can obviously, it would appear, be no more " appeasement " if we are to continue alive. There must be speedy abolition of all enmity and misunderstanding between nations. The atomic bomb leaves no middle way.

* * *

New York City's airport at Idlewild[1] is to cost £200,000,000 by the time its seven square miles have been developed. Some nine miles of 200-ft. wide runway 12 in. thick are planned, capable of bearing 150-ton aeroplanes, and there are also to be six miles of taxiway, 20 miles of road, a 15,000-ft. long basin for sea planes, parking for 30,000 cars, and an administrative area of more than a square mile, housing 40,000 people. The project was started by dredging up 60,000,000 cu. yd. of sand from Jamaica Bay, lifting the original meadows and marshlands several feet above high-water mark. The airport, begun in 1942, is partly in use and should be complete by 1949. Among other interesting details it can be noted that some 2 or 3,000

[1] *Exc. Eng.*, Feb., 1946.

acres of beach grass were planted to stabilize the shifting sands, a mechanized team of eight men completing 4 to 5 acres daily.

* * *

In the quest for more power from engines of less weight the problems of stress are not only metallurgical but also frictional. One result has been a great advance in the science of lubrication and it is to-day possible to make a choice of oils for various jobs, each developed to meet the special needs of the high temperatures, pressures, speeds, and working strains of modern machinery. Some of the lubricants which were developed under war urgency are : Oils which are not exploded by incendiary bullets, as are the usual hydraulic and lubricating fluids ; oils which actively combat rusting, and oils stable between — 100° F. and + 300° F. An explosion hazard was found to exist with ordinary hydraulic oils, due to the ignition of the atomized mist set up on impact by an incendiary bullet, a blast flame of 2,500 cu. ft being shown by testing of a gallon. Glycols form the base of the new " safe " hydraulic fluids. Silicones are finding their way into use, as their remarkable properties become better understood.

* * *

Nylon, not content with present conquests in the textile and allied industries, may soon invade new fields. A method of extrusion of this plastic through a slot of controlled width yields nylon in continuous strip of any colour and thickness desired, and by using embossing rolls the required surface finish can be achieved. Its toughness and strength should make it competitive with leather for handbags and upholstery in cars and furniture.

* * *

The various new dopes used to discourage mosquitos seeking a human free-lunch counter apparently only act when the insect approaches very close to the skin. Indeed, if there were any great volatility in the repellent it would be unable to keep up to its strength. Dimethyl phthallate on the clothing repels the tick-carrying scrub typhus, but a better compound consists of equal parts of benzyl benzoate and dibutyl phthallate, emulsified.

* * *

The *Compressed Air Magazine* recently celebrated its first 50 years by reviewing the developments of the past half century in its special field. Some earlier applications were a refrigerating system (1845), a pneumatic tube system in London 220 yd. long (1853), and the drills used in the Mont Cenis Tunnel (1861). In 1869 George Westinghouse patented his air brake, the Ingersoll, Sergeant, and Shaw drills came along in 1871, 1884, and 1890 respectively, and Leyner introduced the hollow-steel drill in 1897. The jackhammer did not come in till 1912. The pneumatic tyre was patented by Thomson in 1845, ahead of his time. Caisson work goes back to 1890 and the use of compressed-air locos for mine haulage to 1866. The first liquid air was produced in 1877, but not until 1895 did it become a practical source of oxygen for the newly-invented oxy-acetylene flame.

At one time compressed air was doing with some success the kind of jobs now handled electrically. In Paris a small installation set up in 1879 to drive public clocks in a 3-mile network had expanded by 1898 to 138 miles and was doing a number of power jobs in homes and factories.

The use of compressed air goes back 2,000 years and more, the ancients using it in organs, air-guns, and even a coin-in-the-slot device, as well as for diving work. The " trompe " type of compresser in which falling water entraps air and compresses it is first mentioned by Pliny. The Parisian compressor, already mentioned, was in essence a water ram, but in 1866 Burleigh in America was compressing air direct by using a piston action. Around the turn of this century compound compressors and electric drive began to develop. In due course 3,000 lb. pressures were developed for driving torpedoes and in connexion with the fixation of atmospheric nitrogen. Pressures to-day run as high as 15,000 lb./in^2., in the synthesis of ammonia. The early development of the air-actuated rock-drill is obscure, but when the wheel mechanisms of the '50s were superseded by straight reciprocation in the '70s the modern drill began to evolve. Whosoever contributed this or that idea, it seems to be Leyner who first made a practical hollow-steel hammer drill with dust-allaying water, after his first batch of dry-running tools had been thrown back on his hands in 1897. Hammer drills forged ahead when Leyner's patents expired in 1914 and by the English discovery of a technique for rolling hollow drill steel. The detachable bit came in in 1927.

Other applications of compressed air in industry include the chipping hammer (1883), the pneumatic hoisting cylinder (1896), sand blasting (1870), riveting hammers (1892), spray paint guns, foundry moulding machines, slushing motors, railtrack tampers, air wrenches, and similar tools.

* * *

Statistics collected by R. L. Hasche [1] on the German acetylene industry in war-time leave no doubt of the importance the enemy attached to this basic chemical engineering compound. In 1940 some 20 plants had a total capacity of 1,322,000 metric tons of calcium carbide. By May, 1942, this, with new producers, had become 1,471,800 tons and a target of 2,545,800 tons was planned. It went chiefly into the synthesis of solvents, chemicals, artificial rubber, and plastics. Some of the end-products listed are adhesives, lacquers, lubricating oil additives, vinyl esters, filaments, and fibres.

* * *

Plans [2] put forward by engineers of the U.S. Bureau of Reclamation are well advanced, their object being the control of China's "sorrow," the Yangtze River, by means of a 750-ft. dam some 300 miles east of Chungking. If they mature this will be the biggest job of its kind in the world to date, overtopping Boulder Dam by 24 ft. and containing 15,000,000 cu. yd. of concrete against the 10,000,000 of Grand Coulée. The 250-mile reservoir of 50,000,000 acre-feet will conserve water, control floods, provide irrigation for 10,000,000 acres and drive nearly 100 turbines, each generating over 100,000 kW., housed underground. The tremendous drop is to be handled, as regards shipping, partly by locks and partly by a mechanical ship-lift. Ships from down-stream are to enter a basin through a 200 ft. high tunnel and there be attached to cables from gantry cranes straddling the lock 550 ft. above. The cranes, having raised the ship, will move it along the tracks and drop it into the upper navigation channel. It is difficult for the trained engineer to take in figures of this sort and when one attempts to assess the benefits to China's teeming millions of peasants, now living at a dangerously low subsistence level as famine-conditioned family units, but perhaps soon to be welded into a nation by their joint interest in the Ichang Dam and all that it brings them, imagination falters. Chinese thrift, crafts-manship, and ancient civilization, served by modern engineering, may prove to be a big stabilizing factor in the world of to-morrow.

* * *

Kew Gardens are very much more than a place of pilgrimage for flower lovers. They focus a considerable scientific activity of Empire-wide importance. As Prof. E. J. Salisbury recently reminded his hearers at the Royal Society of Arts [1] identification and classification are essential services—the *Penicillia*, *Strychnii*, and Cinchonas being cited as cases where only a few species of numerous *genera* have known specific value. The Kew herbarium houses nearly 6,000,000 specimens of dried plants, to say nothing of seeds, and these are complementary to some 40,000 living species and a library of 45,000 books. A laboratory service has done fine work in developing Empire resources, whether for the purpose of increasing our reservoirs of raw material or of developing new products. Kew is an entrepôt and also a distributing centre for seeds and living plant specimens from all parts of the British Commonwealth and, as such, functions at its best when liaison with other centres in the Common-wealth is fully used. One example of its services is in connexion with the beginning of the cocoa-plantation industry of West Africa. Plants from Kew are believed to have been introduced *via* Brazil to Sierra Leone and Ceylon, cocoa of a different type going from Glasgow Botanic Garden to the Gold Coast in 1864.

[1] *Chem. Met. Eng.*, Oct., 1945.
[2] *Exc. Eng.*, Apr., 1946.

[1] *Journ.* Roy. Soc. Arts, Apr. 26, 1946.

News Letters

JOHANNESBURG

May 30.

St. Helena Flotation.—The prospectus of St. Helena Gold Mines outlines the methods to be adopted in the development of this pioneer mine in the newly-established Free State goldfield. It has been made clear by

all concerned that the work of starting several new mines in the Odendaalsrust area is not by any means free of difficulties. Mr. P. M. Anderson, in his speech at the statutory meeting of the company, did not underestimate these difficulties. He said it would take time to provide the necessary services for large-scale operations, but the various groups will undoubtedly work together in making the best of the available facilities. Water will probably have to be brought 50 miles from the Vaal River, the nearest reliable source, while electricity will have to be brought 120 miles from the nearest large power station. It will be some time before the railway administration is able to build a line from Whites to Odendaalsrust and in the meantime road transport will have to meet all the requirements.

The immediate programme is to sink an incline shaft, equipped with a steam winding engine, to the approximate sub-outcrop of the reef, which should be encountered within 500 ft. of the surface. The incline shaft will be at 30° to follow the reef, which dips between 25° and 30°, and thus allow lateral development to test the reef values in the vicinity of bore-holes T1, V3, V1, and V4. In the view of the company's technical advisers it will be possible to do sufficient work from this shaft to test the underground conditions in what appears to be the most promising part of the closely-drilled area.

Union's Coal Industry.—The South African coal industry continues to flourish, according to the reports of colliery companies in the Anglo American Corporation group for 1945. Higher profits and output are recorded as compared with the previous year. Better prices obtained have helped the companies to overcome the rise in working costs and the general prospects are considered to be good in both the home and export trade. A South African Coal Co-ordinating Committee, which will work in close liaison with the London and Washington Coal Committees, has just been formed for the purpose of allocating the Union's coal exports. The South African Coal Co-ordinating Committee, which is to meet once a month, will include representatives from the British Ministry of War Transport, the Union Department of Commerce and Industries, the South African Railways and Harbours, and the Union Ministry of Transport.

During 1945 the collieries of South Africa produced 25,465,584 tons of saleable coal, the average price per ton realized at the pit-mouths being 6s. 8·19d. per ton—an increase of 2¾d. per ton over the price obtained in 1944. The whole of this increase in price comes from the bunker and export market and South African consumers have obtained coal at practically pre-war prices, notwithstanding the increased costs borne by the industry. Amalgamated Collieries of S.A., Ltd., supplied more than 40% of the total output of South Africa, or approximately 10½ million tons.

In pursuance of a long-term policy of acquiring and investigating new areas for the purpose of providing replacements for the existing collieries, Amalgamated Collieries of S.A., Ltd., has concluded an arrangement with Coronation Collieries, Ltd., in terms of which a new company—called Witbank Coal Holdings, Ltd.—has been formed to consolidate certain coal interests in the Witbank and Middelburg districts of the Transvaal. Preliminary exploration has indicated that a considerable portion of the areas acquired by Witbank Coal Holdings, Ltd., is underlain by an extensive coalfield at workable depths. The development of this new interest will depend on the future of the coal market, but in the meantime it is regarded rather as an asset for exploitation when the present producers require to be replaced.

One new colliery has recently been opened—the Springbok Colliery, which belongs to the Anglo American Corporation of South Africa, Ltd.—and the Van Dyk's Drift Colliery, which is owned by the Corner House group is in the process of formation. The first of these collieries, the Springbok, is situate in the Witbank district. The colliery has been equipped for an output of 80,000 tons per month at an estimated cost of £425,000. The colliery started production in March of this year on completion of the railway line between Oogies and Van Dyk's Drift, for which line the Anglo American Corporation has stood guarantee for all losses. The quality of the coal produced places the colliery in the ranks of producers of first-grade export coal. Sales during March reached the 50,000-ton mark and it is expected that before the end of July the output will be 70,000 tons per month.

The Van Dyk's Drift colliery should reach full production in about two years' time. Bore-hole results have been very satisfactory and from the information obtained it is conservatively estimated that

Table 1

February

Name of Company.	*Tons milled.*	*Yield, dwt. per ton milled.*	*Declared value of revenue per ton milled.*	*Working costs per ton milled.*	*Declared working profit (estimated) per ton milled.*
			s. d.	*s. d.*	*s. d.*
Blyvooruitzicht . .	14,000	14·020	120 11	68 3	52 8
Government Areas .	192,000	4·009	34 11	27 7	7 4
Nigel Gold . . .	38,000	5·557	48 0	36 1	11 11
Randfontein Estates .	321,000	2·523	21 11	18 10	3 1
Springs Mines . .	113,500	3·891	33 8	27 8	6 0
West Rand Cons. . .	205,000	3·620	32 0	20 8	11 5

March

Blyvooruitzicht . .	20,000	13·825	119 6	70 2	49 4
Government Areas .	168,000	3·915	34 1	31 2	2 11
Nigel Gold . . .	38,000	5·263	45 5	38 1	7 4
Randfontein Estates .	298,000	2·557	22 3	21 7	0 8
Springs Mines . .	106,000	3·595	31 0	29 11	1 1
West Rand Cons. . .	175,000	3·694	32 8	24 11	7 9

there is recoverable, by primary extraction alone, at least 77,000,000 tons of high-grade coal, in addition to 65,000,000 tons of a slightly lower calorific value. The best quality in the deposits occurs conveniently in the two main seams, which adjoin each other and are virtually horizontal over the whole area of the farm. The depth of these seams at approximately 180 ft. below the surface will conduce to economical working. An incline and a vertical shaft are being sunk and plans are being completed for a modern coal-mining plant. The company will draw its electrical requirements from a power line already traversing the area and negotiations are in progress for the establishment of a water scheme which will serve both the colliery and the railway administration.

Chrysotile Asbestos.—The expansion of the asbestos-cement industry in recent years has created a demand for the shorter grades of chrysotile fibre in the Union at a much higher range of prices than these grades could formerly command. This demand must, if possible, be met by mines in the Union and at the present time there is an opportunity to investigate the prospects of many propositions which have a low percentage of spinning fibre in their ore-bodies and for that reason could not be exploited profitably on account of the low values received for their products overseas. Now that a steady local demand at satisfactory prices has been established the opening of some of the low-grade mines and the search for new propositions seems imminent. Already a new producer of high-grade chrysotile, which began production in 1945, is helping to meet the demand of the local manufacturing concerns and is also producing fibre of export quality. There is every reason to expect these manufacturing concerns to prosper and expand their business and with that prospect in view there seems no doubt that the production of chrysotile asbestos in the Union must show an increase in the near future.

Stoltzburg Asbestos (Chrysotile) Holdings, Ltd., has been formed with a capital of £200,000. Reports on the property, which is in the Carolina district, indicate that the asbestos ore-bodies occur in lodes and veins over a strike of four miles in the centre of three parallel mountain ranges. Asbestos outcrops have been opened up along the strike on the southern side of the central range, 1,000 ft. above the valley. It is considered that the lode occurrences can be opened up along the strike by stripping the overburden and using open-cast quarry methods. The view is expressed that the occurrence is an ore-body of immense dimensions, containing fibre in the form of stockwork. Although the fibre so far exposed is of shorter staple, the quality is good with a marked absence of talc and a recent analysis indicates that it compares favourably with Canadian fibre. The mill product is remarkably uniform and it is anticipated that production can be stepped up to 200–300 tons of marketable fibre per month without difficulty.

Miners Strike.—The strike of underground workers on the Witwatersrand, which occurred in the middle of March had a widespread effect on gold production in the Transvaal. The strike was called as a result of the dismissal of a miner from the Mine Workers' Union, thus losing his employment under the "closed shop" agreement. The strike, which started on three mines, spread rapidly until the whole of the Reef was affected and production ceased on all mines on the Witwatersrand. The actual losses incurred and the fall in production are shown in the monthly analysis of gold production in the Transvaal issued by the Transvaal Chamber of Mines for March. Table 1 sets out the comparative figures for February and March of six mines on the Witwatersrand.

VANCOUVER

June 5.

Mine Labour.—Labour unrest continues to provide a depressing influence throughout the Canadian mining industry, particularly in British Columbia. The single improvement noted recently has been conclusion of an agreement between Consolidated Mining and Smelting Co. of Canada, Ltd., and its employees. The new agreement provides for the elimination of previously-paid bonuses, which are now frozen into a basic wage rate, and for a 40-hour week to become effective at a later date. While the new contract has been hailed by the union as a labour victory there is some reason to question this interpretation, particularly when it is considered in the light of probable future increases in metal prices. Under the terms of the old agreement, now eliminated, increased metal prices would have meant substantial wage increases in the form of metal bonuses.

Meantime other operators and union officials appear to have reached a deadlock in efforts to negotiate. Most operators have offered an increase approximating 50 cents per day as the maximum possible at the present time. Union demands include 29 cents per hour increase, a 40-hour week, holidays with pay, differential shift pay, severance pay, a guaranteed minimum of 1,900 working hours per year, and full union security. Three large operating properties, Copper Mountain (Granby Consolidated Mining, Smelting, and Power Co., Ltd.), Premier, and Bralorne, have had strike votes and it is expected similar votes will follow at other properties.

Dr. H. T. James, in a recent official statement as President of the Mining Association of B.C., has condemned the union's demands as economically impossible and has warned that accession to them can result only in suspension of operations at many properties and greatly curtailed activity at others. Current negotiations between operators and union representatives evidence little possibility of reconciliation, although the Minister of Mines has been actively engaged in seeking some solution.

Slocan.—Milling has been resumed at the Silverton plant of Western Exploration Co., Ltd. Ore will be drawn from the Mammoth, Standard, and Enterprise mines, with the additional possibility of some custom ore from other properties in the district. The Western Exploration Company has been converted recently into a public corporation.

An increase in capital structure from 2,000,000 to 3,000,000 shares has been approved by shareholders of Utica Mines (1937), Ltd. New shares are to be offered to present shareholders on the basis of one new for each two old held, at a price of 25 cents per share. Funds raised are to be used for development and equipping of Utica's silver mine in the Slocan district. A firm commitment has been received by the company, which provides that in case the share issue is not fully taken up by present stockholders 500,000 shares will be purchased at 25 cents.

Nelson.—Mechanical difficulties, loss of fuel oil in storage, and extremely heavy snowfall during the winter months have delayed resumption of full-scale milling operations at Bayonne Consolidated Mines. These troubles have now been overcome and it is expected the first gold brick will be poured shortly. Development of the "A" vein on the 9th level has opened a substantial length of commercial-grade ore and has enhanced considerably the company's chances of making a successful small tonnage operation. A road is being constructed to the upper levels from the mill to permit transportation of ore.

Beaverdell.—The annual meeting of shareholders of Highland-Bell, Ltd., approved the sale of a controlling interest to Leitch Gold Mines, Ltd. The capital structure of the company is to be increased from 1,500,000

to 2,000,000 shares. Shareholders of Sally Mines, Ltd., have approved the sale of the Sally property to Leitch under an agreement whereby they will receive pro-rated shares in Highland-Bell. The new operators plan to increase materially the scale of operations. For the first quarter of 1946 Highland-Bell made a net profit of more than $131,000—an amount in excess of the net profit for the whole of the preceding year.

Omineca.—A new company—Duthie Mines (1946), Ltd.—has been incorporated with authorized capital of 3,000,000 shares to develop the well-known Duthie property on Hudson Bay mountain at Smithers, B.C. The Duthie mine, control of which passed to Smithers Mines, Ltd., now in liquidation, in 1932, was at one time a substantial producer of silver and base metals. It is equipped with a 50-ton mill. The new company has entered into an agreement with the official liquidator of Smithers Mines, Ltd., under the terms of which sufficient funds will be provided to meet all creditors' accounts and all monies paid for the equity of Smithers Mines, Ltd., will be returned.

Atlin.—It is expected that milling will be resumed at Taku River Gold Mines (Polaris-Taku) before the end of June. At the present time the underground crew exceeds 100 men and is being increased rapidly. The shaft is to be sunk an additional 300 ft. to provide two new levels. A minimum of ore will be hoisted during the time sinking is in process. Required ore will be drawn from the reserve of more than 30,000 tons (broken), most of which is above the main haulage level. Present plans call for an increase of mill capacity to 500 tons daily, to be put into effect as quickly as possible, and with this expansion in view a new Symons cone-crusher has been purchased and is in transit to the property. To provide adequate transport facilities from Juneau, Alaska, to the mine at Taku, B.C., a wooden tug and five steel barges have been purchased. The steamship *Chilliwack* has been chartered and has sailed from Vancouver with more than 400 tons of freight forwarded to the property.

Portland Canal.—An operating loss before write-offs of $14,600 was reported by Silbak Premier Mines for April. Net smelter returns of $43,986 were received from the treatment of 5,745 tons of ore averaging 0·22 oz. of gold per ton and 1·47 oz. of silver.

Production reported by Premier Border Gold Mining Company for the first quarter of 1946 was valued at $8,812, being the recovery from 612 tons of ore averaging $14·40 per ton. Ore from development faces and in the 781A stope is showing increased base-metal content. Average assays of the last 1,000 tons treated, according to Mr. A. E. Jukes, the president, have returned 14·5% lead and 5·28 oz. of silver and 0·09 oz. of gold per ton. It has been estimated that the ore reserves contain 12·3% lead and 20·6% zinc. Under present recovery methods the zinc content is lost.

(Photo : H. S. Fowler.)

Staking Claims in the Liard River Area.

Arrow Silver Mines, Ltd., has assumed the new title of Big Four Silver Mines, Ltd., following the consolidation of Porter Idaho, Prosperity, Silverado, and Silver Range mines, all at Stewart in the Portland Canal mining division. The Big Four company has a capitalization of 4,000,000 shares of 50 cents par value. It is financed by a number of well-known mine operators, including Transcontinental Resources, Ltd., Mr. W. B. Milner and associates, Mr. Karl J. Springer and associates, and Col. Victor Spencer. Development work under the direction of Dr. J. T. Mandy, consulting geologist, has been commenced. An extensive development

programme has been projected. A milling operation of between 150 and 200 tons daily capacity has been suggested by the company consultants.

Cariboo.—The annual meeting of shareholders of Cariboo Gold Quartz Mining Company, Ltd., approved the issue of 200,000 shares of treasury stock to Noranda Mines, Ltd., and Quebec Gold Mining Corporation at a price of $3·00 per share. The meeting also approved the sale of the Westport group of claims to Williams Creek Gold Quartz Mining Co., Ltd., in which the Cariboo company will hold 800,000 shares. Mr. J. Y. Murdoch and Col. G. H. Rainville have been added to the Cariboo directorate.

The April production of Island Mountain Mines Co., Ltd., was 1,486 oz. of gold, valued at $57,211, recovered from 3,488 tons of ore milled, averaging 0·425 oz. of gold per ton.

Following an extensive surface exploration programme conducted during the past year, geological interpretation as to the strike of two potential ore-bearing zones on Proserpine mountain has been revised and it is now believed that both the Rainbow and Lowhee members are situated considerably to the east of where they were previously considered to be. Dr. H. T. James, managing director of Barkerville Mining Company states :

> It is now believed the Rainbow member is to the east of the location previously ascribed, southeast of the town of Barkerville. If this proves to be correct, then the mineralized zone on which most work has been done to date would be a second potential zone, likely the continuation of the Lowhee member. The surface development programme will be intensified with a view to verifying the new concept.

Cariboo-Hudson Gold Mines (1946) has obtained an option to purchase the Cariboo-Thompson group of mineral claims adjoining the present Cariboo-Hudson holdings located near Barkerville. The Cariboo-Thompson holdings also adjoin the property of the newly-incorporated Canyon Cariboo Gold Mines, Ltd.

Alberni.—Construction of plant, mill, and camp buildings, designed by North Coast Engineering, Ltd., has been commenced at the Cangold Mining and Exploration Company property. Initial capacity of the flotation mill will be 50 tons per day. The cost of construction will exceed $150,000, with funds in hand for the project. A competent technical and supervisory crew has been engaged. It is anticipated that production will commence in September.

Nanaimo.—Dr. H. T. James, managing director of Vananda Mining Co., Ltd., informed shareholders at the recent annual meeting that development work on the Texada Island property has produced results justifying the decision to continue. Necessary equipment to increase the capacity of the Vananda power plant has been ordered and should arrive at the property shortly. When this has been installed and additional power is available it is proposed to un-water the Copper Queen workings and commence exploratory and development work in that section of the property. Work done to date has been confined to the Little Billy section.

Lillooet.—The annual meeting of shareholders of Bralorne Mines, Ltd., last month authorized an increase of 250,000 shares in the company's capital structure. However, action on the increase has been deferred indefinitely by reason of unsettled labour conditions. Bralorne's plans for expansion of plant and equipment to allow a daily milling capacity of 750 tons, together with plans for increased housing facilities at the Bridge River property, have been suspended until stable labour conditions obtain. The Bralorne mine is in excellent physical condition, with ore reserves at approximately the highest point in the company's history, exceeding 1,000,000 tons of average half-ounce ore. The large-scale underground development project planned for this year, which included a long drive back on the 20-level to the King mine, with exploration of the Bralorne-controlled Taylor Bridge River property, has also been postponed.

Exceptional activity throughout the Bridge River valley during the past few months has been featured by well-considered programmes of exploration and development at many old properties recently revived. Crews are presently working at Olympic, Congress, Bridge River Consolidated, B.R.X. (1935), Grull Wihksne, Pinebrayle, B.R. Mountain, and Pacific (Eastern). Particularly interesting are the operations at Congress and Pacific (Eastern). A winze has been sunk on the Congress property for two levels and interesting results have been obtained. Two veins, believed to be branches of the main Congress ore-body, have been cut in the sinking programme. Assay results were encouraging.

At Pacific (Eastern) the Quebec Gold Mining Corporation is carrying out a well-financed and determined programme of development following on a diamond-drilling

campaign which produced evidence of commercial ore-bodies. The shaft has been unwatered and a long drive will be made to investigate further the area in which diamond-drilling returned core sample showing free gold.

The Bridge River property of Pioneer Gold Mines of B.C., Ltd., has opened up an excellent body of ore on the "27" vein on the 25th level, extending over 700 ft. with an average width of approximately 6 ft. and returning assays averaging 0·5 oz. of gold per ton. Driving on the "40" vein from the Taylor tunnel, where ½-oz. ore was encountered in the first few rounds, has failed to prove continuation of these values over the approximately 80 ft. driven to date.

TORONTO

May 20.

Gold Production.—During March the gold mines of Ontario milled 623,837 tons of ore and recovered 146,055 oz. of gold and 27,229 oz. of silver, valued at $5,643,975. The month's output figures for the various producing districts were as follows: Porcupine, 343,320 tons milled, 72,387 oz. of gold, 14,540 oz. of silver, value $2,800,020; Kirkland Lake-Larder Lake, 167,044 tons milled, 44,630 oz. of gold, 9,088 oz. of silver, value $1,723,861; Matachewan-Sudbury, 20,422 tons milled, 2,529 oz. of gold, 1,147 oz. of silver, value $98,269; North-Western Ontario, 93,051 tons milled, 26,509 oz. of gold, 2,454 oz. of silver, value $1,021,825.

A Department of Mines report covering the first three months for the current year states that in the period 39 Ontario gold mines produced bullion valued at $16,408,716, which constitutes an increase of 9·45% over the comparable period of 1945, when 37 gold mines were in operation. The ore treated during the period under review totalled 1,764,798 tons, which contained 425,049 oz. of gold and 70,984 oz. of silver. The increase in tonnage milled is equivalent to 13·73% and that of gold content 9·31%; a decrease of 0·67% is reported for the silver content of the bullion. The average grade of ore treated in March, at $9·05, was the lowest recorded in many years and accounted for a slight drop in daily average output from the month of February. MacLeod-Cockshutt Gold Mines, Ltd., which had ceased operating in April, 1945, resumed milling on February 4, 1946. The output for the month of February is included in the March total. Magnet Consolidated Mines, Ltd., which had closed down in November, 1943, resumed milling in March, 1946. A report showing output was received, but the figures are not to be included in the gold bulletin until shown in the report of the Royal Canadian Mint. In Matachewan the Young-Davidson mill was closed down for the balance of the winter months on February 25, 1946. In Porcupine, the Hoyle mine, which closed down in July, 1943, shipped some ore in March, 1946, to the Pamour mine for milling. A report was received from the Hoyle mine for March, but, as in the case of Magnet, no production is being shown until a report is received from the Mint. The number of miners' licences issued and renewed in 1945 totalled 7,099, against 5,607 in 1944, 3,314 in 1943, and 3,244 in 1942. This, it is stated, is a good indication of the amount of interest being displayed in Ontario mining. Evidence that the coming summer will witness unprecedented activity in all the known goldfields of the Province is considerable and it is expected that new records in the number of mining claims recorded will be reached during the present year.

The gold production for the whole of Canada for February totalled 229,099 fine oz., as compared with 212,351 fine oz. in February, 1945, and 238,450 fine oz. in January, 1946. The value of the February, 1946, gold production was $8,820,311. Of the total gold production for that month, 190,543 fine oz. came from auriferous quartz mines and alluvial deposits and 38,556 fine oz. originated in base-metal mines. In March the Canadian gold output rose to 248,403 fine oz., valued at $9,563,516; of the output for that month 204,562 oz. came from auriferous quartz mines and alluvial deposits and 43,841 oz. from base-metal mines. Gold production from auriferous quartz mines and placers rose 8·4% in March, 1946, as compared with the production from corresponding sources in March, 1945. Production of gold from base-metal mines increased 9·5% in a comparison of the same periods. Employees in producing auriferous quartz mines, including both salaried employees and wage-earners, numbered 18,720 in March, 1946; the corresponding total for active non-producing mines was 785. Employees in non-ferrous metal mines, smelters, and refineries totalled 25,841.

MELBOURNE

June 20.

Mining at Yampi Sound.—The iron ore deposits on Cockatoo Island, in Yampi Sound, off the north-west coast of Western Australia, are to be worked by Australian Iron and Steel, Ltd., and it is expected that mining will be started at the end of 1946. Cockatoo Island is 3½ miles long, with a maximum width of 1½ miles, and contains a deposit of high-grade hæmatite 7,000 ft. long on the southern side. The width of the ore-body varies from 15 ft. to 100 ft.; it rises as a cliff from the Sound to a maximum height of 400 ft. above sea level, the average height being 260 ft. Underlying the hard iron ore is a bed of ferruginous schist, which for a length of 1,000 ft. contains an occurrence of soft, powdery high-grade hæmatite. The assay vaue of the main iron ore-body is 69% Fe; 0·005 to 0·05% P; and nil to 0·05% S; manganese is also low. For transport of the ore to the works in the eastern states of Australia a fleet of ships of 12,500 tons deadweight is being built at the Broken Hill Proprietary Company's shipyard at Whyalla, South Australia.

The mining, crushing, and shiploading equipment will be electrically operated and power will be supplied by three 750-h.p. diesel engines each driving a 400-kW. alternator generating 50-cycle, 3,000-volt current, which will be transformed down to 440 volts for reticulation. Two air-compressors will be installed, both of 500 cu. ft. per minute capacity. Caterpillar-mounted electric shovels of 4 cu.-yd. capacity will load broken ore into 28-ton capacity diesel-driven side-dumping motor trucks. The ore will then be delivered to the primary rock breaker, 84 in. by 60 in., driven by a 300-h.p. motor and reducing from a 4 ft. cube to 12 in. The product will pass from a surge bin to two secondary breakers, each 36 in. by 24 in., requiring 125 h.p., which will deliver a 4-in. product. This will be removed by a belt conveyor to a storage bin of 20,000 tons capacity, from which it will be loaded by a belt-conveyor with a shuttle and hinged boom at the outer end into the ship's holds.

Loading presents an interesting feature, for the rise and fall of the tide is 35 ft. Deep water extends close to the shore and as the Sound is sheltered a satisfactory ore-loading base can be established.

Adequate mechanical and electrical maintenance shops and equipment are being provided. Particular attention is being given to housing, for the climate is hot and the island remote. Electric cooking and other domestic appliances will be installed in all houses, as well as refrigerators. Fresh provisions, including vegetables, must be procured from a considerable distance, as the island is rugged and unsuitable for any form of cultivation. A diesel-engined vessel of 100 tons deadweight, fitted with refrigerating plant, has been built for the transport of stores between the island and the port of Derby, 87 miles to the south. It is expected that when mining is commenced, the permanent population of the settlement will approximate 250 people.

King Island Scheelite.—During the war extensive plant additions and much development work was carried out on the property of King Island Scheelite, N.L., on King Island, Tasmania, to increase the output of tungsten to meet requirements. The ore-bodies, which constitute the largest scheelite deposit in the world, occur in a series of slates and quartzites with a flat dip, varying from 20° to 40°. These beds are intruded by narrow veins of aplite and granite outcrops to the south. The ore-bodies conform in strike and dip to the containing rocks and consist of garnet, quartz, and about 1% of scheelite, the garnet rock representing altered and replaced beds in the slate. The ore-bodies are worked by open-cut and have been proved by diamond drilling and other exploratory work to contain over 1,000,000 tons of ore with an average grade of about 0·7% WO_3.

In order to meet war requirements a new mill was erected and other plant provided with a capacity of 20,000 tons of ore per month, at a cost of £520,000 (Aust.). The power plant has, however, proved inadequate for the proposed output and must be extended in order to bring the mine and other plant to full capacity. Possibilities of disposal of concentrate overseas have been examined and satisfactory arrangements have been made in the United States. In order to attain the full output, capital expenditure must be incurred for the plant additions and it is proposed to reconstruct the company with this objective. The war-time development was financed largely by the Government and discussions will take place in regard to the reconstruction. During April 7,321 tons of crude ore was treated for a recovery of 40 tons of scheelite concentrate, valued at £11,223 (Aust.).

Western Australian Gold Production.—Despite difficulties which still confront the industry, there has been an improvement in

the output of gold from Western Australia. Men are returning to the mines and are being re-employed as the availability of stores permits. As there are large arrears of development and stope preparation in most mines, it will be some time before the re-employment of labour affects gold recovery to any great extent. Evidence of improvement in the industry is shown by the issue of 384 miners' rights in the first three months of the year and by applications for 98 prospecting areas and 111 gold-mining leases in the same period. Lake View and Star, Ltd., Kalgoorlie, has raised its output of ore from the war-time level of between 20,000 and 25,000 tons per month, to 35,327 tons for the four weeks ended April 2. Other companies will have increased production, influenced more or less by the lag in development and preparation. The gold production for the State in the month of March was 39,856 fine oz., which is the best return since March, 1943. Comparative figures for March over a period of six years are shown in Table 1. The value of the production for March of this year, in Australian currency, is £428,945. The total production of gold in the State since the inception of the industry is 50,337,698 fine oz., valued at £277,576,565 (Aust.).

Table 1

Year.	*Fine oz.*
1941 . .	85,284
1942 . .	75,458
1943 . .	44,619
1944 . .	38,885
1945 . .	38,855
1946 . .	39,856

Victorian Gold Production.—Victorian gold output for March was lower than that of the previous month, the figures being 5,907 fine oz., valued at £63,577 (Aust.) as compared with the February figures of 6,023 fine oz., valued at £64,823. Production for the three months of the current year was 16,786 fine oz., worth £180,658—an increase of 2,894 fine oz. over the corresponding period of the previous year.

A further improvement can be expected with the gradual resumption of work by the numerous companies which were forced to close down during the war. Preparations for re-opening are in hand on the Bendigo and Daylesford fields, where workings are being unwatered and plant and equipment put in working order. A much greater advance in the industry would take place if the limitation of £10,000 on the capitalization of new companies and the restrictions on share prices and share dealing were removed by the Commonwealth Government. Despite representations, there is as yet no sign that these obstructions to progress will be withdrawn.

Control of Coal Mining.—Agreement has been reached between the Commonwealth and the New South Wales State governments in respect to the control of coal mining. There has been clamour for some time by the miners' unions for nationalization of the industry and the present agreement is the outcome of this agitation. Since the accession to power of a labour Government in the Commonwealth parliament, in the second year of the war, industrial conditions in the coal-mining industry have degenerated into anarchy; to such an extent that transport, power, and lighting, as well as domestic gas supplies, have been very seriously restricted on a number of occasions in the past two years. There has been much propaganda directed against the industry and its control, designed to one end, which is the assumption of control by Government. Actually, Australian collieries are well managed, with a high record of safety, and working conditions are of a high order, much superior to those obtaining in many surface industries. Colliery managers are generally progressive and much of the engineering is of a very superior standard, involving much highly-efficient mechanization. Full benefit to industry and the community has been nullified by the unions through their refusal to permit working of machines on more than one shift or to allow the operations of machines in pillar working. This drastic limitation of employment has been accentuated by the operation of the darg, or limitation of output, and by the unbroken succession of strikes, frequently for most trivial reasons or for no obvious reason at all. Collieries are sufficiently and well equipped to meet the country's demands and ample labour is available for an adequate output if proper control were restored, but production has lagged behind consumption because of deliberate restriction of output by the men.

Under the new conditions which will now come into force the mine owners of New South Wales will be deprived of all powers and all rights in the management of the industry and will be allowed merely formal rights of management in their own mines. The present calamitous condition of the industry has grown directly from the removal of all control and discipline from the manage-

ments by the labour administration during the war. With the new control, introduced solely for political reasons and without regard to the well-being of the industry, no improvement is to be expected.

Coal at Blair Athol.—At Blair Athol, 240 miles inland from Rockhampton, Queensland, is one of the thickest seams of black coal, free from bands, in the world. The thickness varies between 61 ft. and 90 ft. The coal is of Permian age, hard, and of good quality for steam purposes. The seam is practically horizontal and lies under sandstone overburden from 60 ft. to 100 ft. thick. Method of working is by open-cut and development is proceeding with the object of considerably increasing the output. The coal is in demand, but distance from seaboard is a disadvantage. There is a proposal to construct a railway from the mine to the port of Mackay, with the object of shortening the distance of haulage and delivering the coal at a deep-sea port.

Victorian Brown Coal.—The serious present position with regard to supplies of black coal to the State of Victoria and the no less serious future outlook are directing attention to large-scale development of the great brown coal deposits in the Gippsland and Bacchus Marsh areas of the State. Recommendations have been made for a scheme which will make Victoria independent of New South Wales coal in 15 years. The recommendations cover plans for the conversion of the present gas supply system based on black coal to the utilization of brown coal, with the ultimate establishment of gasworks at the coal deposit and the delivery of gas by pipe-line to Melbourne. The railways power station and all locomotives would be converted to the use of brown coal. The old open-cut brown-coal mine at Morwell would be re-opened to provide coal for industry, the coal at this locality containing less moisture than that worked at Yallourn. It is also proposed that the State give financial help to private companies operating brown-coal mines ; several such undertakings have been established in the last two years in order to relieve industry to some extent from the acute shortage of fuel.

The final proposal is the very important—one of the establishment of a fuel research station and a fuel advisory board. The State Government has already made considerable progress toward the establishment of a second large open-cut mine, which is planned to increase the production of briquettes to approximately 1,000,000 tons per annum within four years. This increase in production and the satisfactory results obtained in research into the gasification of brown coal will ultimately cause a very serious decline in the demand for black coal from New South Wales, apart from the more far-reaching recommendations mentioned.

Aluminium in Australia.—The Australian Aluminium Commission is proceeding with plans for an output of 10,000 tons of ingots per annum, for which production a plant is to be erected in Tasmania with a capacity of 60,000 tons of bauxite per year. The estimated cost of the undertaking is £3,000,000 (Aust.), of which the State and Commonwealth Governments will provide one half. New South Wales and Victoria have large deposits of bauxite, but the grade is below that obtainable from other world sources. The general grade of the New South Wales occurrences is 30% to 40% Al_2O_3 and one deposit in Victoria is estimated to contain 750,000 tons with an assay value of 51% Al_2O_3, 7% Fe_2O_3, and 10% SiO_2. High-grade bauxite, but in rather limited tonnage, has been located in Tasmania and active investigation of deposits is being carried out. Results, so far, indicate the existence of 500,000 tons containing 40% Al_2O_3 and 5% SiO_3. Occurrences have also been located in south-eastern Queensland. Ample cheap hydro-electric power is available in Tasmania.

Personal

C. G. Courtney Clarke is home from South Africa.

H. S. H. Donald has retired as Government Mining Engineer to the Union of South Africa. He is succeeded by D. G. Malherbe, who has been Deputy Government Mining Engineer since December, 1943.

J. V. N. Dorr is visiting Germany on a Government mission.

A. L. Gravillou is now in France.

K. C. G. Heath has resigned his position as Additional Chief Mining Engineer to the Central Excise Department of the Government of India.

H. C. Herbert is returning from India.

Aubrey E. Horn is returning from Nigeria.

J. W. Pertwee is home from Venezuela.

A. G. Ramsay has been appointed manager of the Mond Nickel Company at Clydach, South Wales. Dr. Ramsay succeeds I. A. Bailey, who has been appointed managing director of Messrs. Henry Wiggin and Co., Ltd.

Clarence T. Sweet is home from Uganda.

J. B. Toms is now in Cyprus.

H. H. Watson is home from the Gold Coast.

ARTHUR WILLIAM ROGERS, who died in Capetown on June 2, aged 74, was educated at Cambridge. In 1896 he went to South Africa to take up an appointment with the Geological Survey, from which he retired as Director some years ago. An authority on African geology, Dr. Rogers had been the recipient of both the Bigsby and Wollaston medals of the Geological Society of London and of the Draper medal in South Africa. He was also a Fellow of the Royal Society.

WILLIAM MCNEILL died at Hastings on June 10, aged 83. Mr. McNeill was educated at the Royal School of Mines, which granted him his A.R.S.M. in metallurgy in 1888. Mr. McNeill went to Western Australia and was engaged in the examination, development, and management of mines in that country, later taking up similar work in other parts of the world. About the turn of the century he set up in consulting practice in London and in this connexion visited mines in many countries. Mr. McNeill, who was a Whitworth Scholar and a Member of the Institution of Mining and Metallurgy, was also an Associate Member of the Institution of Civil Engineers.

Trade Paragraphs

General Electric Co., Ltd., of Magnet House, Kingsway, London, W.C. 2, in the *G.E.C. Journal* for February have an article on electrical progress and development which discloses matters hitherto kept secret for security reasons, is copiously illustrated, and covers a wide field.

Hadfields, Ltd., of Sheffield, have arranged with Paterson Simons, Ltd., the company's agents in the Malayan Peninsula, for Mr. Patrick R. Brogan to join their staff. Mr. Brogan, who is flying to Kuala Lumpur, has had a long experience at the East Heela Works, where he has specialized in heavy dredger work which is an important feature of the company's business in Malaya.

George Kent, Ltd., of Luton, have produced a well-illustrated booklet comprising an illustrated summary of the firm's principal activities from September, 1939, to August, 1945. In the March, 1945, issue of the MAGAZINE a short account of these was given. The present publication serves to emphasize these activities and is embellished by war pictures taken of the Fleet, anti-aircraft units, tanks, and aircraft.

Edgar Allen and Co., Ltd., of Sheffield, announce that they have just received a contract totalling £420,000 for two complete cement plants for China. Each plant comprises a raw crushing plant, raw grinding mill, rotary cement kiln, cement mill, packing plant, and auxiliary items, as well as a complete generating station for electricity. Each kiln is fired by a " Rema " unit coal plant, to be made by the British " Rema " Manufacturing Co., Ltd., a subsidiary company. Each works will produce 200 tons of cement a day, or approximately 60,000 tons per annum. *Edgar Allen News* for June contains an article on the production of synthetic bauxite from waste materials used in the cement industry and some notes on manganese steel in dredging work.

Consolidated Pneumatic Tool Co., Ltd., of 232 Dawes Road, London, S.W. 6, announce that in view of the expansion of their mining activities it becomes necessary to co-ordinate this branch of their business under central control and they have therefore appointed Mr. Norman H. Dixon as chief mining engineer and manager of their new coal-mining division operating from the above address. Mr. Dixon was educated at Manchester Grammar School, Wigan Mining College, and Manchester University. He was apprenticed to the late Mr. F. L. Ward at Bradford Colliery; was elected a Fellow of the Geological Society of London in 1927, and in 1929 a Member of the Institution of Mining Engineers. He joined the company as mining engineer in 1935, was appointed manager of their Manchester District in succession to the late Mr. E. W. Cetti in 1940, and on reorganization of the company's sales in 1943 was appointed manager of the North Midland District.

International Combustion, Ltd. (Grinding, Screening and Filtering Division), of 19, Woburn Place, London, W.C. 1, report the following among orders recently received :—Home : One Baby Raymond mill; one Baby Raymond mill for tricalcium phosphate 9 cwt./hour to 99·9% passing 400 mesh; three Raymond laboratory mills; one 8-ft. mechanical air separator for limestone at a feed rate of 4½ tons/hour, giving fineness of 99·5% — 200 mesh; one 54 in. by 24 in. Hardinge mill, air plant, and dust collector—to produce 12 tons in 5 days of lead powder at a fineness of 92% passing 100 mesh; one 4 ft. 6 in. by 24 in. Hardinge mill for galena ore tailings at two tons/hr. to 95% — 80 mesh in closed circuit with classifier; five VP 15 Syntron packers; four V 15 Syntron vibrators; five V 55 Syntron vibrators; two 3-in. Vacseal pumps for glass sand, and four 8-disc Rovac filters. For abroad : two Raymond laboratory mills; one 30-ft. mechanical separator for metallic powder; one Baby Raymond mill for iron ore; one Baby Raymond mill for oxides and barytes; one screen pulverizer for dry colour; one VP 55 Syntron packer, six V 55 Syntron vibrators, and one Rotap shaker.

National Gas and Oil Engine Co., Ltd., of Ashton-under-Lyne, in their *National Bulletin* for June have some particulars of a 4-cylinder traction diesel engine from which the following is extracted. Bulletin No. 242 described a " Planet " shunting locomotive in which the makers, F. C. Hibberd and Co., Ltd., Park Royal, London, have embodied our " DA 6 " 6-cylinder diesel (THE MINING MAGAZINE, April, 1946). We are now able to give details of a smaller locomotive of similar make for which we supplied our " DA 4 " 4-cylinder unit. The " DA 4 " engine is described fully in Publication No. 1241 A. It will develop 40 b.h.p. for one hour at 1,000 r.p.m. and 50 b.h.p. at 1,250 r.p.m. Starting is by hand, but electric starting equipment is also provided. There is a large-size radiator with belt-driven fan, water circulation being assisted by pump. It is of ample capacity for temperate and sub-tropical climates. The flywheel is machined all over and spigotted on the crankshaft flange. The clutch is of the inverted cone type, designed to transmit the maximum power of the engine under the severest conditions. The gearbox is of the 3-shaft pattern, with three speeds in either direction and the drive is by heavy roller chains to each axle.

Mond Nickel Co., Ltd., of Grosvenor House, Park Lane, London, W. 1, in their *Nickel Bulletin* for May have abstracts on the polarographic analysis of nickel compounds and other substances, determination of nickel in bronze, hard magnetic

materials, glass-to-metal seals, overheating and burning of steels, nickel, and nickel alloys in the paper industry, and the direct production of nickel-chromium steels from laterite ores. This is taken from a paper by T. F. Bailey to the Electrochemical Society and the following is reproduced from the abstract: The author refers to the war-time development of the Nicaro Project as a means of supplementing supply of nickel and describes a selective reduction process worked out for treating the Cuban ore. The process is based on the fact that nickel is more readily reduced than iron and iron more readily than chromium. Addition to the ore of a reducing agent in an amount insufficient for complete reduction of all the metallic constituents results in reduction of the nickel and part of the iron only. The balance of the iron and all the chromium, in the form of oxides, remain in the slag. Since this slag is of high iron-oxide content the reduced metal is low in carbon and the slag (which will normally require the addition of lime as a flux) is sufficiently fluid to make possible a clean separation of metal and slag. Either the slag, or the metal, or both, may be tapped from the furnace and the metal may then be de-oxidized and finished in the usual manner, producing nickel alloy steels which will meet standard specifications. A further amount of reducing agent is then added to the slag and all the metallic constituents left in the slag are recovered as high-carbon chromium-bearing pig iron, which may be mixed with chromium ore for production of chromium steel. As an alternative a smaller amount of the reducing agent may be added, resulting in recovery of metal in the form of a low-carbon chromium steel, while part of the chromium oxide and a small portion of the iron oxide remain in the slag. The percentage of nickel in the nickel-iron alloy extracted may be controlled by varying the amount of reducing agent added to the ore; the greater the amount of reducing agent added, the lower is the nickel content of the metal produced, due to the higher percentage of iron reduced. Nickel-iron alloys varying from 2 to 20% of nickel may thus be obtained. The author demonstrates the working of the process by giving the history of some typical reductions.

JOHNSON MATTHEY EXHIBITION

Johnson, Matthey, and Co., Ltd., of 78, Hatton Garden, London, E.C. 1, recently afforded us an opportunity of visiting the exhibition to which reference was made here in the May issue. This proved to be full of interest, as showing the remarkably wide range of applications in industry of the precious and rare metals. The exhibition was divided into sections covering chemical plant and apparatus, instruments, electronics, switchgear, a resistance-welding division, low-temperature brazing, a jewellery and allied trades division, a dental, surgical, and optical division, a chemical division, and a ceramic division.

Dealing with these in order the exhibits in chemical plant and apparatus included silver and silver-lined plant, platinum electrodes, agitators, sulphuric acid sprays, glass-melting crucibles, etc., platinum laboratory apparatus, and catalysts, including those of palladium, in many forms.

Instruments require uniformity in the materials of their manufacture and phosphor-bronze, beryllium-copper, platinum, and rhodium-platinum, were exemplified in such components as Bourdon tubes, diaphragms, springs, thermocouples, and resistance thermometers. For electrical instruments there were fine resistance wires, hairspring strip (some of the last-named in cadmium-copper), fine silver, gold-covered silver, and JMC gold suspension alloy for galvanometer suspension strips, fine aluminium tube for pointers, vitrified enamel scales on glass, and other items.

In the field of electronics it is pointed out, in a booklet prepared as a guide to the exhibition, that the metallurgical needs have increased both in scope and severity, particularly with high-frequency equipment. Precision-drawn resistance wires, cathode tubes and wires, and radio-frequency circuit elements were included and the metals and alloys represented in this group comprised nickel-chromium copper-nickel, copper, beryllium-copper, silver-clad copper, and electro-deposited silver and rhodium. Silvered mica condenser plates were also a feature.

Switchgear requires electrical contacts and for these no less than 45 metals and alloys are called into use—platinum, palladium, iridium, rhodium, copper, tungsten, molybdenum, and their many alloys and combinations. Many examples were shown of parts so made, together with contact springs in phosphor-bronze, nickel-silver, etc. For the current-carrying parts of circuit breakers the Mallory range of high-strength high-conductivity castings provides a means of restricting dimensions and reducing weight of moving parts and several examples were on show. In fuse elements silver plays a prominent part and several instances were given.

Resistance welding was well demonstrated as a means of assembling pieces of metal by welds of consistent strength. The importance of the electrodes and holders was shown and here again special examples by Mallory Metallurgical Products, Ltd., were in evidence. Spot welding electrodes, electrode holders and adaptors, seam welding wheels and blanks, Elkonite inserts, and Elkonite faced dies may be mentioned.

Low-temperature brazing afforded an opportunity for demonstrating the company's range of silver brazing alloys, Easy-flo, Argo-flo, Sil-fos, and Silbralloy being the four most widely used. They are available as strip, wire, rod, foil, wire rings, washers, etc. There were many typical applications illustrated. Silver-bearing soft solders—such as, Comsol and Plumbsol—were also featured in this section. They have a higher strength at elevated temperatures than the ordinary tin-lead solders.

Jewellery and its allied trades calls for sterling silver, carat golds, platinum, and palladium and there were interesting exhibits in this division not only of the raw materials of the trade but of the finished products of the silversmiths', goldsmiths', and jewellers' arts. Anodes and salts for electroplating were also a feature and the treatment of residues (sweeps) was indicated.

The three following divisions may be briefly mentioned. Under the heading of radium for medical use the company prepare salts of this metal and fit them into platinum needles and other containers. Rhodium plating is useful for surgical instruments requiring a stainless finish (anti-bacteria). The uses of the simple and complex salts of silver, gold, and the platinum-group metals was well exemplified in the chemical division—in particular silver nitrate, which is but one of over 30

salts of this metal produced. Standardized substances for spectrographic and chemical analysis formed an important feature of this part of the exhibition. The ceramic section covered an interesting display of china and glassware and evidence of the part played by precious metals in producing the bright colours to which this art lends itself.

By way of rounding off this story the company staged a small exhibit demonstrating the history of the firm. This served to recall the pioneer work of Percival North Johnson, whose grandfather, John Johnson, was in 1767 working as an "Essayer"—the only private practitioner in London at the time. His grandson established himself as a gold assayer at 79, Hatton Garden in 1817. Percival brought into the business a long experience of assaying and analysis and the acquisition of a new type of balance enabled him to introduce a finer degree of accuracy. This attention to detail was not welcomed in the bullion market where a wider margin yielding greater profits was advocated. He was therefore forced to buy bullion on his own assay, which influenced him to start a refinery in his garden. This refinery also employed a nitric acid process giving silver nitrate as a by-product and the methods for the industrial uses of this were investigated and the company's business in silver nitrate began. In the meantime the salts of the new and rare element uranium were being extracted from pitchblende and applied to the colouring of glassware. Vitreous colours for the decoration of pottery followed and these formed the basis of the wide interest in the ceramic industry held by the company to-day. Many items of historical interest have been preserved and these were included in this section of the exhibition.

Metal Markets

Copper.—The American copper "ceiling" was finally raised by the Office of Price Administration from 12 cents to 14·375 cents per lb., effective as from June 3. Difficulties resulting from strikes in the United States and Chile made themselves felt during the month and domestic production of raw copper has been adversely affected. It is understood that Chilean producers are seeking a price of 15 cents per lb.

In Britain the demand for copper has been well maintained and while consumers have been able to cover themselves fairly satisfactorily there have been reports of somewhat extended delivery delays. Little has yet been received from Chile against the 30,000 tons contract entered into earlier in the year. In the meantime United Kingdom stocks are on the decline and a good deal of blister copper has been sent to Belgium for refining and return to this country. In order to bring the selling price of copper more closely into line with current purchasing costs the Ministry of Supply has raised the price in this country £12 to £84 per ton, delivered, with effect from July 1, 1946.

Tin.—There has been no falling off in world demand for tin and supplies are still a long way from satisfying requirements. An additional allocation of metal amounting to 9,476 tons has been made by the Combined Tin Committee in addition to that announced on March 20—a further 2,840 tons going to France, 2,350 tons to America, 1,070 tons to Canada, and 640 tons to India.

The possibility of a substantial rise in the official maximum price is believed to have been discussed by the authorities and the chances of establishing a reasonably stable international quotation was also considered. No change was, however, made in the official tin quotation when the recent rises in copper, lead, and zinc were announced. Exports of Bolivian tin ore are likely to be on a smaller scale during 1946; costs of production and continued operations at a loss have already caused certain mines in that country to announce their intention to close down.

United Kingdom official maximum price £300 a ton, delivered.

Lead.—As was to be expected the shortage of supplies, small imports, and the continuance of rationing have resulted in lead consumption in this country being curtailed. The firmness in price of the raw metal has been responsible for more interest being shown in scrap and a good business has been done in this direction. The Ministry of Supply has recently announced that as a result of high purchasing costs it has been necessary to raise the official maximum price of lead to £55 a ton, as from July 1, 1946.

This decision has certainly not come as a surprise. The situation in America is no better, with deliveries to consumers very limited. The agreement with Britain regarding lead supplies has come in for a certain amount of criticism, as it is believed that American imports of pig lead are being adversely affected.

Mean price of soft foreign lead, July 1, 1946, £55 per ton, delivered, duty paid.

Zinc.—Effective as from July 1, 1946, the Government has raised the official maximum price of zinc by £10 a ton to £49 5*s*. This decision was made as a result of high Governmental purchasing costs. While adequate supplies are available there has certainly been a steady attrition of stocks and it is to be hoped that the Government has a long-term supply plan formulated and that zinc will not be permitted to go the same way as lead.

Mean price g.o.b. foreign zinc, July 1, 1946, £49 5*s*. per ton, delivered, duty paid.

Iron and Steel.—Production of iron and steel has shown no falling off. In fact peak war-time outputs have been exceeded and there is every possibility of this state of affairs continuing. Pig-iron output has also shown a further increase, but it is still barely adequate for current requirements. More interest has been shown in defective semi-finished material, owing to inadequate home and overseas supplies, although it has been reported that Belgium may export some 35,000 tons of semis to the United Kingdom later in the year. Finished-steel makers and plate and sheet rollers have very full order books and new business tends to be confined to fourth-quarter, 1946, and first-quarter, 1947, delivery. Demand for tinned and galvanized sheets continues unabated and is such that export orders in many instances have to be refused.

Iron Ore.—Production of iron and steel during the month has been maintained at a high rate and the call for high-grade ore has, as a result, been on an equally good scale. Home ore production

has fallen off as imports of good foreign ore have improved. Whilst imports are governed to some extent by foreign exchange problems, the need for high-grade ore to economize in fuel is widely appreciated.

Antimony.—The output of antimony metal has continued to be readily absorbed. There has continued to be a scarcity of ore supplies, so that smelting activity has remained somewhat limited. For 99% English regulus the official quotation has shown no change at £125 a ton.

Arsenic.—A steady demand for arsenic has been reported at the ruling price of £29 10*s.* to £29 15*s.* per ton ex store for 99% to 100% white material.

Bismuth.—Supplies of bismuth have not been any too plentiful, so that the market has remained firm at the current quotation of 9*s.* per lb. for merchant quantities.

Cadmium.—A world shortage of cadmium has remained in evidence and as a result the decision by the Ministry of Supply to decontrol the metal in this country with effect as from June 24 has come as something of a surprise. The acquisition, disposal, and price of the metal is now a matter of free negotiation and, for the present at any rate, the price can only be regarded as nominal. On the Continent around 9s. to 10s. per lb. is regarded as the ruling quotation.

Cobalt Metal.—Leading interests have continued to ask 9s. to 9s. 1d. per lb. throughout the month.

Cobalt Oxides.—The market has remained steady, with black oxide quoted at 8s. 7½d. per lb. and grey at 9s. 5½d.

Chromium.—Demand has been well maintained and the current price is firmly held at around 4s. 5d. to 4s. 8d. per lb.

Tantalum.—Sellers in this country have continued to quote £18 to £19 per lb.

Platinum.—A large pent-up war demand for luxury and industrial purposes has resulted in a strong demand for platinum metal, while the general shortage of supplies has resulted in the price in this country being raised to £17 10s. per troy oz. The export quotation is now around £22 to £23 an oz.

Palladium.—Leading interests in this country continue to quote £5 15s. to £6 per troy oz. A good demand has been reported during the month, mainly as a result of the world shortage of platinum.

Osmium.—Around £11 to £14 per troy oz. remains the current quotation.

Iridium.—Sellers here have recently raised their price to £31 to £32 per troy oz.

Tellurium.—There has not been a great deal doing here latterly, but the market has been firm at around 7s. per lb.

Selenium.—With a steady call noted for selenium, leading interests have maintained their quotation at about 8s. 6d. per lb.

Tungsten Ore.—A quietly steady tone has characterized the tungsten market throughout the month and with adequate official stocks consumers have been able to cover their requirements fairly easily. The official selling price for ore in Britain has shown no change at 75s. per unit, delivered, while the current open market quotation has been held at 67s. 6d. c.i.f.

Manganese Ore.—Conditions throughout the month have shown little change, consumers in this country being able to cover their needs fairly satisfactorily. So far as some countries are concerned, however, difficulties over transport have continued to exert an unfavourable influence. The official United Kingdom selling price remains controlled at 1s. 2d. per unit c.i.f. on the basis of pre-war freight and insurance rates, while buying prices vary from 1s. 2¾d. to 1s. 4¾d. per unit, on the same basis.

Aluminium.—There has been no falling off in the demand for aluminium and with considerable tonnages of both virgin and secondary metal available users are finding it easy to cover their requirements in contrast to the state of affairs at present ruling in the other major non-ferrous metals. For 99% material the price is maintained at £67 per ton, delivered.

Copper Sulphate.—Sellers here continue to quote £32 5s. per ton f.o.b., less 2%.

Nickel.—A steady demand has been reported throughout the month at the current figure of £190 to £195 per ton, depending on quantity.

Chrome Ore.—High-grade metallurgical ore has remained scarce, although, generally speaking, consumers have been able to cover their requirements fairly satisfactorily. For Rhodesian metallurgical ore £10 17s. 6d. remains the current official quotation, with £10 15s. named for Baluchistan chemical chrome.

Quicksilver.—The official quotation of £30 to £31 5s., according to quantity, at present ruling in this country continues to run a good deal above world values, which at the moment are in the neighbourhood of £19 to £21 a flask of 76 lb There is something of a glut of quicksilver on the world market at the moment and a reduction in the United Kingdom figure is not impossible.

Molybdenum Ore.—Demand remains steady at the ruling figure of 42s. 6d. to 45s. per unit of MoS_2, f.a.s.

Graphite.—The price is nominal and is mainly a matter of negotiation.

Silver.—Official stocks continue to cater for current requirements and the price is unchanged at 44d. per troy oz.

Metal Prices

Aluminium, Antimony, Copper, Lead, Nickel, Tin, and Zinc per Long Ton; Platinum per standard oz.; Gold and Silver per fine oz.; Wolfram per unit.

	£	s.	d.
Aluminium (Home)	67	0	0
Antimony (Eng. 99·6%)	125	0	0
" (Crude 70%)	100	0	0
Copper (Electro)	84	0	0
Lead (Soft Foreign)	55	0	0
Nickel (Home)	£190–£195		
Tin	300	0	0
Zinc (g.o.b.)	49	5	0
Platinum (Refined)	17	10	0
Silver		3	8
Gold	8	12	3
Wolfram (Buying, f.o.b.)	3	15	0
" (Selling, Delivered)	3	15	0

Statistics

TRANSVAAL GOLD OUTPUTS

	May*		June*	
	Treated Tons.	Yield Oz.	Treated Tons.	Yield oz.
Alpine (Barberton)	5,947	1,010	—	—
Blyvooruitzicht	29,500	22,272	30,000	24,041
Brakpan	109,000	£188,083	106,000	£187,560
City Deep	92,000	23,468	89,000	22,676
Cons. Main Reef	217,000	28,596	212,000	28,377
Cons.Murchison (T.V.L.)	6,900	£18,843	7,300	£20,036
Crown Mines	275,000	60,121	260,000	57,539
Daggafontein	163,000	£389,400	161,000	£385,811
Dominion Reefs	24,800	3,508	23,000	3,375
D'rb'n Roodeport Deep	180,000	33,495	175,000	32,390
East Champ D'Or	31,000	£47,640	29,000	£45,382
East Daggafontein	94,000	£204,588	94,000	£204,018
East Geduld	162,000	45,705	151,000	43,204
East Rand P.M.	210,000	41,437	204,000	40,566
Geduld	111,000	23,529	102,000	21,584
Geldenhuis Deep	68,500	7,938	64,000	11,396†
Glynn's Lydenburg	10,300	2,834	10,000	2,800
Government G.M. Areas	225,000	£366,617	212,000	£339,929
Grootvlei Proprietary	168,000	43,346	158,000	40,685
Langlaagte Estate	55,000	£71,154	48,000	£67,066
Luipaards Vlei	84,500	17,694	84,000	17,559
Marievale Consolidated	57,500	17,266	53,500	16,053
Modderfontein B	62,000	9,633	62,000	9,483
Modderfontein Deep	31,000	5,521	30,000	5,086
Modderfontein East	135,000	20,255	128,000	19,212
New Kleinfontein	104,000	15,961	101,000	15,491
New Modderfontein	90,000	11,910	84,000	16,164†
New State Areas	118,000	£189,044	110,000	£181,069
Nigel Gold	43,500	10,865	41,000	10,113
Nourse	74,000	14,076	71,000	13,561
Rand Leases	196,000	£319,041	181,000	£299,404
Randfontein	360,000	£403,284	360,000	£383,322
Rietfontein Consolid't'd	28,000	5,632	26,000	5,472
Robinson Deep	100,000	19,391	94,000	18,532
Rose Deep	75,000	11,346	75,000	11,050
Simmer and Jack	147,000	26,344	139,000	25,087
S. African Land and Ex.	92,000	£168,422	91,000	£162,752
Springs	124,500	£203,544	125,000	£199,140
Sub Nigel	69,000	35,501	64,500	33,156
Transvaal G.M. Estates	23,300	4,571	24,200	4,705
Van Dyk Consolidated	104,000	20,581	98,000	19,359
Van Ryn	59,000	£57,412	58,000	£57,374
Venterspost Gold	112,000	23,039	102,500	22,131
Village Main Reef	24,200	£33,841	24,200	£33,648
Vlakfontein	24,000	10,020	23,000	9,683
Vogelstruisbult	78,000	19,116	73,000	17,996
West Rand Consolidated	222,000	£346,944	221,000	£346,276
West Springs	59,000	£108,839	59,000	£107,647
Western Reefs	77,500	£158,230	77,500	£158,598
Witw'tersr'nd (Knights)	82,000	£97,637	79,000	£98,395
Witwatersrand Nigel	9,100	£22,791	8,600	£21,476

* Gold at 172s. 3d. per oz. † Includes 4,000 and 5,000 respectively, as Special Declarations.

COMPARATIVE TRANSVAAL GOLD FIGURES

	1943	1944	1945	1946
	Oz.	Oz.	Oz.	Oz.
January	1,074,754	1,029,398	1,029,384	1,016,458
February	1,011,672	969,017	965,569	946,577
March	1,108,789	1,038,414	1,036,443	877,449
April	1,075,363	995,915	1,028,544	994,988
May	1,096,195	1,058,875	1,030,990	1,049,195
June	1,064,572	1,038,331	1,024,796	—
July	1,089,708	1,039,851	1,032,717	—
August	1,059,932	1,053,954	978,097	—
September	1,054,980	1,024,341	1,002,716	—
October	1,060,198	1,024,574	1,058,283	—
November	1,056,979	1,006,986	1,020,990	—
December	1,046,879	997,572	1,005,016	—
Total	12,800,021	12,277,328	12,213,545	—

PRODUCTION OF GOLD IN THE TRANSVAAL

	Rand	Elsewhere	Total
	Oz.	Oz.	Oz.
June, 1945	1,002,071	22,725	1,024,796
July	1,009,518	23,199	1,032,717
August	953,280	24,817	978,097
September	982,537	20,179	1,002,716
October	1,032,907	25,376	1,058,283
November	999,212	21,778	1,020,990
December	981,168	23,848	1,005,016
January, 1946	996,175	20,283	1,016,458
February	923,468	23,109	946,577
March	855,832	21,617	877,449
April	974,434	20,554	994,988
May	1,026,007	23,188	1,049,195

NATIVES EMPLOYED IN THE TRANSVAAL MINES

	Gold Mines	Coal Mines	Total
June 30, 1945	306,394	27,433	333,827
July 31	303,686	27,316	331,002
August 31	303,479	27,498	330,977
September 30	303,642	27,159	330,801
October 31	301,366	26,944	328,310
November 30	298,406	27,195	325,601
December 31	292,408	27,028	319,436
January 31, 1946	298,756	27,533	326,289
February 28	306,719	27,640	334,359
March 31	310,446	27,746	338,192
April 30	310,923	28,012	338,935
May 31	307,190	27,768	334,958

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.	£
June, 1945	4,979,300	34 4	23 8	10 8	2,657,517
July	5,066,800	34 0	23 7	10 5	2,632,027
Aug.	4,758,300	34 2	25 1	9 1	2,148,765
Sept.	4,897,800	34 4	24 1	10 3	2,517,628
Oct.	5,104,300	34 4	23 6	10 10	2,758,873
Nov.	4,926,100	34 8	24 1	10 7	2,622,409
Dec.	4,780,500	35 1	24 6	10 7	2,526,770
Jan., 1946	4,884,100	34 9	24 5	10 4	2,514,880
Feb.	4,464,000	35 2	25 3	9 11	2,225,680
Mar.	4,224,600	34 6	28 0	6 6	1,364,982
April	4,744,400	35 1	25 2	9 11	2,356,640
May	—	—	—	—	2,506,332

MISCELLANEOUS METAL OUTPUTS

	4-Week Period To May 25		
	Tons Ore	Lead Concs. tons	Zinc Concs. tons
Broken Hill South	23,080	3,548	4,148
New Broken Hill	2,927	299	539
North Broken Hill	30,358	5,704	5,918
Zinc Corp.	38,663	6,975	1,665
Rhodesia Broken Hill *a*	—	1,074*	7,564†

(*a*) May. * Lead. † Zinc.

PRODUCTION OF GOLD AND SILVER IN RHODESIA

	1945		1946	
	Gold (oz.)	Silver (oz.)	Gold (oz.)	Silver (oz.)
January	47,829	7,444	45,261	7,961
February	46,009	7,518	42,089	7,440
March	48,166	8,547	44,969	8,094
April	49,072	8,622	—	—
May	47,797	7,554	—	—
June	46,998	7,772	—	—
July	47,972	8,705	—	—
August	47,666	7,846	—	—
September	47,995	8,100	—	—
October	47,550	8,471	—	—
November	45,567	7,687	—	—
December	45,620	7,707	—	—

RHODESIAN GOLD OUTPUTS

	May		June	
	Tons.	Oz.	Tons.	Oz.
Bushtick	13,300	1,869	—	—
Cam and Motor	25,000	£45,194	24,100	£45,255
Globe and Phœnix	6,100	2,841	—	—
Rezende	21,000	£16,182	20,100	£20,518
Sherwood Starr	7,800	£8,371	7,300	£7,456
Thistle-Etna	6,200	891	6,100	883
Vubachikwe	2,900	£4,781	—	—
Wanderer Consolidated	35,000	3,211	34,500	3,127

WEST AFRICAN GOLD OUTPUTS

	May		June	
	Tons	Oz.	Tons	Oz.
Ariston Gold Mines	21,500	£63,922	21,500	£63,957
Ashanti Goldfields	16,500	17,356	16,500	17,358
Bibiani	22,500	6,421	22,500	6,454
Bremang	—	1,784	—	—
Gold Coast Main Reef	9,080	3,868	9,230	3,861
Konongo	7,190	4,200	8,580	4,227
Marlu	7,250	253	17,680	1,983
Taquah and Abosso	20,000	4,974	25,000	5,986

WESTRALIAN GOLD PRODUCTION

	1944	1945	1946
	Oz.	Oz.	Oz.
January	36,796	41,508	42,471
February	33,196	35,947	37,523
March	38,885	38,855	39,855
April	26,806	35,134	41,297
May	37,762	34,202	46,312
June	40,973	36,591	—
July	36,582	39,861	—
August	60,193	59,414	—
September	39,475	33,578	—
October	37,331	34,108	—
November	36,156	41,590	—
December	42,107	39,760	—
Total	466,362	468,548	—

WESTRALIAN GOLD OUTPUTS

	4-Week Period			
	To Apr. 30		To May 28	
	Tons	Oz.	Tons	Oz.
Boulder Perseverance	6,244	1,881	6,356	1,687
Central Norseman	7,420	2,218*d*	8,558	3,067
Comet Mine	—	—	—	—
G.M. of Kalgoorlie	12,013	2,710*d*	11,274	3,139*b*
Golden Horse Shoe		755*f*	—	763*a*
Gt. Boulder Prop.	26,651	5,945	28,722	6,544
Kalgoorlie Enterprise	3,751	978	3,854	1,184
Lake View & Star	38,682	10,264	42,118	10,796
Morning Star (G.M.A.)	—	582	—	—
North Kalgurli	7,922	2,495	8,067	2,618
Paringa	7,046	1,434	7,150	1,458
Phœnix Mine	—	—	—	—
Sons of Gwalia	7,124	1,991*d*	7,608	2,054*b*
South Kalgurli	5,808	1,521	5,933	1,410
Tindals Gold	—	—	—	—
Waronga (Emu)	—	—	—	—
Wiluna	13,986	2,000*f*	—	—
Yellowdine	—	—	—	—

a June. *b* 4 weeks to June 11. *d* 4 weeks to May 14. *f* May.

PRODUCTION OF GOLD IN CANADA

	1945		1946	
	*Output oz.	*Total value $	*Output oz.	*Total value $
January	233,210	8,974,350	238,450	9,180,325
February	212,351	8,175,513	229,099	8,820,311
March	228,687	8,804,450	248,403	9,563,516
April	223,737	8,613,875	—	—
May	217,556	8,375,906	—	—
June	212,163	8,103,086	—	—
July	210,209	8,093,046	—	—
August	211,754	8,152,529	—	—
September	211,529	8,143,866	—	—
October	229,550	8,837,675	—	—
November	220,755	8,499,067	—	—
December	239,749	9,230,337	—	—
Total for Calendar Year	2,651,250	102,004,700	—	—

* Subject to revision.

ONTARIO GOLD AND SILVER OUTPUT

	Tons Milled	Gold Oz.	Silver Oz.	Value Canad'n $
May 1945	498,258	127,173	22,583	4,898,332
June	505,448	121,217	18,796	4,673,033
July	481,596	119,151	16,276	4,593,064
August	482,402	119,407	28,130	4,607,639
September	492,626	122,175	18,394	4,709,952
October	539,554	130,320	20,458	5,023,191
November	556,671	136,974	19,724	5,279,708
December	589,792	145,493	51,752	5,622,718
January, 1946	589,148	144,509	22,600	5,574,375
February	551,813	134,485	21,155	5,190,366
March	623,827	146,055	27,229	5,643,975
April	594,266	141,230	16,673	5,449,639

CANADA'S LEADING MINERAL PRODUCTS

		February,* 1946	March,* 1946
Asbestos	Ton	29,614	36,305
Cement	Brl.	273,379	603,811
Clay products	$	684,258	801,126
Coal	Ton	1,638,333	1,593,556
Copper	Lb.	28,298,803	34,374,946
Lead	Lb.	30,477,148	31,287,569
Nickel	Lb.	12,450,659	15,677,068
Silver	Fine oz.	1,045,448	1,179,862
Zinc	Lb.	39,784,315	42,957,226

* Subject to revision.

GOLD OUTPUTS, KOLAR DISTRICT, INDIA

	May		June	
	Tons	Oz.	Tons	Oz.
Champion Reef	9,440	4,354	9,440	4,546
Mysore	13,240	3,586	14,149	3,422
Nundydroog	12,962	3,522	13,110	3,694
Ooreguin	7,742	1,849	9,052	2,349

MISCELLANEOUS GOLD AND SILVER OUTPUTS

	May		June	
	Tons	Value £	Tons	Value £
Blackwater (N.Z.)	1,443	489*	—	—
British Guiana Cons.	—	594*	—	—
Emperor Mines (Fiji)	—	—	32,723	10,591*b*
Frontino Gold (Colombia)	8,240	32,813	—	—
Geita Gold (Tanganyika)	7,523	1,566*	9,470	1,851*
Martha Gold (N.Z.)	10,886	{ 2,156* { 15,610†	10,211	{ 2,642* { 21,001*
New Goldfields of Venezuela	4,795	3,081*	—	—
Rosterman (Kenya)	4,000	1,650*	—	—
St. John d'el Rey (Brazil)	—	100,200	—	103,800
Tati Goldfields (Bech'land)	4,500	173*p*	4,300	158*p*
Victoria Gold (Vic.)	—	834**d*	—	925**c*
Yukon Consolidated	—	$101,000	—	—

* Oz. Gold. † Oz. Silver.
b Period to June 5. *d* Period to May 14. *p* Profit. *c* To June 11.

OUTPUTS OF NIGERIAN AND OTHER TIN MINING COMPANIES

In Long Tons of Concentrate

	Mar.	Apr.	May.
Amalgamated Tin Mines	850	490	625
Bisichi	33‡	32	33‡
Ex-Lands	96	68	—
Fabulosa	84	—	—
Geevor	50	45	50
Gold and Base Metals of Nigeria	60	48	60
Jantar Nigeria	37	40	33
Jos Tin	—	—	—
Kaduna Prospectors	6	4	8
Kaduna Syndicate	49	54	45
Kagera	—	—	—
Kefn Tin	24	11	33
United Tin Areas.....	15	11	12

(*a*) Feb.

TIN RESTRICTION

Year	International Export Quota %			
	Jan.–Mar.	Apr.–June	July–Sept.	Oct.–Dec.
1931 ...	—	77·7	65·4	65·4
1932 ...	56·2	56·2*	43·8	33·3†
1933 ...	33·3	33·3	33·3	33·3
1934 ...	44	54	54	44
1935 ...	40	45	70	80
1936 ...	90	85	90	105
1937 ...	100	110	110	110
1938 ...	70	55	35‡	35†
1939 ...	35‡	40	120§	100**
1940 ...	120††	80	130§§	130
1941 ...	130	130	130	130
1942 ...	105	105	105	105
1943 ...	105	105	105	105
1944 ...	105	105	105	105

* Jan.–May. † July–Dec. ‡ *Plus* 10 for Buffer Stock. § June 14, 45; Sept. 1, 60; Sept. 12, 80; Sept. 18, 100; Oct. 11, 120. ** Sept. 1, 60; Oct. 11, 70; Nov. 1, 100. †† Nov. 1, 60; Dec. 1, 100; Dec. 8, 120. §§ May 27, 100; July 8, 130.

QUOTATIONS OF OIL COMPANIES' SHARES

Denomination of Shares £1 unless otherwise noted

	May 8, 1946			June 6, 1946			July 9, 1946		
	£	s.	d.	£	s.	d.	£	s.	d.
Anglo-Ecuadorian	1	17	3	1	18	3	1	19	3
Anglo-Egyptian B.	4	3	9	4	3	9	4	1	3
Anglo-Iranian Ord.....	5	3	9	4	18	9	5	5	0
,, ,, 1st Pref.	1	18	0	1	18	0	1	16	9
,, ,, 2nd Pref.	2	0	0	2	0	6	2	0	0
Apex Trinidad (5s.)	1	9	9	1	12	3	1	13	0
Attock, India	2	16	3	1	15	6	2	17	0
British Borneo Pet. (6s.)	1	1	3	1	4	0	1	3	6
British Burmah (4s.)		8	9		9	0		10	0
British Controlled ($5)		4	3		5	0		4	6
,, ,, Pref. (,,)		13	6		14	9		13	9
Burmah Oil	3	10	6	3	17	6	3	11	3
,, ,, Pref.	2	1	6	2	2	6	2	3	6
Canadian Eagle Ord.	1	14	0	1	16	6	1	13	9
,, ,, 7% Pref. ($3)		13	3		13	3		13	3
,, ,, 8% Pref.	1	12	9	1	16	6	1	14	3
Kern (3s. 4d.)		4	9		5	0		5	6
Lobitos, Peru	3	0	3	3	6	0	3	8	0
London and Thames Haven		15	3		16	6		15	6
Mexican Eagle Ord. (4 pesos) ...		16	6		14	9		13	9
,, ,, 8% Pref. (4 pesos)		16	6		14	9		14	0
,, ,, 7% Pref. (,,)		8	9		8	9		8	9
Phœnix Roumania		3	0		3	6		3	3
Royal Dutch (100 fl.).....	32	10	0	36	10	0	34	0	0
Shell Transport Ord.	4	3	0	4	13	9	4	13	9
,, ,, 5% Pref. (Units)	1	8	6	1	9	6	1	9	3
,, ,, 7% Pref.	1	18	3	1	19	0	1	18	9
Steaua Romana		5	0		6	0		5	9
Trinidad Central (10s.).....	1	5	0	1	6	3	1	5	3
Trinidad Leaseholds	5	3	9	5	13	9	5	16	9
Trinidad Pet. Dev.	4	12	6	5	7	6	5	3	0
,, ,, 6% Red. Cm. Pf.	1	3	0	1	2	9	1	2	9
Ultramar (10s.)	3	16	9	4	2	6	3	16	3
United British of Trinidad (6s. 8d.)		18	0	1	4	6	1	6	0
V.O.C. Holding (13s. 4d.)	3	8	9	3	17	6	3	15	0
7% Pref. (13s. 4d.)	3	8	9	3	17	6	3	13	9

Prices of Chemicals

Chemical stocks and prices are generally under control and the figures given below represent those last ruling.

		£	s.	d.
Acetic Acid, 40%	per ton	25	12	0
,, ,, 80%	,,	49	10	0
,, ,, Glacial	,,	59	0	0
Alum	,,	16	0	0
Aluminium Sulphate, 17 to 18%	,,	11	10	0
Ammonia, Anhydrous	per lb.		2	0
Ammonium Carbonate	per ton	42	0	0
,, Chloride, 98%	,,	22	10	0
,, Nitrate	,,	19	0	0
,, Phosphate (Mono- and Di-) ...	,,	69	0	0
Antimony, Sulphide golden	per lb.		1	11
Arsenic White, 99/100%	per ton	32	0	0
Barium Carbonate (native), 94%	,,	6	5	0
,, Chloride	,,	19	10	0
Barytes	,,	9	3	6
Benzol	per gal.		2	6
Bleaching Powder, 36% Cl.....	per ton	11	5	0
Borax	,,	30	0	0
Boric Acid (Comml.).....	,,	52	0	0
Calcium Chloride, solid, 70/75%	,,	5	15	0
Carbolic Acid, crude 60's	per gal.		3	9
,, ,, crystallized	per lb.			11
Carbon Bisulphide	per ton	39	0	0
Citric Acid	per lb.		1	9
Copper Sulphate	per ton	32	5	0
Creosote Oil (f.o.r. in Bulk)	per gal.			6
Cresylic Acid, 98%	,,		4	2
Hydrofluoric Acid, 59/60%	per lb.		1	1
Iron Sulphate	per ton	3	17	6
Lead, Acetate, white	,,	60	0	0
,, Nitrate	,,	55	0	0
,, Oxide, Litharge	,,	59	0	0
,, White	,,	72	0	0
Lime, Acetate, brown.....	,,	19	0	0
,, ,, grey, 80/82%	,,	23	10	0
Magnesite, Calcined ex W'h'se	,,	20	15	0
,, Raw.....	,,	9	7	6
Magnesium Chloride, ex W'h'se	,,	22	0	0
,, Sulphate comml.	,,	13	0	0
Methylated Spirit Industrial 66 O.P.....	per gal.		3	0
Nitric Acid, 80° Tw.	per ton	25	0	0
Oxalic Acid	,,	62	10	0
Phosphoric Acid (S.G. 1·750)	per lb.		1	1
Pine Oil	per cwt.	4	7	0
Potassium Bichromate	per lb.			7½
,, Carbonate (hydrated)	per ton	57	10	0
,, Chlorate	per lb.	Nominal		
,, Chloride, 96%	per ton	16	10	0
,, Amyl Xanthate	per lb.		1	3½
,, Ethyl Xanthate.....	,,			8
,, Hydrate (Caustic) solid	per ton	65	10	0
,, Nitrate	per cwt.	3	16	0
,, Permanganate	,,	7	19	3
,, Sulphate, 90%	per ton	Nominal		
Sodium Acetate	,,	41	0	0
,, Arsenate, 58–60%	,,	Nominal		
,, Bicarbonate	,,	11	0	0
,, Bichromate	per lb.			6½
,, Carbonate (crystals)	per ton	5	7	6
,, ,, (Soda Ash) 58°	,,	8	0	0
,, Chlorate	,,	36	0	0
,, Cyanide 100% NaCN basis	per lb.			8½
,, Hydrate, 76/77%	per ton	16	4	0
,, Hyposulphite, comml.	,,	14	15	0
,, Nitrate	,,	15	5	0
,, Phosphate	,,	22	10	0
,, Prussiate.....	per lb.			9½
,, Silicate	per ton	8	10	0
,, Sulphate (Glauber's Salt).....	,,	4	10	0
,, ,, (Salt-Cake).....	,,	4	11	0
,, Sulphide, flakes, 60/62%	,,	20	17	6
,, Sulphite, comml.	,,	13	0	0
Sulphur, American, Rock (Truckload).....	,,	12	10	0
,, Ground	,,	16	15	0
Sulphuric Acid, 168° Tw.....	,,	6	12	6
,, ,, free from Arsenic, 140° Tw.	,,	4	11	0
Superphosphate of Lime	,,	5	10	0
Tartaric Acid	per cwt.	15	8	0
Tin Crystals	per lb.	Nominal		
Titanium white, 70%	per ton	37	10	0
Zinc Chloride	,,	20	0	0
,, Dust, 95/97%	,,	Nominal		
,, Oxide (White-Seal)	,,	45	15	0
,, Sulphate	,,	25	0	0

Share Quotations

Shares are £1 par value except where otherwise stated.

GOLD AND SILVER:	June 6, 1946. £ s. d.	July 9, 1946. £ s. d.
SOUTH AFRICA:		
Blyvooruitzicht (10s.)	9 12 6	10 3 9
Brakpan (5s.)	17 9	15 9
City Deep	2 15 0	2 12 6
Consolidated Main Reef	2 8 9	2 6 3
Crown Mines (10s.)	6 17 6	6 2 6
Daggafontein (5s.)	3 7 6	3 6 9
Dominion Reefs (5s.)	5 6	5 9
Durban Roodepoort Deep (10s.)	3 17 6	3 16 3
East Daggafontein (10s.)	2 11 9	2 10 0
East Geduld	10 17 6	10 6 3
East Rand Consolidated (5s.)	18 6	16 6
East Rand Proprietary (10s.)	2 13 9	2 10 6
Geduld	7 2 6	6 12 6
Geldenhuis Deep (17s. 6d.)	1 2 6	1 2 6
Government Gold Mining Areas (5s.)	1 8 9	1 6 9
Grootvlei	7 1 3	6 17 6
Klerksdorp (5s.)	6 9	6 9
Lace Proprietary (5s.)	1 8 3	1 6 3
Libanon (10s.)	1 9 6	1 7 9
Luipaards Vlei (2s.)	1 4 9	1 3 0
Marievale (10s.)	1 13 6	1 12 3
Modderfontein B (5s.)	8 0	8 9
Modderfontein East	3 5 0	3 0 0
New Kleinfontein	1 10 6	1 9 6
New Modderfontein (10s.)	8 3	8 0
New State Areas	1 10 0	1 10 6
Nigel Gold (10s.)	1 12 6	1 10 0
Nourse	1 16 9	1 15 0
Rand Leases (10s.)	3 0 0	2 16 3
Randfontein	1 11 9	1 8 9
Rietfontein Consolidated (5s.)	16 6	15 6
Robinson Deep B (7s. 6d.)	18 9	15 9
Rose Deep	1 8 9	1 8 9
Simmer and Jack (2s. 6d.)	13 0	12 0
South African Land (3s. 6d.)	2 6 3	2 5 0
Springs (5s.)	14 9	14 9
Sub Nigel (10s.)	5 7 6	5 2 6
Van Dyk (10s.)	15 9	15 0
Van Ryn (10s.)	14 6	15 0
Venterspost (10s.)	2 11 9	2 8 9
Vlakfontein (10s.)	1 10 9	1 8 9
Vogelstruisbult (10s.)	1 9 0	1 6 6
West Driefontein (10s.)	5 0 6	5 8 9
West Rand Consolidated (10s.)	1 18 3	1 16 9
West Springs	1 6 3	1 3 9
West Witwatersrand Areas (2s. 6d.)	7 7 6	8 5 0
Western Holdings (5s.)	4 17 6	4 12 6
Western Reefs (5s.)	2 10 9	2 5 0
Witwatersrand Gold (Knights)	1 11 3	1 8 9
Witwatersrand Nigel (5s.)	7 9	8 9
RHODESIA:		
Bushtick (10s.)	6 3	5 9
Cam and Motor (12s. 6d.)	1 15 0	1 12 6
Globe and Phœnix (5s.)	1 5 0	1 4 6
Rezende (1s.)	6 9	6 3
Sherwood Starr (5s.)	3 0	2 9
Wanderer	8 3	9 3
GOLD COAST:		
Amalgamated Banket (5s.)	9 0	7 9
Ariston Gold (2s. 6d.)	13 6	13 3
Ashanti-Adowsena (2s.)	3 0	2 9
Ashanti Goldfields (4s.)	3 5 9	3 5 0
Bibiani (4s.)	1 15 3	1 13 0
Bremang Gold Dredging (5s.)	6 9	6 3
Gold Coast Banket Areas (2s.)	3 9	3 6
Gold Coast Main Reef (5s.)	14 0	13 0
Gold Coast Selection (5s.)	1 16 9	1 15 3
Konongo (2s.)	6 9	6 3
Kwahu (2s.)	1 18 9	1 16 3
London & African Mining Trust (5s.)	14 0	12 3
Marlu (5s.)	9 9	8 9
Nanwa	6 0	5 3
Offin River Gold (5s.)	7 0	6 6
South Banket Areas (2s.)	3 3	3 3
Taquah and Abosso (4s.)	1 13 3	1 11 9
AUSTRALASIA:		
Blackwater Mines, N.Z.	13 0	13 0
Boulder Perseverance (4s.), W.A.	10 0	10 0
Gold Fields Aust. Dev. (5s.), W.A.	5 0	7 3
Gold Mines of Kalgoorlie (10s.)	9 0	10 6
Golden Horse Shoe (3s.), W.A.	2 9	2 6
Great Boulder Propriet'y (2s.), W.A.	8 9	9 6
Lake View and Star (4s.), W.A.	1 7 6	1 7 3
Martha Gold (5s.), N.Z.	5 0	4 9
Mount Morgan (2s. 8d.), Q.	6 6	6 3
North Kalgurli (1912) (2s.), W.A.	1 0 0	1 1 9
Paringa (1s.), W.A.	4 0	4 9
Sons of Gwalia (10s.), W.A.	1 8 9	1 10 0
South Kalgurli (5s.), W.A.	19 6	1 3 3
Wiluna Gold, W.A.	14 0	16 6

	June 6, 1946. £ s. d.	July 9, 1946. £ s. d.
INDIA:		
Champion Reef (10s.)	1 5 0	1 5 6
Mysore (10s.)	12 0	10 6
Nundydroog (10s.)	17 6	16 3
Ooregum (10s.)	8 9	10 0
MISCELLANEOUS:		
Fresnillo	2 2 6	1 18 3
Frontino, Colombia	1 11 3	1 10 0
Kentan Gold Areas (10s.), E. Africa	8 3	8 9
Mexican Corporation (10s.), Mexico	1 1 0	19 0
New Goldfields of Venezuela (5s.)	1 9	1 9
Rosterman (5s.), Kenya	11 3	10 3
St. John d'el Rey, Brazil	2 2 6	2 0 0
Yukon Consolidated ($1)	10 0	9 6
COPPER:		
Esperanza Copper and Sulphur	2 9	2 9
Indian (2s.)	7 0	8 0
Messina (5s.), Transvaal	19 0	19 6
Mount Lyell, Tasmania	18 3	17 6
Nchanga Consolidated, N. Rhodesia	3 11 3	4 0 0
Rhodesia-Katanga	3 6	5 6
Rhokana Corporation, N. Rhodesia	9 16 3	9 15 0
Rio Tinto (£5), Spain	13 15 0	17 5 0
Roan Antelope (5s.), N. Rhodesia	16 6	16 0
Tanganyika Concessions	15 6	16 9
Tharsis (£2), Spain	1 18 9	1 18 9
LEAD-ZINC:		
Broken Hill South (5s.), N.S.W.	1 8 3	1 6 9
Burma Corporation (9 rupees)	12 9	12 6
Electrolytic Zinc, Tasmania	2 9 0	2 11 3
Lake George (10s.), N.S.W.	10 3	10 9
Mount Isa, Queensland	1 8 9	1 12 6
New Broken Hill (5s.), N.S.W.	1 12 3	1 13 0
North Broken Hill (5s.), N.S.W.	2 13 3	2 10 9
Rhodesia Broken Hill (5s.)	13 3	13 3
San Francisco (10s.), Mexico	1 3 9	1 3 6
Sulphide Corporation (15s.), N.S.W.	8 6	8 9
Zinc Corporation (10s.), N.S.W.	4 3 9	4 1 3
TIN:		
Amalgamated Tin (5s.), Nigeria	12 9	12 9
Beralt (5s.), Portugal	9 3	8 3
Bisichi (10s.), Nigeria	10 0	10 6
Ex-Lands (2s.), Nigeria	5 0	6 9
Geevor (5s.), Cornwall	6 9	6 3
Gold & Base Metals (2s. 6d.), Nigeria	2 3	3 0
Jantar Nigeria (3s.)	8 3	8 3
Jos Tin Area (Nigeria) (5s.)	10 0	11 0
Kaduna Syndicate (2s.), Nigeria	9 0	9 3
Mawchi Mines (4s.), Burma	1 9 6	1 8 0
Naraguta (10s.), Nigeria	9 0	9 0
South Crofty (5s.), Cornwall	4 6	4 0
United Tin Areas (2s. 6d.), Nigeria	5 0	5 3
DIAMONDS:		
Anglo American Investment	3 4 6	3 1 9
Consol. African Selection Trust (5s.)	1 16 3	1 16 3
Consolidated of S.W.A. (10s.)	2 9 0	2 6 9
De Beers Deferred (£2 10s.)	22 15 0	21 5 0
West African Diamond (5s.)	2 3	2 9
FINANCE, ETC.:		
African & European	11 7 6	10 10 0
Anglo American Corporation (10s.)	6 17 6	6 11 3
Anglo-French Exploration	1 12 6	1 15 0
British South Africa (15s.)	1 16 3	1 17 0
British Tin Investment (10s.)	16 9	15 9
Broken Hill Proprietary	1 19 0	1 17 6
Camp Bird (10s.)	13 6	13 3
Central Mining (£8)	26 10 0	25 15 0
Central Provinces Manganese (10s.)	2 16 9	2 17 0
Consolidated Gold Fields	4 11 3	4 6 3
Cons. Gold Fields of N.Z. (4s.)	6 0	6 0
Consolidated Mines Selection (10s.)	2 17 6	2 13 9
Eastern Trans. Consolidated (5s.)	12 3	12 0
General Mining and Finance	7 3 9	7 2 6
Gold Ex. and Fin. of Australia (10s.)	12 0	13 3
Gold Fields Rhodesian (10s.)	14 0	13 9
H.E. Proprietary (10s.)	2 8 9	2 8 3
Henderson's Trans. Estates (4s.)	9 9	11 0
Johannesburg Consolidated	5 15 9	5 10 0
London & Rhod. M. & L. (5s.)	7 0	6 6
London Tin Corporation (4s.)	6 0	5 6
Marsman Investments (10s.)	15 6	15 3
Minerals Separation	5 7 6	4 13 6
New Central Witwatersrand (5s.)	1 3 0	1 2 6
Oroville Dredging (4s.)	1 1 0	1 1 0
Rand Mines (5s.)	7 8 9	7 7 6
Rand Selection (5s.)	2 15 0	2 11 3
Rhodesian Anglo American (10s.)	1 7 9	1 9 3
Rhodesian Corporation (5s.)	8 9	8 6
Rhodesian Selection Trust (5s.)	1 3 9	1 3 6
Selection Trust (10s.)	2 10 0	2 12 0
South West Africa Co. (13s. 4d.)	1 6 3	1 5 0
Union Corporation (12s. 6d.)	13 15 0	14 13 9
Venture Trust (6s. 8d.)	6 3	6 6
West Rand Ind. Trust (10s.)	2 10 0	2 8 0
Zambesia Exploring	1 3 0	1 2 9

THE MINING DIGEST

A RECORD OF PROGRESS IN MINING, METALLURGY, AND GEOLOGY

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

United States Barytes

The mining and marketing of barytes in the United States are reviewed by C. L. Harness and F. M. Barsigian in U.S. Bureau of Mines Information Circular 7345. In their introductory notes the authors point out that the barytes industry has made notable progress since the days when the mineral was used only as an adulterant in white-lead paints and the only method of mining it was with pick and shovel. They give a chronological record to show how the mineral has grown in importance in United States economy and at the same time to indicate development of methods for obtaining it.

1845.—Barytes first mined in Fauquier County, Virginia, for use as an adulterant in white-lead paints.

1850 (approx.).—French settlers 60 miles southwest of St. Louis, Missouri, discovered barytes; called it "tiff", meaning white. It was mined and shipped to St. Louis for use in paint.

1860.—Price of Missouri barytes was $7 a short ton, as shown by old ledgers.

1880.—Census recorded production of 4,425 short tons of barytes in Missouri, 465 in Tennessee, and 4,575 in Virginia.

1892.—Second major outlet for barytes: Lithopone industry began in the United States.

1901.—Production first reported in Georgia.

1903.—Production first reported in Kentucky.

1914.—Rollin Chemical Co. built barium chemical plant at South Charleston, acquired by Barium Reduction Corporation in 1923.

1914–16.—First washers and jigs installed in Georgia and Tennessee.

1914.—Barytes and witherite first mined near El Portal, California, by Barber Chemical Co. for manufacture of barium chemicals in San Francisco. (Not the same mine now worked by National Lead Co.)

1915.—Chicago Copper and Chemical Co., Blue Island, Illinois, began making barium chemicals.

1915.—Precipitated barium carbonate first used as a substitute for ground bone meal in case carbonizing, as price of bone meal had risen to over $60 a ton.

1916.—Thompson-Weinman and Co. opened grinding plant at Cartersville, Georgia.

1916.—Grasselli Chemical Co., Grasselli, N.J., began manufacture of barium chemicals.

1920.—The deposit at El Portal, California, now operated by National Lead Co., first worked by another producer.

1923–4.—First washer installed in Missouri.

1926.—Third major market for barytes: Stroud patented its use as a mud weight in rotary well drilling, and National Pigments and Chemical Co. (now National Lead Co.) put "Baroid" (ground barytes for well drilling) on the market.

1928.—First use of barytes as a flux in window and container glass.

1929.—Great Western Sugar Co., Denver, Colorado, first produced barium hydroxide from witherite for use in sugar refining.

1934.—Price of barytes in Missouri fell to $1·50 a short ton, too low to permit competition of washers with hand miners.

1941.—Magnet Cove Barium Co., Malvern, Ark., separated ground barytes from associated minerals by flotation.

Mineralogy

Barytes, the Circular states, varies widely in appearance in various parts of the United States. In Washington County, Missouri, and in Tennessee and Georgia it takes the shape of white abraded nodules, commonly stained with iron oxide, ranging from microscopic size to 8 in. or larger. Most of the pieces appear to be smaller than fist size. Recognizable orthorhombic crystals are mined commercially from time to time near Jefferson City, Missouri. Massive Nevada barytes is generally grey. That mined at El Portal, California, is white. Barytes from Nevada County, California, is marketed in the form of white lumps with iron stains. Arkansas crude barytes has replaced shale with a varvelike effect of alternating thin (about $\frac{1}{8}$ in. to $\frac{1}{16}$ in.) brown and white layers. The distinguishing feature of the mineral, wherever found, is its high specific gravity, 4·5. A piece of barytes fuses at its thin edges with a yellow-green flame when held in the blowpipe flame. The reported hardness of barytes is 3 (Mohs' scale). However, there seems to be some variation in Missouri and Eastern barytes in the ease with which the material can be crushed and ground, and the former is preferred for grinding because it is softer.

In Georgia and Tennessee the mineral barite is called barytes; in Missouri, tiff; and in Nevada and California, barite.

Barytes is theoretically 65·7% BaO and 34·3% SO_3. However, impurities of iron, silica, strontium, calcium, magnesium, and other materials are nearly always present. Minimum permissible impurities are discussed under specifications included in the Circular. Chemical-grade barytes is generally sold

on a basis of 94% barium sulphate minimum and 1% iron oxide maximum.

United States Occurrences

Roughly speaking, the authors say, there are two commercial types of occurrence: (1) Residual, where lumps of barytes remain as a result of weathering of barium-bearing rocks—chiefly dolomites in Missouri and the Eastern States—and (2) total or partial replacement in shale or limestone—such as, the deposits near Magnet Cove, Arkansas, in northern Nevada, in Cocke County, Tennessee, at El Portal, California, and other areas. Barytes can rarely be recovered commercially as a gangue of metal mining, although this has been tried in a few instances, nor has it so far been separated commercially from fluor-barytes. Deposits are then discussed by States.

Mining and Preparation

There is no one general method of winning barytes in the United States, according to the Circular. Mining methods are governed by the type of deposit, price, cheapness of labour, availability of water, and intended use. Five methods of recovering barytes have been employed in recent years in America and are given in their order of importance in 1944:

(1) Barytes-bearing clay is dug with power shovels in open-pits, the clay washed out in log washers, and the log-washer concentrates further beneficiated (Missouri, Tennessee, and Georgia).

(2) Barytes-bearing shale is blasted in open-pits and the mineral separated by flotation (Arkansas).

(3) Barytes veins are mined underground, and low-grade ore is beneficiated (California, Nevada, Tennessee).

(4) Massive barytes is blasted in open-pits with little or no subsequent sorting (Nevada).

(5) Barytes is mined by hand (Missouri).

Washer Operations

The prime incentive for supplanting hand mining with washer production is cost reduction. Thus, the high labour costs of the 1914–18 war brought the first steam shovels and log washers to Georgia and Tennessee. Hand labour began to be displaced by the machine in Missouri during the boom years of the 1920's, but the transformation has never been so complete as in Georgia and Tennessee and hand-mined barytes competed actively with washer material in Missouri until after the depression of the '30's. Since the beginning of the recent war, a number of factors has operated to reduce hand mining in Missouri to a minimum—namely, the high wages available to unskilled labour, the general labour shortage, and the finding of the National Labour Relations Board that hand miners are the employees of the owners of the land they mine.

The typical Georgia or Tennessee producer operates somewhat as follows: Prospecting is done in areas containing fragments of barytes ("float") lying on the surface or exposed in gully walls. Formerly, prospecting was limited to sinking auger holes or hand-dug test pits to depths of about 25 ft., but with the increased overburdens now encountered in the East one producer has turned to core drilling to locate and map new deposits.

After a deposit has been outlined, overburden, if present, is stripped by a ¾-yard power shovel operating in conjuction with trucks (petrol or diesel). Some producers strip with tractors pulling 10-cu. yd. scrapers. As soon as enough overburden is stripped to permit a shovel to start mining, it moves in, and stripping and mining go on simultaneously until stripping is complete. Overburden may be up to 50 ft. and working benches are carried at about 11 ft. The shortage of shovel operators during the war has curtailed such double use of shovels. The mining shovel loads the barytes-bearing clay into a truck, which carries it to the washer not over a mile away. (When this distance is exceeded, the washer is moved nearer the deposit.)

The following, it is stated, are the essential steps in washing the mineral:

The truck dumps the clay into the bullpen, a bin of which the bottom is a grizzly consisting of railroad rails set about 4 in. apart. The bullpen man hydraulics the clay, rock, and barytes through the grizzly with a 2-in. hose and throws aside all lumps too big to pass the grizzly. At some washers oversize rock and clay balls are thrown aside, but oversize barytes is hammered through. (Rock in Georgia washers consists of jasperoid quartz and in Missouri washers of dolomite, chert, and quartz.) The slurry falls from the grizzly upon a log washer, generally with 27-ft. double logs. Log overflow enters a wooden sluice leading to the mud pond. Log discharge enters a trommel, where oversize may go to a picking belt or to a jaw crusher. Undersize larger than 1 in. is crushed in rolls set at 1 in. and may be returned to the logs, trommel, or screened directly. Jigs separate the barytes from rock, and ordinarily three screen sizes are produced—*minus* 12-mesh, *plus* 12-mesh, *minus* ⅜-in., and *plus* ⅜-in. The fine-mesh material may be tabled and the iron removed with high-intensity magnetic separators to produce a high-grade (98% plus barium sulphate) material, or it may be added to one of the other sizes.

It is estimated that 7% to 12% of the total barytes in the clay is lost as fines in the logwasher overflow. One Georgia producer has installed shaking tables and flotation cells to recover this fine material.

Mining in Missouri is fundamentally similar to that in Georgia and Tennessee, but certain differences make for cheaper recovery. Prospecting is easier. Washers frequently are erected in areas that hand miners have exhausted, on the theory that the hand miners left enough fine barytes to support a washer. Also, overburden is rarely more than 1 ft. or 2 ft. and is often ignored by the shovel operator. Sometimes, however, it is found profitable to strip it, generally with a dragline shovel. Missouri barytes tends to string out in "runs" or "leads" 10 ft. to 20 ft. wide and several hundred feet long and the shovel operator exercises considerable insight in following the run. This practice is somewhat simpler than Georgia and Tennessee procedure, where the richer parts of the clay are very irregular vertically as well as horizontally and mining and stripping are carried on concurrently to depths greater than 100 ft.

Missouri barytes is softer than that found in Georgia and Tennessee and may be disintegrated in the trommel without the necessity of crushing. The trommel, which follows the log washer, is generally about 6 ft. long by 4 ft. in diameter, with holes ⅜ in. in diameter. Nearly all the barytes is shattered and passes through the trommel screen, leaving lumps of unbroken quartz, limestone, and dolomite to be ejected at the discharge. The trommel

concentrate contains impurities and is jigged and shipped wet or air-dried, depending on what the buyer will take.

About 1,800 gallons per minute, including 500 gallons of make-up from well, river, or spring, is needed for the average washer producing 1,000 tons of barytes a month. Local stream-pollution ordinances generally prevent turning washer waste into rivers, as it is said to kill the fish and make the water unpalatable for cattle. Therefore, a mud pond is made by throwing up an earthen dyke across a little valley from which the barytes has previously been mined. The dyke is increased in width and height as time goes on and may reach 30 to 70 ft. by the time the washer must be moved. At this stage the pond may cover 8 or 10 acres. Abandoned ponds date to the time of the 1914–18 war, but, according to producers, have never completely dried up. However, crusts strong enough to support ploughing teams have formed on some of the older ponds and these have been turned to cultivation.

A barytes washer complete with double log, trommel crusher, jigs, shovel, and 4 or 5 trucks may cost $30,000 or more.

Flotation

The two largest barytes producers in the United States—Magnet Cove Barium Corporation and National Lead Co. at Malvern, Arkansas—recover barytes from shale-replacement formation near Magnet Cove, a few miles from Malvern. The barytes is "intimately mixed with quartz and small amounts of iron oxide and residual shale." A typical analysis of high-grade rock shows 85·1% barium sulphate, 11·11% silica, and 2·85% iron oxide and alumina. Poorer samples range down to 50% barium sulphate. A working average seems to be about 70%.

The operations are open-pit and the rock is shot down and loaded on trucks with power shovels and carried to crushers near the pit. Crushing practice differs somewhat between the two competing plants, one firm crushing a maximum-size feed for a ball-mill, the other crushing somewhat finer for a jig feed before grinding. Both producers wet-grind very fine, nearly all the material passing a 325-mesh screen. The ball-mill discharge is classified and froth-floated. One firm floats barytes and the other depresses it. The concentrate is filtered, dried in a rotary kiln at a temperature high enough to destroy traces of organic reagents (which would otherwise interfere with use in drilling mud), cooled, sacked in 100-lb. ply bags, and shipped 400 or 500 bags to a car.

Working details of the flow-sheets used by the two Arkansas producers are largely confidential; however, one satisfactory flotation method has been developed in Bureau of Mines laboratories. Briefly, the crude material was dry-ground in a Raymond mill to 98% through 200 mesh and this was fed into a ball-mill with the addition of about 50% water and a little sodium silicate to deflocculate the pulp. The ball-mill discharge was pumped to a conditioner, where coco-nut fatty acid was added. From the conditioner the pulp overflowed to a six-cell flotation unit and was introduced at the third cell of the unit. Flow of concentrate and tailing was countercurrent, cell to cell, giving four rougher and two cleaner cells. Pine oil was added in No. 4 cell. Adequate dilution of the feed was obtained from froth-breaking sprays in the concentrate launders. Concentrate and tailing were collected in separate thickening cones. This process gave a 90% recovery of barium sulphate of the original rock and the concentrate analysed 98% barium sulphate, specific gravity 4·395—both unnecessarily high for its use (well drilling) but indicative of the possibilities of flotation.

Ground Barytes

There are, according to the Circular, two general systems of grinding barytes, depending on whether it is to be bleached. Barytes intended for use in well drilling is generally ground in ball-mills, for contamination from the iron balls is immaterial. The same applies to filler uses in which the colour does not matter. Whether the mineral is wet- or dry-ground depends on several factors. Arkansas barytes must be ground before flotation and hence is wet-ground. Barytes at El Portal, California, used for making mud-weighting material, is jigged in the same plant where ground and therefore it is simpler to grind it wet. In Georgia, after preliminary treatment in a gyratory crusher, the product is ground dry in a 5-roll Raymond mill. In Missouri unbleached barytes is ground dry and barytes to be bleached is wet-ground. Nearly all ground barytes is bagged automatically in multi-ply kraft bags. Manufacturers of bleached barytes use a 50-lb. bag and all other grinders use a 100-lb. bag.

In preparing bleached barytes considerable care must be exercised to avoid contamination from iron. The process consists of wet-grinding ⅝-in. jigged barytes in a tube-mill with flint pebbles, followed by thickening in a Dorr classifier; then it is bleached, vacuum-filtered, dried in a continuous kiln, dispersed in a small mill, and bagged. For this process Missouri barytes has an advantage over barytes found elsewhere, in that it is softer and more easily bleached.

The bleach process is generally a trade secret, but the general principles are well known. The main impurities are the oxide, sulphide, and silicates of iron and manganese and lead sulphide. These are brought into solution by digesting the ground pulp in a hot solution of strong sulphuric acid. The pulp is settled, separated, and washed. Washing removes almost all the impurities, but traces of ferrous sulphate, which is only slightly soluble, remain and tend to oxidize the brown basic ferric sulphate or brown ferric oxide. Washing would be more effective in so far as removal of iron is concerned if the ferric sulphate could be converted to the much more soluble ferrous sulphate. This may be done by reacting the pulp from the sulphuric acid vats with a little sulphurous acid, thereby reducing ferric ions to ferrous ions.

Most ground barytes, whether bleached or unbleached, is classified so that 95% passes a 325-mesh screen. A small fraction of the output is ground to only 200 mesh for less-exacting filler uses.

Uses

The chief use of barytes in 1944 was in oil-well drilling; lithopone was the second largest market, chemicals third, fillers fourth, and glass fifth.

Drilling Mud.—In drilling oil wells with the rotary system a drilling bit is used which generally consists of four cutting gears rotated by a central shaft. The bit cuts or abrades the formation and the cuttings are removed by a fluid that is forced down

through the drilling shaft, out at the bit, and up the well to the surface. This fluid serves several other purposes too, such as lubricating and cooling the bit, " plastering " the walls to prevent caving, and restraining abnormal gas and oil pressures to their formation levels. It is the last-named function in which barytes is useful.

Oilfields on the Gulf Coast of Texas and Louisiana, in the San Joaquin Valley of California, and near Ventura, California, are noted for abnormally-high gas and oil pressures—that is, oil or gas seeks to enter the well at pressures greater than that of a column of water in the well. If the oil or gas is not confined to its formation it will blow out the well, with resulting danger to life and property. One of the early solutions to the problem of abnormal pressures was to increase the specific gravity (" weight ") of the drilling fluid by adding clay to water with a little bentonite as a suspending agent. Clay drilling muds, however, are comparatively light, unless large quantities of clay are added, in which event the mud becomes too viscous. A mud is said to be too viscous when cuttings do not settle out readily in the mud ditch, or if entrapped gas is unable to free itself when the fluid enters the ditch. A heavy but viscous mud may be made so light by gas " cutting " that a blowout may occur. To obtain a heavier mud without increasing viscosity several ground materials heavier than clay have been tried—principally barytes, celestite, and iron oxide.

There seems to be no logical objection to iron oxide as a weighting agent, for it is heavier than barytes and, when properly prepared from native oxide, contains no detrimental soluble salts. However, it stains clothing almost indelibly and this may be a psychological deterrent to its wider use. Since about 1938 a few thousand tons of celestite has been mined annually in Texas for use in well drilling, but celestite has the disadvantage of being lighter than barytes.

Barytes, because of its high specific gravity, low cost, cleanness, freedom from detrimental impurities, and inertness, is used almost universally when a heavy weighting agent is needed in drilling muds. Its use in well drilling was patented by Stroud, who assigned the patents to the National Lead Co. Drillers were charged a royalty of $13 a ton until the patent expired.

Useful barytes drilling muds may be obtained in specific gravities ranging up to 2·5. The barytes is kept in suspension with a little bentonite. About 5 tons of barytes is consumed for each 1,000 ft. of high-pressure well drilled.

Gold Fineness in Portuguese East Africa

A study of the fineness of gold in relation to geological features in the Macequece field in Portuguese East Africa is contributed by L. L. Colin to the *South African Mining and Engineering Journal* for May 18. The author says that geologically the Macequece field consists, generally speaking, of Archæan schists—talcose, chloritic, and hornblende ; granite bounds the field on the north and the south. Diorite, diabase, and other basic igneous rocks occur in the schistose area and granite and felsite outcrop at various points.

Practically all the gold reefs are found interlaced in talc schists or sericites, but they are also intercalated in clay schists and between the quartzites. The gold reefs are frequently found in the contact of the schists and the granites. The gold reefs are quartz and the outcrops are generally formed of large caps of " banded ironstone " in which the sulphides were oxidized, leaving the free gold.

In extent the field runs east–west for some 32 kilometres and from north–south the width averages about 8 kilometres at the extremes and some 25 kilometres at the centre. The surrounding country is made up of a group of high hills which lie in an east–west direction. The field is enclosed to the north by Serra Moriangane and Serra Chuara and on the south by Serra Vuma.

Nearly all the intermediate valleys have mountain streams but the chief rivers are the Revue, the Chua, the Zambusi, the Inhamcurara, the Chimezi, and the Muza, all having auriferous alluvial deposits, so that each will be treated in turn.

Revue Valley

The Revue valley is predominantly schistose, being overlain with quartzites, conglomerates, and grit. Between these layers and the schistose are found quartzites and ferruginous grits with fine grains of quartz, hæmatite, and limonite and containing sometimes magnetite. The existence of dykes, reefs, and masses of " greenstone " cutting the terrain and the reefs show the intimate relation between the eruption of these rocks and the presence of gold ores. These faults and sheared zones have probably helped in localizing the gold-bearing sections for the rich gold occurrences are to be found where the reefs have been much altered by metamorphic action.

Bars of " banded ironstone " run along the north and south banks of the Revue and running parallel to those ironstone bands are large oxidized quartzite bodies. Alluvial gold is found practically along the whole length of the river and it is likely that the gold has come from the oxidized quartzite bodies and from the country rock in which the quartz bodies are situated. These outcrops have been worked at irregular intervals and the gold obtained has been of a high fineness. The outcrops shed their gold into the lower Revue and the gold compares with that found in the river. A syndicate, the Bohorla, worked the lower Revue for alluvial for a short time and the gold recovered had a total fineness of 942. Gold is also shed into the small tributary of the Revue, the Inhamazonga river, running between the Serra Vengo, and the Serra

Mancota. The values of the gold fineness noticeably increase with the distance from the source.

The principle of increasing fineness of alluvial gold with distance from its source has been noted on several occasions by different authors. Their findings suggest that this increase in fineness is due to leaching of the silver from the surface, leaving the gold enriched and this increase will be proportional to the grain size and therefore to the distance travelled.

The Inhamazonga thus shows an increase in gold fineness of 25 parts per mile, which is fairly substantial and this would find an explanation in the fact that the river is shallow, with a rocky bottom, while the gold is relatively fine, thus offering a greater surface area to the refining action.

The Revue river also shows a definite increase in fineness with distance from the source, but the increase is much less marked. Over an approximate distance of 10 miles the gold fineness—*i.e.*, true gold fineness—increased from 918 to 940, which is only 2·2 parts per mile. Gold in the Revue, however, is rough and nuggety and the river bottom is sandy. Also the river has a fairly high fall so that the large gold particles would have less time to be affected by refining actions, since they would move down the river with greater difficulty than the finer particles which would be carried very rapidly away.

Near the junction of the Revue with the Chua a dyke cuts across the river, but above this the alluvial gold has a higher gold fineness. This gold has been shed into the Upper Revue above the dyke into what constituted the Mina Andre workings, which made use of a dragline excavator. Over a period of five years the gold averaged a true fineness of 939. As the excavator worked its way up the river a slight fall in the fineness from 942 to 939 was noted in the gold returns.

Towards the source of the Revue two mines operated on a decomposed kaolinized schist, returning gold of a true fineness of 958 for the Carlos mine and 901 for the Revue mine. These mines were situated on the Mahungue River just above where it joins the Revue.

These values are substantially higher than the gold just below the dyke in the Revue—namely, 918 true fineness. This drop in gold fineness is due to dilution with the gold of lower fineness which is brought in by the Chua River.

Although the alluvial gold is slightly higher in fineness than that of the near-by outcrops, it nevertheless compares with the outcrop gold from which it was derived. On the other hand, there is a great difference between the alluvial gold, the outcrop gold, and the gold mined from the deeper sulphide zones. Whereas outcrop gold at the Guy Fawkes mine had a true fineness of 930, that from the sulphide zone was only 833. Of other mines in the vicinity, the Pardy's West returned gold of 732 true fineness and the A. Sorte mine 798.

In the auriferous quartzites at depth the gold is accompanied by sulphides which frequently carry free gold, proving that the alteration which operated there was a progressive concentration of mineral. The oxidation and solution of the auriferous pyrite left the gold, which it originally contained, in the cavities so produced. With the gold and the pyrite the reefs contain galena, blende, stibnite, chalcopyrite. Cyanide bullion from the Guy Fawkes mine contained gold of true fineness of 432, illustrating that there has been solution of the silver from silver-bearing minerals, in this case probably galena.

Chua River

Along the Chua river and valley lies another gold-mining area of equal importance.

The Chua valley is predominantly talc schist and sericite containing numerous layers of white, compact, and sugary quartz. These quartz layers outcrop frequently and are less altered by external agencies which closed up the schists. The " banded ironstone " reefs abound in the region, striking eastwards from the river mouth. Above the grits and the ironstone the schists and green talcy clay continue, finally reaching one or more layers of conglomerate which continue to the summit of the Mount Chiromiro in the Vengo. The region gives indications of having been subjected to intense dynamic reactions. The reefs running parallel to each other are connected by veins and stringers varying in width from a few inches to about three feet, but the wide reefs soon pinch out to nothing. The reefs are found in the talc schist and sometimes imbedded in clay schist and quartzite.

The gold is generally to be found where acid intrusions of varied character consisting of felsite or quartz porphry have taken place. Although at present only four small workers are active, the Chua saw much mining activity up until the outbreak of war in 1939. The gold in the outcrop workings is generally higher in silver than similar workings along the Revue, but cyanide bullion from two mines which treated the battery sands differed only slightly from the plate gold. At the Two Fools the gold so recovered had a true fineness of 650, compared with 738 by plate ; at the S. Firenza the corresponding true fineness was 818 and 855. At the Chimezi, where galena and sphalerite are found, the cyanide bullion was low, the gold having a fineness of 513.

Gold in these workings is generally coarse and gives no appearance of redeposition. Taking average gold fineness at similar contour lines for these mines does not show any marked difference between the lower levels and higher up the mountain slope. Actually the gold fineness decreases from 836 to 830 in a rise of some 500 or 600 ft.

The gold which has been recovered from alluvials in the Chua valley has certainly been shed from these hills. The Chua excavator operated for five years above the Revue and the true gold fineness of the gold returned varied from 897 to 893 as the excavator moved up the valley. The gold in the alluvials was noted for its coarseness and for the amount of large nuggets which were recovered.

Since no serious mining at depth has been carried out in this field, no comparison can be made between the gold in the oxidized regions and the primary gold at depth.

Zambusi River

The Zambusi river joins the Revue below the junction of the Chua. Here again the gold-bearing reef is found in conjuction with bars of banded ironstone which run east to west. North and south of the river rhyolite intrudes in the talc schists, while towards the Serra Penhalonga the schists are crossed by greenstones, serpentine, and felsites.

At the Dot's Luck mine a low-grade outcrop is treated by open quarrying. The gold which originated in epithermal deposits is consistently higher

in silver than that of the Chua and the Revue. The Monarch mine lies at the summit of the Serra Penhalonga. Here the ironstone which is enclosed in a talc chloritic schist is crossed by a dyke of dolerite. The mineral is composed of irregular fragments of very hard ironstone, surrounded by quartz containing much pyrite and pyrrhotite and mispickel. Mining operations were commenced on the oxidized zone, after which the sulphide ore was treated by all-sliming cyanidation. It is of interest to note the small difference between the true gold fineness for each case.

The origin of the gold is probably connected with the injection, during a period of less intense movements, of the auriferous quartz after the faults caused by the solidification of the granite had been filled with porphyry-quartz. There has been little evidence of secondary enrichment and the slight increase in gold fineness in the oxidized zone could be accounted for by some of the silver being partly leached from the outcrop.

At the eastern extreme of the Serra Penhalonga the formation enters the actinolite and chloritic schists with the ironstone bars contacting the granites on the south. The relatively-high silver content of the gold is maintained.

Inhamcurara River

The Inhamcurara river lies north of the Serra Vengo and flows east. The terrain is noted for the folding of the sedimentary layers which appear to have been accompanied by eruptions of diorite, diabase, and by formations of gold-bearing reefs, which are in turn cut by "greenstone." The gold can be found in those layers which by their permeability were more easily penetrated by the mineral emanation into the siliceous breccia and grits; here also are to be found galena, pyrite, sphalerite.

The deposits are always interbedded with talc schist indicating that these talc schists in part owed their actual state to metamorphic reactions which accompanied the uplift to the surface of the mineralized agents. The presence of the metamorphic schists can, in conjunction with the greenstone reefs, be taken as an indication of gold.

The region is not greatly different in character from the Chua field except that the conglomerates are more predominant throughout the formation. On the north the field is bounded by the acid igneous rocks, granites, felsites, and granite gneisses. The gold fineness returned from mines in this field show that the values are not very dissimilar to those obtained from the Chua.

Situated in the lower Inhamcurara valley, the Braganca mine was developed down to about 200 ft., where the quartz reefs were fairly consistent in width and gold values averaged 10 dwt. over 5 ft. The quartz contained much galena, pyrite, and stibnite and the higher silver was no doubt carried by the galena; cyanide bullion gave a gold true fineness of 513 as against 676.

Very little alluvial work has been done. One small worker, the Victoria, yielded a few ounces of gold of a true fineness of 955. The formation continues to the east to the Chimezi River, with the conglomerates predominating in the talc schists, sericite schists, and diabase schists. Parts of the banded ironstone reefs are found with layers of graphite, talcose schists, and quartz.

A few mines worked the banded ironstone outcrops and the silver is appreciably higher. At the Rhodes Banket mine layers of graphite are found in the talcose schists and quartz. Gold from this mine had a fineness of 798.

Muza River

Although not an important gold producer, some mines have been worked along the slopes of the Vengo. The Vengo range is exceptionally badly faulted and the reefs are lenticular, especially when situated in talcose formation.

The reef is of quartzite bounded by ferruginous talc schist with intrusive bodies of felsites and microgranites. In practically all cases the gold has been of a high fineness with indications of reprecipitation in the oxide zone, since the gold is generally in a fine state of aggregation. Below the Muza Reef mine small alluvial workings returned the following: Muza alluvial, 891 T.G.F.; Galiza alluvial, 880 T.G.F.

The total gold production taken over the period 1910 to 1944, is shown in Table 1.

Table 1

Source.	*Reef Workings Gold.* oz. fine.	*Alluvial Workings Gold.* oz. fine.
Revue Valley	10,629	156,478
Chua Valley	10,881	9,680
Muza	1,420	50
Inhamazonga	—	1,010
Serra Penhalonga and Zambusi Valley	11,258	—
Ihamcurara	20,344	—
Chimezi	292	—
Total	54,824	167,218

Fine gold recovered from all sources, 1914–1944: 222,042 oz.

Conclusions

In summing up the records of gold fineness from the various deposits of the Manica goldfield there is a general agreement with the findings reported from other fields. All the alluvials which have been worked fairly extensively show a general increase in the fineness of the gold down-stream, probably due to a surface refining action. The alluvial gold was almost always found to be slightly higher in gold fineness than the gold in the oxidized workings. Where mining has been carried out at depth the gold fineness of the oxidized outcrop is appreciably higher than the average gold in the lode.

The epithermal deposits show higher silver content than the other deposits encountered; the gold varied from 600 to 780 in true fineness. These deposits were to be found along the Serra Penhalonga and the Zambusi valley, extending in direction along the south of the Revue River and crossing to the Serra Mancota. They also occur in the Revue valley along the Serra Vengo.

Gold from mesothermal deposits was generally higher—between 700 to 900. The Inhamcurara and the Chua valley returned gold which, in isolated cases, was as low as 676 and as high as 910, but on the average was 850.

Where the deposits showed signs of erosion and much decomposition—such as, was found along

the Revue River, where the gold occurred in a kaolinized schist—the gold fineness was invariably high, varying between 890 to 950.

The gold is not confined to any one type of formation; it is found in acid rocks and acid intrusions along the Chua and the Inhamcurara; in the basic rocks such as diorites, dolerites, and greenstones along the north bank of the Revue, the Serra Penhalonga, and the Zambusi; in talc schists and sericites, quartzites, conglomerates, and ironstones in the Chua, the Inhameurara, the Chimezi, and the Vengo.

Geophysical Prospecting

An address by H. Lundberg given before the Prospectors and Developers Association in Toronto on March 12 last is published in the *Western Miner* for May. The author, reviewing "Modern Trends in Geophysical Prospecting" said that systematic geophysical exploration was introduced into prospecting after the 1914–1918 war and has now passed through its infancy—in fact it has been so highly developed that it may be considered a good and useful tool at the disposal of the prospector and the geologist. He said that the development of geophysical exploration has gone through many phases, both of success and despair. There has been the danger of over-emphasis on the scientific side and many geophysicists, by using too academic language, managed to scare away, for a while, both the prospector and the geologist.

The author went on to say that more than 300 years ago the compass was used to find ore-bodies. This work was carried out by the prospectors themselves. These old-timers used practical judgment and knew how to correlate their observations with the occurrence of ore. He knew of one example where an ore-body was found under 60 ft. of overburden.

After the 1914–1918 war enthusiastic geophysicists, their backers, and clients thought that they could indicate the ore direct. It is now known, however, that rock formations are full of magnetic and conductive bodies that have no commercial value. If, like the old-timers, geophysicists use power of observation and apply their skill in correlating clues they obtain from a study of topography, soil, water, rock outcrops, and vegetation, together with the results in magnetic and electrical surveys, they may select places where there are best chances of finding ore.

In certain favourable areas the usefulness of the magnetic methods may be amply demonstrated, but the necessity of using caution is also important when drawing conclusions from a magnetic survey alone. An example from the Golden Manitou illustrates vividly that a magnetic survey may entirely miss the ore-body and in other examples it is demonstrated that the magnetic anomalies had no economic significance. The interpretation, therefore, is of very great importance. The prospector should gradually be trained and taught the principles of how to use the instruments and how to interpret the results to get the best economic value out of the survey. It should be remembered not to squeeze too much detail out of a geophysical survey, but to drill or dig if there is any good indication that cannot be explained by any known non-commercial features.

In Canada, Mr. Lundberg said, sufficient clues may be gathered by magnetic and electrical instruments to guide the exploration campaign intelligently. Why should the prospectors not be able to do such work themselves? Anybody with geological training or skilled in prospecting should have enough judgment and enough common sense to make such surveys and to draw useful conclusions from the results. It had been his dream for a long time that the Government institutions undertake to instruct and guide prospectors in the use of these tools.

Since this had not been done, he suggested that instruments that are simple to operate, but still scientifically sound and sufficiently sensitive, be made available to the prospector. To begin with, perhaps, it should be on a rental basis and the manufacturer should keep the instruments in good repair and have a trained geophysicist at the disposal of the prospectors to consult with and to help with the interpreting of the results.

There are instruments on the market now, Mr. Lundberg said, that would answer these qualifications. In fact, they had also tried to construct a magnetic instrument that would be suitable to the prospector. There are firms who also sell simple electrical exploration instruments and in the near future such instruments will be available in Canada on a similar basis as the magnetic.

Recent developments in electrical methods indicate that reliable readings may be taken with ease and results obtained that may be directly interpreted by a geologist or prospector of ordinary intelligence. With such instruments as these the prospector should be able to locate conductors or magnetic anomalies (as shown on the pictures) and soon, under the guidance of the more skilled experts, learn to make his own interpretation.

In a little while, perhaps a few years, experience in interpretation will be so widespread that the services of the expert geophysicist may no longer be required. In this way the prospector will investigate the most promising indications or anomalies by trenching or drilling and become acquainted with the local mode of occurrence and characteristics of important anomalies that would guide him when prospecting further in the same area. If he has an outcrop with a showing the methods can be quickly used to determine the extent and strike of this mineralization. If the ground is covered by heavy overburden the prospector knows that he must cover a large territory and take a great number of observations.

By systematic plotting of these results on a map the prospector will soon have a pretty good idea of the distribution of conductors or magnetic bodies on his property. Only when his results are too complex or his problems become too involved does he need to consult with an expert geophysicist, who then should be available and willing to guide the prospector until he can make out by himself.

With the simple instruments directly operated by the prospector very large areas may be surveyed in a short time and the ore-bodies existing near the surface may be revealed at a good rate.

The locating of deep-seated deposits naturally will require more sensitive and more developed equipment, as well as more experienced geophysicists. Owing to the fantastic developments in electronics during the war it has been possible to work out entirely new techniques to be used in prospecting and soon reconnaissance surveys may be carried to very great depths in the order of thousands of feet.

Another development is a simple instrument for surveys on heavy overburden, capable of finger-printing the rock underneath, so that not only the contact may be determined, but also a reasonable identification of the rock type may be accomplished. This method will be particularly useful for the geologist in his aerial mapping. This method of identification may also be used in drill holes.

For the prospecting of large areas, particularly remotely located, airborne equipment has been tried out successfully and they were now preparing to make their first test flights with both magnetic and electrical instruments. If tests were as successful as believed four to five square miles per day might be surveyed. With ordinary land methods it would require four to five months to do the same work. Such surveys can be carried out winter and summer and the results would be as good over land as over lake or muskeg.

Electrometallurgy in Eastern Canada

Some developments in the electrometallurgical field in Eastern Canada are reviewed by W. M. Goodwin in the *Compressed Air Magazine* for May. The author says that it was at the turn of the last century that Canadians began to take an interest in their large water-power resources. The first developments at Niagara Falls attracted some of the early electrometallurgical industries. Other enterprises followed quickly and when the 1914–18 war came along the Dominion was able to supply an appreciable share of the munitions of war with the aid of her hydro-electric power. By the time of last war the power systems and their products in Ontario and Quebec had multiplied many fold.

The author briefly describes certain plants along the St. Lawrence and its tributaries that provide basic products for industry, all of which were turned to war use and were essential to the making of munitions. This capacity to expand and to diversify the output of such products constitutes, he says, one of the Dominion's main industrial opportunities.

Dominion Magnesium, Ltd., whose plant is the most westerly of those considered, is a "war baby" that promises to have a useful adult life. It was placed out in the country at Haley, Ontario, because of a plentiful local source of dolomite and of low-cost power from a site close by on the Ottawa River that had recently been harnessed. Another reason was the nearness to Ottawa, where the research that had resulted in the works was still being conducted by Dr. Lloyd M. Pigeon in the National Research Laboratories.

The Pigeon process is based on the thermal reduction of calcined dolomite under vacuum. The operating cycle is very simple. Dolomite from the company's open-pit is crushed to *minus* ¾ in., calcined in a rotary kiln and the finely-ground material is mixed with a suitable proportion of ferrosilicon and then briquetted. The briquettes are heated in cylindrical metal retorts horizontally disposed in electrically-heated furnaces. The latter are maintained at a temperature of 2138° F. under an extremely high vacuum and one end o each retort projects beyond the furnace and is water cooled. The ferrosilicon takes the oxygen away from the magnesium oxide of the calcined dolomite and the volatile magnesium metal is condensed as "crowns" in the cool end. The crowns are melted and cast into ingots, billets, slabs, or sticks, with or without alloying metals.

Near the old French-Canadian town of Beauharnois on the St. Lawrence River, just beneath the rock-rimmed escarpment over which the water from the diversionary canal falls to provide power, there is an ideal site for the production of ferrosilicon. The rock of this escarpment is sandstone of a quality well suited for the reduction process. A quarry has been opened that yields the raw material at exceptionally low cost. From the nearby factories of Montreal and vicinity is obtained an ample supply of steel turnings. Coke and coal for reduction are obtained economically and electric energy is delivered from the adjacent power plant at a minimum rate. Rail connexions are good and lake vessels can dock and transport to overseas markets from the port of Montreal.

St. Lawrence Metals and Alloys was set up in 1936 by Robert Turnbull, one of the pioneers of Canadian electrometallurgy, specifically to take advantage of the resources mentioned and mainly to serve foreign trade. When the war started in 1939 there were seven furnaces in operation consuming 32,000 kW. of electrical energy and yielding daily 35 tons of ferrosilicon and silicon metal. The war-time demand more than doubled production and diversified it somewhat, so that now there are 13 furnaces that use 64,000 kW. for an output of 70 to 75 tons of ferroproducts a day.

It has been found that electric furnaces of moderate size are the most economical type for the manufacture of ferrosilicon. However, the input of electrical energy is much greater than it is in the case of all other electroproducts except aluminium so that a furnace requiring 7,000 kW. is about 15 ft. across the hearth. The plant regularly makes ferrosilicon of 50% and 75% silicon content, as well as silicon metal of 98% purity.

An interesting war-time yield has been calcium silicide for smoke bombs. This is produced in one of the regular furnaces by adding lime or limestone to the charge to provide the required proportion of calcium. A special plant was erected to prepare the material, which is called calcium-silicon

in the alloys trade. To-day it is serving to an increasing extent as a powerful de-oxidizer for certain iron and steel products. Thus, as in so many other instances, war-time development may remain as a useful adjunct to peace-time pursuits.

While almost every iron and steel plant in the Dominion consumes at least a small amount of ferrosilicon or silicon metal, the principal single customer of St. Lawrence Metals and Alloys during the latter years of the conflict was Dominion Magnesium. As has already been noted, it is ferrosilicon—the 75% grade—that is used to obtain the metallic magnesium from the magnesium oxide of the dolomite rock. The total Canadian market for ferrosilicon and silicon is small, however, compared with the capacity of St. Lawrence Metals and Alloys and the firm will continue to sell the larger part of its output overseas.

A great diversity of products is made in the plants of Shawinigan Chemicals, Ltd., at Shawinigan Falls, Quebec, and all are derived from calcium carbide. In 1915–16 a group of young Canadian chemists and engineers, with only the data in some German patent applications to guide them (and some of that information was misleading), succeeded in the incredibly short time of nine months in devising a series of workable processes that resulted in carload-lot shipments of acetone obtained from acetylene gas. This was one of the feats that saved the day for Britain and some of her Allies, who had previously been largely dependent upon Germany for the acetone used in the manufacture of their chief propulsive explosive, cordite. These methods were perfected between wars and many other acetylene derivatives have been made available to the chemical industry by additional processes.

In 1939 Shawinigan Chemicals, among other companies in Canada, was called upon immediately to supply the chemical sinews of war. Among these might be mentioned monoethylaniline (a stabilizer for cordite), butyl alcohol, acetic acid, vinyl resins, acetylene black, and small amounts of a number of unusual products required for war research, which was conducted on an experimental scale in the company's laboratories. Shawinigan's outstanding contribution was its share in the development of the super-explosive known as RDX. After test and pilot-plant work had been completed in a matter of three or four months, the Canadian Government authorized Defence Industries, Ltd., to construct a plant that was operated by Shawinigan Chemicals until the close of hostilities. The production record of this establishment is one of the epics of the Canadian war effort.

When Norway was invaded by the Germans, Great Britain's normal supply of calcium carbide for cutting and welding metals was discontinued. There was no help to be had from the United States, where huge shipyard demands had caused an acute carbide shortage. Canada was urged to take up the slack and the building of a new 20,000-kW. closed furnace at Shawinigan was ordered in 1941 by the Department of Munitions and Supply in Ottawa. As the need for carbide in Canada increased, another similar furnace was authorized in 1942, bringing the total capacity of the works to about 250,000 tons a year. Furthermore, the parts of three carbide furnaces were fabricated and shipped to England for assembly, together with technicians and a crew to start up the installation and to see it through to smooth operation. Already additional plant to serve peace-time requirements are under construction at Shawinigan Falls and it is very likely that other projects will be attracted to the region by the low-cost power available there and at the nearby St. Lawrence ports.

The most spectacular war-time enterprise in Canada, the author says, was the development of the aluminium industry. In 1939, both production and fabrication were already firmly established—in fact, the largest single smelting plant in existence had but lately been built at Arvida on the Saguenay River. The sudden demand (largely from Great Britain) in 1940 necessitated an immediate and substantial increase in output. Heroic measures were taken and the 1939 smelting capacity of 440,000 pounds of metal a day reached 3,000,000 pounds daily by 1944. This sevenfold increase in such a short time was possible only because a large percentage of the essential electric power was available and the remaining 1,200,000 h.p. could be obtained rapidly by completing the plan already under way on the Saguenay. When the war came to an end the aluminium industry alone was using one-sixth of all the power that was being consumed in Canada.

The first aluminium plant in Canada, and one of the first in the world, was established in 1900 at Shawinigan Falls on the St. Maurice River. As has been mentioned previously aluminium requires more electrical energy for reduction than any other common electroproduct. Therefore it is of prime importance to have low-cost power and that the reduction works be as close as practicable to the generators. At Shawinigan the pot-lines are within a few hundred feet of them so that the cost of transforming the power is eliminated and that of transmission is cut to a minimum.

War-time expansion was effected mainly by adding new pot-lines to the existing establishments at Arvida and Shawinigan Falls. Non-essential civilian consumption of electricity was curtailed drastically and all standby generating units were finally put to steady use. Pot-lines were also built close to the large power plants at LaTuque on the St. Maurice and at Beauharnois on the St. Lawrence and as fast as they were installed there was a proportionate increase in the output of aluminium. The industry's production plans, however, considerably exceeded the capacity of the existing hydro-electric stations. Work was started in 1941 on the great Shipshaw No. 2 canal and power plant and by the end of 1942 the first of the giant 100,000-h.p. units was in action. A year later all 12 were available and the station was in a position to furnish 1,200,000 h.p. of electrical energy.

Enlargement of the aluminium reduction works of course involved a corresponding sevenfold increase in all the auxiliaries feeding them. The bauxite mines in British Guiana, the fluorite mine in Newfoundland, the steamship lines, the docking facilities at both ends, the ore plant for purification of the bauxite at Arvida, the special railway cars for transport of the refined alumina to the scattered pot-lines—all these and many more things essential to the complete plan had to be expanded.

The author says his article covers only some of the outstanding projects in the war-time electrometallurgy of eastern Canada to illustrate the prime importance to the Dominion of her abundant, low-cost, year-round hydro-electric power and some of the means by which the metallurgist and the chemist have put it to use.

Ore Changes in Depth

A paper by Dr. E. L. Bruce, read at the annual meeting of the Prospectors and Developers Association held in Toronto in March last, covered " Depth Changes in Ore Deposition." The paper is published in the *Canadian Mining Journal* for April and the following notes have been abstracted.

Dr. Bruce points out that one of the fundamental considerations in assessing the value of any vein or lode deposit is the depth to which ore will continue. An answer to that question is possible only when the origin of the deposit can be determined and, commonly, no absolute criteria of that are available. Some deposits, like those of contact-metamorphic type, definitely related to an intrusive body, evidently will persist downward only to the contact of the intruded rocks with the intrusive. Other deposits have no close relationship to any intrusive and although it seems certain that they too have derived their minerals from some igneous body that body is so deeply buried that it may never be observable ; the ore-bearing fluids have travelled so far from their original source that that source cannot be reached either by the natural process of erosion or by mining or drilling.

Assuming an igneous source for the mineral-bearing fluids, in some body of magma far below the earth's surface, a reasonable process of mineral deposition must be assumed. It seems clear that the fluid passing out from the magma chamber where it was concentrated, along whatever channelways may have been provided by deformation, must at first be under conditions such that none of the materials in solution can be precipitated. Ordinarily high temperature is considered to be the main condition that keeps in solution everything carried by the fluid. Pressure may, however, play an important rôle and, possibly, both high temperature and high pressure are characteristic of the fluids as they leave the magma chamber and for some distance upward from the chamber. Assuming for the sake of simplicity a channelway in which neither structure nor replaceable wall rocks would tend to complicate the process of mineral deposition the ore solution can be imagined to begin to deposit certain minerals at a definite level above the magma chamber. The kind of mineral will depend of course upon the composition of the solution and the relative proportions of the various elements that it contains.

At first the quantity of material deposited will be small, but as the solutions rise and temperature or pressure, or both, decrease, greater and greater quantities of minerals will be formed and new species will continually appear as they reach their appropriate point of saturation in the solution. At some point above the magma chamber the quantity of precipitated material will reach a maximum, and above that point the quantity must decrease, for although the temperature and pressure may be much below that of the maximum level the rising solutions will have been robbed of their dissolved materials and be therefore relatively dilute and so capable of still carrying all the material that remains in them.

If this is the generalized and simplified picture of a single vein or lode then it becomes a matter of prime importance to know what particular part of it is exposed at the surface. Should the surface be high up, the lode might be barren since, at that level, no valuable minerals were left in the spent uprising solutions. At a lower level values would appear in the vein and the quantity of them would increase downward to a maximum and then decrease as levels are reached where temperatures and pressures were too high to allow deposition. On the other hand, if the exposure is below the most favourable level of deposition, values would decrease downwards in the vein and probably would finally disappear altogether.

If the lode were as simple as assumed the problem would be easily solved, since increase in depth should be marked by a gradual increase to a maximum if the surface were above the maximum point, whereas if the surface were below it there would be a continuous decrease in the quantity of valuable minerals as greater depths were reached. Deposits, however, are not regular, and never is all the gold or other valuable mineral completely removed. The amount depends upon economic conditions. Nor is grade of material a criterion, since improvement of treatment, or increase in the value of a metal, may make possible the mining of lower-grade material. That, Dr. Bruce said, has been the case in most Canadian mines.

The problem is still further complicated by the fact that the character of one of these complex lodes is not unique at a certain level. Faulting and shearing have been so complex that it is possible that conditions may vary from place to place on a single level and hence the physical environment of part of a lode at a given level may be that which prevails in parts of the deposit hundreds of feet below or above it. Yet it seems unquestionable, says Dr. Bruce, that in general, these local variations may be neglected and that the average conditions are controlled by the depth.

Careful study of the minerals of deep gold mines in Canada has failed to show any significant changes in the mineral species present. Thus the minerals occurring at the outcrop of Porcupine or Kirkland Lake gold veins are found in the deepest workings and no new ones appear at the deeper levels. Although no change has been recognizable in these larger features of the lodes, however, it seems possible that in certain of the minor relationships there may be significant changes related to depth.

Silver is the one minor constituent always found with gold, but without very extensive and exhaustive sampling at various levels any change that occurs in the ratio of gold to silver could not be recognized. Few mines keep records of the amount of silver their ores contain. It seemed possible, however, that the gold bullion shipped from some of the deeper mines might show some significant changes.

Unfortunately the workings of none of the Canadian gold mines have progressed continuously downward with complete extraction of ore at each level. Ore is mined at various levels and the bullion shipped is therefore a composite of that from a zone perhaps 1,000 ft. in vertical thickness. Moreover, with the change from $20 to $35 per oz. in the price of gold many mines went back into upper level and mined material previously too low grade to be utilized.

However, in spite of the certainty that any results obtained could be no more than approximations

and, assuming that the zones being mined, in a general way at least, were progressively deeper, the gold-silver ratios of bullion shipped from some of the Ontario mines were calculated.

The Lake Shore, Wright Hargreaves mines at Kirkland Lake show rather similar patterns. Lake Shore began with an apparent ratio of gold to silver of 17 to 1, but this high ratio may not be that of the ore. The sharp decrease in the gold-silver ratio in the bullion in 1930 may be due to a higher recovery of silver rather than a larger quantity of it in the ore. This is indicated also by the regularity of the silver content in the years before and after. Assuming that the higher content is more nearly the actual amount of silver in the ore, and using the value 0·1 oz. per ton for the period 1918–1930, the gold-silver ratio dropped from 10 to 1 in 1920 to approximately 4½ to 1 in the period 1935–1940. Similarly Teck Hughes bullion dropped from 13 to 1 in 1924 to 6 to 1 in 1935–9.

If the gold ratio is connected with the point of maximum precious-metal deposition the surface at Lake Shore was at or below that level. At Teck Hughes the near-surface workings were above the level of optimum precipitation and the ore mined in 1939 came from a level considerably higher above the magma chamber than that coming from Lake Shore at the same time.

Bullion from the Porcupine mines shows a much lower ratio of gold to silver than any of the Kirkland Lake mines and a relatively slower decrease in that ratio. The McIntyre ratio decreased from about 5 to 1 in 1920 to 4 to 1 in 1933 and the Hollinger ratio from slightly less than 6 to 1 to approximately 4 to 1 from 1918 to 1935. The rise in the ratio from 1935 to 1940 may be due to the drawing of more ore from upper levels. The Dome ratio is too erratic to make any generalizations.

It is probably not safe to draw conclusions from such inadequate data, Dr. Bruce said, especially as the basic lavas which form the wall rocks in Porcupine were no doubt much less inert towards the vein solutions than the porphyry and syenite at Kirkland Lake. It is at least suggestive to note, however, he says, that the ratio at Porcupine mines is not far from the 4½ to 1 ratio that obtains at Lake Shore when workings had reached a depth of 4,500 ft. and at Teck Hughes at more than 6,000 ft. It seems safe to say that workable ore will be found to continue in both camps below the reach of even the most efficient mining methods.

Concentration of U-235

In *Chemical and Metallurgical Engineering* for May extracts are given from a paper by R. R. Wisner read before the Midwest Power Conference, held in Chicago on April 5, covering the electro-magnetic process of concentrating U-235 used at the United States Oak Ridge plant. As the author points out the process is basically a modification of the mass spectrometer, in which a suitable compound of uranium is first vaporized, then ionized by passing through an electric arc, after which the electrified atoms are given a forward acceleration by passing through electric fields having an increase in potential. The electrified and accelerated atoms move at high speed in a strong magnetic field which causes them to travel in a circular path, the diameter of the path being a function of the mass of the atoms. Thus the lighter U-235 atoms travel on a smaller diameter than the heavier U-238 atoms. At the proper point in the circular path separate containers are placed to receive the U-235 and U-238 atoms respectively.

An idea of the magnitude of this development may be gained from the fact that work supervised or done by the Stone and Webster Engineering Corporation of Boston had a value of $427,000,000, including purchase of equipment for the plant and construction of most of the city of Oak Ridge. The electro-magnetic plant contains about 175 buildings and a total floor working area of about 4,500,000 sq. ft. The urgency was so great that small-scale laboratory developments were expanded directly into a gigantic production unit which was the first one to produce considerable quantities of usable products and for nearly a year was the only plant in production.

One of the most impressive features of the plant is the tremendous size of the electro-magnets. These structures are 250 ft. long and contain thousands of tons of high-permeability steel. Prior to their construction the largest magnet was probably that of the 184-in. cyclotron at Berkeley. The magnets used in the Y-12 plant are nearly 100 times as large.

Details of the construction cannot be given, it is stated, but the magnets have many parallel circuits, there is about 40 tons of insulation between the conductors and ground in one magnet, and there is a large amount of heat generated which is carried away by transformer oil through heat exchangers. It is necessary that all types of insulation be thoroughly dry and that the oil piping should be maintained scrupulously clean and dry. Excitation of the magnets is accomplished by motor-generator sets from which 100% service continuity and 100% annual load factor (without standby or reserves) are demanded.

In the air gap of the magnet is an evacuated operating chamber which the plant personnel call a "bin." The beams of the electrified uranium atoms which are curved by the action of the strong magnetic field must operate in an extremely high vacuum of the order of 25,000,000 times less than that considered standard in power-plant condenser practice. To produce such a vacuum enormous pumps of the diffusion type were designed and built, working in series with standard mechanical constant-displacement vacuum pumps. Were it not for this high vacuum the electrified uranium atoms would collide with atoms of oxygen, nitrogen, and other gaseous elements and in so doing might lose

their electrical charges and no longer be under the proper control for the desired collections in the receiving pockets. The fabrication and installation of this vacuum equipment and piping required utmost care and skill and involved tremendous amounts of field welding. The testing for and location of leaks was enormously facilitated by a so-called leak detector.

An interesting aspect of the magnets is their enormous strength, so great that when a 20-penny nail is held in the hand strong effort is necessary to prevent the wrist from being twisted. The pull on the nails in the heels of a pair of shoes is strong enough to make walking difficult at some points. Owing to such effects all movable equipment and structures used within the range of the magnetic field had to be built of non-ferrous metals or of non-magnetic steels.

Some of the most important developments, but likewise the most secret, lie in the contributions to the process made by the electronic experts. To provide the required power supply, and to control it, many thousands of standard items (particularly electronic) were used in very ingenious circuit arrangements.

On some of the high-voltage circuits cooling water having an extremely high resistance value is used to secure adequate insulation to ground. For this purpose a high-resistance water-cooling system was developed, using continuously-de-aerated, de-ionized water, which allows the use of common materials for the water piping circuits.

The problems encountered were not all electrical and mechanical by any means, but were spread pretty well throughout all phases of engineering, physics, and chemistry. Concerning chemistry, for example: During the operating period not all the feed material is separated into its two component isotopes. A considerable portion of it goes astray and has to be recovered from the interior walls of the containing vessels and from parts of the operating equipment. Practically all uranium compounds have a high capacity for absorbing water. The metal also has a tendency to revert to the oxide. Another complication was introduced by the fact that the energy of the ionized particles is so great that those which go astray and impinge on various parts of the equipment combine chemically or physically with the metals forming those parts. The result is that a large operating area must be provided for washing and cleaning operations, where all parts of the apparatus can be cleaned with steam or acid. The product is an acid solution of uranium compounds containing large quantities of iron, nickel, copper, and a number of other metallic elements. All these must be separated from the uranium before it can be recycled in the process, or before it can be passed on to final concentration. Also the uranium must be converted to the chemical compound which is more suitable for feed to the process and this compound must be of the highest purity, as well as completely dry and very finely pulverized. One important task was the design of an enormous chemical plant in which these reclaiming operations are conducted.

One of the interesting things about the chemical operations, the author says, is the precautions taken to salvage every possible grain of uranium whose U-235 content has been enriched. One such precaution is the recovering of splashings from uniforms of the operators in the chemical area. For this purpose uniforms are washed every day in small laundries in individual buildings. The wash water is saved and treated for the recovery of its uranium content. When the uniforms are worn out (and shoes as well) they are collected and sent to an incinerator building where they are burned and the ashes digested in acid and treated for uranium recovery.

In the separation apparatus a large number of carbon parts is provided to protect the metal structures from beam impingement. These become impregnated with uranium atoms and some of the carbon parts have a life of only one run. Others may be used for several runs, but then they are collected and sent to the incinerator building to be burned in an atmosphere of oxygen. The resulting small quantity of ash is treated for uranium recovery. Similarly whenever a metal part is replaced the old part is sent to a salvage room, dissolved in acid, then treated for uranium recovery. Several large buildings are provided exclusively for treating salvage solutions. Another salvage operation which may seem far fetched is the treatment of the ventilating air from the chemical areas for uranium-bearing entrained dust which might otherwise escape to the outside atmosphere.

In concluding his talk the author offered the opinion that the electro-magnetic process should have almost unlimited scope in the development of atomic power and that the method would be most versatile in the commercial separation of the isotypes of many elements.

Chromite Associations

In *Economic Geology* for May T. P. Thayer discusses a preliminary chemical correlation of the chromite with the containing rocks, saying that detailed study of chromite deposits during Strategic Mineral Investigations of the United States Geological Survey has revealed great variations in the composition of chromite, not only from widely-separated regions, but within relatively small districts in which all the deposits occur in one kind of rock. Local variation is shown in the Sagua de Tanamo district in eastern Cuba, where samples of chromite from two deposits, both of which are in dunite and about a mile and a half apart, contain about 38% and 55% Cr_2O_3 respectively, and show comparable variation in Al_2O_3. Regional variation is shown by the difference between the high-iron chromites of the Stillwater complex and the high-alumina chromites from Cuba; the major differences in the chemical composition of these chromites have been known for about 20 years, but knowledge of the rocks in which they occur has been so meagre that the controlling petrological factors could not be discussed with any degree of assurance. Although much more detailed chemical and microscopic work is necessary for a thorough study of chromite and its relation to associated peridotites, some

aspects of the problem involved, the author says, can be indicated from the information which has become available in the last five years.

The ideas presented in his paper were developed in discussions of problems related to the genesis of chromite and ultramafic rocks with other members of the Geological Survey who took part in the chromite investigations. Gabbroic rocks and highly-aluminous chromite are clearly associated in several districts. The aluminous chromites in Grant County, Oregon, are in peridotite which grades into gabbro and dykes of highly calcic pegmatitic gabbro cut some of the ore-bodies. Investigations in Cuba have revealed many gabbro and troctolite dykes, some of which are several feet thick and very coarse grained, cutting large chromite ore-bodies. In several mines and notably at the Cayoguan mine in Oriente Province, masses of brecciated chromite tens of feet across have been invaded and cemented by gabbro and troctolite that are pegmatitic in habit. Some of the larger gabbro dykes contain pyroxene crystals up to three feet in length and enclose blocks of chromite several feet across. The inclusions in troctolite show evidence of resorption, for splinters of chromite are rarely seen and some of the larger fragments have been so rounded that they resemble stream-worn pebbles. Most of the blocks of chromite in gabbro, however, show little evidence of corrosion, although in places some bright-green pyroxene which probably contains chromium is present.

Reaction between gabbro and chromite is unusually well illustrated in a specimen collected at La Constancia mine in eastern Oriente Province, Cuba. In this specimen the breccia fragments of chromite show many hooks and embayments apparently developed by resorption and are rimmed by white decomposition products of calcic plagioclase. The interstitial material consists of diopside, enstatite, and partly-serpentinized olivine. These minerals are zonally arranged: Felspar or its decomposition products are nearest the chromite, olivine is next to the felspar, and enstatite next to the diopside, which lies midway between the chromite grains. The irregular outlines of the diopside grains and rod-like inclusions of diopside in some enstatite grains show that the diopside was replaced by the enstatite and the embayment of the enstatite by olivine indicates that it, in turn, was replaced.

Analogous relations are shown in nodular chromite cut by a dyke of millimeter-grained olivine gabbro in the Guillermina mine in Camaguey Province. The dyke is about an inch thick and composed of olivine, augite, and calcic plagioclase (An_{65}). The olivine is much more abundant near the margins and the nodules of chromite at the edge of the dyke are highly resorbed and plated, as it were, with plagioclase.

These relations are believed to illustrate reaction of chromite rich in spinel with diopsidic gabbro under suitable conditions to form anorthite and forsterite and to substantiate Bowen's hypothesis for the formation of chromites of various compositions.

Concluding his review the author says that chromites form an isomorphous series expressed by the formula (Mg,Fe)-$(Cr,Al,Fe)_2O_4$ and are closely related chemically to the silicate systems in which they occur. Although the ratio of MgO : FeO in the associated silicates is much higher than in the chromite, the ratios vary in the same direction in the provinces studied. The proportions of Cr_2O_3, Al_2O_3, and Fe_2O_3 in the chromite appear to be determined by the relative proportions of total Cr_2O_3 and Fe_2O_3 in the magma and by the excess of Al_2O_3 over CaO and Na_2O with which alumina may be combined in anorthite. The silica content of the magma theoretically should have slight effect on the composition of the chromite in environments deficient in lime and even in lime-rich environments the composition of the chromite might not be affected by a wide range in silica content.

Correlation of the composition of chromites with the associated rocks shows that high-alumina chromites occur in peridotitic masses which contain felspathic members and high-chrome chromites occur in felspar-free peridotites low in alumina and iron. The high-iron chromites of the Bushveld type apparently resulted from crystallization in pyroxenic environments deficient in alumina and relatively rich in iron.

The chromites studied seem to fall into overlapping but distinct compositional groups when plotted in the spinel triangular prism of composition according to the petrologic provinces from which they were collected.

The chromites from the Caribbean province are consistently rich in magnesia and cover about half the range between aluminian chromite and chromian spinel. The Bushveld and Stillwater chromites are very much alike; they are relatively rich in iron and though restricted to a narrow range in composition, appear to trend more toward chromian magnetite than spinel. Chromites of the Pacific Coast province appear to be uniformly rather high in chromium and the principal variation is in the ratio of MgO to FeO, causing the long axis of the corresponding field in the prism of composition to lie normal to that of the Caribbean field. Chromites from the Kenai Peninsula resemble those from the Stillwater complex in many respects and those from eastern Oregon show affinities for both the Pacific Coast and Caribbean provinces.

B.C. Mineral Industry

Reviewing the mineral industry of British Columbia for 1945 in the *Western Miner* for April H. Sargent says that 1945 began with most mining operations acutely short of labour. Both production and development were seriously hampered by the shortage. In the latter part of the year the supply of labour improved greatly although the shortage of experienced miners still restricted both explorations and production at some properties. Exploratory work was undertaken in the Portland Canal, Cariboo, Bridge River, Hedley, Boundary, Nelson, Slocan, Texada Island, Taseko Lake, and Whitesail Lake areas. This work was directed principally toward the search for gold ore, but base-metal ores also received attention. Prospectors were active and preliminary work was done on prospects in several areas.

Since labour has become more plentiful and war-time restrictions have been relaxed or removed production at several operating properties has been increased while several other properties shut down during the war have been re-opened or are to be re-opened. If labour continues to be available

the increasing skill of men already recruited will help to relieve the shortage of experienced miners. The present prices of silver and the principal base metals encourage production. The adjustment from war to peace conditions has not affected demand for these metals adversely, on the contrary demand is good as indicated by price increases. These factors along with the interest in exploration and prospecting should contribute to increased production and an active year in metal mining can be expected. Substantial increases in production of metals, particularly gold and copper, are indicated. However, it should be realized that some factors are uncertain and could react unfavourably on metal production. Actions which may be taken by the United States regarding stockpiling of metals and minerals, duties on metals imported, and subsidies on metals produced in the United States cannot be predicted with certainty and may well have important bearing on metal prices. The ability of Great Britain and European countries to purchase metals is also an important factor. United States and Canadian production may be affected, directly or indirectly, by industrial disputes. Coal production in British Columbia was reduced in 1945 because of strikes, fortunately of short duration. The coal and steel industries and some metal refineries in the United States have been affected by more protracted disputes. The proposals for settlement of the steel dispute called for an increase in price which would no doubt be reflected in the prices of steel products which our mining industry must purchase. These disputes and consequent loss of production serve also to postpone the time when equipment needed by the industry can be obtained promptly.

Several of the factors mentioned may have an important bearing on the production of coal, structural materials, and miscellaneous metals, minerals, and materials. Demand for several of the miscellaneous metals and minerals is good and it seems probable that requirements of the British Columbia market will call for increased production of structural materials. There are good prospects that 1946 will be a year of large production and also one in which substantial amounts of exploratory and development work will be done.

Oregon Bauxite

A description of ferruginous bauxite deposits in north-western Oregon is given by F. W. Libbey, W. D. Lowry, and R. S. Mason in *Economic Geology* for May. These deposits, which are extensive, were formed by laterization of Miocene basalts before the deposition of unconformably overlying continental silts of Pliocene age. Their distribution is related to the structure of the Miocene basalt which has been folded into gentle anticlines and synclines. The deposits occur on rather flat-topped hills or ridges or on gentle slopes ranging in elevation from about 200 ft. to nearly 2,000 ft. Erosion has dissected and removed a large part of the original laterized basaltic terrane. Thickness of the deposits is from 6 to 20 or more feet. The silt overburden ranges in thickness from a foot to more than 50 ft. in places. The average thickness is moderate and the ratio of overburden to ore will probably average less than 2 to 1. Several textural varieties of ore are present at most localities. In Washington and Columbia counties the upper part of the ore section in most places is oolitic or pisolitic. The lower part of the section ranges from earthy to nodular with some nodules containing much crystalline bauxite and minor limonite. Nodules made up essentially of light-coloured bauxite occur as float.

Exploration of two of the larger deposits in Washington County by the Oregon Department of Geology and Mineral Industries has indicated more than 5,000,000 long tons of ferruginous bauxite.

Although the Oregon ferruginous bauxite cannot be treated economically by the Bayer process, the Pedersen process has been employed in Norway to treat material of similar composition, and such a process or a modification of it to produce alumina, iron, and possibly titanium appears to be feasible. The Aluminium Company of America is exploring the deposits in Washington and Columbia counties and conducting metallurgical tests on the ore. These deposits, so favourably situated in relation to aluminium reduction plants on the Lower Columbia River, may become an important source of alumina for these plants.

RECENT PATENTS PUBLISHED

☛ A copy of the specification 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.

3,263 of 1941 (577,281). Soc. Anon. des Manufactures des Glaces et Produits Chimiques de Saint-Gobain and G. C. Ory, Paris. Controlled roasting of pyrites ensures the total combustion of the combined sulphur.

4,130 of 1943 (576,906). National Smelting Co., Ltd., S. W. K. Morgan, S. E. Woods, and L. J. Derham, Tadley, Hants. Zinc is recovered from zinc-containing vapours by a process of shock chilling.

7,419 of 1944 (576,982). Davey, Paxman and Co., Ltd., and F. H. Allman-Ward, Colchester. Froth flotation concentration.

10,282 of 1944 (576,702). F. L. Smidth and Co., Ltd., London. Agglomeration of iron-bearing materials.

NEW BOOKS, PAMPHLETS, ETC.

☛ Publications referred to under this heading can be obtained through the Technical Bookshop of *The Mining Magazine*, 482, Salisbury House, London, E.C.2.

Stress Grading of Timber : What it is and why it is needed in a competitive world for the future development of the use of timber in structures. By C. J. Chaplin. Limp cloth, 32 pages, illustrated. London : Timber Development Association, Ltd.

Wood Flooring : The Preparation, Laying, Finishing, and Properties of the Various Types of Wood Flooring. Limp cloth, 37 pages, illustrated. London : Timber Development Association, Ltd.

Rapid Survey of Coal Reserves and Production : A First Appraisal of Results. D.S.I.R. Fuel Research Paper No. 58. Paper covers, 23 pages, with tables. Price 9d. London : H.M. Stationery Office.

Canada : The Sand-Lime Brick Industry, 1944. Paper covers, 4 pages, typescript. Price 10 cents. Ottawa : Dominion Bureau of Statistics.

The ABC or Alphabetical Air Guide : With Complemental Shipping Services. No. 146, June, 1946. Paper covers, with map. Price 2s. 6d. monthly. London : Thomas Skinner and Co. (Publishers), Ltd.

Selected Index to Current Literature

This section of the Mining Digest is intended to provide a systematic classification of a wide range of articles appearing in the contemporary Technical Press, grouped under heads likely to appeal to the specialist.

* Article in the present issue of the MAGAZINE. † Article digested in the MAGAZINE.

Economics

†**Production, Canada :** *Metals, Eastern.* Modern Electroalchemy. W. M. GOODWIN, *Comp. Air Mag.*, May, 1946.

Production, Germany : *Metal, War-Time.* Non-Ferrous Metallurgy in Wartime Germany. A. J. PHILLIPS, *Eng. Min. Journ.*, June, 1946.

Production, Germany : *Metals, Control.* Allied Council Restricts German Metal Output. J. D. WILSON, *Eng. Min. Journ.*, May, 1946.

Production, Italy : *Marble, Carrara.* Marble Quarrying in the Apian Alps. *Mine, Quarry Eng.*, July, 1946.

Production, Mexico : *Calcite, Sonora.* How a Sudden Demand for Optical Calcite was Met. C. R. KING, *Eng. Min. Journ.*, May, 1946.

Production, Mexico : *Conditions, Industrial.* Mexico is Strangling Its Mining Industry. E. JUST, *Eng. Min. Journ.*, June, 1946.

Production, Mexico : *Copper-Lead, Chihuahua.* New Flotation Technique in Copper-Lead Separation. G. O. DESHLER, T. R. HERNDON, *Eng. Min. Journ.*, May, 1946.

Production, South Africa : *Gems, South-West.* South-West Africa's Gem Production. *S.A. Eng. Min. Journ.*, May 25, 1946.

†**Production, United States :** *Barytes, Review.* Mining and Marketing of Barite. C. L. HARNESS, F. M. BARSIGIAN, U.S. Bur. Mines Inf. Circ. 7345.

Production, United States : *Diatomaceous Earth, California.* Digging for Dicalite. R. J. GREEN, *Exc. Eng.*, June, 1946.

†**Production, United States :** *Power, Nuclear.* Developments on the Nuclear Front. *Chem. Met. Eng.*, May, 1946.

Production, West Africa : *Mineral, Gold Coast.* Mining in the Gold Coast. W. W. VARVILL, *Min. Pet. Tech. Mag.* of Birmingham University.

Resources, Colombia : *Gold, Tolima.* Untested Colombian Basin May Hold Large Gold Placers. J. F. TROUTMAN, *Eng. Min. Journ.*, May, 1946.

Resources, South Africa : *Coal, Cape.* Coalfields of the Cape Province : Fresh Examination to Be Made. *S.A. Min. Eng. Journ.*, June 1, 1946.

Resources, West Africa : *Mineral, Gold Coast.* Progress in Geological Investigations and Mineral Development in the Gold Coast. N. R. JUNNER, *Bull. Imp. Inst.*, Vol. XLIV, No. 1., Jan.-Mar., 1946.

Geology

Economic, Canada : *Oil, Alberta.* Structure at Depth on the Plains of Alberta. R. L. RUTHERFORD, *Can. Min. Met. Bull.*, May, 1946.

†**Economic, Mozambique :** *Gold, Macequece.* Gold Fineness in Relation to Geology : Consideration of the Macequece Field. L. L. COLIN, *S.A. Min Eng. Journ.*, May 18, 1946.

†**Economic, United States :** *Bauxite, Oregon.* Ferruginous Bauxite Deposits in Northwestern Oregon. F. W. LIBBEY, W. D. LOWRY, R. S. MASON, *Econ. Geol.*, May, 1946.

†**Genesis, Ore :** *Changes, Depth.* Depth Changes in Ore Deposits. E. L. BRUCE, *Can. Min. Journ.*, Apr., 1946.

Mineralogy, Canada : *Lead-Zinc, B.C.* Mineralogy of the Ores of the Highland-Bell Mine—I. A. B. STAPLES, H. V. WARREN, *Western Miner*, May, 1946.

†**Mineralogy, Economic :** *Associations, Chromite.* Preliminary Chemical Correlation of Chromite with the Containing Rocks. T. P. THAYER, *Econ. Geol.*, May, 1946.

Petrology, Theory : *Differentiation, Magmatic.* Thermal Diffusion—Convection as a Cause of Magmatic Differentiation—I. W. WAHL, *Am. Journ. Sci.*, June, 1946.

Regional, Canada : *McConnell Creek, B.C.* The McConnell Creek Area. C. S. LORD, *Western Miner*, May, 1946.

Survey, Aerial : *Reconnaissance, Photographic.* Aerial Photographs Speed Reconnaissance Work. J. EDWIN, *Eng. Min. Journ.*, June, 1946.

***Survey, Geophysics :** *Gravimetric, Nottingham.* Gravimeter Test in a British Oilfield. THE MINING MAGAZINE, July, 1946.

Survey, Geophysics : *Magnetometer, Airborne.* The Airborne Magnetometer : A New Aid to Geophysics. A. W. KNOERR, *Eng. Min. Journ.*, June, 1946.

†**Survey, Geophysics :** *Methods, Review.* Modern Trends in Geophysical Prospecting. H. LUNDBERG, *Western Miner*, May, 1946.

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Copper, Melting : *Furnace, Electric.* The Electric Furnace Melting of Copper. R. H. WADDINGTON, J. C. BISCHOFF, *Can. Min. Met. Bull.*, May, 1946.

Iron, Melting : *Lining, Cupola.* The Basic-Lined Cupola. *Engg.*, July 5, 1946.

Works, Steel : *Utilization, Fuel.* Fuel Utilization in Iron and Steel Works. N. H. TURNER, F. A. GRAY, *Iron, Coal Trades Rev.*, June 14, 1946.

Works, Steel : *Utilization, Fuel.* Waste-Heat Recovery in the Iron and Steel Industry. J. A. KIRBY, W. G. CAMERON. *Iron, Coal Trades Rev.*, June 28, 1946.

Machines, Materials

Driers, Rotary : *Coal, Treatment.* Application of Rotary Louvre Driers : Reduction of Moisture in Small Coal. *Iron, Coal Trades Rev.*, June 7, 1946.

Drill, Rock : *Life, Economic.* New Yardstick for Gaging a Drill's Economic Life. A. F. HORLE, *Eng. Min. Journ.*, May, 1946.

Locomotives, Diesel : *Types, Underground.* The Diesel Locomotive Underground—4 and 5. B. REED, *Coll. Eng.*, June, July, 1946.

Machine, Gravel : *Screen, Portable.* A Portable Gravel-Washing and Screening Machine. *Eng.*, June 7, 1946.

Steel, Drill : *Progress, Review.* Progress in Mining Drill Steels. L. SANDERSON, *Mine, Quarry Eng.*, July, 1946.

Washer, Coal : *Type, Cyclone.* The Cyclone Washer, *Coll. Eng.*, June, 1946.

Mining

Breaking, Blasting : *Charge, Shaped.* The Shaped Charge for Cheaper Mine Blasting. J. B. HUTTL, *Eng. Min. Journ.*, May, 1946.

Coal, Power : *Electricity, Use.* Electricity at the Coal Face. E. L. MARTHELEUR, *Can. Min. Met. Bull.*, May, 1946.

Costs, Power : *Equipment, Electric.* Plant Power Costs Reduced with Shunt Capacitors. W. H. CUTTINO, *Eng. Min. Journ.*, May, 1946.

***Education, Training :** *Future, British.* Industrial Training. J. B. RICHARDSON, THE MINING MAGAZINE, July, 1946.

Handling, Conveyors : *Lead-Zinc, B.C.* Underground Belt Conveyor Handles Increased Tonnage. J. B. HUTTL, *Eng. Min. Journ.*, June, 1946.

Handling, Hoisting : *Equipment, Skip.* The Skip Winding of Coal. J. W. WARDELL, *Coll. Eng.*, July, 1946.

Hazard, Explosion : *Dust, Coal.* Effect of Relief Vents on Reduction of Pressures Developed by Dust Explosions. I. HARTMANN, J. NORGY, U.S. Bur. Mines Rep. Inv. 3924.

Hygiene, Silicosis : *Control, Dust.* Dust Suppression by Foam Apparatus. F. H. PRICE, *Iron, Coal Trades Rev.*, June 28, 1946.

Labour, Control : *Choice, Foreman.* Qualities of the Foreman Men Like to Work With. P. D. PEARSON, *Eng. Min. Journ.*, May, 1946.

Management, Coal : *Position, Future.* Mine Management in a Nationalized Industry. A. M. BRYAN, *Iron, Coal Trades Rev.*, June 7, 1946.

Safety, Training : *Uses, Colour.* Colour as a Safety Aid. L. L. COLIN, *S.A. Min. Eng. Journ.*, June 1, 1946.

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Ore-Dressing

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Filtration, Review : *Theory, Practice.* Correlating Filtration Theory with Industrial Practice. B. F. RUTH, *Ind. Eng. Chem.*, June 10, 1946.

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Flotation, Selective : *Lead, Copper.* New Flotation Technique in Copper-Lead Separation. G. O. DESHLER, T. R. HERNDON, *Eng. Min. Journ.*, May, 1946.

General, Copper : *Examples, Review.* The Dressing of Copper Ores. F. B. MICHELL, *Mine, Quarry Eng.*, May, June, July, 1946.

***Gravity, Sink-Float :** *Flotation, Sand.* Chance Sand Flotation. Ore-Dressing Notes, THE MINING MAGAZINE, July, 1946.

Gravity, Sink-Float : *Scope, Selectivity.* Scope and Selectivity of Sink-and-Float Separation. F. J. TROSTLER, T. ANDREWS, *Mine, Quarry Eng.*, July, 1946.

Gravity, Tin : *Tables, Canada.* Modernized Device Makes Tin Plant Possible. J. B. HUTTL, *Eng. Min. Journ.*, May, 1945.

†**Non-Metallics, General :** *Barytes, United States.* Mining and Marketing of Barite. C. L. HARNESS, F. M. BARSIGIAN. U.S. Bur. Mines Inf. Circ. 7345.

Washing, Coal : *Machine, Cyclone.* The Cyclone Washer. *Coll. Eng.*, June, 1946.

COMPANY MEETINGS AND REPORTS SECTION

AFRICAN AND EUROPEAN INVESTMENT CO., LTD.

(Incorporated in the Union of South Africa)

Directors : R. B. Hagart (*Chairman*), C. R. Davis, B. H. Friel, H. C. Koch, Sir Ernest Oppenheimer, H. F. Oppenheimer, S. S. Taylor, R. W. Townsend (*Manager*), F. A. Unger. *Consulting Engineer :* M. C. G. Meyer. *Secretary :* B. E. Humphrey. *Office :* 65, President Street, Johannesburg. *London Secretaries :* Anglo American Corporation of South Africa, Ltd. *Office :* Stafford House, 14–20, King William Street, E.C. 4. *Formed* 1904. *Capital issued :* £2,596,033 in £1 shares.

Business : Finance of and investment in mining and other ventures, mainly in South Africa.

The forty-first ordinary general meeting of the African and European Investment Co., Ltd., was held in Johannesburg on May 22 last, Mr. R. B. Hogart presiding.

In moving the adoption of the report and accounts for 1945 the chairman first dealt with the changes that had taken place in the Board of Directors following the acquisition by the Anglo American Corporation of South Africa, Ltd., and associated companies of practically the whole share capital of Lewis and Marks, Ltd. He then said : The profit for 1945 amounted to £404,675, as against £461,917 for the year 1944. The principal reasons for the lower profit are declines in dividends and interest and in profits on share transactions. The latter is always a variable source of revenue, but with regard to dividends we have not brought into the accounts the final dividends for the year 1945 from the Vereeniging Estates, Ltd., and the Union Steel Corporation (of South Africa), Ltd., which were only declared in 1946.

After including the balance of unappropriated profit at December 31, 1944, the total available for appropriation amounted to £550,728. Provision for taxation absorbed £40,000 and an amount of £1,250 being expenditure incurred in increasing the nominal capital of the company was written off. Dividends declared were maintained at 12½% and totalled £324,501. Directors' additional remuneration, in terms of the articles, amounted to £5,000, and the balance of unappropriated profit of £179,977 was carried to the balance-sheet.

With regard to agricultural interests, owing to drought conditions at the commencement of the year, our Closer Settlement Blocks in the Lichtenburg and Ventersdorp districts, which are leased on a share of crop basis, had an exceptionally bad season and returned a gross revenue in maize to the company of £11,310, as against £24,780 for the previous year.

Prospects

The prospects for the current year are very much more encouraging and may well prove to be as good, if not better, than the 1943–4 season, when the company's share in maize alone totalled 25,850 bags. Rentals from other leased farms have been maintained at normal levels. Our ranching operations were also affected by the drought conditions. More cattle were sold than in the previous year, but owing to poor grazing and to the incidence of lumpy sickness, slaughter animals were in such bad condition that they had to be stall-fed at considerable expense, which naturally had the effect of reducing profits.

At the end of the year the company's herds totalled 13,120 head, approximately two-thirds of which were at the Bechuanaland Ranches, the balance being distributed over the two Waterberg stations. Since the close of the year, the company has concluded a satisfactory deal by disposing of the Bechuanaland Ranches as a going concern. The profits from this transaction will be reflected in the accounts for the current year. The sale involved an area of approximately 97,180 morgen and included some 9,000 head of cattle.

There was a modest revival in the sale of our township properties, in addition to which the company co-operated with the National Housing Commission and made available at a reasonable figure large blocks of building stands, which are now being turned to good account in the alleviation of housing shortage.

The company's central town properties in Johannesburg and Pretoria continue to be fully let.

Orange Free State

It has been the practice of the chairman at annual meetings to review at length the progress of drilling operations in our important Free State areas, but as full details of the drilling results are published for the information of shareholders in the quarterly reports of the company, I do not think it is necessary for me to repeat these results in detail now. I should, however, like to give you a summary of what we have achieved to date.

In the western portion of Block 7, or what has been called the positive (or proved) area, two conglomerate reefs of economic importance have been located. These reefs have become known as the "Leader Reef" and the "Basal Reef"—the latter being the more important. A summary of the 42 bore-holes put down in this area, up to April 30, 1946, is as follows :—

	Leader Reef.	*Basal Reef.*
Bore-holes which intersected Leader or Basal Reef	28	32
Bore-holes which intersected payable Leader or Basal Reef.	2	16
Average unreduced value of reef sampled in payable intersections —dwt.	4·4	25·6
Average corrected width of reef sampled—inches	46·8	17·1
Average inch-dwt., unreduced .	206	438

In addition, in bore-hole K.P.2 on the farm Klippan No. 403, an Upper Reef was intersected 424 ft. above the Basal Reef, assaying 3·5 dwt. per ton over 72·9 in. corrected width, equivalent to

255 inch-dwt. and a further reef 10 ft. above the Basal Reef, assaying 37·7 dwt. per ton over a corrected width of 27·6 in., equivalent to 1,041 inch-dwt.

These drilling results, in our view, demonstrate that your company owns, or has under option, a very valuable reef-bearing area, which is some 8,000 morgen in extent. No further drilling is necessary to prove this area other than that incidental to shaft sinking and immediate steps can therefore be taken to open it up by means of shaft sinking and development work. I shall refer to this again later. In addition to the area already mentioned above, there are approximately 2,000 morgen of potentially reef-bearing ground which has not yet been finally proved.

In the eastern side of Block 7 eight bore-holes were completed during the year without revealing anything of economic importance. Although, therefore, we have not met with any encouragement so far in this area it is proposed to do a certain amount of further drilling before making up our minds finally as to whether the area has any economic worth.

In the Block 8 area which, as you know, consists of 16,231 morgen adjoining the Block 7 area to the north-east, three holes, two of which were joint with Block 7, were completed during the year and two more have been completed since the end of the year. No results of any economic consequence were obtained, but exploration in the form of a geophysical survey is being carried out at present and if this survey gives any encouragement further drilling will be carried out.

In the Heilbron and Edenville area three bore-holes are at present in progress, two of which have intersected Witwatersrand formation but in which there is nothing of any importance to be reported so far. Drilling is, however, continuing. In the Brandfort area one bore-hole has been drilled but has not yielded results of any economic importance. The options in the Winburg area have been abandoned, as it was not considered that this area held out much promise judging by the latest bore-hole results in the area south of the Sand River.

I now wish to refer again to the western portion of Block 7 and to explain the steps we are taking to open up this area. You will appreciate that before mining on any substantial scale can be undertaken in this part of the Orange Free State certain essential services have to be made available. These comprise, in the main, power, water, railways, roads, and townships. These services are of course required by other parties also interested in opening up of mines in the Odendaalsrust area and we are acting jointly with them in endeavouring to expedite their provision. A joint application had been made for a branch line to serve the area and also for the supply of power.

Investigations are also proceeding as to the most suitable means of providing a permanent water supply to serve the new mining fields. We are also making application in conjunction with the Union Corporation, Ltd., for permission to establish a new township adjacent to Block 7 and the farm St. Helena and for this purpose have jointly formed a small township company. All these matters take time and we are handicapped by the area being somewhat remote and by the post-war difficulti of shortage of general mining equipment and housing materials. Every effort, however, is being made to overcome these problems and to get adequate services available with the minimum of delay.

Negotiations with Leases Board

Apart from the foregoing general requirements which have to be dealt with, we have opened negotiations with the Mining Leases Board regarding the division of Block 7 into suitable mining areas. We are also discussing with Western Holdings, Ltd., the inclusion of a small portion of their so-called "Northern Area" in our lease application as the area in question is separated from the rest of their ground by a major fault and can most conveniently be mined in conjunction with adjoining ground on Block 7. Our negotiations have not yet proceeded far enough to enable us to advise shareholders of the terms we can obtain or of the financial provisions we propose to make, but as soon as we are in a position to do so we shall publish full details.

A great deal of attention has been focused in recent months on the important results obtained from drilling in the Odendaalsrust district of the Orange Free State and your Board is proud of the fact that your company and Western Holdings, Ltd., were pioneers in the discoveries made in that area. Apart from our valuable ownership of Block 7, we have a direct interest in St. Helena Gold Mines, Ltd., of 2⅓% in the provision of the original working capital and a further interest through our shareholding in Western Holdings, Ltd. The large claim area held by the St. Helena Company and the very encouraging bore-hole results give every promise that the company has a very successful future before it.

Coal Interests

The company's coal interests continue to be a most important asset. The Amalgamated group of Collieries, together with the Coronation Collieries, Ltd., and the Vryheid Coronation, Ltd., produced more than 8,100,000 sales tons of coal during 1945. This output was equivalent to practically 32% of the total Union production of approximately 25½ million tons.

It is noteworthy that of the total Union production in 1945 some 4¾ million tons were exported to overseas markets. These markets were, of course, largely increased during the war period and while the prospects of retaining this business are quite good, it must be remembered that a considerable volume was gained at the expense of competitors elsewhere, particularly in Great Britain and it may be anticipated that in due course British producers will strive to regain their share of these markets.

Apart from the potentialities of the export trade, the promise of the new Free State goldfields indicates that we are on the threshold of a greatly increased internal demand for coal. New power stations must be established and there will be new industrial and domestic requirements to be met. In short, the outlook for the coal trade as a whole is encouraging.

There has recently been a Parliamentary discussion on the desirability of the Government establishing a plant for the conversion of low-grade coals into oil, petrol, and kindred by-products. No decision was taken, but I may say that we would welcome the appointment of a commission to go into the matter.

The motion was seconded by Sir Ernest Oppenheimer and carried unanimously.

CENTRAL MINING AND INVESTMENT CORPORATION, LTD.

Directors : Sir Clive Baillieu (*Chairman*), A. J. Brett and J. Martin (*Managing*), Brigadier R. S. G. Stokes and R. Walker (*Assistant Managing*), A. Chester Beatty, R. Beaumont, Sir R. Sothern Holland, W. Mure. *Secretary :* G. W. Flint. *Office :* 1, London Wall Buildings, London, E.C. 2. *Formed* 1905. *Capital :* £4,400,000.

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

The forty-first ordinary general meeting of the Central Mining and Investment Corporation, Ltd., was held on June 28 at 1, London Wall Buildings, E.C.

The following are extracts from the statement by the chairman, which was circulated with the report and accounts for 1945.

The accounts show that the profit for the year amounts to £679,832, as compared with £847,761 (after allocating £50,000 to Contingencies) in 1944.

The directors propose the payment of a final ordinary dividend of 9s. 3d. and a bonus of 4s. 9d. per share.

The balance sheet makes clear that the Corporation has maintained its financially strong position. There is little change in the amount of the liquid assets at £19,029,001, against £19,022,165 last year. The surplus of current assets over the claims of creditors, subsidiary companies, and dividends is just over £1,700,000. The Corporation thus has ample resources to meet current financial commitments and to take advantage of suitable investment opportunities.

Our major interest continues to be our holding of shares in gold mining companies on the Witwatersrand.

The operations of the industry during 1945 were again restricted owing to the inadequate supply of native, and also of European, labour although the number in service was rather greater than in the previous year. The serious fall which has taken place during the war in the ore reserves of the mining companies and the urgent necessity, when conditions permitted, of increasing development work in order to redress the situation has been pointed out at our recent annual meetings. During the year as much labour as possible was therefore directed towards expediting development operations and, as a result, the development footage throughout the industry was increased by 176,621 ft. to 1,733,055 ft. The extent of the leeway to be made up, however, is apparent when comparison is made with the footage of 2,704,346 ft. driven in 1941. While carrying out this additional development work milling operations were maintained on approximately the same scale as in the previous year, the tonnage treated, namely 58,897,600 tons, showing an increase of 393,200 tons. I should call your attention to the further increase which took place in working costs which reached 24s. 6d. per ton in December, 1945. The average for the year of 23s. 9d. per ton was higher by 11d. per ton than that of 1944. This compares with a figure of 19s. 5d. per ton for the year 1939. It will be apparent that this rising tendency of costs must result in the loss of large tonnages of marginal ore which are rendered unpayable on account of the gradually rising pay limit.

In his Budget Statement to Parliament on February 28, 1946, the Minister of Finance for the Government of the Union of South Africa announced certain revisions in the future system of taxation of the gold mines. The Special Levy of 22½% on profits is to be discontinued and a new increased formula, or sliding scale, for income tax, based as previously on the ratio of profit to gold recovered, is to replace the flat rate tax of 15% and the formula tax at present existing. Changes are to be made in the manner in which capital expenditure is to be allowed as a deduction in computing taxable profits and the Government is to relinquish certain revenue in respect of claim licences and native pass fees. These changes are welcomed as affording some relief from the heavy war-time burden on the industry and as a measure of simplification, but taxation still remains on a very high level.

Of the individual mines of the Group I think I need refer only to Blyvooruitzicht Gold Mining Co., Ltd. During the year No. 2 shaft was sunk to its final depth and connexion was made with No. 1 shaft. The mine is thus relieved of the restrictions regarding the number of men who would be employed underground while there was only one outlet and can expand its operations accordingly. With the removal also of the restrictions on the raising of capital, the company was able in November last to provide itself with the necessary funds to expand the milling output from the present figure of about 30,000 tons per month to 80,000 tons per month, by the issue to shareholders of 490,000 reserve shares at £5 10s. per share.

In the Orange Free State the Corporation is interested in certain blocks of farms situated at from 3 to 15 miles north-east from Odendaalsrust. Exploratory drilling in the block including the farms New Kameeldoorns, Leeuwbosch, and Weltevreden, some five miles from Odendaalsrust, has been continued. The Corporation was a member of the Syndicate formed some years ago to finance the initial exploitation of the prospecting and mining lease granted by the Union Government to Western Holdings, Ltd., over certain farms in the Orange Free State, including the farm St. Helena. A new company, called St. Helena Gold Mines, Ltd., has recently been formed. The Corporation is also interested in the New Consolidated, Free State, Exploration Co., Ltd., which is carrying out exploratory work in the Orange Free State.

You will have seen from the Directors' Report that the Transvaal Consolidated Land Company is embarking on a new enterprise through the opening up of a colliery on its farm, Van Dyk's Drift in the Transvaal, where a large deposit of good quality coal has been proved by drilling and shaft sinking operations have begun. Since the close of the year the Pretoria Portland Cement Company has raised further capital in order to modernize and extend its plant. The other industrial enterprises in South Africa in which we are interested, including Witbank Colliery, Limited, and Hume Pipe Co. (S.A.), Limited, have made good progress and have distributed satisfactory dividends.

Investments in oil ventures, both producing and exploratory, constitute a large and growing proportion of the Corporation's interests.

GOLDEN HORSE SHOE (NEW), LTD.

Directors : R. Ellerton Binns (*Chairman*), John A. Clark, Sir Frederick Hamilton, Capt. H. Loeffler, E. Turk. *Manager in Western Australia :* J. E. Ede. *Secretary :* H. L. Jones. *Office :* Friars House, 39/41 New Broad Street, London, E.C. 2. *Formed* 1929. *Capital issued :* £110,000 in 2s. shares.

Business : Re-treatment of tailings dumps in Western Australia.

The annual general meeting of Golden Horse Shoe (New), Ltd., was held on June 25 at Friars House, E.C. 2, Mr. E. Ellerton Binns presiding.

The following are extracts from the chairman's address, circulated with the report and accounts for 1945.

During the first ten months of the year the treatment of the Great Boulder No. 2 Dump was continued and produced a joint working surplus of £8,676 and for the remaining two months, work was carried out on the Lake View No. 3 Dump, yielding a joint working surplus of £1,426.

Your company's half-share of the profit for the complete year was, therefore, £5,051, which, with £1,369 received from dividends, interest, etc., and £5,750 in respect of the estimated Excess Profits Tax deficiency relief for the year, gives a total gross income of £12,170. From this sum, London and Adelaide expenses amounting to £4,007 have been deducted, £1,600 set aside for income-tax, and £1,000 provided for depreciation of plant. As a result of these charges and appropriations, there remains a balance profit for the year of £5,563, to which is added £1,006 brought forward on profit and loss account, giving a total amount available of £6,569. From this sum it is proposed to distribute 2d. per share which, after deducting tax at the standard rate of 9s. in the £, will absorb £5,042 and leave a balance of £1,527 to carry forward.

With regard to treatment operations, throughput for the year totalled 399,930 tons, of which 279,010 tons were from the Great Boulder No. 2 dump and 120,920 tons from the Lake View No. 3 dump. The difficulties of profitably treating the Great Boulder No. 2 dump increased as it gradually approached exhaustion and by the end of October, 1945, it was clear that the small remaining balance could not be profitably treated. Operations were then transferred to the Lake View No. 3 dump.

This latter dump which, as you are aware, is being worked under a profit-sharing arrangement with the Lake View and Star, Ltd., was estimated to contain approximately 500,000 tons of tailings. Results to date show that, although the tailings are easily sluiced, the percentage of gold recovered has not been up to expectations, owing largely to the presence of charcoal. If throughput is maintained at the current rate, the estimated stock of tailings in this dump is sufficient for a further three months' work. We shall then commence work on other dumps which we have arranged to treat on a profit-sharing basis.

The report was adopted.

H.E. PROPRIETARY, LTD.

Directors : N. S. Erleigh (*Chairman*), R. Ellerton Binns (*Deputy Chairman*), J. A. Clark, H. G. Latilla, W. A. Mackenzie. *Consulting Engineers :* McCarthy and Binns. *Secretary :* R. Q. Cruttwell. *Office :* Friars House, 39–41 New Broad Street, E.C. 2. *Formed* 1931. *Capital :* £300,000 in 10s. shares.

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

The annual general meeting of H.E. Proprietary, Ltd., was held on July 3 at Winchester House, E.C. 2, Mr. R. E. Binns presiding.

In moving the adoption of the report and accounts for 1945 the deputy chairman said :—

The accounts reveal a satisfactory position. Total revenue at £122,835 is £28,679 higher than for the previous year, but against this there is an increased taxation charge of £27,159 as a result of the increased profit and the fact that the previous year's provision was reduced by adjustments which did not arise last year. After making full provision for tax liability on profits to the date of the accounts, the net profit for the year is £64,670, which amount, together with the balance of £47,124 brought forward from the previous year, gives a total of £111,794 available.

In November last we paid an interim dividend of 5%, less income tax at 10s. in the £, and now recommend a final dividend of 10%, the same as for the previous year, as a large part of our gross revenue was derived from a non-recurring source—namely, liquidation distributions from the Associated Mining and Finance Company, Ltd. We also recommend the payment of a bonus of 7½%—that is, 2½% higher than last year—which will bring the total distribution to 22½% by way of dividend and bonus, as against 20% for 1944.

The distributions recommended will absorb £28,875 and the directors' additional remuneration in terms of the articles of association £2,408, after which payments there will remain a credit balance on profit and loss account of £73,011 to be carried forward.

At the close of the year under review the administration of the South African company was transferred to the New Union Goldfields, Ltd., and the strong liquid position of the company will permit full advantage to be taken of any fresh business which may develop from its association with this progressive group.

Our Australasian gold-mining interests continue to be adversely affected

I have pleasure in advising this meeting that arrangements are in course of completion whereby the H.E. Proprietary will be enabled to participate with New Union Goldfields both in additional outlooks in the Orange Free State—notably, in the New Free State Gold Estates, Ltd., and in the expansion of the Union's industrial future through the South African General Industries, Ltd. The proposals, details of which will be made available later, will aim at the H.E. Proprietary joining and playing a part in a policy which I hope will be endorsed by shareholders and will also be followed by other home companies with a view to furthering the interests of this integral and most valuable component of the Commonwealth.

The report and accounts were unanimously adopted.

GENERAL MINING AND FINANCE CORPORATION, LTD.

(*Incorporated in South Africa*)

Directors : Sir George W. Albu (*Chairman and Managing*), C. S. McLean, T. Shearer, Major N. F. H. Railing, W. H. A. Lawrence, W. M. Frames. *Secretary :* C. W. Kearns. *Head Office :* Johannesburg. *London Secretary :* B. M. Ivison. *Office :* Winchester House, E.C. 2. *Formed* 1895. *Capital issued :* £1,264,579 in £1 shares.

Business : Finance of and investment in mining and other ventures, mainly in South Africa.

The forty-sixth ordinary general meeting of the General Mining and Finance Corporation was held in Johannesburg on June 18, Sir George W. Albu, Bart., presiding.

The chairman, in moving the adoption of the report and accounts for 1945, said : I have pleasure in presenting to you the report and accounts of the corporation for the year ended December 31, 1945. They disclose full particulars of the corporation's operations for the year under review and include a summary of the results obtained by the companies in which the corporation is interested.

The profit for the year at £376,685 was approximately the same as the previous year and together with the unappropriated balance of £132,212 at the beginning of the year, made £508,897 available for distribution, compared with £503,870 in the 1944 accounts. Dividend distributions for the year were maintained at equal to 5s. per share, absorbing £316,145. It will be seen that an amount of £19,395 representing exploration expenses was written off during the year, while £25,000 was appropriated and placed in a special exploration contingency reserve. After deducting these and other appropriations shown in the accounts an unappropriated balance of £142,238 (compared with £132,212 last year) was carried forward to the new financial year. The total of £1,350,000 represents the unchanged balances of general reserve and investment reserve accounts.

Shareholdings and other interests taken into the balance-sheet at £2,485,930 show an increase of £84,385 over the previous year's figures. Investments for which market quotations are available appear in the books at or under cost, but in no case above the market price at December 31, 1945. Unquoted securities have been entered in accordance with the conservative valuations made by the Board, but in no instance exceeding cost. The aggregate market value of investments greatly exceeds the value shown in the balance-sheet.

The increase in the figure under the heading of Land and Buildings is accounted for by the purchase of a building adjoining and to the back of the present General Mining buildings. As soon as it is permitted it is proposed to erect a large modern building on the combined site, the plans for which are in the course of preparation.

After dealing briefly with the Corporation's principal interests—*viz.*, Van Ryn Gold Mines Estate, West Rand Consolidated Mines, East Rand Proprietary Mines, Durban Roodepoort Deep, and the Phœnix Oil and Transport Company—the chairman said : The working results of the above gild-mining companies for the first four months of the current year were adversely affected by a strike of European miners in March last which led finally to a virtual stoppage of operations throughout the industry for a period of some days.

The formidable strain to which the industry was subjected during the war years in maintaining the output so vital to the welfare of the country has in some respects eased.

Orange Free State.—All eyes have been turned to the prospective mines in the Orange Free State, where drilling has revealed phenomenal bore-hole values. It is well known that these mines will not be able to make any contribution to gold production for some years to come. But it is my firm conviction based on the lessons of history that the new gold discoveries will be the precursor of a revival in world trade and a great expansionist programme. I visualize a very bright future for our country when the new fields on the Far West Rand and Orange Free State come into production. I think you will agree that if the capital is forthcoming, which I have no reason to doubt, there are boundless possibilities to an era of prosperity.

With regard to the corporation's interest in the Orange Free State, we acquired during the year 52½% of the shares in a company known as General Exploration Orange Free State, Ltd. This company during the year was incorporated with a capital of £500,000 in four million shares of 2s. 6d. each, under the secretarial and technical ægis of the corporation. The company, in which New Union Goldfields, Ltd., and New Nigel Estate and Gold Mining Company, Ltd. are also largely interested, is at present undertaking geophysical and exploratory work in the Free State. Application for a quotation on the Stock Exchange will be made when more information of a positive nature is available.

Briefly the chief interests of the company are as follows :—

1. The company holds prospecting and option contracts in respect of mineral rights over approximately 102,000 morgen situated in the St. Helena, Odendaalsrust, Bothaville, Kroonstad, and Ventersburg areas.

2. The company holds options in respect of the surface rights over the Odendaalsrust townlands.

3. The company is entitled to participation in vendor and subscription rights which may accrue to the Free State Development and Investment Corporation, Ltd., in respect of certain farms in the Odendaalsrust, Kroonstad, and Ventersburg districts.

Natal.—As stated in the report, a considerable amount of work was done in investigating a large area of ground in the vicinity of the old Denny Dalton mine near Vryheid. The results proved negative and drilling and prospecting operations were stopped.

At the end of last year the Corporation passed its fiftieth anniversary and although it has seen many vicissitudes I think shareholders can be grateful to that day in 1895 when the founders saw fit to incorporate the General Mining and Finance Corporation, Ltd.

The resolution was adopted.

KONONGO GOLD MINES, LTD.

Directors : Robert Annan (*Chairman*), Sir Frank M. Baddeley, H. G. Fleming, W. H. Geikie, B. W. Mason. *Secretary :* J. H. Nicholls. *Office :* 49, Moorgate, London, E.C. 2. *Formed* 1933. *Capital issued :* £619,258 12s. in 2s. shares.

Business : Operating gold-mining properties in Gold Coast Colony.

The twelfth ordinary general meeting of Konongo Gold Mines, Ltd., was held on June 18 at River Plate House, E.C., Mr. Robert Annan presiding.

In moving the adoption of the report and accounts for the year ended September 30, 1945, the chairman said :—

Dealing first with the profit and loss account, the output of gold shows an increase of £22,000 over the previous year, but working costs were higher by £8,500, export duty by £6,000, and care and maintenance contributions, etc., by £4,000, leaving a net increase in operating profit of £5,500. Bringing in the balance from the previous account there is a total of £152,561 available, compared with £177,173 in the previous year.

Owing to further credits from repayment of excess profits tax provision for taxation only calls for £13,720 and after providing £21,020 for depreciation and transferring £50,000 to general reserve your directors recommend the payment of a dividend of 10%, less tax at 9s. in the £, absorbing £34,059 and leaving £28,485 to be carried forward.

In February last notice was given bringing to an end the scheme for concentration of the mining industry on terms which allowed the mines which had been closed down a period of six months in which to resume work and get into production. Our contributions under this scheme will accordingly come to an end in August.

Under the arrangements for reciprocal relief the increase in the rate of Gold Coast income-tax will not affect us and the fact the dominion tax relief is no longer included in the rate of tax deducted from dividends does not alter the net amount available for distribution by the company. The export duty on gold, however, is a heavy burden on the industry. This type of levy on the value of the product is an unscientific tax which bears with particular severity on the lower-grade mines and which places below the pay limit large quantities of ore which would otherwise be worked for the benefit of the community. When the war surcharge on this tax was repealed recently the basic rate was increased and extended and the tax now stands at 20% of the amount by which the price of gold exceeds 84s. 11½d. per oz. At the present moment this works out at 17s. 5d. per oz., which is only 3s. 5d. per oz. less than the maximum war-time figure. On the basis of last year's results the effect may be expressed either as an addition of 8s. per ton to our working costs or as an appropriation of about 25% of the total profit before taxation. The gold-mining industry of the colony does not expect to avoid its fair share of taxation, but it does regard this tax as bad in principle and unfair in incidence and we shall endeavour to secure some modification.

Production at the property continued at the normal rate, an increase in the grade of ore treated giving a slightly larger gold output from a smaller tonnage, but the advantage of this was largely offset by an increase of 4s. 10d. per ton in operating costs, due in the main to an increase of 15% in labour costs. The cost of fuel has shown some reduction, but any early return to a lower level of general costs cannot be foreseen at present.

Development footage for the year increased from 5,019 ft. to 6,480 ft. Of 3,080 ft. driven on reef 721 ft., or 23%, proved payable and at the end of the period the ore reserve showed a decrease of 46,663 tons, the average value and stoping width remaining practically the same.

The amount of development which we have been able to carry out in recent years has been much below our requirements and we are now more than two years behind in our programme. As you know we have been concentrating under these conditions on the main Odumase ore-shoot, which has shown a distinct falling off in productivity between the 8th and 11th levels. How far this zone of reduced payability may extend we are not yet aware, but its appearance at this time has made still more urgent the need for rapid expansion of our development programme. Fortunately the sinking of the main Odumase shaft to a depth of 2,020 ft. was carried out some time ago. Its equipment has now been completed and work on the opening of the 15th level has begun. A cross-cut on the 13th level has already reached the vein, on which driving is now in progress, but has not yet reached the ore-shoot. It is of great importance that the Odumase ore-shoot between the 11th and 15th levels should be developed as rapidly as possible and, at the same time, a vigorous programme of diamond drilling and development has been started in other parts of the property where there is promise of developing new bodies of ore. Our existing ore reserves will cover our production needs for the next two or three years and our objective in the meantime is to develop new ore at a rate greater than the rate of extraction. Provided that the Odumase vein does not disappoint us there should be no difficulty in doing this. Development results over the next two years will therefore be of particular interest. Details of other areas being developed are contained in the report of the consulting engineers.

The plant has been maintained in good condition. We now have an ample reserve of power for our requirements and should be better off in the future in respect of the quantity and quality of supplies available. There was no shortage of labour during the period. Rates of pay were increased to conform with the new schedule agreed by the Chamber of Mines. Seven days were lost during the period owing to a strike of underground labour for higher wages and more recently there has been a strike of winding engine drivers against certain provisions of the Mining Regulations. Both strikes were settled without undue difficulty. The position of the European staff has been more difficult, partly owing to actual deficiency in numbers, but particularly to the extreme difficulty in securing passages for the purposes of leave or replacement. In this respect the industry feels that it has received less than fair treatment.

The resolution was unanimously adopted.

SELECTION TRUST, LTD.

The thirteenth annual general meeting of Selection Trust, Ltd., was held on July 4 in London.

The following are extracts from the statement of the chairman, Mr. A. Chester Beatty, circulated with the report and accounts for the year ended March 31 last: The net profit after taxation is £201,103, compared with £197,484 for the previous year. The dividend has been increased from 1s. (less tax at 7s. 11½d.) to 1s. 6d. (less tax at 9s.).

In the past the company has suffered severely from the effects of double taxation, particularly on income derived from its holding in the American Metal Company, but the Income-Tax convention between the United Kingdom and the United States of America and changes in Income-Tax law here will result in removing this unfair burden.

I am glad to report that since I issued my statement to the Mufulira shareholders, dated February 5, 1946, the copper market has taken an upward turn. Outside the United States, the production and consumption of newly mined copper have turned out to be on the whole approximately as we anticipated, while as regards scrap, various causes have combined to hold back any substantial tonnage from the market. But in the U.S.A. there has been a drastic change in the anticipated conditions. Mine production has fallen to unexpectedly low levels due to strikes, shortages of labour, and development, etc., while demand has reached a level higher than was expected. This has made the U.S.A. an importer of copper and moreover an importer who can, under present conditions, absorb the surplus in the rest of the world.

The result has been an increase in both the world price and U.S.A. domestic price. The latter has recently been advanced from 12 cents to 14⅜ cents per lb. and the former has risen to about the same parity.

The present market conditions will not be reflected to any appreciable extent in the Rhodesian companies' accounts for the current year which ends on June 30, 1946, but the outlook for the coming year is distinctly promising. It still remains to be seen to what extent scrap copper will return to the market, especially at the new level of prices and until this is clear a note of caution is still necessary. I can, however, say that the outlook generally is better than we dared to hope for a year ago and justifies the long-term optimism I have expressed in my statements in recent years to the shareholders of the Roan Antelope and Mufulira companies.

Consolidated African Selection Trust and its subsidiary, Sierra Leone Selection Trust, have renewed their sales arrangements with the Diamond Corporation for a period of five years from January 1 last. While these contracts involve no change in the participation of the companies in a small or moderate market turnover, they increase their participation, and consequently earning capacity, when diamond sales are large.

In the Gold Coast, after 21 years of production, the expected life of the mines is now greater than at any time during their history. In Sierra Leone, the developed reserves have been substantially reduced as a consequence of nearly seven years of production under war-time conditions, when it was impossible to carry out a commensurate development programme. An active campaign of exploration and development work is, however, now coming into operation and it is anticipated that the reserve position will be re-established at a satisfactory level in due course.

Information concerning our interests in the Orange Free State is set out in the directors' report. Before the war we acquired options over certain farms and came to an agreement with Union Corporation providing for equal participation in any business which developed from our options and their arrangements with Western Holdings, Ltd. It was also agreed that management should be in the hands of Union Corporation in view of their established organization in South Africa.

The first business to be developed under this arrangement is in the hands of a new company, St. Helena Gold Mines, Ltd., in which we have taken up about 930,000 shares at par since the close of the last financial year. Further business may be expected to result from the rights we have in other flotations which may be made by Western Holdings, Ltd. and from the other properties in which we are participating with Union Corporation.

On the St. Helena property, drilling done some years ago intersected the Leader and Basal Reefs with encouraging results, in view of which the new company now intends to develop these reefs by shaft sinking and underground work. This will take some time, as the company is a pioneer in a new mining field and the necessary services required for large-scale operations have still to be provided. It is intended to sink an incline shaft in the northern part of the area where the sub-outcrop is shallowest, followed by driving to open up the reefs. When power becomes available, a vertical shaft will be sunk from which further development will be carried out, after which a decision will be taken regarding the erection of a reduction plant. Funds recently raised are considered to be sufficient to finance the business to that stage.

The development work on the Venezuelan properties in which the Ultramar Company is interested has proved the existence of an oil field from which it is hoped that production will start in the early part of 1948. The remaining areas held are so large that it is impossible to form an estimate of their eventual possibilities until considerable further progress has been made with the exploration programme which is being actively pursued. It is satisfactory that the first oil field in these properties is nearing the production stage.

Selection Trust is participating in a new company, British Bahamian Oil Development, Ltd., which has been formed under the aegis of Central Mining and Investment Corporation and Associates to explore for petroleum in the Bahamas.

The company has substantial and well-spread interests which include copper in Northern Rhodesia, diamonds in West Africa, oil in Venezuela, and gold in the Orange Free State. These interests have considerable actual as well as potential value, but I would remind stockholders that it will take time for the developing businesses to arrive at the dividend-paying stage.

HENDERSON'S TRANSVAAL ESTATES, LTD.

Directors : Sir Joseph Ball (*Chairman and Joint Managing*), Viscount Elibank (*Deputy Chairman and Joint Managing*), W. E. Lawson Johnston, the Hon. H. de B. Lawson Johnston, H. G. Latilla, H. B. Spiller. *London Office :* 1, Cornhill, E.C. 3. *Secretaries :* African Investment Trust, Ltd. *Johannesburg Office :* Barclays Bank Building, Commissioner Street. *Secretary :* M. Ralphs. *Formed* 1912. *Capital issued :* £563,697 in 4s. stock units.

Business : Finance and development of mining and other ventures in South Africa.

The thirty-fourth ordinary general meeting of Henderson's Transvaal Estates, Ltd., was held on June 20 at River Plate House, E.C.

The following are extracts from the statement by the chairman, which was circulated with the report and accounts for the year ended March 31, 1946 :—

During the year under review the company has made satisfactory progress, as indeed is evidenced by the balance sheet and profit and loss account and by the fact that the directors recommend the payment of an increased dividend of 12½% as against 10% for each of the five preceding years.

Our subsidiary companies—*viz.*, The Henderson Consolidated Corporation, Tweefontein Colliery, and Delagoa Bay Development Corporation have all done well, the former two having maintained their dividends at the previous year's level and the last-named having increased the dividend on its ordinary share capital from 6% to 12%.

I am glad to be able to state that at the close of the year under review the valuation of those of our holdings for which quotations are given exceeded the book value by nearly £250,000.

I would add that in the opinion of the Directors the unquoted securities which we hold also possess a value considerably higher than the figure at which they stand in the books of the Company.

Shortly after our annual general meeting last year, Viscount Elibank, your deputy chairman, paid a visit to South Africa for the purpose, *inter alia*, of conferring with the members of the local board of the company in Johannesburg on several matters of vital importance to its welfare. He visited the Tweefontein United Collieries and was successful in bringing to a satisfactory conclusion the negotiations for the acquisition of additional coal-bearing areas adjacent to our existing mines, to which I referred in my speech last year. The acquisition of these new areas has resulted in a substantial extension of the life of the collieries and has afforded additional justification for the capital expenditure now being incurred in opening up and equipping a new shaft on Klipplaat No. 47, situated approximately one mile south of the present Tweefontein mine. It is expected that the new coal-handling plant, including an up-to-date washery, will be completed and brought into operation early next year.

The coal industry of South Africa continued to expand throughout the year 1945 and the sales tonnage rose to a new record of over 25,000,000 tons. It appears probable that these conditions will continue for some time to come and the prospects are encouraging.

ST. JOHN D'EL REY MINING CO., LTD.

Directors : Sir Hugh O'Neill (*Chairman*), Lord William Percy, Lord Remnant, S. H. Le Roy-Lewis, L. E. Langley (*Managing*). *Manager and Superintendent :* Eric Davies. *Secretary :* S. S. Tegner. *Office :* Finsbury House, Blomfield Street, London, E.C. 2. *Formed* 1830. *Capital issued :* £646,265.

Business : Operates the Morro Velho mine and neighbouring properties in Minas Geraes, Brazil.

The ordinary general meeting of the St. John d'el Rey Mining Co., Ltd., was held at Winchester House, E.C., on June 20.

The following are extracts from the statement by the chairman, which was circulated with the report and accounts for the year ended December 31, 1945.

The profit for the year amounts to £173,516, compared with £278,548 last year and if we add to this £56,729 brought forward from last year, there remains the sum of £230,245 to be dealt with. Out of this we have again paid a dividend on the Ordinary Stock of 10%, tax free. This payment, together with the Preference dividend, absorbs £64,626. The amount we have to provide for taxation comes to £108,000, which leaves a balance of £57,619 to be carried forward to next year's accounts.

With regard to the year's operations, the tonnage treated amounted to 345,400 tons, produced as follows : 216,900 from Morro Velho, 99,100 from the Espirito Santo group and 29,400 from Faria. There was again no stoping in Bicalho. The average grade was 13·21 grammes (8·49 dwt.) per ton and the value of the bullion produced was £1,395,031. This compares with a tonnage of 361,700 and a grade of 13·22 grammes (8·50 dwt.) last year, when the bullion produced realized £1,313,926. The higher revenue from the somewhat lower tonnage is due partly to the increase during the year of 4s. 3d. per fine ounce in the London price of gold, and partly to still higher prices obtained for that portion of our gold for which we receive payment in Brazilian currency. In about the middle of 1945 the authorities gave us permission to sell gold to licensed buyers in Brazil at a price of 26·50 cruzeiros per gramme as against the official price of 22·70 cruzeiros. In November the price was reduced to 25·25 cruzeiros. The cause of this very welcome concession was the strong demand for gold among the general public in Brazil, to whom we have been selling in quite small quantities. This demand has persisted up to the present, and we are still obtaining the higher price, though it is of course impossible to say how long it will continue.

This higher price has been especially helpful in meeting the heavy increase in costs due to rises in wages and other expenses. For example, during 1945 labour costs were up by £117,000 as compared with 1944 and social obligations were up by nearly £32,000, which included higher contributions for both pensions and workmen's compensation. As will be seen from the Directors' Report, the cost per ton was 65s. 1d., whereas in 1941 it was 34s. 7d.

In view of these rising costs our policy must be to increase production and treat a larger quantity of ore. For some years production has been running at an average of about 30,000 tons per month, and our aim is to increase this to 40,000 tons at the earliest possible moment. This will require a somewhat larger labour force, which may be obtainable in time, but our main requirement is a higher output per man in the mines. In recent months there has been a definite decline in the output, which is partly due to the fact that in conformity with Brazilian labour legislation the normal working shift underground has been reduced from eight to six hours, but also because the workmen are not producing, either individually or collectively, as they did in the past. This phenomenon is apparent in many other industries in Brazil, and one can only hope that it will gradually disappear. Unless there is an improvement, we shall not be able to get the increased tonnage and consequent reduction in the cost per ton upon which the future success of the Company must largely depend.

The ore reserves at the end of the year amounted to 8,741,000 tons, made up as follows : 5,918,000 in Morro Velho, 2,533,000 in the Espirito Santo group, 189,000 in Bicalho, and 101,000 in Faria. The average indicated grade of these reserves is 12·105 grammes, which is slightly below the grade worked during the year. We have recently obtained from the mines a very full and detailed analysis of the ore reserves which shows that at the present rate of production they should last for a period of about 25 years, mining at a grade slightly higher than the average and apart from any future additions.

Dr. Getulio Varga's long period in office as President came to an end during the year, and early in December the election for a new President took place. The successful candidate was General Dutra, to whom we extend our best wishes that under his guidance Brazil will continue to prosper and to flourish. Since he came into office the Government have issued two Decrees which have caused some concern, but it is impossible to say exactly what their effect will be until we have more experience of their actual operation. The first Decree (No. 9025 of February 27, 1946) seems to provide for a limitation of remittances to this country to a fixed percentage of registered capital. Everything, therefore, depends on what is held to be registered capital. As far as we understand the position, such capital will include profits which have been ploughed back into the business in the past and which in our case are well over £3,000,000. If this is correct the Decree will not affect us. The second Decree (No. 9159 of April 10, 1946) provides for taxation of profits in excess of a certain standard, which would appear to be the average net profits in any two years from 1936 to 1940 inclusive, plus 50%. On this basis we should not be subject to any liability.

During the year under review Lord Remnant and I paid a visit to the mines from the middle of October to the end of November, during which time we were able to make a thorough inspection of all our properties. We also had the advantage of many discussions on the spot with the General Superintendent, Mr. Davies, and other officers of the company. Such visits are of great advantage and I am glad that it has been possible to renew these contacts between the board and the management in Brazil, which had to be postponed during the years of war.

NEW CONSOLIDATED GOLD FIELDS GROUP OF COMPANIES.

DECLARATION OF DIVIDENDS.

NOTICE IS HEREBY GIVEN that dividends have been declared payable to shareholders registered in the books of the undermentioned Companies at the close of business on 29th June, 1946, and to persons presenting the respective Coupons, detailed below, detached from Share Warrants.

The dividends are declared in the currency of the Union of South Africa and become due on 1st July, 1946. Warrants in payment will be posted from both the Head and London Offices on or about 14th August, 1946.

The dividends will be paid as follows :—

(*a*) From the Head Office, Johannesburg, to :—

1. Shareholders with registered addresses at 29th June, 1946, in Africa, south of the Equator, other than those who may have given notice under (*b*) 2 below.
2. Shareholders with registered addresses elsewhere, who by written notice received by the Companies concerned on or before 29th June, 1946, request that payment be made to an address in Africa, south of the Equator.

(*b*) From the London Office to :—

1. Shareholders with registered addresses at 29th June, 1946, elsewhere than in Africa, south of the Equator, other than those who may have given notice under (*a*) 2 above.
2. Shareholders with registered addresses in Africa, south of the Equator, who by written notice received by the Companies concerned on or before 29th June, 1946, request that payment be made to an address elsewhere.

Notwithstanding the provisions of the preceding paragraph dividends accruing to registered shareholders whose shares are vested in the Custodian of Enemy Property, in terms of the Union of South Africa National Emergency Regulations, will be paid to the Custodian or dealt with in accordance with his instructions, from the Head Office, Johannesburg.

Dividends payable from the London Office will be paid in British currency at par provided there is no difference that may be regarded by the Boards as material between South African and British currencies on 1st July, 1946. Should there be any such material difference between the two currencies the London Office will pay on the basis of the equivalent British Currency calculated at the rate of exchange ruling on that date. Amounts payable to persons presenting Coupons will be on the same basis irrespective of the date of presentation of Coupons.

Warrants despatched from the London Office to persons resident in Great Britain or Northern Ireland will be subject to a deduction of United Kingdom Income Tax at rates to be arrived at after allowing for relief (if any) in respect of Dominion Taxes.

The Transfer Books and Register of Members will be closed in each case from 1st July to 5th July, 1946, both days inclusive.

The dividends on the shares included in Share Warrants will be payable on or after 15th August, 1946, to the persons presenting the relative Coupons at :—

The Standard Bank of South Africa, Limited, 63, London Wall, London, E.C. 2

or

Lloyds and National Provincial Foreign Bank, Limited, 43, Boulevard des Capucines, Paris.

Coupons must be deposited at least FOUR CLEAR DAYS before being paid and, unless accompanied by Inland Revenue Declarations, they will be subject to a deduction of United Kingdom Income Tax as above.

In terms of the Union of South Africa Income Tax Act, 1941, as amended, a Non-resident Shareholders' Tax of 7½% is imposed on dividends payable to (*a*) persons, other than companies, not ordinarily resident nor carrying on business in the Union, (*b*) Companies not registered nor carrying on business in the Union, (*c*) Holders of Bearer Shares irrespective of whether they are resident within or outside the Union. The Companies will accordingly deduct the tax from dividends payable to shareholders whose addresses in the Share Registers are outside the Union and from all Share Warrant Coupons presented for encashment.

Name of Company (each incorporated in the Union of South Africa)	Dividend No.	Coupon No.	Rate of Dividend	
			Per Cent.	Per Share
Rietfontein Consolidated Mines, Ltd.	21	—	12½	7½d. per 5s. share
Robinson Deep, Ltd., "B" Shares.	37	38	5	4½d. per 7s. 6d. share
Simmer and Jack Mines, Ltd.	31	33	6¼	2d. per 2s. 6d. share
The Sub Nigel, Limited	67	69	45	4s. 6d. per 10s. share
Venterspost G.M. Co., Ltd.	13	—	5	6d. per 10s. share
Vlakfontein G.M. Co., Ltd.	6	—	2½	3d. per 10s. share
Vogelstruisbult G.M. Areas, Limited.	15	—	5	6d. per 10s. share

By Order of the Board,

G. H. WARD,
London Secretary.

LONDON OFFICE :
49, MOORGATE, E.C. 2.

11th June, 1946.

Professional Directory

BANKS, Charles A.,
Royal Bank Building, Vancouver, B.C., Canada,
and
23rd Floor, Russ Building, San Francisco, Cal.,
Cables: Bankca. U.S.A.

Tel.: Clerkenwell 4956/9.
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62, London Wall, London, E.C.2.
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Selection Trust Building, Mason's Avenue,
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Cables: Kukeba, London. No professional work entertained.

Tel.: Flaxman 8085.
BOTSFORD, R. S.,
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London, S.W 5.

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DEGENHARDT, W. R., Tel. Royal 7921.
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49, Moorgate, London, E.C.2. Usual Codes.

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Tel.: Kelvin 4080/2.
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Cable: Neolithic, London. Code: Bedford McNeill.

JOBLING, Charles E.,
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KINGAARD, Alexander R.,
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The Pacific Southwest, Mexico, Central
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321, Spruce Street, San Diego, Calif.

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Consulting Mining Engineers & Mine Managers,
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Plas Wynne, Glyn Ceiriog, Nr. Chirk, Denbighshire.
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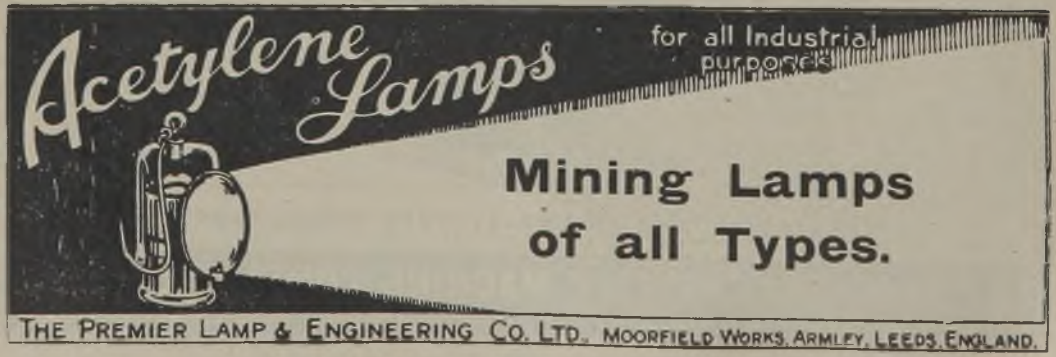

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BUYERS' DIRECTORY (*continued*).

* June issue. † May issue.

Alphabetical List of Advertisers.

* June issue. † May issue.

World production of metallic Chromium in 1940 was* 1,405,500 long tons

*This is largely an estimated figure, the latest completely verified totals kindly supplied by Dr. David Williams, M.Sc., B.Eng., M.Inst.M.M., Sec. G.S., being those for 1938 when the world production was given as 1,100,000 tons. Subsequent changes included a big increase in Philippines production (presumably lost during the Japanese invasion).

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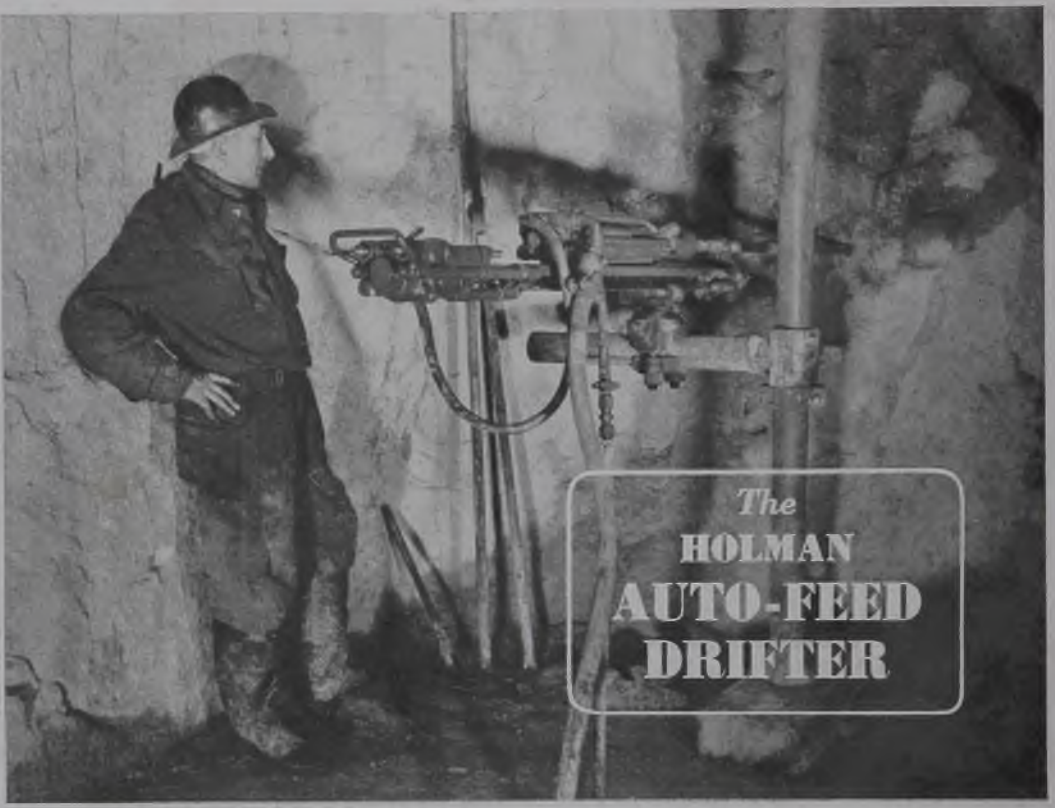

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