THE A.B.A. STORY

This is the story of Australian Blue Asbestos Pty. Ltd., the blue asbestos mine at Wittenoom in the north-west of Western Australia.

This operation was a development in the growth of The Colonial Sugar Refining Company Limited, in the expansion of its bases from purely sugar interests, into the utilization of by-products from sugar milling, such as bagasse, for use as a building material, and the company's eventual interest in the mining of asbestos fibre for incorporation in exterior wall linings.

The embarkation of the Company into mining typifies the pioneering spirit on which the Company was founded and with which it has always been associated.

The information in this report has been collected by Mr. E.K. Penrose at the request of Mr. K.O. Brown. Much of the information has been supplied by the General Superintendent, Manager and heads of departments of Australian Blue Asbestos Pty. Ltd.

1st October, 1963.

Australian Blue Asbestos Pty. Ltd.

THE A.B.A. STORY

Volume 1.

Chapter 1

Historical

A. Early prospecting

The occurrence of blue asbestos in the Hamersley Ranges has been known for nearly 50 years. In the early days, the known exposures were the outcrops of flat seams situated in the faces of cliffs in deep gorges in the ranges, sometimes up to 200 feet above the creek bottom. Access was through stony, and in some cases comparatively heavily timbered creek beds. The inaccessibility of the deposits, combined with the hazardous track of over 200 miles to Roebourne, the nearest port, made their exploitation at current world market prices quite uneconomical.

In later years, however, parcels of high grade fibre, marketed in London brought prices up to £75 sterling per ton. When this became known, together with the fact that large quantities of asbestos were available by stripping and hand dressing methods, a small scale rush to the area took place and an uncontrolled output of fibre by some 100 or more men commenced pouring into Roebourne.

Local agents, who were paying £35 to £40 per ton advance on fibre, which was shipped to London and America, found that they could not cope with the supply and suddenly stopped buying. As the advances paid barely covered the cost of production and transport under the primitive conditions of working, this action was the cause of considerable distress among the miners. The majority of these men had no capital whatever and were consequently dependent on advances for their immediate necessities, and numbers of them had not as yet marketed any of their product. The upshot was that all but a very few men were starved from their holdings and left the district. Speculators purchased outright the production of these men at prices varying from £20 to £25 per ton and a number of producers, who had received advances on their fibre as mentioned above, received no final payments, although the value of the material was supposed to be from £60 to £70 sterling per ton.

The output over this period (1937-8) is recorded at the Mines Department, Perth, as not more than 150 to 200 tons.

The asbestos rush thus ended rather dismally and most unprofitably for the would-be producers. In two ways, however, it was not without value. Firstly, it demonstrated the futility of uncontrolled production on a market that is not firm and, secondly, it brought into prominence the fact that high grade crocidolite was available in commercial quantities in Western Australia.

Small parcels continued to be broken out by a few remaining operators and at least two companies or syndicates were floated with a view to continuous production. However, these companies did not reach the production stage, and eventually disposed of their holdings to the Asbestos, Molybdenum and Tungsten Company Limited, an English company, which was operating a chrysotile plant at Lionel, near Nullagine. After the acquisition of the crocidolite leases, this company abandoned the chrysotile workings, removed the plant to Yampire Gorge in 1939, and concentrated on the production of the blue fibre.

However, this company's interests were taken over by the de Benales Group, Australian Mines Management and Secretariat in 1943, in the name of Western Australian Blue Asbestos Fibres Limited.

At the same time, The Colonial Sugar Refining Company Limited acquired the asbestos leases (and a primitive mill) held at that time by the Hancock Syndicate (Messrs. Lang Hancock, Wright and Warren) and formed Australian Blue Asbestos Limited to develop the deposits. Mr. Hancock became Superintendent of the operation from its inception to 1944. The company was incorporated on 17th April, 1943.

At a later date the interests of the de Benales Group, including those of their subsidiary company, Lionel Chrysotile, which held leases at Yampire and Colonial Gorge, were acquired by Australian Blue Asbestos Limited by an exchange of shares.

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The main reason for C.S.R.'s interest in the asbestos deposits was as a raw material for an asbestos cement factory in

Sydney, acquired about 1942 as part of the operations of its Building Materials Division.

Although the venture had the full approval and support of the Federal and State Governments, progress in such an isolated area and at such a time was necessarily slow and because of the low yield of fibre and the high cost of mining, it was several years before the venture showed any promise of being a success. Its isolation will be understood when it is realised that at that time, the nearest aerodrome was 200 miles away; the nearest railhead 490 miles; the nearest port 210 miles; and by the shortest track, Perth was 1,000 miles away.

By 1947, sufficient work had been done to make it clear that the operations had to be on a much larger scale than previously anticipated if the venture were to be an economic success. Consequently, a town was planned. During the next few years there were constructed 152 houses for married employees, accommodation for 100 single men, a hotel, a general store, a cinema, hospital, police station, State school, tennis courts, and several other sporting facilities including a cricket ground and race track. Later, an aerodrome was built about a mile from the town.

Labour was extremely scarce about the time the town was built and it became necessary to select about thirty miners in Holland and Italy and to fly them out to Wittenoom, their families following by boat. On the whole these people proved a success and settled in extremely well to the very different conditions from those existing in Europe, particularly from a climatic point of view.

As the Federal Government's Immigration Scheme gathered momentum more Europeans were employed and except for a few private quarrels it is interesting to record that very little real difficulty was experienced, although there were at one time twenty-one different nationalities employed on the leases. The language problem was overcome to a great extent by engaging several migrants on the office staff, some of whom could speak five or six languages.

B. Development of the mine and town

Development at Wittenoom commenced with the erection of a small mill in Wittenoom Gorge and by building a small settlement in the same Gorge, about one mile from the mill.

It was recognised that the mining technique would be unique in Australian mining practice. The opinions of many mining men were sought in an endeavour to obtain knowledge and to select personnel best suited to a rather unusual problem - although the country rock was a very hard rock, such as is normally associated with metalliferous mining, the seams of ore were flat and low in height, which is rare in metalliferous mining. Such seams are common in coal mining but with coal mining practically all the development work is carried out in the soft coal. Finally, the services of Mr. J.D. Bowdler, then Mine Manager at Glen Davis shale mine in N.S.W., were secured on a consulting basis and the mining at Wittenoom was developed in accordance with his plan on a modified bord and pillar system, very similar to orthodox coal mining technique.

Up to 1947, except for a small settlement of 13 houses built by the company in Wittenoom Gorge itself, all labour was accommodated in barracks and tents. The company was opening up in a quite isolated and unsettled area. It was found difficult to get either adequate or good labour at Wittenoom and development and general progress lagged sadly. For the industry to progress, it became obvious that proper living accommodation for men and their families and reasonable amenities and recreation facilities were essential.

At the end of 1946, therefore, a reappraisal of the industry was made and the position discussed in detail with officers of the Commonwealth and Western Australian State Governments. The late Mr. J.B. Chifley, who was then Prime Minister of Australia, and Senators H.V. Johnson and W.P. Ashley were interviewed and they agreed to the desirability of continuing with the industry. Mr. F. Wise, then Premier of Western Australia, also discussed the position with the Commonwealth Government.

As a result of these discussions, both Governments again expressed the view, which was communicated to the company through the Premier of Western Australia, that everything possible should be done to ensure the development of the blue asbestos industry at Wittenoom as Australia was entirely dependent on import for this important material. As proof of this support for the industry, the Governments agreed to join with A.B.A. Ltd. in the construction of a town at the mouth of Wittenoom Gorge, 7 miles from the mine to accommodate 700 to 1,000 people. (As the Gorge is liable to severe flooding this was the nearest location for a township of reasonable size).

The Governments agreed to supply all housing requirements, a school, post office, hospital, police station, to provide water supply for the town, and to bitumenise the seven miles of road connecting the mine and town, as their contribution to the development of the industry, whilst A. B. A. Ltd. agreed to provide a hotel, general store, butchery, bakery, cafeteria, library, cafe and employees' amenities building and accommodation for 100 single men, as well as the expenditure involved in developing the mine and mill. Both parties carried out their undertakings and the town is now completely established.

The agreement by the Governments to render this assistance was given after a close investigation of the prospects of the industry by Government officers. At that time, at the end of 1946, the company advised the Government that a cost of production competitive with world prices could not be expected unless a minimum of 6,000 tons per annum of fibre was produced, because of the heavy overheads involved in creating a complete town to service one industry. Because Australian costs have risen faster than world costs since 1946 this minimum production is now estimated to be 15,000 tons per annum. (It was estimated in 1946 that at 6,000 tons per annum to give a return on capital of 6%, the selling price would be about £50 per ton f.o.b. Fremantle based on then existing costs and conditions).

The price of £50 per ton was assessed with reference to 4K Canadian fibre, which is the basic staple fibre for asbestos cement production and which cost £46 per short ton landed Sydney in 1946. Because No. 3 Grade South African blue fibre on the world market commanded a slight premium over Grade 4K, it was therefore considered that £50 per ton for Wittenoom fibre would be a reasonable price.

C. Why C.S.R. engaged in mining asbestos

From 1925 onwards C.S.R. had carried out extensive research and development work on wallboards, particularly fibre wallboards. In 1935 it commenced the erection of a pilot plant at Macknade sugar mill in North Queensland, to manufacture insulation board and hardboard from sugar cane fibre.

Later, in 1938, a large factory for the manufacture of cane fibre insulation board was built by C.S.R. at Pyrmont, Sydney. An Australia-wide sales organisation was set up to sell the products of this factory. In 1940 it was considered that other types of wall-board should be added to the range manufactured to give a complete wallboard service to the building industry. Steps were taken to investigate also the use of gypsum and asbestos for the manufacture of wallboards. One result of this was the development of the gypsum deposits of N.S.W. in order to manufacture a plaster base wall-board, widely known and used in England and U.S.A., now known as "Gyprock".

Asbestos fibre was of interest to C.S.R. for two reasons. Firstly asbestos fibre had been incorporated in vegetable fibre insulation board in many parts of the world in order to make flame-proofed boards. Secondly C.S.R. wished to be able to offer distributors and the building trade a complete wallboard service, and needed asbestos cement sheeting to sell to provide an exterior as well as interior wallboard.

Asbestos cement sheet was complementary to and not competitive with the other lining boards produced by C.S.R. Asbestos cement sheeting is used mainly for exterior walls of timber frame houses whereas insulating board, gypsum wallboard and hardboard are used for internal linings in timber framed houses.

When the asbestos fibre position was investigated, it was found that almost all asbestos fibre was imported into Australia, the annual value at that time being some £400,000. (The annual value today is more than £2,000,000. Of this, asbestos to a value of more than £1¼ million is from dollar sources). This supply position appeared so uncertain and Australia so dependent on overseas sources for such an important raw material that C.S.R. set about investigating the possibility of obtaining asbestos on a large scale in Australia. Such investigations led to the realisation that the only deposits in Australia worth developing on a large scale were the blue fibre deposits in the Hamersley Ranges, Western Australia.

Discussions took place with Mr. Telfer, the Under-Secretary of the Mines Department of Western Australia, with Mr. A.W. Panton, Minister for Mines, Western Australia, with officers of the Commonwealth Department of Supply and with the Minister for the Interior of the Commonwealth Government and with the Premier of Western Australia, Mr. Willcock.

After close inspection of the asbestos deposits in the Hamersley Ranges, it was decided by C.S.R. that if the Commonwealth Government concurred in the opinion that it was important to Australia to develop the deposits, the company should do this.

The Minister for the Interior, Mr. H.V. Johnson, strongly supported the establishment of the mine and on 22nd December, 1942, C.S.R. was advised by the Director-General of the Department of War Organisation of Industry as follows:

> "Following your call on 3rd December on Mr. A.E. Mander, Controller of New Manufacture in this Department, enquiries have been made amongst all the Commonwealth Departments concerned; and I am now able to place on record the fact that there is complete agreement as to the importance and urgency attached to your projects for the production of *Asbestos Fibre in Tasmania* and in Western Australia.
>
> A copy of this letter is being sent to the Capital Issues Committee; and every effort will be made by this Department to facilitate the establishment of the industry. It will be appreciated if, should any difficulties arise, you will communicate with this Department so that any possible assistance may be given in overcoming them.
>
> It will be appreciated also if you will keep this Department informed of developments, and particularly if you would be good enough to indicate, as soon as you are able to do so, when it may be hoped that production of fibre will commence.
>
> Yours faithfully,
>
> (Sgd.) G. T. Chippindall.
> DIRECTOR-GENERAL

C.S.R. was subsequently advised on 13th April, 1943 by Mr. A. E. Mander, Controller of New Manufacture, that orders for its asbestos plant were to be allotted the highest possible priority.

As a result, it was decided to proceed with the venture. A company to develop the deposits, Australian Blue Asbestos Limited,

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was incorporated on 17th April, 1943. Some asbestos leases in Wittenoom Gorge, on which some prospecting work had been done, also a small pilot mill in Wittenoom Gorge, were taken over by this company from L. G. Hancock Asbestos Co. Ltd.

D. Addendum.

Dr. Oxer, in addition to his exploring activities, has also made some research into some of the early history of the area related to asbestos mining and his notes are recorded verbatim as follows:-

Notes on the origin of Wittenoom -(1963)

by Dr. G. Oxer

George Park, living in retirement at Mulga Downs Station says he founded Juna Downs Station in 1924. Says he found blue asbestos (without knowing what it was) in 1924 in Yampire Gorge, through which runs the track to Juna Downs.

The first lease in Yampire Gorge was pegged by Leo Snell working (about 1930) in association with Lang Hancock. This was initially worked for him by Andy and Bob Peacock. Later Snell investigated Dale's Gorge, and with a native named Weano (who had initially led him to the deposits in Yampire Gorge) found a way into the top of the Gorge. Dale's Gorge was named after a well-sinker employed on Mulga Downs Station and after him are called Dale's Well and Dale's Paddock.

Later, other men worked for and independently of Snell in both gorges. One was Alec McBeith Cooper now about 75, still living in Wittenoom. Says he was working Dale's Gorge about 1930. The fibre was knapped by hand, raised to the plateau by flying fox, and carted by horse dray the 240 odd miles to Point Samson. The fibre returned about £2.15.0. per bag.

Asbestos was first worked in Wittenoom Gorge by one, Bill McCarty on behalf of Lang Hancock. This was on the southern face of Western (or Colonial) Gorge, the lease on the opposite face - at present the A.B.A. mine - having been taken out in the name of Miss K. L. Hancock, Lang's sister.

Ultimately, Mr. Snell disposed of his leases in Yampire and Dale's Gorges to the Asbestos Molybdenum and Tungsten Company of London, for whom Mr. Islwyn Walters was Manager. "Issy" Walters was later associated with Mr. Hancock in the Wittenoom Gorge workings, and his house (the present market gardens house) was the first built in Wittenoom Gorge. The Asbestos, Molybdenum and Tungsten Company subsequently went in partnership with the de Benales Group, the combined interests forming a new Company, - The West Australian Blue Asbestos Fibre Company.

Later this went into production under a Manager from the Comet Gold Mine at Marble Bar, Mr. Stuart Stubbs, another de Benales Company. The Group was however unable to obtain enough capital to work the asbestos effectively and the venture folded up. It was then that The Colonial Sugar Refining Company Limited bought up the machinery and leases.

About 1949 all readily available ore still remaining in Yampire Gorge was transferred to Wittenoom Gorge for milling.

In 19~~3~~48 a start was made on a brand new town, just outside the mouth of the Gorge. Prior to that the only building in the locality had been a hangar belonging to Mr. Hancock.

From Dave Watkins. (A Dogger). About a year ago. (a year and two days, to be precise) I had the following from Mr. Watkins.

The first party to work at Yampire Gorge came with Roy Thomas from Roebourne in an old Dodge car. They joined Leo Snell and the native Weano, Andy Peacock and his brother and later Dick Richards and Eric Walker, then Keith Fitzgerald: one returned to Ballarat, the other worked for Lang Hancock.

A Syndicate run by H. Marshall (Road Board Secretary, Roebourne) and Bill Baizely, a policeman. They had about twelve shows, including leases around the Fig Tree well. This Syndicate had about 50 men working at one time.

It was Weano who showed Leo Snell the fibre in Yampire Gorge and was thus the one who started off the fibre activities in these ranges. He was a very big man: a magnificent specimen of a native. Had a gin, Laura.

Alec Cooper was at the Fig Tree - never at the top end. Lang Hancock had men working for him at the Fig Tree, but was never associated with Snell, or "Issy" Walters in the de Benales Group at Yampire Gorge, but was associated with Walters at Western Gorge. He had good leases, but was taken down by some of his men and their moving to Western Gorge (1937 or early 1938). Billy Hewett, Ian Dignam (later Manager at Nunyerry, and more recently garage proprietor at Wittenoom, and now in Esperance) and himself (Dave Watkins) were the first men working in Western Gorge for Lang Hancock. Roy Thomas had left to go shearing. Dave stayed there until Lang Hancock sold out to C.S.R. in 1943.

There were lots and lots of other small shows - perhaps even one-man shows - in Yampire Gorge, but only the three above were shows of any size. A large number of young men enlisted from Yampire and many were killed at Singapore. Dave Watkins and Roy Thomas were the first ones to work fibre in Dale's Gorge, in 1936, working for Leo Snell. This lease was at the junction of the North Arm (where the deep pool and the waterfall are) and the Western Arm. They piled up a lot of fibre which, a few months after starting there, was washed away in the next flood, they not knowing how to get it to the surface. (Note: there was a flying fox later, traces of which are still there).

In the early days at Yampire Gorge one, Crocker, was hanged in the Fig Tree, but wouldn't die. He, with his horses, had been drinking up all the water in the well. Another time there was one, Markovich, was shot at with a 303 for stealing fibre but he wasn't hit. He was later lost when the "Betty" was lost with all hands, through a faulty engine, on a trip to the Abrolhos.

Stuart Stubbs, Foreman Engineer, Manager of the Coment Mine for de Benales, was in charge of the de Benales' interests in Yampire Gorge.

Later, on 6th July, 1962, I again saw Dave Watkins, and asked about an inconsistency in his evidence. Lang Hancock had told me that Bill McCarty was the first man to work for him in Wittenoom Gorge. Dave confirmed this, saying that he never met Mr. McCarty, he having already left when Dave and Ian Dignam started there about a month after the commencement of operations in Western Gorge. One month after these two started, Bill Hewitt commenced work there also.

Lang Hancock has confirmed to me that Dave Watkins and Roy Thomas, (Lang called him "Ron") were the first to work in Dale's Gorge, Lang was sent there by Snell. This pair were followed by one, Reid, and a party of four or five others, who started a little north of Snell's leases. (Dave Watkins had told me that a pair named Frank Reid and Dick Richards were working in Dale's Gorge for some time (in 1937).

Lang Hancock states that the Peacock Bros. were definitely the first to break fibre in Yampire Gorge. He and Snell had discussed the possibility of working the fibre. He lent Snell horses to go to Yampire, whilst he himself, chose Wittenoom. Snell sent the Peacocks to Yampire to start work for him. He said the next person to own a lease in Yampire was Eric Walker (mentioned above by Dave Watkins), or after that "quite an influx of people, of whom Cooper was one".

Lang mentions Jim and Tony Tsakalos as having worked for him; and Dave Walters mentions Marko Tsakalos as having worked in Yampire and also being shot at. Lang mentions Hooley and Slee whom (in 1909) he thinks were the first to develop Nunyerry white asbestos. This, then, is the origin of the name of Hooley Station, and now Gorge.

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<u>17th June, 1963 - Dr. Gordon Oxer.</u>

Chaoter 2

Asbestos and its uses

A. The asbestos minerals
B. Uses of asbestos
C. Grades of fibre
D. Properties of crocidolite fibre
E. Procedures for testing blue asbestos
F. World production of asbestos fibre
G. Principal world producers

A. The asbestos minerals

The term "asbestos" is a commercial rather than a mineralogical one and embraces the fibrous varieties of several minerals of the serpentine and the amphibole group, which are characterized by highly developed prismatic cleavage allowing them to be readily separated into fibres or filaments.

ASBESTOS MINERALS

Mineral Group	Mineral	Chemical Formula	Composition
Serpentine	Chrysotile	$3MgO.2SiO_2.2H_2O$	Hydrated magnesium silicate
	Crocidolite	$2NaFe(SiO_3)FeSiO_3$	Sodium-iron silicate
	Amosite	$(MgFe)O.SiO_2$	Magnesium-iron silicate
	Anthophyllite	$(MgFe)O.SiO_2$	Magnesium-iron silicate
	Tremolite	$CaO.3MgO.4SiO_2$	Calcium-magnesium silicate
	Actinolite	$CaO.3(MgFe)O.4SiO_2$	Calcium-magnesium-iron silicate

The asbestos minerals are commonly found in narrow veins. At Wittenoom they occur as "cross-fibre" - the fibres are arranged at right angles to the vein walls; the fibre length is thereby limited to the vein width and is often less, due to a break or parting, in the vein.

The commercial suitability of these minerals depends almost entirely on the length, tensile strength and flexibility of the fibres, although colour, impurities and the degree of resistance to electricity, heat or acids are sometimes important. The fibrous minerals have a fairly wide distribution, but deposits containing fibre

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suitable for use in industry are comparatively rare.

Chrysotile is the most important of the asbestos minerals and is generally referred to commercially as "white" asbestos. It usually occurs in veins, ranging from a fraction of an inch to several inches in width, in serpentine - an alteration product of basic igneous rocks, such as gabbro and peridotite or of sedimentary rocks rich in magnesium, such as dolomite.

Crocidolite and Amosite are the most important of the amphibole asbestos minerals. Both are commonly found as inter-bedded cross-fibre veins in ferruginous slate or quartzite, associated with dolomite.

Crocidolite is commercially the more important of the two, and is commonly known as "blue" asbestos from the blue colour, which is retained in the separate fibres. The fibres are, as a rule, of good length and flexibility, and the tensile strength is at least comparable with that of chrysotile.

Amosite is usually ash-grey in colour but the fibres are white on separation, pliable and often exceptionally long, though rather coarse in texture.

The unique variety of properties possessed by asbestos combine to make it an essential raw material in certain branches of industry. Asbestos withstands fire and insulates against electricity, heat and sound; it is light in weight and can be made into pliable fabrics and resists corrosion by soil and the attack of vermin. The degree to which these properties are developed varies considerably with the various types of asbestos and also according to the grade, so that each type and grade has specific applications in industry.

B. *Uses of asbestos*

CHRYSOTILE has by far the widest range of uses and constitutes about 90 per cent. of the asbestos consumed. Much of the long-fibre chrysotile is spun into yarn from which fabrics such as cloth and tape are woven for use in the manufacture of electrical insulation, brake linings, gaskets, theatre curtains, insulating mats, fire-proof suits, aprons and gloves. Yarn is also manufactured into asbestos thread and rope. Portion of the longer fibre is used in the manufacture of wick and rope packings, fillings for mattresses and for magnesia block insulation, which contains 85 per cent magnesia and 15 per cent asbestos.

Medium-length fibre is extensively used as a binding and reinforcing agent in cement products, in plasters and in asphaltic and moulded articles. The major consumption of chrysotile is in the asbestos-cement industry, in the manufacture of wallboards, shingles, tiles and other asbestos products for building, and in piping and conduit. Asbestos-cement pipes are extensively used for gas and water mains on account of their superior resistance to corrosion. Medium-length fibre is also processed with rubber to make sheet packings, jointing and some brake linings. Similar length fibres are used in the manufacture of boiler lagging and pipe coverings.

Shorter fibres are utilized in the manufacture of asbestos paper which is used in the production of boiler and pipe coverings, insulating switchboard materials, etc. The development of moulded brake lining and clutch facing made from heavy paper of the millboard variety has created additional demands for the shorter fibres.

Waste, "shorts" and plaster grades are used in the manufacture of asbestos lagging which is widely used for boiler insulation, as a filler in paints and greases and in other compositions such as cold-moulded synthetic resin products and types of flooring material. Floor tiles are now the largest tonnage user of short asbestos.

CROCIDOLITE also has a wide range of uses, but it is not as extensively used as chrysotile, due largely to its colour and slightly inferior spinning qualities. On the other hand, it is superior to chrysotile in its resistance to acids, alkalies and sea-water and, therefore, has its own specific uses such as in flexible boiler and steam pipe coverings for mercantile use, in acid resistant packings and in specialized military equipment. The use of crocidolite in asbestos-cement products is increasing, one important feature being the "harshness" of the fibre, which is referred to later.

South African crocidolite has found a wide application and has been used in the manufacture of asbestos cloth, rope and yarn; in packings and millboard; and in asbestos products for building.

AMOSITE fibre is inferior in strength and flexibility to chrysotile and crocidolite but commonly occurs in very long fibres. It has a restricted use in industry, mainly in the manufacture of special types of lightweight insulation and in asbestos-cement products in which it is blended with chrysotile. However, the producers of amosite in South Africa, which is the only known source of the mineral, have demonstrated that amosite can be used satisfactorily in the manufacture of a wide range of other asbestos products.

Main uses.

Although asbestos is put to many uses, the main outlets are:-

(i) Asbestos cement products
(ii) Floor tiles
(iii) Brake linings

At least 50 per cent of the world production of asbestos is used in asbestos cement products. Of the total world production of asbestos cement products of all types about half is used in the manufacture of asbestos cement pressure pipes. It is in the making of pressure pipes that blue asbestos fibre finds its main use but there is no technical restriction on its use in flat sheets, corrugates and other asbestos cement products. Being a harsh fibre it assists drainage of water from the product in its wet state.

In making pipes, better drainage resulting in greater pressures on the pipe walls and higher speeds improves the quality and the economics of the finished product, and enables it to compete very favourably with iron and steel pipes for water supply and sewerage installation. To the best of our knowledge, with very few exceptions manufacturers of asbestos cement pressure pipes, except possibly in Russia and China, use a percentage of blue fibre in the asbestos mixture.

Although the users claim that satisfactory pipes can be made without blue fibre, they all admit that by using a percentage of blue, smoother operation and a higher yield of product is achieved, thus producing a more economical result.

One comparatively new use for blue fibre is that of sprayed asbestos for fire protection of steel structures. This application has extended to sprayed ceilings and walls for insulating and acoustical effect. All of these applications are growing steadily and should in a few years account for quite an appreciable amount of extra fibre usage.

C. Grades of fibre

Commercially, asbestos is divided into "crude" asbestos and "milled" asbestos. As defined by the Quebec Asbestos Mining Association, "crude" asbestos consists of hand selected material essentially in its native state or unfibreised form and "milled" asbestos consists of all grades produced by mechanical treatment of asbestos ore. Almost all asbestos imported into Australia and almost all asbestos used in Australia is "milled" asbestos.

Asbestos is graded basically according to fibre length, the highest grades generally consisting of long fibred material. To a large extent, each country has its own system of grading but the Canadian system is recognized all over the world, and forms a firm basis for comparing white fibres.

In the Canadian system, the longest white fibre is called Grade 1 and the shorter fibres are numbered up to Grade 7, the latter consisting of very short fibres less than 1/16" long. Each numerical group is further subdivided according to length and distinguished alphabetically, e.g. Grade 4K is longer than Grade 4M.

A full description of the Canadian system, together with the classification of Canadian fibres and those from other countries is given on page 39 of the Tariff Report M 3 (1954). Briefly, however, the method is simply to take 16 oz. of asbestos and screen it through three screens consisting respectively of mesh sizes ½" opening, four meshes to the inch and ten meshes to the inch. The amount left in each screen and that in the final tray under the last screen is weighed and expressed, as for example:-

7 - 7 - 1.5 - 0.5, meaning 7 oz. in top screen, 7 oz. in the mesh screen, 1.5 oz. in the 10 mesh screen and 0.5 oz. in the tray.

Various common grades of asbestos are:-

Canadian Chrysotile (White Asbestos)	Canadian Screen Test	Approximate Average Length
3K	4 - 7 - 4 - 1	½"
3T	1 - 9 - 4 - 2	3/8"
4K	0 - 4 - 9 - 3	¼"
5K	0 - 0 -12 - 4	1/8"

Crocidolite
Australian:-

Blue - No. 3 grade	Fibres up to 5/8" long. Canadian screen test as received from mine. (Equivalent to 3T Canadian)

Amosite (South Africa)

Grade DCA/D	Fibres up to 5/8" long.
Grade AW	
Grade K3	Equivalent to Canadian 3K by screen test as received from mine.

D. Properties of crocidolite of fibre

The principal properties of blue asbestos are:-

(i) Very high tensile strength

(ii) Resistance to chemical attack

(iii) Its insulating value.

The tensile strength of blue asbestos fibre is about equal to carbon steel and glass fibre and at least twice as strong as cotton fibre.

Comparative specification of the three main asbestos minerals are as follows:-

	Tensile Strength lbs. per sq. inch	Fusion Point ^{o}F	Specific Gravity S.G.
Chrysotile	80/100,000	2,700	2.4
Amosite	16/90,000	2,550	3.1
Crocidolite	100/300,000	2,180	3.2

It should be noted, however, that for most purposes, asbestos fibre is fluffed out or "willowed" before use. For the manufacture of asbestos cement it is the properties of the "fluffed out" condition and not the specific gravity that is important.

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E. Procedures for testing blue asbestos

The principal tests are:-

(i) Bauer-McNett Classification

The four tanks of the classifier are fitted with the following screens: 4 mesh in the first tank, followed by 14 mesh, 28 mesh and 200 mesh. Filtered water is passed through the tanks at the rate of 3 U.S. gallons per minute, from constant head supply.

The sample to be tested is dried in an oven, and 10 gm. ± 0.01 gm. is weighed and added to about 300 mls. of water. The beaters in the tanks are started and the slurry of asbestos is added to No. 1 tank. During the test an 1/8" brass rod covered with 1/4" O.D. rubber tube is drawn rapidly across the face of each screen about once each minute to free any fibre adhering to the screens. Towards the end of the test period the dead spaces behind the screens are agitated with a fine jet of water to wash any settled rock of fibre into the next tank.

At the end of 15 minutes the water flow is shut off and 1.00 gm. ± 0.01 gm. of diatomaceous filter aid is added to the first tank. After a few seconds stirring the beaters are stopped, the discharge bungs removed and the contents of each tank filtered through a pre-weighed filter paper in the filter cup. During filtering the screens are removed and any fibre adhering to them washed into the tank.

After the completion of filtering, the filter papers are removed, dried and weighed, and each fraction is expressed as a percentage of the original sample weight. 1.00 gms. is subtracted from the weight of the +4 mesh fraction to allow for the filter aid used. Any rock caught on the 4 mesh screen is weighed separately and recorded as +4 mesh rock. Each sample is tested in duplicate.

(ii) Buoyancy Test

4.00 gms. ± 0.01 gm. of asbestos is weighed and transferred to a 1000 ml. stoppered measuring cylinder. 1000 ml. of water is added to the cylinder and it is oscillated 20 complete times in one minute. The asbestos is then allowed to settle undisturbed for one hour and the volume of the column of asbestos measured. The buoyancy is expressed in mls. per gm.

(iii) Dyckerhoff Air Permeability Tester

James Hardie & Co. Pty. Ltd. now have in operation their Dyckerhoff Tester and have found that as supplied, the times recorded for grade 3F blue asbestos have been about 7 seconds. It may be necessary to modify the sample cell of this equipment to give more accurate readings with blue asbestos.

F. World production of asbestos fibre

Total world production of the main types of asbestos, as quoted by Bureau of Mines, U.S.A., Materials Survey at 1960 was approximately as follows:

	Chrysotile White	Crocidolite Blue	Amosite	Total
World production short tons p.a.	2,258,000	93,000	69,000	2,420,000
Total consumption in Australia at present is:- short tons p.a.	33,000	6,000	7,000	47,000

The following figures show growth of total production of asbestos and the growth of production of crocidolite asbestos.

Year	Production Short Tons			
	Total	Chrysotile	Blue	Amosite
1935	403.000	395,900	2,500	4,000
36	552,000	542,900	4,300	4,800
37	673,000	661,300	5,200	6,500
38	496,000	478,400	8,800	8,800
39	605,000	583,600	10,100	11,300
1940	627,000	600,300	8,900	17,800
41	744,000	717,400	7,400	19,200
42	720,000	687,500	7,600	24,900
43	700,000	666,700	10,300	23,000
44	660,000	627,100	9,900	23,000
45	690,000	663,300	10,000	16,700
46	790,000	771,100	9,100	9,800
47	960,000	930,100	10,100	19,800
48	1,100,000	1,057,900	11,800	30,300
49	985,000	920,700	22,300	42,000
1950	1,300,000	1,226,200	31,800	42,000
51	1,575,000	1,484,300	36,500	54,200
52	1,550,000	1,436,600	49,300	64,100
53	1,565,000	1,483,400	43,300	38,300
54	1,670,000	1,575,000	49,000	46,000
55	1,935,000	1,829,900	54,800	50,300
56	1,990,000	1,868,100	71,800	50,100
57	2,080,000	1,947,300	75,700	57,000
58	2,050,000	1,886,100	93,800	70,100
59	2,260,000	2,089,100	99,000	71,900
1960	2,420,000	2,258,200	93,200	68,600

Sources - Materials Survey Asbestos 1960
National Security Resources Board
Bureau of Mines, U.S.A.

NOTE: Asbestos Tonnage. World wide, a ton of asbestos fibre is taken as 2,000 lbs.

Chrysotile (white) is produced mainly in Canada but also on a large scale in Russia and South Africa. Small deposits exist in Australia and two small deposits have been mined, one in New South Wales by a subsidiary of James Hardie & Co. Pty. Ltd.

Production from each of these mines is quite small. No large deposits of chrysotile asbestos are known to exist in Australia.

Crocidolite (blue) asbestos is mined mainly in South Africa, Bolivia and Australia. The Australian deposits of blue asbestos are considerable in extent and of very high quality but are fairly low grade. (In the Report by the United States Tariff Commission dated December, 1951, blue asbestos (Australian) is referred to as being of strategic grade - that is asbestos that is suitable for stockpiling for war and defence purposes).

Amosite asbestos is mined in the Union of South Africa only.

G. Principal world producers

	Type of Asbestos Mined
CANADA	
Canadian Johns-Manville Ltd., Asbestos, Quebec Province.	Chrysotile
Asbestos Corporation Ltd., Thetford, Quebec Province.	"
Johnston's Asbestos Company, Thetford, Quebec Province.	"
Cassiar Asbestos Corporation Ltd., Cassiar, British Columbia.	"
American Smelting & Refining Corporation, (Black Lake).	"
SOUTH AFRICA	
African Associated Mines (Private) Ltd., Bulawayo, Southern Rhodesia. (Turner & Newall)	Chrysotile
Cape Asbestos Co., Johannesburg, South Africa and 114 Park Street, London, W.1.	Amosite & Blue
Federale Mynbou Mining Company, 5 Fenchurch Street, London, E.C.3.	Blue
Rhodesian Asbestos Limited	Chrysotile
Kuruman Cape Blue	Blue
Northern Blue Asbestos Mines	Blue
Consolidated Blue Asbestos Corporation, John Beith.	Blue

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U.S.A.

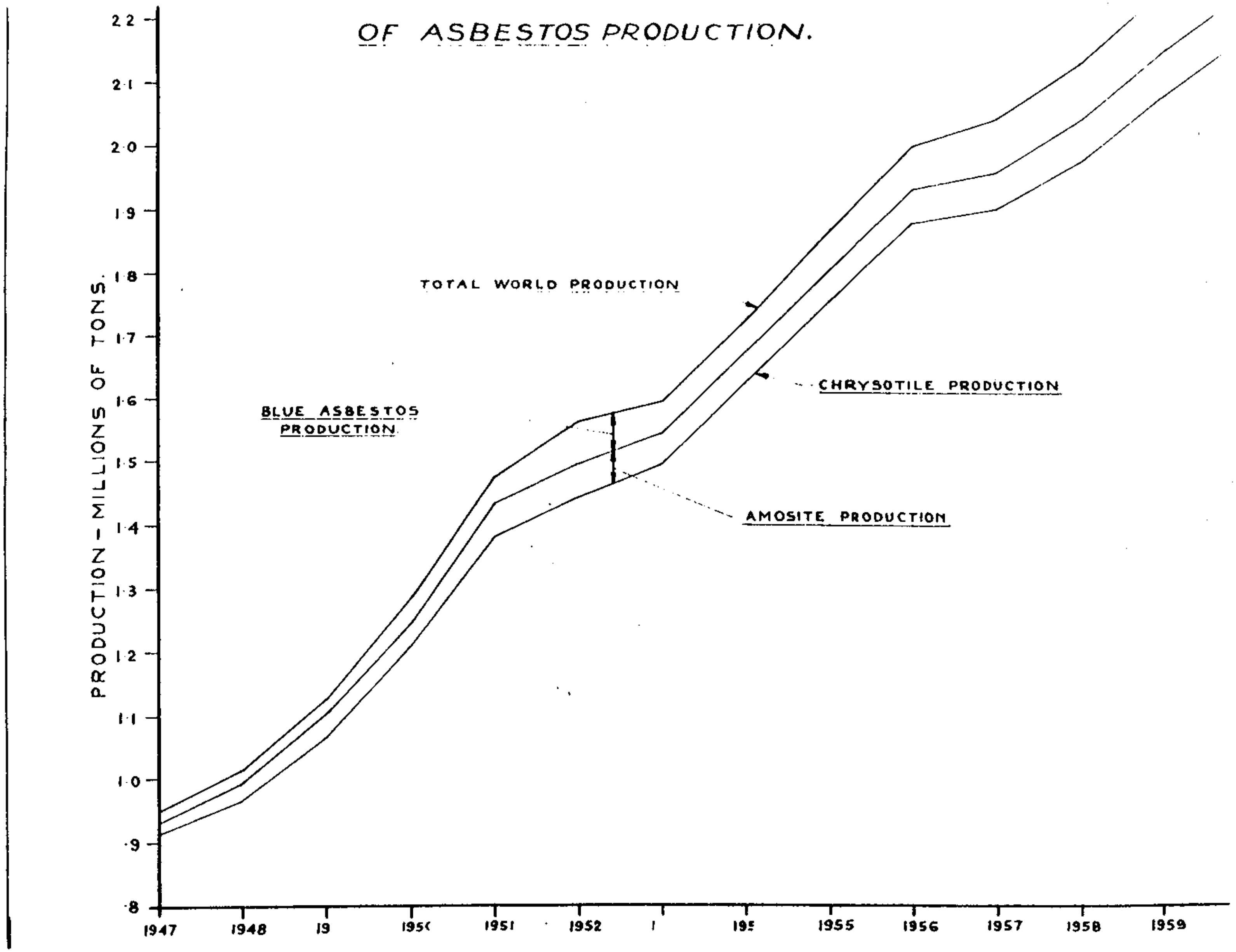
Jefferson Lake Asbestos Corporation	Chrysotile
The Ruberoid Co., Lowell, Vermont.	"

CORSICA

Sociètè de Miniere de I'Amiante, Bastia, Corsica.	Chrysotile

AUSTRALIA

Asbestos Mines Ltd., Baryulgil, N.S.W.	Chrysotile
Australian Blue Asbestos Pty. Ltd., Wittenoom Gorge, W.A.	Blue


OF ASBESTOS PRODUCTION.
PRODUCTION - MILLIONS OF TONS.
2·2
2·1
2·0
1·9
1·8
1·7
1·6
1·5
1·4
1·3
1·2
1·1
1·0
·9
·8
TOTAL WORLD PRODUCTION
BLUE ASBESTOS PRODUCTION
CHRYSOTILE PRODUCTION
AMOSITE PRODUCTION
1947
1948
1951
1952
1955
1956
1957
1958
1959

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Chapter 3
Location, Climate and Seismology

A. Location

Australian Blue Asbestos Pty. Ltd., a wholly owned subsidiary of The Colonial Sugar Refining Company Limited operates a blue asbestos mine at Wittenoom in north-west Western Australia.

The mine and town are located 700 miles, in a line about north-north-east of Perth; 130 miles south-east of Roebourne and its port, Point Samson; 120 miles south-west of Marble Bar ("the hottest place in Australia") and 300 miles north of Meekatharra, the sheep and cattle rail head and the terminal of the line from Perth which serves the pastoral country and the mining towns of the Murchison Goldfield. It is a remote locality.

The distance by road from Perth is close to 1,000 miles and it is about 200 miles by road from Point Samson, shipping port for the asbestos.

The blue asbestos mineral, crocidolite, occurs in the banded ironstone sediments of the Hamersley Ranges in beds of the so-called Nullagine Series rocks, which form a belt 180 miles long and 20 to 30 miles wide, trending east-south-east from Mill Stream Station, approximately 45 miles south of Roebourne, to the Opthalmia Ranges.

These ranges rise abruptly from the barren coastal tableland, which stands at 1,411 feet above sea level at Wittenoom. The ranges are generally up to 3,000 ft. above sea level; with one exception, Mt. Bruce, 25 miles from Wittenoom, which is the highest point in Western Australia, at 4,024 feet.

The centre of mining operations is 7 miles from the mouth of Wittenoom Gorge in the Hamersley Ranges and is in latitude 22°15'S and longitude 118°20'E.

It is a generally rough and tedious journey by road from Perth, but there are good air services in and out of Wittenoom almost

It may be said that the hot season extends from early October to the end of April, in which period the conditions are very hot and dry, with warm but tolerable nights.

From the end of April to the end of September the days are clear and mild with cool mornings and evenings and very cold nights.

(i) Rainfall.

The average annual rainfall for the past eleven years is 15 inches, of which more than half falls in the period January to March. The average number of wet days per year is 34. Over a longer term the average rainfall would most certainly be nearer 10 inches or less.

For the past six years the average relative humidity index is 35 per cent, ranging from 24 to 42 per cent.

(ii) Temperature.

Generally the air is very dry. When temperatures of 100° and more are experienced, conditions are not enervating, even if trying.

The recorded annual average temperatures for the past six years are:-

Maximum	91.2°
Minimum	67.3°
Mean	79.3°

It is not unusual to experience sixty or more successive days over 100°F in the summer.

(iii) Winds.

Summer winds blow cyclonically from the west in the morning, veering to the west at night.

The winter winds generally blow from the south-east in the mornings and drift around to evening southerlies.

Dust storms when they occur, are generally from the south-east to south.

Wittenoom is in the track of the cyclones which inflict the north-west coast and the January to March rainfall figures confirm that if Wittenoom is not directly on the course each year, then it certainly receives the fringe effects of these cyclones. In the rare year it gets right in the path of a cyclone, and severe rain and flooding is experienced, when more than the average rainfall

TABLE NO. 1

METEOROLOGY AT WITTENOOM

	Years	January	February	March	April	May	June	July	August	September	October	November	December	Year.
						TEMPERATURE - F								
DAILY TEMP.														
Maximum		103.9	100.8	99.6	92.2	79.7	76.6	75.3	78.9	87.2	95.8	100.8	104.1	91.2
Minimum		78.4	76.9	76.5	71.4	60.0	54.6	53.1	54.9	61.8	68.8	74.3	77.4	67.3
Mean	6	91.1	88.9	88.1	81.8	69.9	65.6	64.2	66.9	74.5	82.3	87.5	90.7	79.3
						RELATIVE HUMIDITY - PER CENT								
Average Index	6	33	40	32	38	40	42	42	34	30	24	29	31	35
Average Daily 3 p.m.	4	22	28	22	25	26	30	31	23	17	15	17	21	
							RAINFALL							
Points recorded	11	477	299	191	60	108	84	86	20	12	10	15	136	1498 (14.98 in.)
Rainy days	11	7	7	3	3	3	3	2	1	1	0	1	3	34

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can be experienced in one day, with resultant flooding of the gorges in the area from the extensive catchment areas behind the ranges.

It could be said that for half the year the heat is very trying and for the other half the climate is very pleasant but the climate in general is not a vital factor affecting the operations at the mine.

C. Seismology

It appears that an inter-continent, north to south fault line passes through the north-west of Western Australia and movements on this fault have been recorded as far back as 1907 at places like Carnarvon, Marble Bar, Nullagine, Cue, Onslow and Port Hedland. The Perth Observatory record of these disturbances is appended as Table 2.

On 22nd October, 1962, a tremor recorded at the Perth Observatory coincided with a major fall of ground in the mine at Wittenoom, mainly in the old workings. The fall, affecting 20 acres of ground, was in the area where both the upper and lower seams of fibre, (which will be referred to later), were almost completely worked out, one above the other.

However, there was advance warning of the major fall, by unexpected minor falls in the northern end of the mine and most of the men were withdrawn from underground before the main collapse occurred.

There was no loss of life but there was substantial loss of equipment and broken ore.

However, the financial loss was partly recouped because an earthquake damage clause had been included in the Company's insurance policy in recent times.

TABLE 2

Western Australian earthquake record and damage as from year 1904. (Perth Observatory)

DATE	LOCATION	REMARKS
12. 7. 1907	Carnarvon	Slight but distinct tremor felt here: also felt at Hamelin Pool and Shark Bay. No damage.
28. 9. 1907	Marble Bar	Earth tremor at 6. 35 a. m., duration 25 seconds.
15. 10. 1910	Marble Bar	Two distinct earthquakes - the first at 5. 45 a. m. and the second 10 minutes later. A sound as of distant thunder was heard by people 20 miles away. The shocks travelled from a southerly to a northerly and caused crockery etc. to rattle in almost every dwelling.
11. 12. 1911	North of W. A.	Two well marked earth tremors. No damage. Not felt in Perth. Recorded at the Observatory. 7h. 50. 5 p. m. 8h. 08. 3m. p. m.
27. 5. 1912	Nullagine	Earth tremor at 6. 15 a. m. - one minute duration.
June, 1913	Marble Bar	Slight earth tremors accompanied by audible sounds like distant thunder on mornings of these dates, lasting in each case for a few seconds.
1914	Day Dawn (Murchison)	Earthquake shock on Great Fingall Mine, which resulted in considerable underground disturbance.
22. 11. 1914	Wahroonga Station and Gascoyne District.	Wahroonga reported:- "At about 6. 30 a. m. two reports, south of west from here, resembling dynamite explosions were heard only two or three seconds between each explosion at 6. 30 a. m. Meedo reported:- Severe earth tremor accompanied by two rumblings, close together, travelling from west to east. Natives report same, saying "ground shook making great noise". About 6 a. m.
21. 12. 1914	Marble Bar	Earth tremor at 9 a. m. lasting one second travelling N. W. to S. W.
6. 4. 1915	Marble Bar	Distinct earth tremor, at 12. 13. p. m. appeared to be travelling N. W. to S.
16. 8. 1916	Day Dawn (Murchison)	Two distinct earth tremors were felt on the Great Fingall Mine - the first at 10. 30, when a long rumbling sound ran through the earth and the second at 10. 45. Several falls of earth occurred. The shock was felt as far out as Meeban Station to the south and in a northerly direction as far as the Cue Hospital.
1. 12. 1916	Meckering Northampton Onslow	Between 11 a. m. and noon on the 1st several earth tremors reported. Shook buildings and rattled crockery, etc.
1. 12. 1916	Day Dawn (Murchison)	Severe earth tremors felt in Great Fingall Mine at 8 p. m. lasting 5 to 7 seconds. They were accompanied by two violent reports such as might be expected from the explosion of a magazine. At the 16 level there was a very considerable fall of rock and much of timber-work was crushed in. Damage was done to other parts of the mine, more particularly in the breaking of pipe connections.

TABLE 2 Cont'd)

DATE	LOCATION	REMARKS
14 5 1932	350 Miles of N. W. of Perth.	Recorded in Perth at 9. 20 p. m. but no damage done at Perth.
3. 10. 1935	Onslow	Severe earth tremor felt at Yanrey Station. No damage.
29. 4. 1936	Onslow	Tremors at 4. 30 p. m. and 5. 30 p. m. ground trembled and windows shook. Recorded at Observatory.
29. 4. 1941	East of Geraldton Weeberrie Station.	Tremors felt from Pt. Hedland to Albany and Kalgoorlie. Widely felt over the State. Many buildings in Perth shook. Local damage at Geraldton. Extensive area affected. Centred at Weeberrie Station. Epicentre 26 1/2° S 117° E. Magnitude 6 3/4 (Richter). Most severe earthquake to occur in Australia.
5. 10. 1949	Goolaraneth Station.	Reports earth tremor quite severe. Pictures rattled and doors slammed at 3. 55 p. m. Also felt at Moonthuna and Warraragine.
1. 12. 1950	Onslow	Slight earth tremor felt at 7. 10 a. m.
11. 7. 1954	Marble Bar	Report of severe earth tremor. No damage. Not recorded in Perth.
28. 3. 1957	Marble Bar	
19. 6. 1962	Port Hedland Marble Bar	Felt Hooley to Mandora. U. S. C. G. S. epicentre 20. 0S 119. 3E. H. 16 13 58.
26. 2. 1963	80 miles E. of Roy Hill Station	Intensity 4. 8 magnitudes centre 22° 5 S. and 121° 2 E.

TABLE 3

Earthquakes located in N. W. Australia and recorded at Mundaring Geophysical Observatory, July, 1959 - October, 1962.

DATE	POSITION		APPROXIMATE MAGNITUDE	
7. 11. 1959	25. 3^S	116. 2^E	5. 5	Recorded Adelaide
7. 7. 1960	28. 2^S	112. 5^E	4. 2	
18. 6. 1961	20. 0^S	119. 3^E	6. 4	See table 1. Recorded at most Aust. Observatories.
23. 8. 1961	18. 5^S	119. 0^E	5. 1	Recorded Adelaide and Darwin.
28. 8. 1961	27. 5^S	116. 2^E	4. 0	
22. 10. 1962	22. 9^S	116. 2^E	4. 8	Occurred at 13 28 05 (W. S. T.)

bearing from M. G. O. $\pm$ 10° hence position could be 100 miles east or west of long. 116. 2E.

NOTE: (1) The list includes only earthquakes which could be located.

(2) An unlocated tremor occurred at 03 08 53 W. S. T. on 17th October, 1962 at same distance from Mundaring as the tremor of 22nd October, 1962. Epicentres probably roughly same position.

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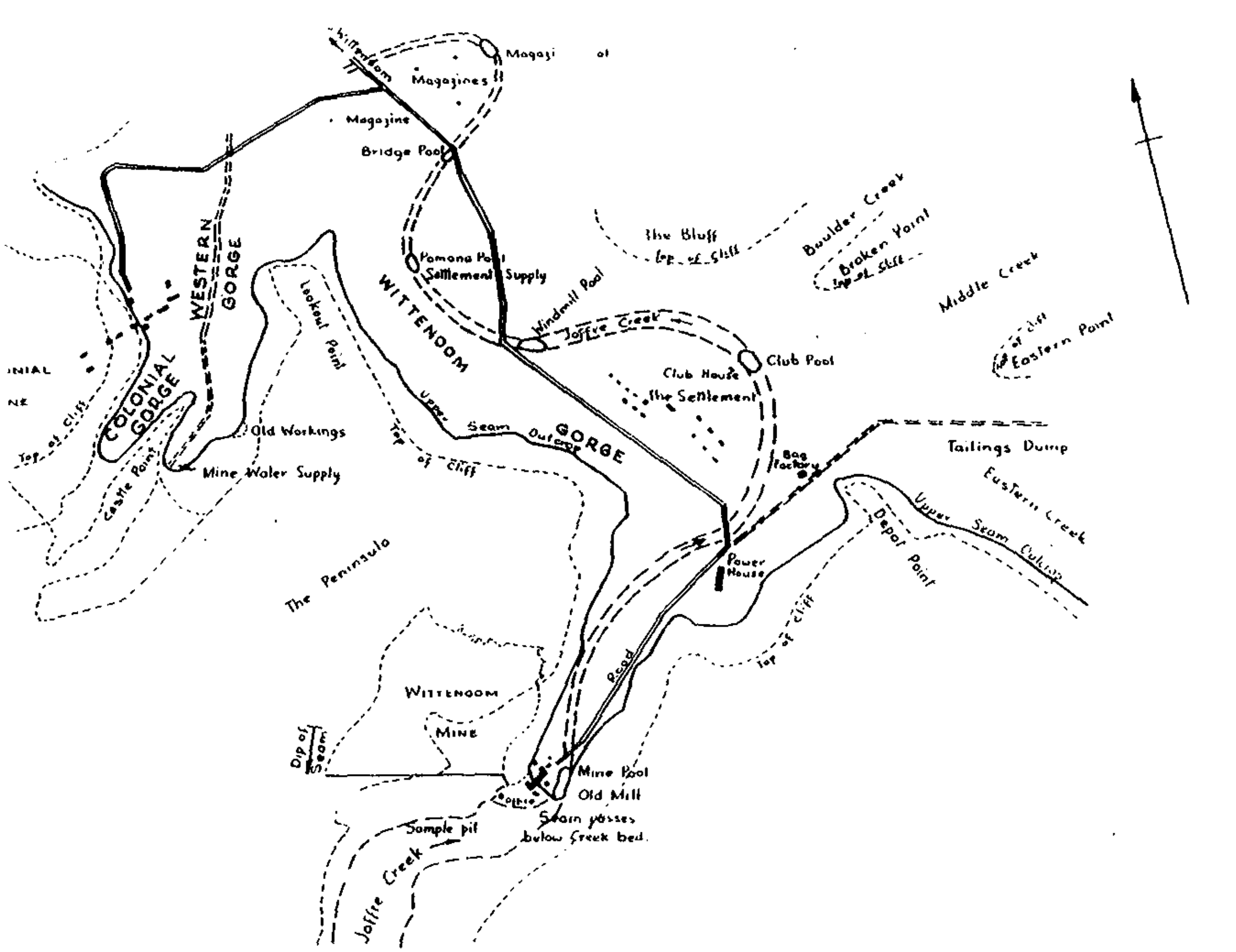
SCALE: 1 INCH = 260 MILES (APPX)

MACROBERTSON MILLER-ANSETT AIRLINES
FRIENDSHIP ROUTES
D.C.3 ROUTES



Note: Road and Creek detail is approximate in places

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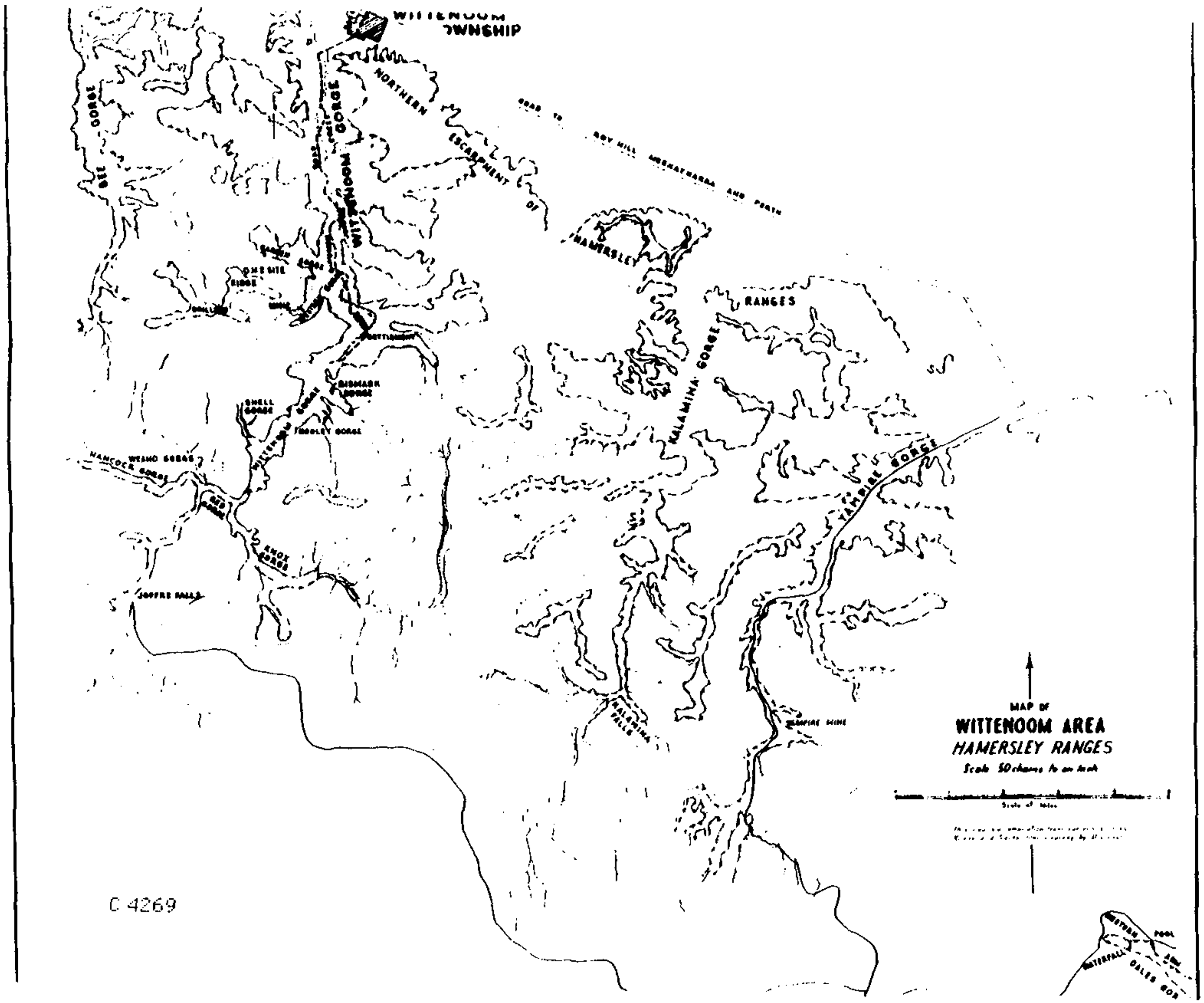
Scale

1000 0 1000 2000 3000

1000 ft. to 1 inch

GENERAL PLAN
AUSTRALIAN BLUE ASBESTOS

Dwn.



MAP OF
WITTENOOM AREA
HAMERSLEY RANGES
Scale 50 chains to an inch
Scale of Miles
WITTENOOM TOWNSHIP
NORTHERN ESCARPMENT OF HAMERSLEY RANGES
ROAD TO ROY HILL NEWMAN AND PERTH
WITTENOOM GORGE
BEE GORGE
KALAMINA GORGE
YAMPIRE GORGE
YAMPIRE MINE
KALAMINA FALLS
SHELL GORGE
BISMARCK GORGE
WEANO GORGE
HANCOCK GORGE
RED GORGE
KNOX GORGE
JOFFRE FALLS
OXER SITE RIDGE

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Chapter 4
Township of Wittenoom

Wittenoom is by far the largest inland community in the north-west of Western Australia and so far, is completely dependent on the blue asbestos industry. Its population at present is 1,000 people which compares with:

	Population
Carnarvon	2,750
Derby	1,450
Broome	750
Roebourne	250

Carnarvon has a port, whaling station, banana and bean industry, and is a pastoral outlet.

That portion of Western Australia, north of the 26th parallel ("north of 26") which is usually referred to as the Nor-West has an area of 527,000 square miles and a total population, excluding a few natives, of 8-9,000.

Until the blue asbestos industry commenced, Roebourne and Point Samson were gradually fading off the map. From their key-day in the early mining days, notably including the Whim Creek copper mine, the population had dwindled from thousands in the early 1900 s to 126 people in 1945.

Because of asbestos production, the numbers in Roebourne/Point Samson have increased steadily to 250 people. Of the total cargo amounting to 12,800 tons passing over the wharf in 1953, 10,000 tons were directly connected with the activities at Wittenoom and this picture still stands today.

The continued existence of Roebourne and the nearby port Point Samson is the result of activities at Wittenoom.

The town of Wittenoom now consists of:

178 houses for married employees built by the W.A. State Housing Commission. These are managed by the Company for the Commission.

huts and barracks for 180 single men built by A.B.A.

hotel owned and operated by the company
school catering for 140 pupils
convent school
retail store including a butchery and bakery
police station
modern post office
shire council centre and town hall.
cinema sponsored by the company
hospital
churches.

The houses, barracks and huts in the compound have septic sewerage facilities and are supplied with running water and electricity supplies.

The first houses cost on an average £1,600 each, but the 26 most recent houses, constructed of plaster slabs and generally on more generous lines have cost £3,300 each.

To date the total cost to the Governments for works in the town has been approximately £600,000 and the Company has spent £150,000.

At present the eight-bed district hospital is being modernised and enlarged by the W.A. Medical Department at a cost of £113,000.

Also a new school has been approved for completion by early 1964 and is expected to cost £25,000.

The Department of Civil Aviation is erecting a D.M.E. (Distance Measuring Equipment) station on "Drillers Range" at an estimated cost of about £40,000 to serve the Darwin - Port Hedland to Perth air services.

A radio telephone link with Port Hedland (and the rest of the world) is scheduled to be completed by November, 1963.

The recently appointed Community Officer is a member of the mine staff and is responsible for the smooth running of the company's interests in the town and for the planning of its development.

Currently a programme of beautification, partly by a campaign of painting and by the planting of trees and flowering shrubs is under way, and is showing striking results.

Wittenoom is one of the principal tourist attractions in Western Australia, and large numbers of people, mainly sponsored and organized by the W.A. Government Tourist Bureau regularly visit the area.

Besides the amenities mentioned there is also a 9-hole golf course, tennis courts equipped for night play, and a rifle club. A synthetic bowling green surface is being laid at present, and plans are being considered for a swimming pool and a social club, both of which are needed. In addition there is a racecourse and sports oval, a basketball court and a children's playground.

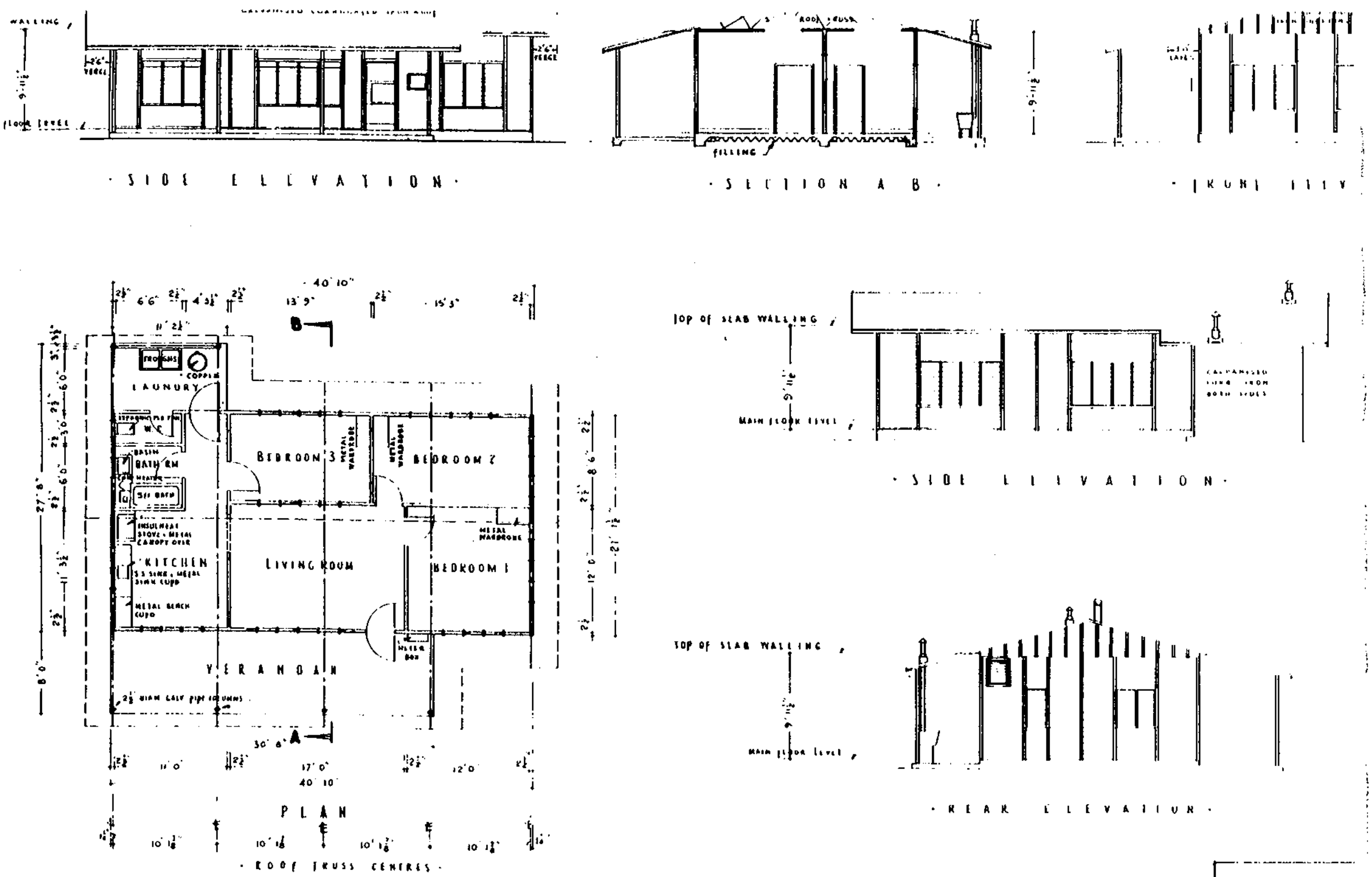
Other activities in the area

Other activities, such as the construction of a major U.S. tracking station near Carnarvon, the establishment by the U.S. Navy of a major radar base at North-West Cape on Exmouth Gulf; the renewed activities of Ampol Exploration Company in the Exmouth Gulf area, and the activities and plans of the Civil Aviation Department for the provision of the latest navigational aids and landing facilities, as alternatives for the Perth International Airport, all point very clearly to real and early advances in the development of the long neglected northern area.

The most recent development is the imminent signing of an agreement between Western Mining Corporation Limited and un-named Japanese steel interests for the supply of £29 million worth of high grade iron ore from Tallering Peak to be shipped from the port of Geraldton at the rate of a half a million tons of ore per annum initially.

Geraldton is south of what is regarded as the true north west, but the Western Mining Corporation position there is indicative of the potential of the iron ore deposits in the general area.

As it stands, the extensive manganese deposits are too high in iron content; too difficult to beneficiate and too far from the coast to justify large scale capital spending on roads, railways and harbour and loading facilities in their own right, particularly in the face of the present world glut of manganese, but the activities of the major mining companies in relation to the development of this area should be closely watched, particularly, as to date Wittenoom and Australian Blue Asbestos Pty. Ltd. constitute the only established centre and base of organised full scale mining in the north-west.

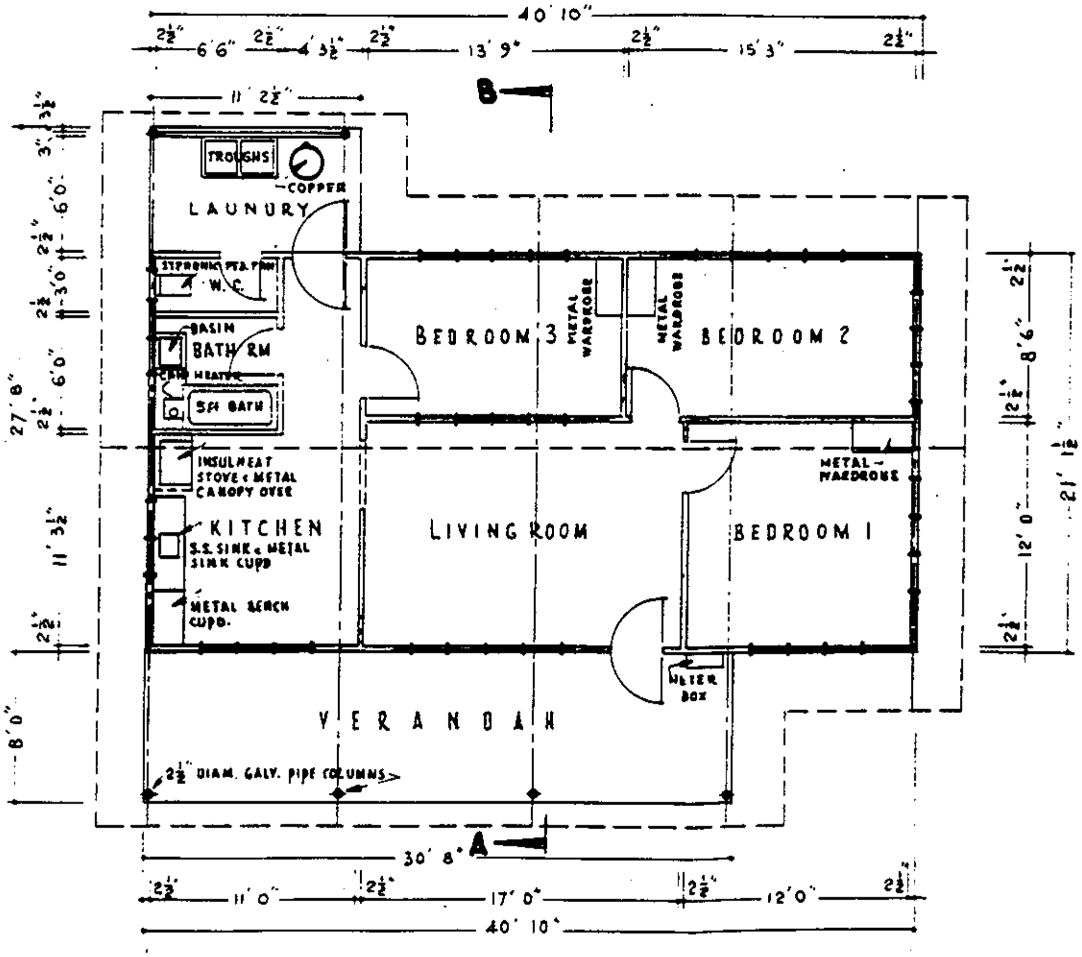


C 4273

PLASTER

STATE HO

· SIDE ELEVATION ·



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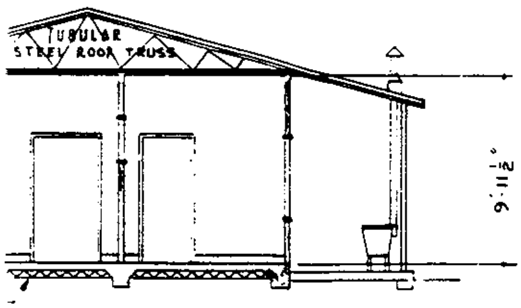
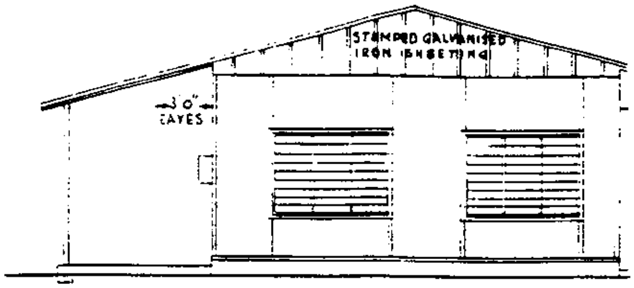
PLAN

10' 1⅞" — 10' 1⅞" — 10' 1⅞" — 10' 1⅞"

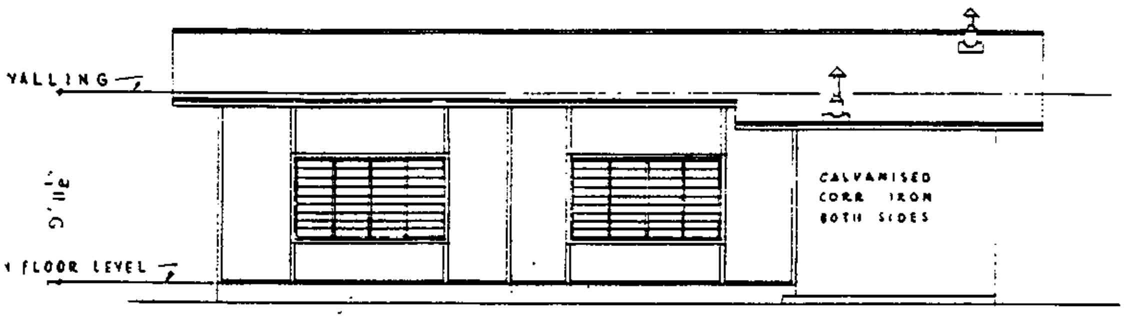
· ROOF TRUSS CENTRES ·



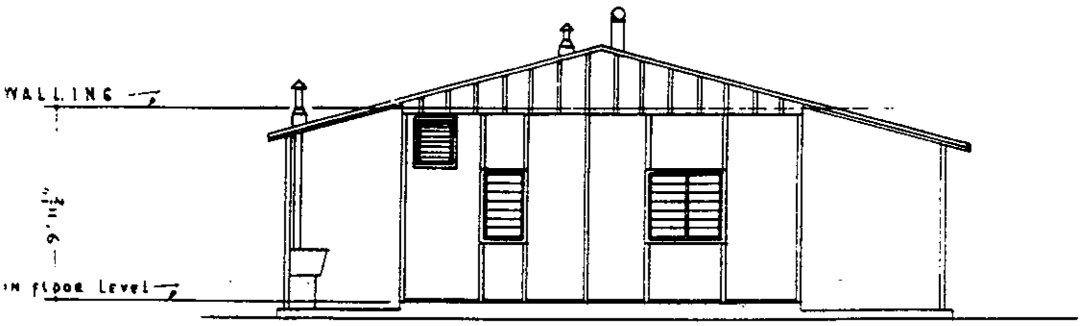
· CTION A-B ·



· FRONT ELEVATION



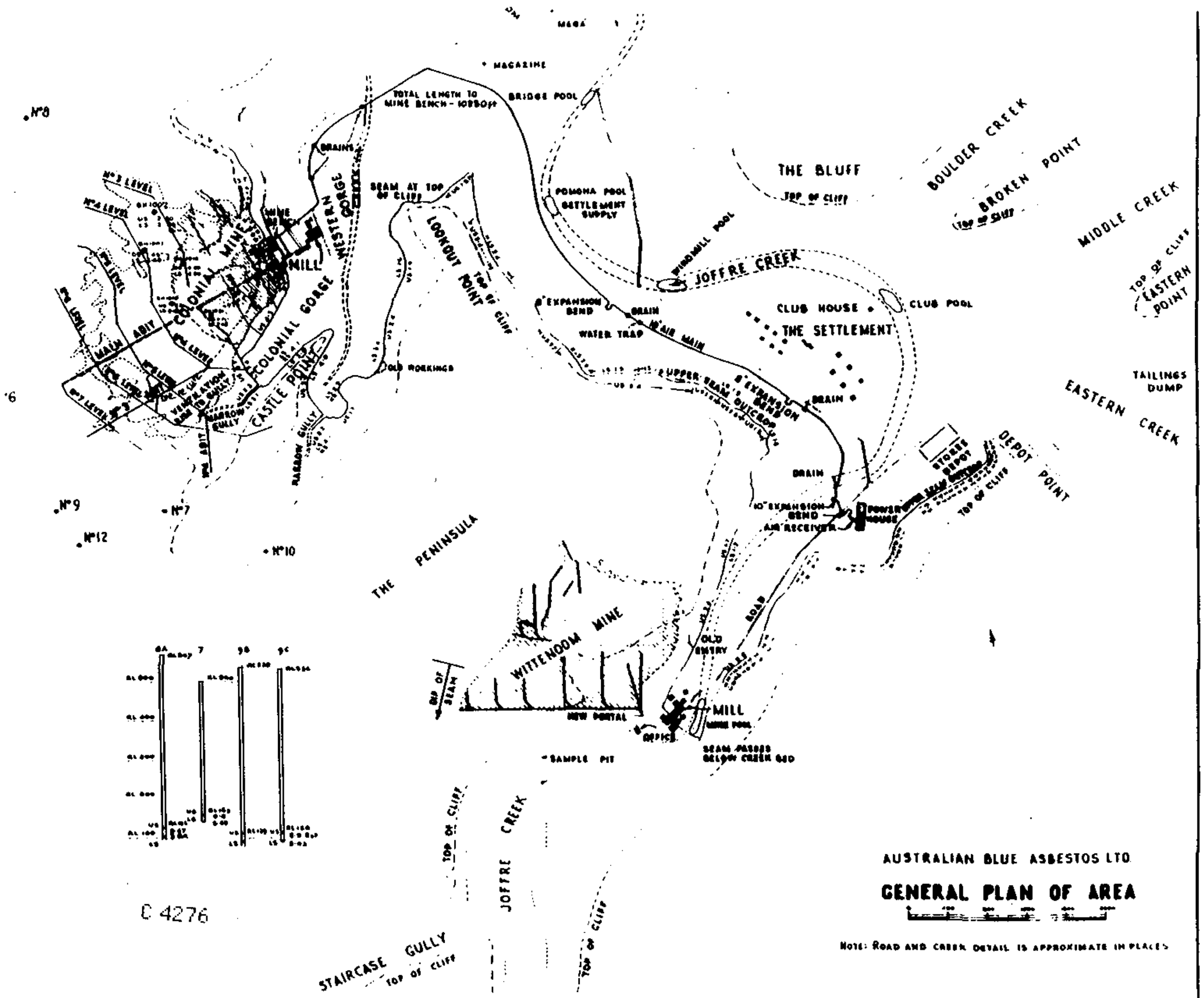
· SIDE ELEVATION ·



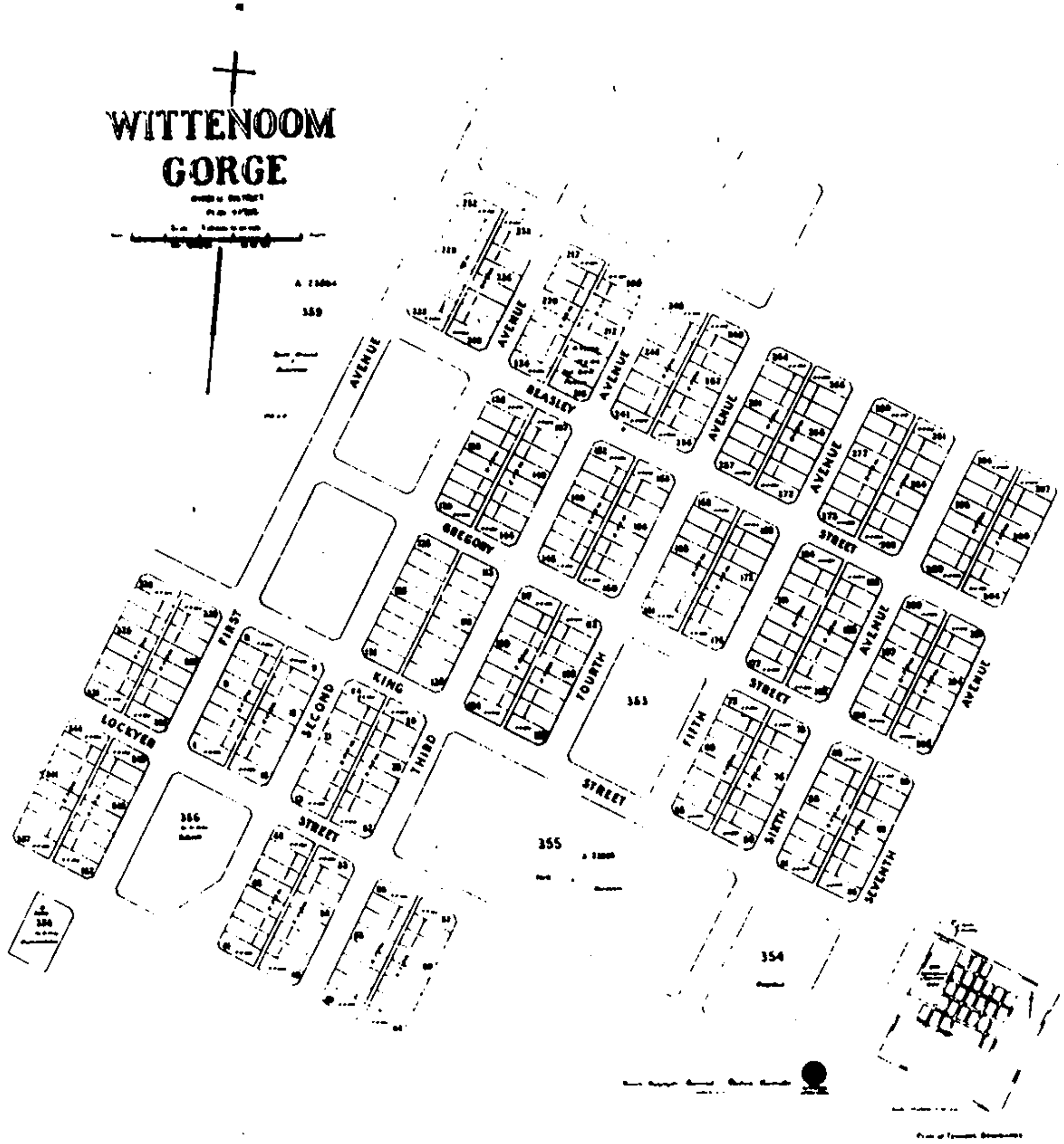
· REAR ELEVATION ·

C 4275

PLASTER SLA



AUSTRALIAN BLUE ASBESTOS LTD
GENERAL PLAN OF AREA
NOTE: ROAD AND CREEK DETAIL IS APPROXIMATE IN PLACES
MAGAZINE
BRIDGE POOL
TOTAL LENGTH TO MINE BENCH - 10850ft
DRAINS
SEAM AT TOP OF CLIFF
POMONA POOL
SETTLEMENT SUPPLY
THE BLUFF
TOP OF CLIFF
BOULDER CREEK
BROKEN POINT
MIDDLE CREEK
EASTERN POINT
TAILINGS DUMP
EASTERN CREEK
DEPOT POINT
STORES DEPOT
POWER HOUSE
AIR RECEIVER
ROAD
OLD ENTRY
MILL
SEAM PASSES BELOW CREEK BED
OFFICE
NEW PORTAL
SAMPLE PIT
WITTENOOM MINE
DIP OF SEAM
JOFFRE CREEK
STAIRCASE GULLY
THE PENINSULA
WINDMILL POOL
CLUB HOUSE
CLUB POOL
THE SETTLEMENT
EXPANSION BEND
DRAIN
WATER TRAP
AIR MAIN
UPPER SEAM OUTCROP
LOOKOUT POINT
OLD WORKINGS
WESTERN GORGE
COLONIAL GORGE
COLONIAL MINE
CASTLE POINT
NARROW GULLY
MAIN ADIT
No 3 LEVEL
No 4 LEVEL
No 8
No 9
No 7
No 12
No 10
C 4276


WITTENOOM
GORGE
AVENUE
BEASLEY
GREGORY
FIRST
SECOND
KING
THIRD
FOURTH
FIFTH
SIXTH
SEVENTH
STREET
LOCKYER
353
354
355
356
359

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Chapter 5

Leases held by the company and others in the area.

A. Leases and reserve held by the A.B.A. Company, and by Mr. L.G. Hancock
B. General conditions pertaining to the Temporary Reserve
C. Other mining interests in the area

A. Leases and reserves held by the A.B.A. Company and Mr. L.G. Hancock

The mineral leases held by the company and its Temporary Reserve area are shown in the accompanying plan (plan No. 9) at the end of this chapter.

As far as is known at present, the current lease holdings are adequate for, at the least, ten years ahead, but this will be confirmed by the current exploratory drilling programme.

The probable proven ore reserves at this date are to the order of 321,992 square yards of payable ore at 18th June, 1963 (of grade above 2.6 ins.), equal to three to four years of ore supply at the present rate of production, based on mining the two seams.

The Temporary Reserve is held for twelve months only and the company is obliged to do exploratory work and submit monthly reports with plans and drill logs of all holes bored. This Reserve can however be re-applied for in January, 1964.

Details of the Leases and Reserve held are as follows:

Mineral Claims	16,784 acres	
Temporary Reserve	5,100 "	
Sub-total	21,884 acres	21,884
Residential leases	90 "	
Water rights	23 "	
Business areas	5 "	
Gardens	17 "	
Tailing leases	48 "	
Homestead	10 "	
Sub-total	193 acres	193
Grand total		22,077 acres

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The conditions associated with the granting of the Reserve are listed in the following schedule.

B. General conditions pertaining to the Temporary Reserve

(i) That the occupants shall within 14 days of the date of approval of right of occupancy as appearing in the Government Gazette, mark at a corner of the boundary of the Temporary Reserve a landmark consisting of a post or cairn to serve as a commencing or datum point and shall advise the Minister for Mines in writing the position of such point.

(ii) That the occupants shall not use the land comprised in this reserve for any other purpose than that of prospecting for blue asbestos.

(iii) That operations satisfactory to the Minister are undertaken during the right of occupancy to assess the value of blue asbestos deposits in the Reserve.

(iv) That the right of occupancy will not give any rights to the occupants to prospect for any mineral other than blue asbestos, and upon the discovery of payable mineral other than blue asbestos, the Minister for Mines, may by notice, require the occupants to surrender their right of occupancy and apply for mining tenements.

(v) That the right of occupancy does not include any tailings or other mining materials lying on the land and the right is reserved to the Crown to grant licences in respect of such tailings or other mining materials, as provided under the Mining Act, 1904 - 1957 and Regulations thereunder.

(vi) That the existing rights of any prospecting area, claim, lease or authorised holding, shall be preserved to the holder thereof and shall not be encroached on or interfered with by the occupant of this reserve.

(vii) That the rights granted under this authority shall be no bar to any person desiring to acquire mining tenements for any mineral other than blue asbestos, in the said reserve or to any person desiring to acquire a holding under the Land Act, 1933, provided the land applied for does not include any of the occupants' workings which may in the discretion of the Minister for Mines be secured to the occupants of this reserve.

(viii) That this authority to occupy may be cancelled or the area reduced by the Minister for Mines upon application being made by any person for authority to prospect for any mineral other than blue asbestos, on any portion of the reserve if prospecting thereon by the occupants is not carried on to the satisfaction of the Minister for Mines. The Minister for Mines reserves

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the right to grant any mining tenement within the reserve upon being satisfied that the applicant for such mining tenement was already carrying out bona fide prospecting operations before the creation of the reserve.

(ix) Any land alienated or in the course of alienation and any land reserved and any land registered or *to be acquired and held under the Mining Act*, 1904-1957 shall be excised from the said Authority to Occupy.

(x) No transfer of this authority to occupy will be permitted without the approval of the Minister for Mines first obtained.

(xi) To such further conditions as may in the opinion of the Minister for Mines from time to time be deemed necessary.

(xii) That the Minister for Mines may cancel the right of occupancy upon being satisfied that the WHOLE or ANY of the conditions are not being or have not been fulfilled.

(xiii) That the occupant of this reserve shall commence prospecting operations forthwith, and shall furnish the Minister for Mines with a MONTHLY REPORT *applicable to operations being carried on within the* said reserve.

(xiv) That upon surrender, expiry or abandonment of this reserve, the occupant shall furnish the Minister for Mines with a summary report of the economic results of the prospecting operations carried out on this ground, including the following information:- (a) Method of testing; (b) Number of penetrations or excavations; (c) Nature of material tested; and (d) Assay values.

(xv) That the rights granted under this authority shall be subject to the provisions of the Forests Act, 1918 and the Regulations made thereunder, and also to the exclusion of all land alienated or in the course of alienation within the reserve.

C. Other mining interests in the area.

In the years since World War II, the existence of very great deposits of iron and manganese ores in Western Australia have been announced. Leading Australian mining companies, such as The Broken Hill Pty. Co. Ltd. and Western Mining Corporation Limited as well as overseas, United Kingdom and principally U.S. mining groups, have mapped and pegged areas in the north and north-west areas of Western Australia, for the iron ore in particular.

The activities became publicised when the Federal Government lifted its embargo on the export of iron ore.

With the development and active construction of the Ord River Dam and Irrigation Scheme, in addition to the activities of these major mining groups of companies, it is sure that the long awaited, active development of the north-west of the continent has at last reached an established threshold.

The present complex activities in the north-west in the exploration and exploitation of the iron ore deposits is the subject of a report (14th June, 1963, given verbatim below) by Mr. P.C. Thomas, *General Superintendent of Australian Blue Asbestos Pty. Ltd.*, Perth.

It will be noted that more recent events have shown that in this very high capital, high tonnage, low cost, low profit margin per ton business, that Western Mining Corporation Limited, who are very experienced in mining and in Western Australia in particular, have "stolen a march" on the newcomers and any day now, will be in business.

(i) Chrysotile

Mr. *Stuart Stubbs, an outstanding personality in mining* in the north-west, based on the Comet Mine at Marble Bar, has apparently got access to £100,000 of capital to mine several white asbestos - chrysotile - areas and to treat the ore at the Comet Mine treatment plant at Marble Bar.

His pegged interests are also shown with the iron ore interests on the accompanying map.

(ii) Major iron ore deposits of the north-west of Western Australia.
(A report by Mr. P.C. Thomas)

The following is a list, with some information, of the major prospecting companies operating throughout the north-west of Western Australia.

The position of mineral claims relative to Wittenoom is shown on the maps at the end of this chapter.

a) MT. GOLDSWORTHY GROUP.

- Consolidated Goldfields (Aust.) Pty. Ltd., A.C.T., Australia.
- Utah Construction & Mining Co., Delaware, U.S.A.
- Cyprus Mining Corporation, New York, U.S.A.

Head Office:	15 O'Connell Street, Sydney.
W.A. Office:	R. Belliveau, C.M.L. Building, St. George's Terrace, Perth.
Shareholding:	Equal percentage each company.
Area under Reserve:	2,062 square miles.
Location of Reserve:	Port Hedland - Goldsworthy West of Marble Bar. Roebourne - Pt. Samson area.
Plan reference:	Sheet 14 of the DeGrey area. Sheet 13 of the Onslow area.
Anticipated town facilities	Reported to be considering two settlements - (a) Mine (b) Port.
Port facilities:	Regard Depuch Island as most likely.
Haulage:	Rail from mine to port site - probably 125 miles.
Other information:	Copy of newspaper cuttings regarding Export Licence. Copy of Iron Ore (Mt. Goldsworthy) Agreement.

An agreement has been entered into between the Mt. Goldsworthy group and the State of Western Australia which provides £291,000 to be spent on geological exploration and investigation of townsites, port sites, rail line, overall economics, etc. This to be completed inside two years. If at the end of two years the group decides to continue they must build townships, construct a port and a railroad etc. Payments to Government are to be 7½% of f.o.b. price of ore as a royalty (min. 4/6 per ton), and 2/6 per ton or minimum £75,000 per annum as charges for rental of land on which port facilities will be erected.

The present idea is a causeway three miles long from the mainland to Depuch Island, a port on the island for 40,000 ton ships and a railway from Mt. Goldsworthy to Depuch Island.

Capital cost is expected to be £23 million to £30 million.

The group has been granted a licence to export a total of 64,000,000 tons of ore. Rate of export is hoped to be 4 - 5,000,000 tons per annum.

b) HAMERSLEY IRON PTY. LTD.

- Rio Tinto Southern Pty. Ltd.
- Kaiser Corporation, U.S.A.
- Conzinc Ltd.

Head Office:	Conzinc Rio Tinto (Aust.) Pty. Ltd. 95 Collins Street, Melbourne.
W.A. Office:	J. Hohnen, T. & G. Building, St. George's Terrace, Perth.
Shareholding:	Equal proportion each Company.
Area under Reserve:	1,168 square miles.
Location of Reserves:	To west of Wittenoom, approximately 60 miles. This is the nearest deposit to Wittenoom.
Plan reference:	Sheet 14 of the DeGrey area. Sheet 13 of the Onslow area.
Anticipated town facilities:	Dependent upon location of port but currently investigating the availability of land in the Roebourne area.
Port facilities:	This is still the subject of conjecture and thorough investigation. Pt. Samson -Cossack area not discarded at this stage.
Haulage:	Understood to be by rail.
Current activities:	Intense surface drilling programme at Boolgeeda (area 60 miles West of Wittenoom). 100 men engaged in site. Negotiating Iron Ore Agreement with W.A. Government. Over £300,000 has been spent to date on exploration etc.

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c) BROKEN HILL PROPRIETARY CO.

- Operating as a single company.

Head Office:	Melbourne
Perth Office:	Mr. Chessel, T. & G. Building, St. George's Terrace, Perth.
Area under Reserve:	1,330 square miles.
Location of Reserves:	Deepdale area east of Onslow, Roy Hill.
Plan reference:	Sheet 14 of the DeGrey area. Sheet 13 of the Onslow area.
Town and port facilities:	Yet unknown but understand survey of coast line just completed. Probably aim to locate port with minimum haulage between mine and harbour.
Current activity:	Surface exploration and drilling.

d) A.S. HILDITCH & C.H. WARMAN.

- Details of company formation unknown.

Head Office:	C/- Jackson McDonald & Co., 55 St. George's Terrace, Perth.
Shareholding:	Unknown.
Area under Reserve:	1,349 square miles.
Location of Reserve	South of Roy Hill Station in the Ophthalmia Ranges.
Plan reference:	Sheet 14 of the DeGrey area.
Other information:	Unknown.

e) BASIC MATERIALS CO. PTY. LTD.

- Garrick Agnew Pty. Ltd.

- Cleveland Cliffs of America.

Head Office:	167 St. George's Terrace, Perth.
Shareholding:	Unknown.
Area under Reserve:	246 square miles.
Location of Reserves:	East of Onslow and South of Roebourne.

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Plan reference: Sheet 13 of the Onslow area.

Other information: Unknown.

(iii) Other iron ore reserves granted throughout the State.

Bell Bros. - Guildford, W.A.
100 sq. miles in the Kimberley Division.

A. McDonald - South Perth, W.A.
49 sq. miles in the Yalgoo area.

Hancock Prospecting - Victoria Avenue, Perth W.A.
Area not known but located south of Onslow.

R. Batchelor - Claremont, W.A.
293 sq. miles in the Derby area.

H. B. Moncrieffe - Mullewa, W.A.
1 sq. mile in the Yalgoo area.

R. Synott - Esperance, W.A.
4 sq. miles, Joyner's Find area.

A. Acton - Ravensthorpe, W.A.
2 sq. miles, Ravensthorpe area.

H. Young - Wyndham, W.A.
50 sq. miles, Kimberley area.

E. Rick - Perth, W.A.
11 sq. miles, Marble Bar area.

Metal Traders (Aust.) Pty. Ltd. - Perth, W.A.
50 sq. miles, Hamersley Range area.

(14th June, 1963).

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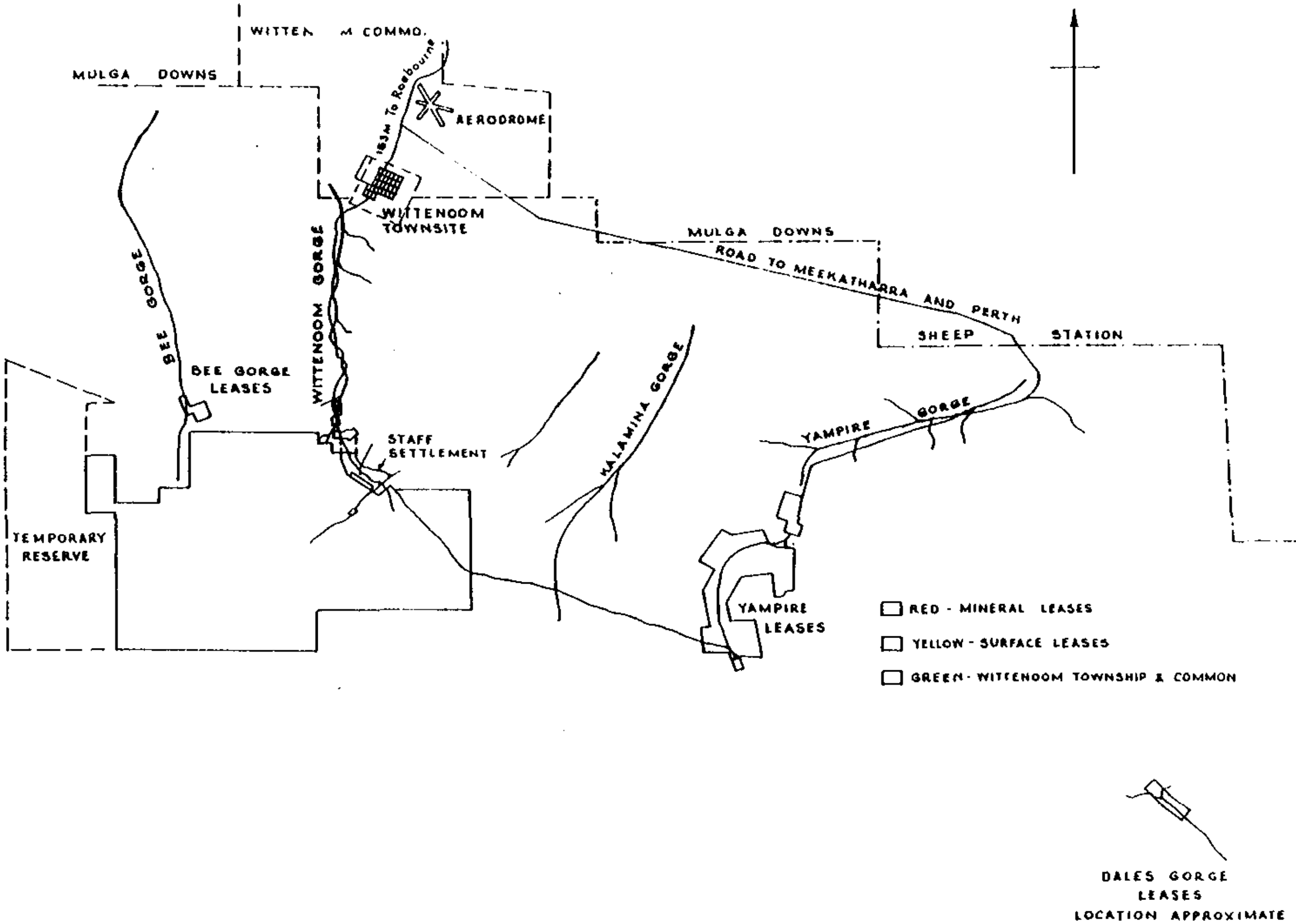

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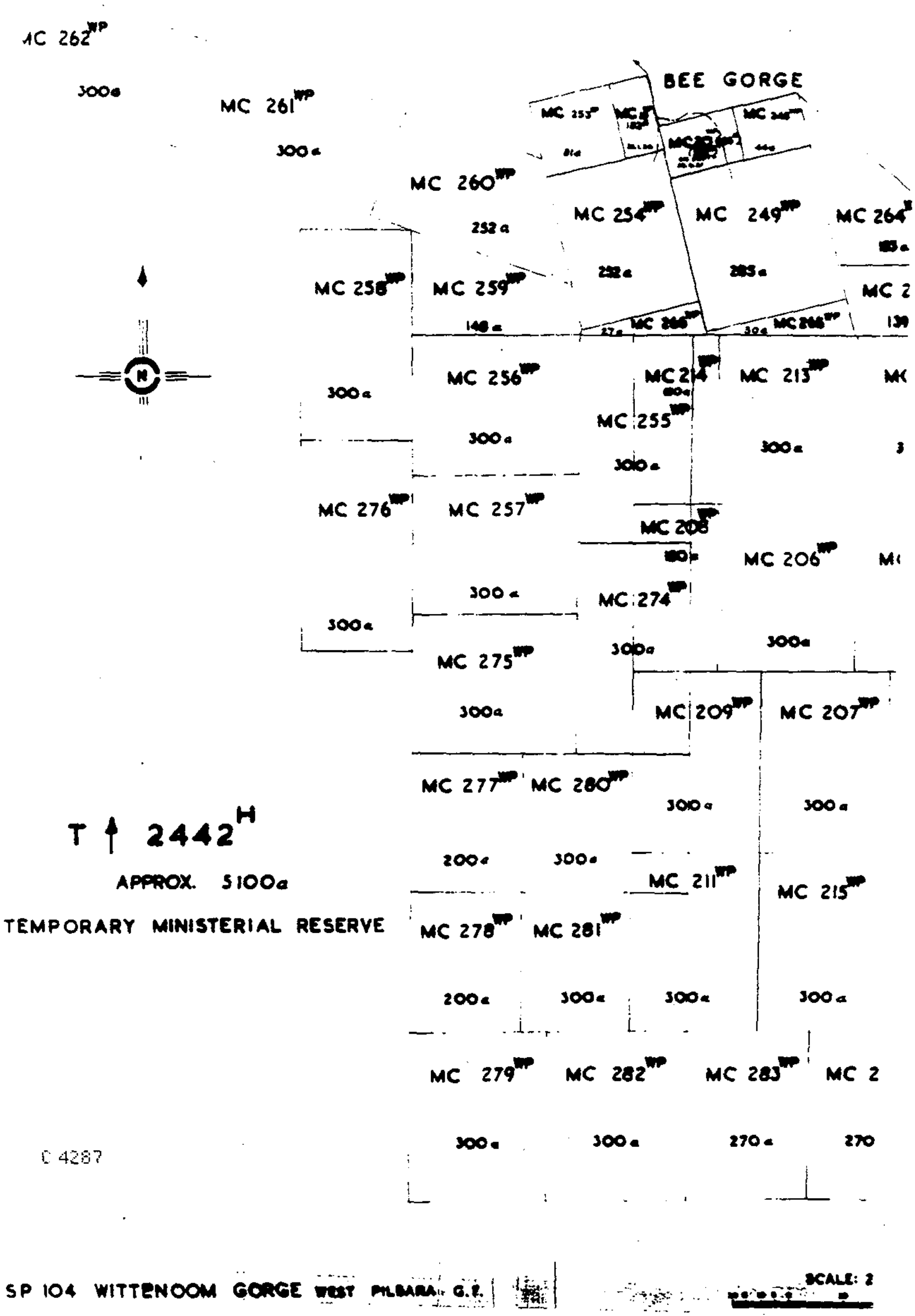
Scale: 9000' to 1"	MINING AND OTHER LEASES
Drawn: Traced: A.E.F. Date: 26.6.63.	
AUSTRALIAN BLUE ASBESTOS	ABA 1062



MC 262 WP
300a
MC 261 WP
300a
BEE GORGE
MC 260 WP
252 a
MC 254 WP
MC 249 WP
MC 264
252a
285a
MC 258 WP
MC 259 WP
148 a
MC 256 WP
MC 214
MC 213 WP
300a
300a
MC 255 WP
300a
300a
MC 276 WP
MC 257 WP
MC 208
180a
MC 206 WP
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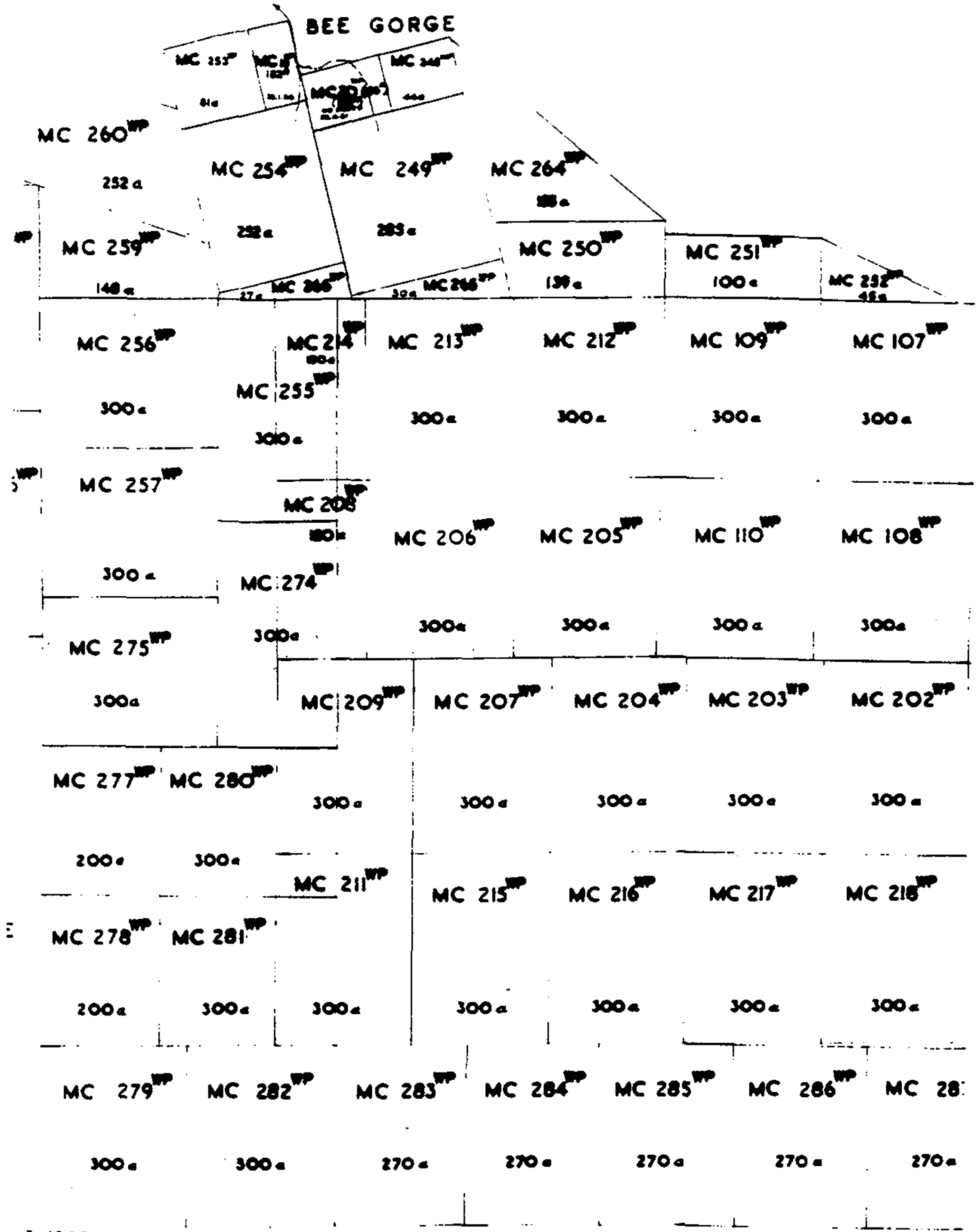
APPROX. 5100a
TEMPORARY MINISTERIAL RESERVE
C 4287
SP 104 WITTENOOM GORGE WEST PILBARA G.F.
SCALE: 2



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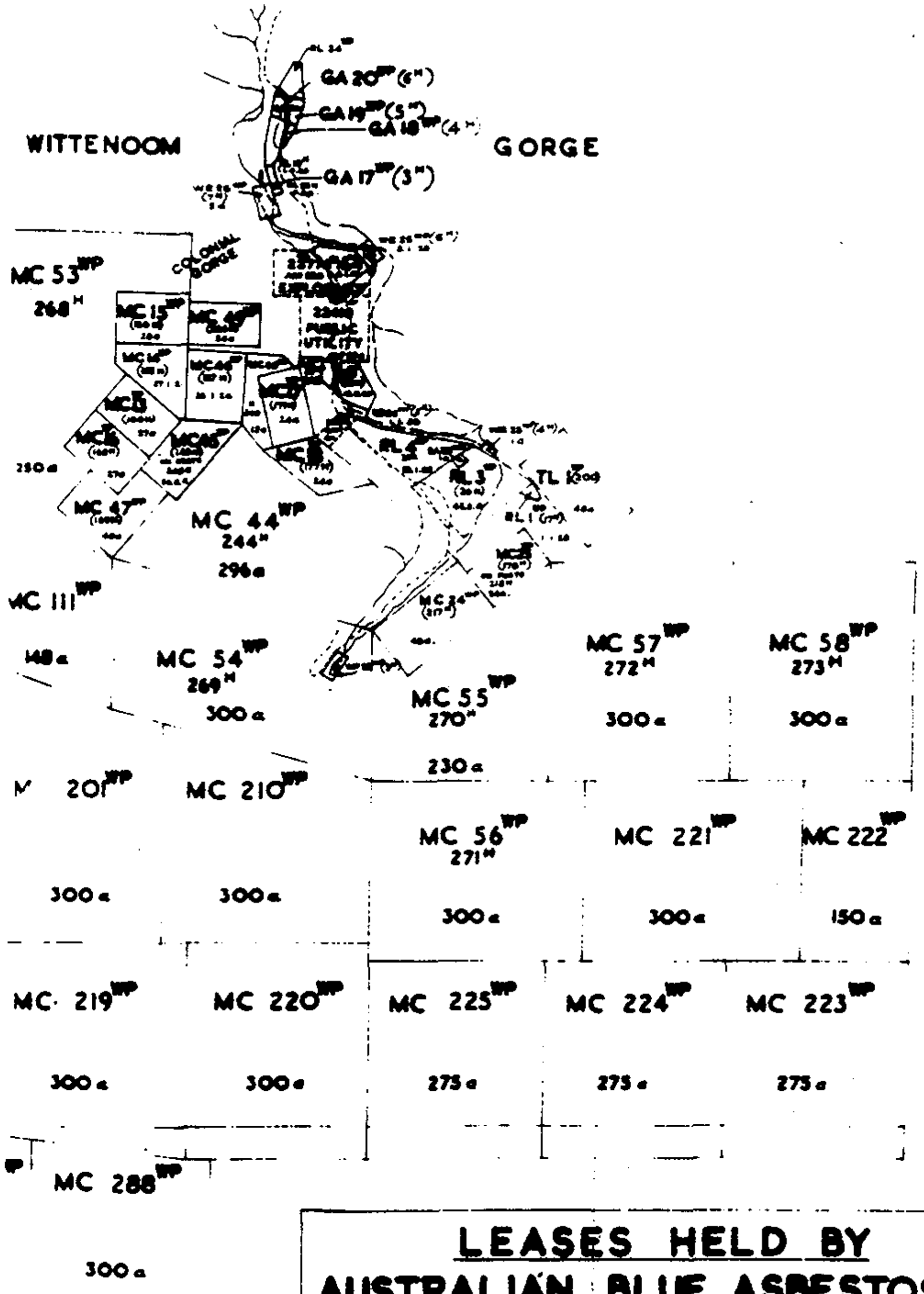
PILBARA G.F.

SCALE: 20 CHAINS TO 1 INCH



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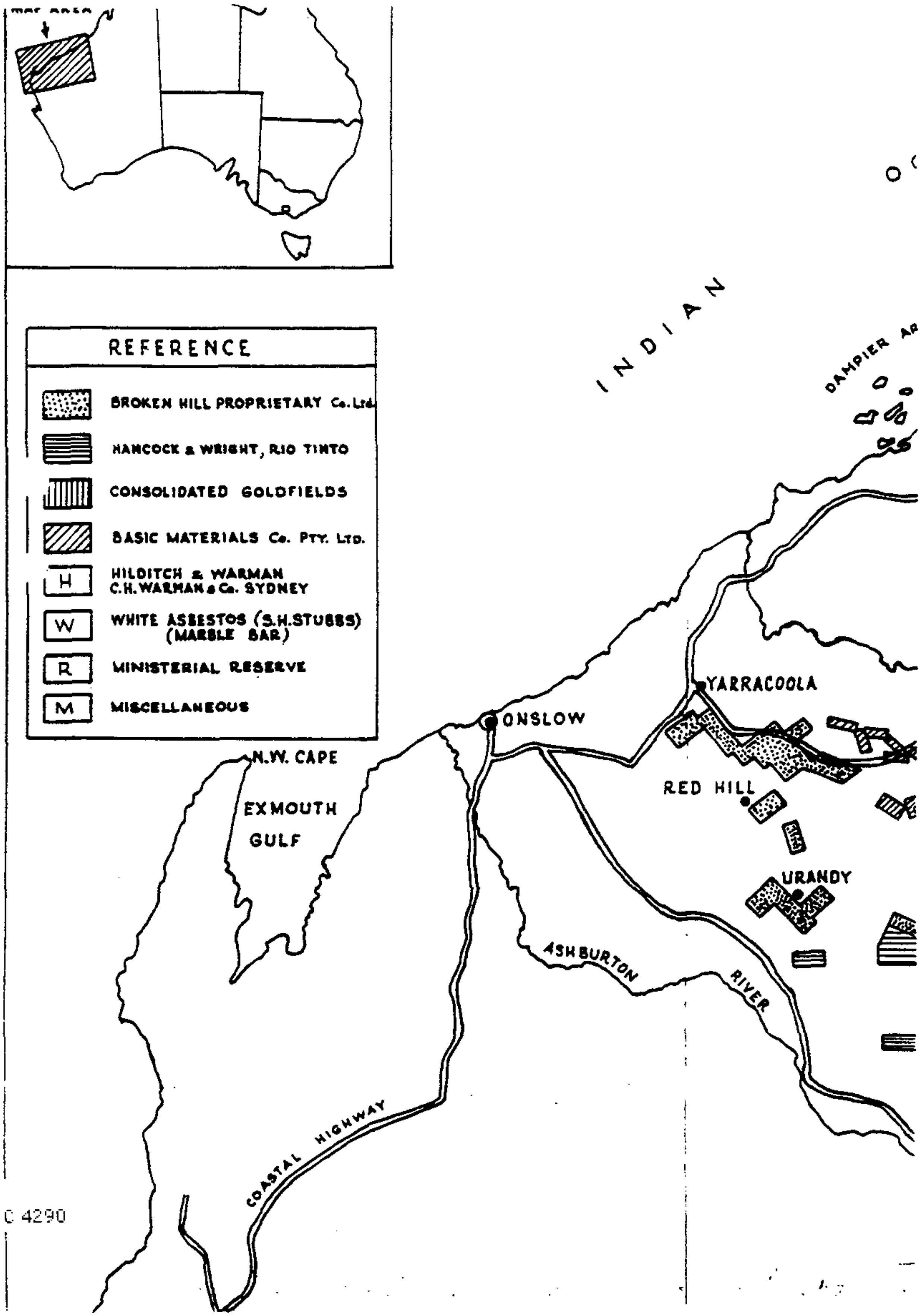
SP 104.

LEASES HELD BY AUSTRALIAN BLUE ASBESTOS PTY. LTD. AT JUNE 1963

NOTE:– THE LEASES OUTLINED IN RED ARE THOSE HELD BY L. G. HANCOCK.


REFERENCE
BROKEN HILL PROPRIETARY Co. Ltd.
HANCOCK & WRIGHT, RIO TINTO
CONSOLIDATED GOLDFIELDS
BASIC MATERIALS Co. PTY. LTD.
H
HILDITCH & WARMAN
C.H. WARMAN & Co. SYDNEY
W
WHITE ASBESTOS (S.H. STUBBS)
(MARBLE BAR)
R
MINISTERIAL RESERVE
M
MISCELLANEOUS
INDIAN
DAMPIER
YARRACOOLA
ONSLOW
N.W. CAPE
EXMOUTH
GULF
RED HILL
URANDY
ASHBURTON
RIVER
COASTAL HIGHWAY

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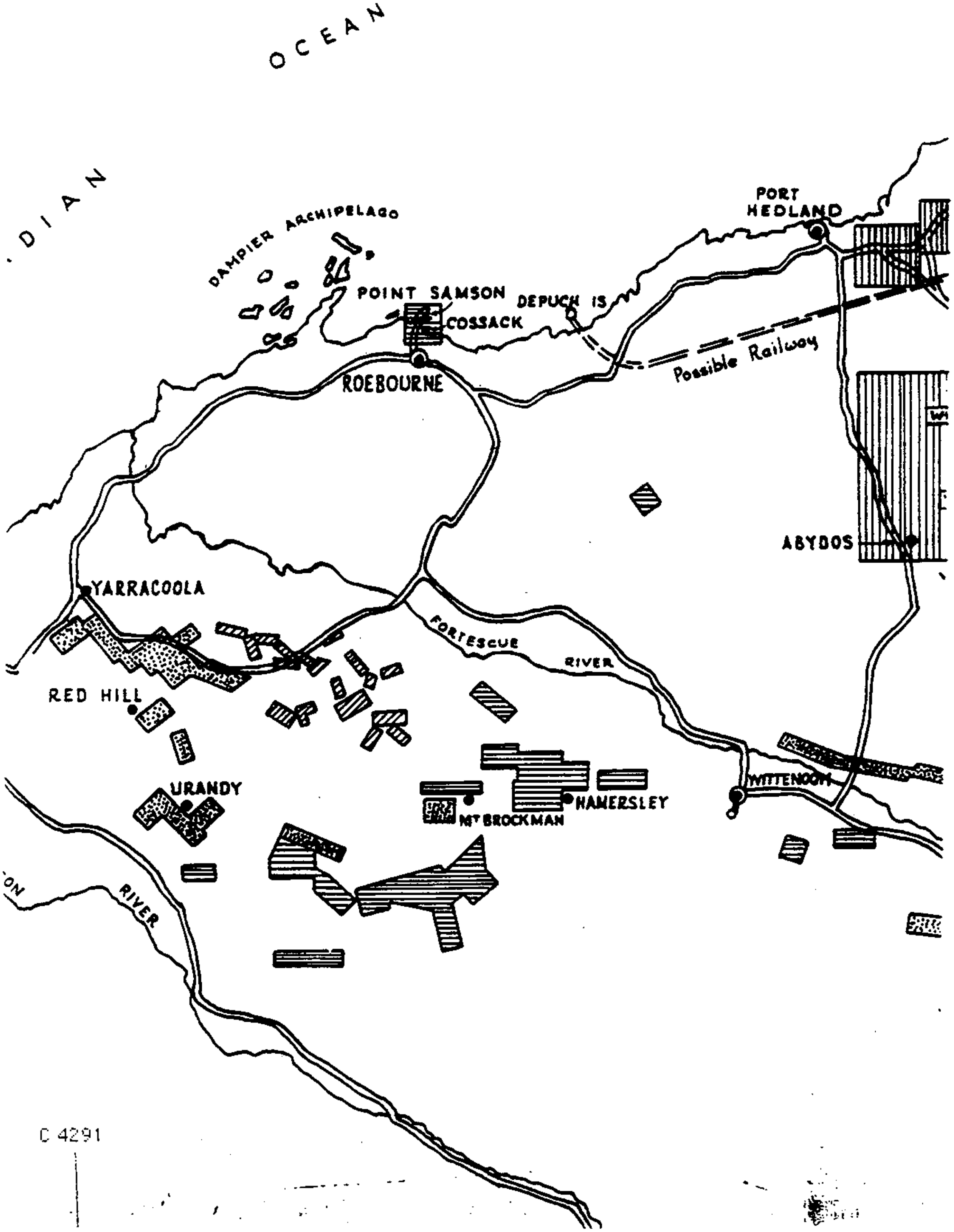
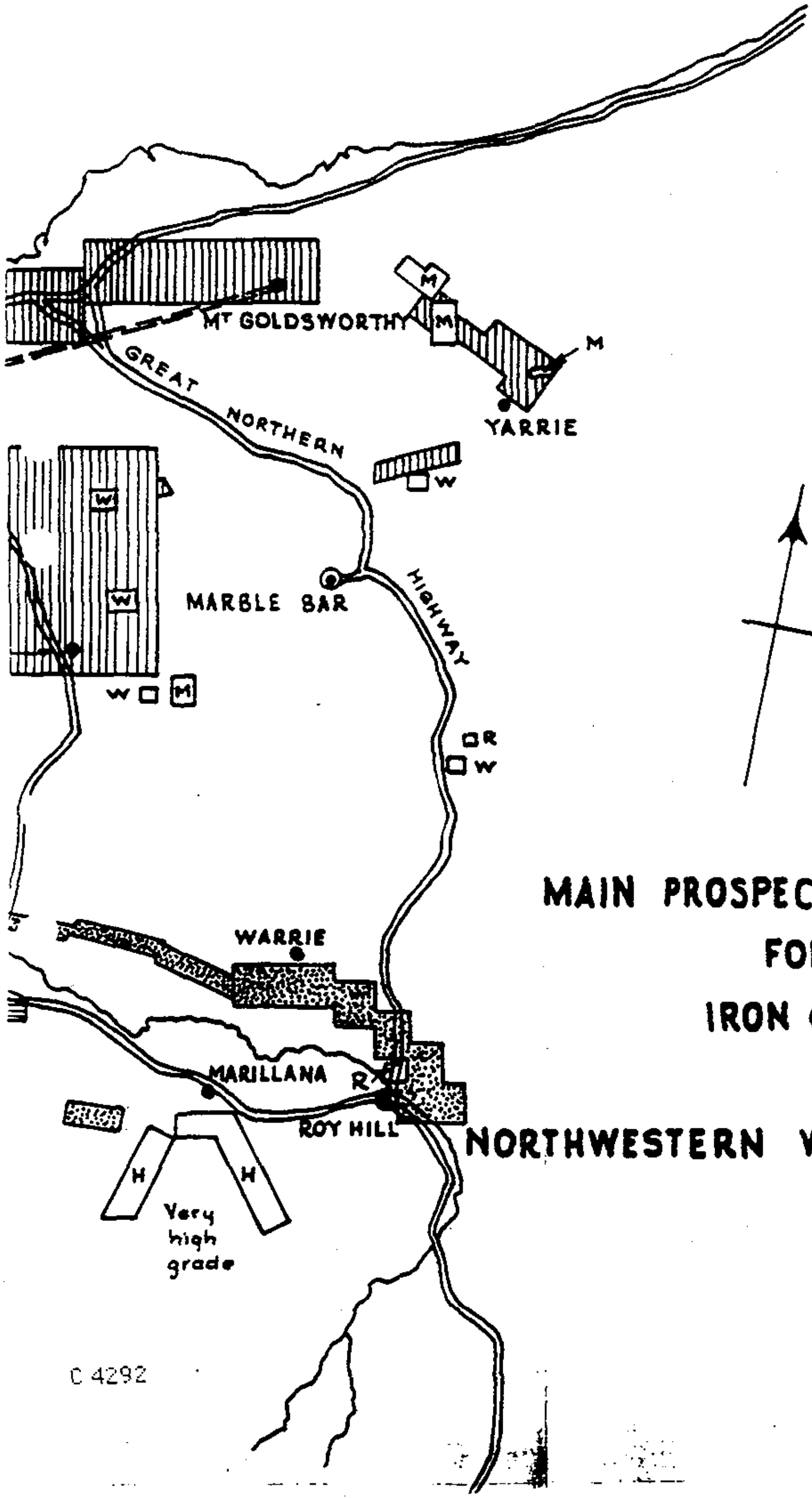


OCEAN
DIAN
DAMPIER ARCHIPELAGO
PORT HEDLAND
POINT SAMSON
DEPUCH IS
COSSACK
ROEBOURNE
Possible Railway
ABYDOS
YARRACOOLA
FORTESCUE
RIVER
RED HILL
URANDY
HAMERSLEY
Mt BROCKMAN
WITTENOOM
ON
RIVER

C 4291



MAIN PROSPECTING AREAS
FOR
IRON ORE
NORTHWESTERN WEST AUSTRALIA

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Chapter 6

Geology

Geology of the blue asbestos deposits

of the

Hamersley Ranges

by K. J. Finucane, Consultant Geologist
June, 1963

Introduction

The Hamersley Ranges are located in the North-West Division of Western Australia and extend, approximately, between latitudes 21° 30' to 23°S and longitudes 117° to 120°E. Their mean height above sea level is 2,000 feet and they rise from 600 to 800 feet above the general level of the tableland extending south-east from the coastal town of Roebourne. Mt. Bruce, the highest peak, rises to 4,024 feet above sea level. The ranges are intersected by numerous north-flowing streams, dry during the greater part of the year, which over the ages have carved deep gorges and it is in these that the principal deposits of crocidolite outcrop.

The presence of the mineral had been known for many years, the first official record being in 1917, when reports of a strong market demand for crocidolite, in 1937-38, resulted in considerable prospecting and mining activity, particularly in Yampire, Wittenoom and Dale's Gorges. It was further established that the blue asbestos belt extended from Willi Wolli Springs north-west to Millstream Station, i.e. over a length of 180 miles and a width of 20 to 30 miles. A numl er of attempts were made to develop and treat the Yampire and Wittenoom Gorge occurrences from 1939 through to 1945 but for a variety of reasons none of these proved successful.

Production by Australian Blue Asbestos commenced in 1944 and has continued since then. Operations have been concentrated in Wittenoom Gorge, initially in the Wittenoom Mine and since January, 1959, in the Colonial Mine, there being a transition period in the transfer of production from one mine to the other. Details of ore production are shown in Appendix 1 to this chapter.

Previous investigations

A number of scientific papers, geological and mining reports have been published on the crocidolite deposits by State and Commonwealth Government officers and various investigations have been made by officials of Australian Blue Asbestos Ltd. The results of these are summarised below and, while the knowledge of the deposits is steadily accumulating, the total available only emphasises the need for a more thorough and complete study than has been undertaken previously.

In 1929, a brief paper on the occurrence of blue asbestos in the Hamersley Ranges was presented before the Royal Society of W.A. by the late Dr. E.S. Simpson, who was then State Government Analyst and Mineralogist and had an extensive knowledge of Western Australian minerals.

A report on crocidolite occurrences in Yampire Gorge was made by Mr. F.G. Forman, then Government Geologist, in 1937 and is published in the Annual Report of the Geological Survey for that year. In the following year, Mr. J.S. Foxall examined the workings in Wittenoom Gorge and his description of the Upper and Lower Seams and the Knapping Seam and workings thereon are contained in the Annual Report of the Mines Department for 1938.

A more detailed report was made on behalf of the Aerial, Geological and Geophysical Survey of Northern Australia by the writer, in 1938, and covered Yampire, Dale's and Wittenoom Gorges. The primary object of this was to draw attention to the nature and extent of the deposits and their economic possibilities. Limited staff and time made it impossible to concentrate on other than the essential features.

In 1942 the W.A. Geological Survey published Bulletin 100 in which Dr. Keith Miles dealt in considerable detail with the petrology, mineralogy and microscopic characteristics of the crocidolite and associated rocks, while Mr. J.S. Foxall described Yampire, Dale's and Wittenoom Gorges and also the Marramamba area. In addition Mr. Foxall dealt with economic aspects of the deposits and drew attention to their size and the prospects of establishing an industry based on the production of blue asbestos.

Reports on the occurrences at Willi Wolli Springs, Marramamba and Yampire Gorge have been made also by technical officers of Australian Blue Asbestos Pty. Ltd. and detailed sampling plans are available of most of the Main Yampire workings and of part of the Intermediate Series. These form part of mine records.

Geological work over the past three years has been concentrated in the area north and south of the Colonial and Wittenoom Mines and west beyond Bee Gorge with the object of delineating key marker horizons to aid the drilling programme and ultimately establish an accurate structure-contour plan of the area.

A limited amount of broader reconnaissance work has been carried out in Yampire and Dale's Gorges and near Joffre Creek in order to consolidate the background and regional aspects of the geological investigation.

The stratigraphy and sequence of beds over a thickness of 500 to 600 feet has been reasonably well established in the immediate host rocks of the crocidolite seams but it has not been possible to extend the scope of the work beyond the immediate mine environment or to delineate the detailed structural features of the Wittenoom - Colonial Mine area; nor has it been possible to correlate the Wittenoom-Yampire-Dale's group with a view to delineation of favourable areas for exploratory drilling. Lack of time and the need to consolidate the Colonial Mine operation have precluded any major attempt to expand the scope of the work with the staff available.

Geology

Rock types throughout the ranges comprise an appreciable thickness of almost horizontally bedded ferruginous or hematite quartzites, quartzites, shales, calcareous shales, dolomites and bands of limestone, together with thin bands of riebeckite rock. These form part of the Nullagine Series, of Proterozoic age, and probably represent the upper portion of it.

The crocidolite occurs as conformable seams of cross fibre and the immediate host rocks constitute a reasonably well defined horizon, possibly 400 to 450 feet thick with the principal bands of fibre concentrated in the lower section. Generally, it occurs in hematite quartzites in proximity to beds of dolomite or calcareous shale or to thin beds of bluish coloured, fine grained riebeckite rock.

Light coloured, thinly bedded shales, with occasional limestone beds a few feet thick, occur below the fibre zone and these are well evidenced in road cuttings and in creek and talus exposures. They are softer and less resistant than the quartzites. Outcrops in the higher country, above the fibre zone, comprise quartzites with occasional beds of shale in which there is rather less iron than is characteristic of the rock types in closer proximity to the productive beds.

In general the beds are horizontal or only gently dipping but there is a definable amount of warping in some areas, with short, restricted zones of buckling, folding and faulting. The average range of dips varies from horizontal up to 4° with maximum readings between 8° and 10°.

It is difficult to assess the extent to which warping and flexing may have influenced the formation of better grade fibre zones. The most widely accepted hypothesis regarding the genesis or origin of the deposits is that in some places the crocidolite was formed by growth of fibre in situ along the margins of beds having a similar chemical composition to that of the crystalline fibre, while, in others, the original beds contained iron and silica in similar relative proportions to those required in the formation of fibre, with soda and magnesia being introduced from adjacent beds. The heat and pressure necessary to effect the crystalline growth could have been produced by burial of the rocks under other strata. As the presence of water or aqueous solutions would be an essential condition of growth, it is probable that flexing of the beds would lead to greater volume and freedom of circulation and hence to greater deposition of crocidolite.

The consistent association of fibre with a definite sequence of beds or rather with a particular group of rock types indicates that the Hamersley occurrences are probably restricted to a definite lithological group or stratigraphic horizon in the upper portion of the Nullagine Series. However, the precise conditions which govern the distribution of the better grade mine-able zones are not apparent, possibly they depend partly on the chemical composition of the host rocks and partly on structure.

Systematic structural mapping is required to correlate the several deposits described below but their general associations are broadly comparable, though they vary in the actual detail of fibre width, vertical interval between seams and immediate or contiguous host rocks.

The deposits

Principal among the known deposits are those of Wittenoom, Yampire, Bee and Dale's Gorges. Fibre also occurs at Willi Wolli Springs near the known eastern limit and leases are held at Marramamba some seventy miles due west of Wittenoom. Their distribution is illustrated on the accompanying plan, Fig. 1.

(i) Wittenoom Gorge

Examination of cliff faces and of the underground workings of the Colonial and Wittenoom Mines shows that the crocidolite occurs in three main seams or bands covering a vertical range of 42 to 46 feet. The Upper or No. 1 Seam comprises a band of hematite-quartzite from 15 to 18 inches thick containing lenses and veins of fibre varying from a fraction of an inch up to 1.5 inches and aggregating 3.0 to 3.5 inches. A foot below this and separated by barren quartzite there is a bed of calcareous shale, 9 to 12 inches thick, which persists throughout the gorge, but which fades north of the Colonial Mine. The Lower or No. 2 Seam occurs from 21 to 22 feet below the Upper, with quartzites intervening, and is almost identical except that the aggregate thickness of fibre is about 2.6 inches. About three feet below the "Lower Seam" there is a bed of crystalline dolomite which grades gradually into black, calcareous or dolomitic shale, particularly in the northern workings of the Colonial Mine. This is succeeded by a 6 to 9 inch bed of quartzite below which there is a lenticular knapping seam showing from 0.5 to 1.5 inches of fibre and which, at times, may be totally absent. The Lowest or No. 3 Seam occurs from 42 to 44 feet below the top of the "Upper Seam" and consists of lenses and veins of fibre aggregating 1.5 to 2.0 inches and extending over a thickness of two feet; the intervening beds are quartzites. Thin veins of fibre occur between the three principal seams but these are of no economic significance. Narrow bands of calcareous rock, an inch or two thick, are interbedded with the quartzites adjacent to the fibre bands. A typical section illustrating the relationship of the various seams and associated beds is shown in Fig. 2.

The Colonial Mine workings cover a length of 2,900 feet extending west from the cliff outcrop and an average width from north to south of about 2,000 feet. They follow the dip of the bedding into the hillside at an average inclination of 4° west. Both the Upper and Lower, or No. 2 Seam have been mined extensively but No. 3 Seam is too low grade to be worked economically. The Wittenoom Mine is currently inoperative but the overall fibre relationships are similar to those of the Colonial Mine except that average fibre content of the Upper and Lower Seams is less; workings cover a length of about 2,000 feet from east to west and a width of 1,000 feet. A wide zone of faulting and barren fibre occurs along the northern periphery of the Wittenoom workings and appears to extend northwards for some 2,000 feet towards the Colonial Mine. The southern faces of the Wittenoom Mine have been check sampled.

A number of key stratigraphic beds or markers have been established in the Wittenoom-Colonial area principal among these being:-

> Green quartzite 9 in.- 12 in. thick, above the Upper Seam, at a depth of 460 ft.
>
> Grey quartzite breccia 12 in. plus or minus, above the Upper Seam, at a depth of 300 ft.
>
> Two shale bands of 12 in. and 6 in. from 15 ft. to 17½ ft. and 12 in. to 18 in. thick at 75 ft. below the Upper Seam.

These define the productive zone within close limits and materially assist in drilling.

(ii) Bee Gorge

Fibre occurs in Bee Gorge about three and a half miles north-west of the Colonial Mine and has been exposed along a series of east-west benches over a length of 240 feet. These show from 1 to 2 inches of high grade crocidolite associated with bands of quartzite and riebeckite. Fourteen feet above there is a narrow seam, from 6 to 18 inches thick, containing three or four narrow veins of fibre aggregating 1.0 to 1.75 inches. A third seam is located 28 feet below the main benches but this rarely exceeds 0.5 of an inch. The total vertical range is 42 feet, a number of bands of riebeckite are associated with the fibre and the general occurrence is broadly comparable with that of the northern peripheral area of the Colonial Mine. However, the beds of calcareous shale and dolomite, so characteristic of both the Wittenoom and Colonial Mines, appear to be absent.

Economically, Bee Gorge is not attractive on its present showing. Reconnaissance work to the south and west of it show outcrops of the grey quartzitic breccia mentioned above and, provided reasonable structural conditions can be established, exploratory drilling could be undertaken south of Bee Gorge and on the western prolongation of the Colonial Mine.

(iii) Yampire Gorge

This is located about twelve miles south-east of Wittenoom. Fibre has been mined from a series of shallow benches and scattered workings which extend over a distance of three miles. Three main horizons have been established, viz., the Main Yampire Series, an Intermediate Series and a Top Horizon which is from 150 to 200 feet stratigraphically above the main seam.

The principal occurrences are at the southern end of the gorge where the Main Yampire Series outcrops over a length of 3,000 to 4,000 feet in a broad anticlinal structure. Here there is a total of 3.5 to 5 inches of fibre in several seams of varying thicknesses over a vertical height of 8 to 9 feet. Bands of riebeckite rock are associated with the fibre. The beds dip gently to the north and pass below the surface but reappear with a change of dip towards the northern entrance of the gorge.

Comparatively little work has been done on the Intermediate Series which showed promise in places but scattered workings on the Top Horizon over a length of several thousand feet give an average thickness of 2 inches of crocidolite over a vertical height of 2 to 4 feet. There is a consistent bed of riebeckite rock associated with the Top Horizon and a thick bed of dolomitic limestone occurs between the Main Yampire and the Intermediate Series.

Mr. J. Young's sampling of the Main Yampire Series gave an average of 4.59 inches of fibre over a vertical height of 8'6" for an outcrop length of 4,760 feet. The best exposures occur in the old workings on the eastern side of the gorge where 3,210 feet sampled

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averaged 4.9 inches over 9 feet. The west wall gave 3.67 inches over 8 to 9 feet for a sampled length of 1,550 feet. These results were checked by Mr. J. Shanahan.

(iv) Dale's Gorge

Located about 9 miles east of Yampire Gorge, the fibre occurrences in Dale's Gorge extend over a length of one and a half miles and present some contrasting features. Two definite dolomite beds, each from 6 to 10 inches thick, may be seen in the cliff faces. These are 20 feet apart and the following asbestos seams are associated with them:-

(a) The Top Seam, 10 feet above the upper dolomite bed and containing from 1.2 to 1.5 inches of fibre.

(b) Mahlberg's Seam 15 feet below the upper dolomite and containing from 0.5 to 2.5 inches.

(c) The Main Bottom Seam, 10 feet below the lower dolomite, with 0.5 to 1.5 inches,

and

(d) A small seam known as the "Stringer" 7.5 feet below the lower dolomite.

All of these are mainly single seams which were benched by prospecting parties in a search for long fibre. *Fig.* 3 illustrates their occurrence. Their immediate importance is limited.

(v) Marramamba

These deposits are described by J.S. Foxall in W.A.G.S. Bulletin 100. Outcrops of fibre occur at intervals along a range of low hills, trending approximately east and west, and cover a total length of about 9.5 miles.

At the western end, the crocidolite formation is reported to be 7 feet thick with an aggregate of 6 inches of fibre in seams from 0.12 to 1.0 inches. It is lenticular in habit and the beds dip east into a hillside at 15°.

From four to six miles east of the above two horizons have been exposed of which the upper carries from 2 to 3 inches of fibre and the lower about 2 inches in two seams. These are about 20 feet apart stratigraphically and dip north-east at 25°.

One mile further east there is a cliff face outcrop showing 9 to 10.5 inches over 8 to 8.5 feet, the dip being 10° north-east.

About two miles south-east, on M.C. 201 H, fibre with an aggregate length of 4.5 inches occurs in a formation three feet wide. The dip is east or north-east.

Unfortunately little is known of the stratigraphic association at Marramamba.

There has been no opportunity to examine the Marramamba leases or to make any assessment of their aggregate potential. Foxall's description of them presents an attractive picture as to width of fibre over a given vertical range in the exposures he examined. However, it is not known whether linear continuity can be established such as would be necessary for a continuous mining operation. The only course open at present is to map and check sample the various outcrops and workings and carry out such initial test work as may be necessary to establish continuity.

Summary

Summarising the overall position in relation to ore prospects, mill and townsite location, access facilities and in the light of current knowledge, I would place the priority of investigational work and drilling as under:-

(i) Consolidation of the Wittenoom-Colonial area by extending geological mapping and drilling west of the Colonial Mine and south of the Wittenoom Mine.

(ii) Structural mapping and some preliminary drilling of the Main Yampire Series, i.e. the lower fibre occurrences, and

(iii) Investigation of the Marramamba area with a view to establishing structural continuity and layout of a preliminary test programme.

A good deal of progress has been made with the geological programme, check sampling, preparation of assay plans and the establishment of the precise stratigraphic succession in the mine environment but the demands of the drilling programme have limited the time available for detailed field mapping and the most pressing need at present is to try and establish by structure contour mapping, or other line of attack, the factors controlling distribution of the better grade fibre zones and to establish a technique for delineating them.

References:

Finucane K J., 1939. The Blue Asbestos Deposits of the Hamersley Ranges. A.G.G. Survey of Northern Australia Report Western Australia No. 49.

Hall, A.L., 1912. Asbestos in the Union of South Africa. Geol. Survey Union of South Africa Memoir 12.

Miles K.R. and Foxall J.S., 1942. W.A. Geol. Surv. Bulletin 100. The Blue Asbestos Bearing Banded Iron Formations of the Hamersley Ranges and The Blue Asbestos Deposits of the Hamersley Range and Their Economic Importance with appendices by F.G. Forman (1937) and J.S. Foxall (1938).

APPENDIX I

(to Chapter 6)

AUSTRALIAN BLUE ASBESTOS PTY. LTD.

Fibre Production

Year Ended	Ore Long Tons	Fibre therefrom Long Tons	%
Dec. 1946	6,567	601.82	9.2
1947	14,406	895.10	6.2
1948	13,296	759.07	5.7
1949	18,477	993.75	5.4
1950	20,756	1031.58	5.0

Note: Some hand sorting 1948-1950.

Year Ended	Ore Short Tons	Fibre therefrom Short Tons	%
Dec. 1951	42,015	1,398.98	3.3
1952	97,076	3,133.34	3.2
1953	130,805	4,253.97	3.3
1954	126,374	4,248.92	3.4
1955	89,610	4,845.67	5.4
1956	124,611	8,160.34	6.5
1957	184,906	12,222.19	6.6
1958	212,896	13,313.57	6.3
1959	277,180	16,416.65	5.9
1960	262,400	14,472.22	5.5
1961	295,878	15,777.00	5.3
To June 1962	152,264	7,844.78	5.2

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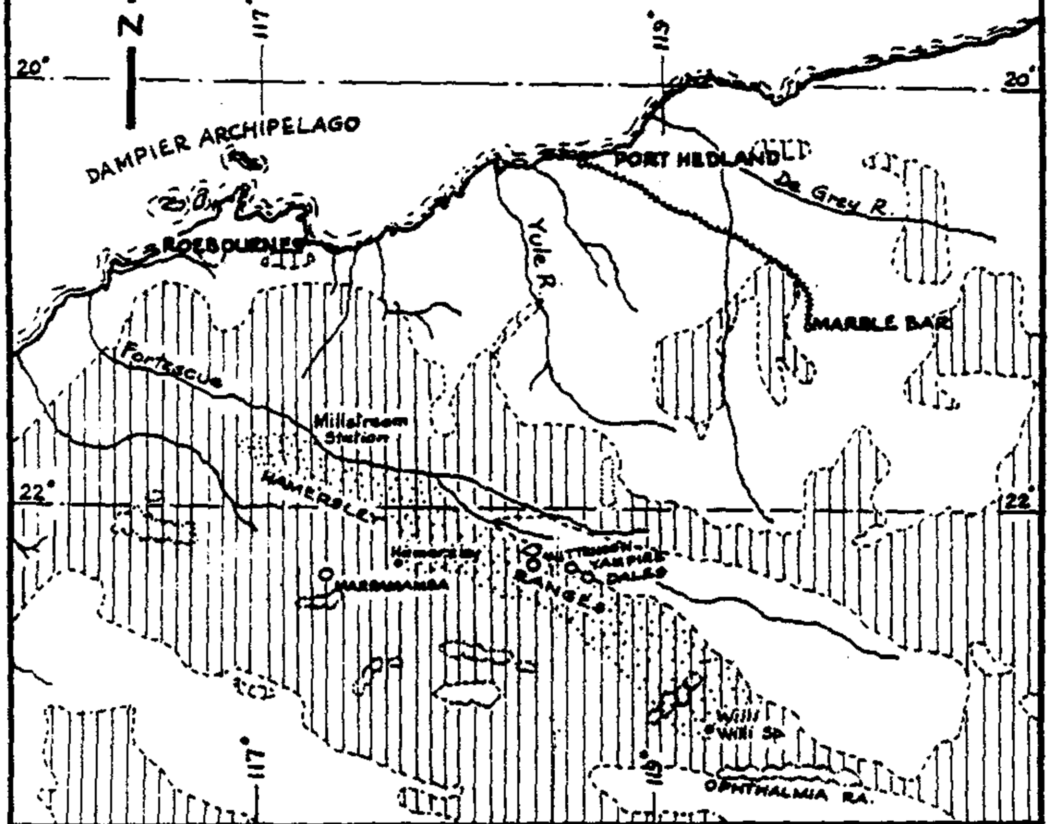
CHART Nº 12



— LEGEND —

Crocidolite Belt

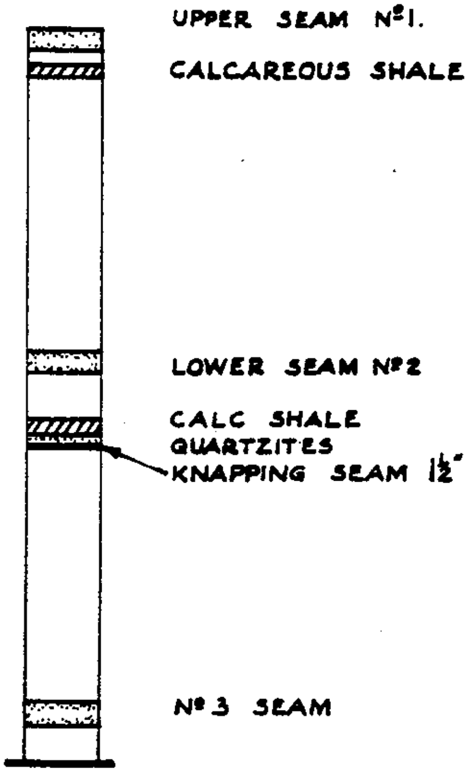
Areas occupied by Rocks of Nullagine Age

LOCALITY MAP

SHOWING DISTRIBUTION OF CROCIDOLITE

SCALE IN MILES

50 0 50 100



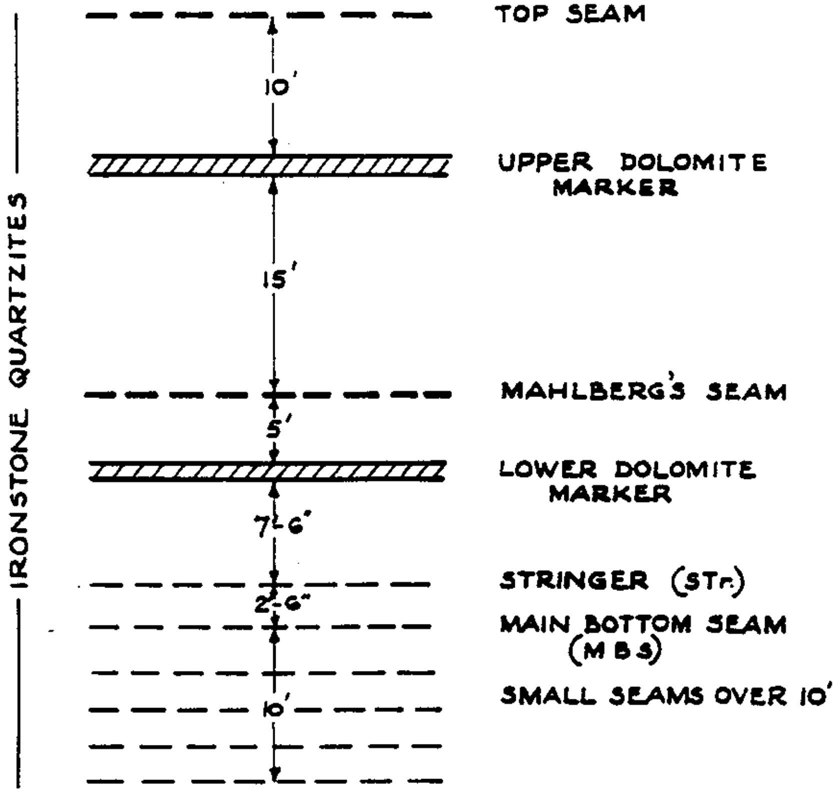
VERTICAL SECTION
SHOWING OCCURRENCE OF CROCIDOLITE SEAMS
WITTENOOM GORGE

SCALE IN FEET
10 0 10 20

FIG. 2

C 4304

CHART N° 14



VERTICAL SECTION
SHOWING OCCURRENCE OF CROCIDOLITE SEAMS
DALE'S GORGE

SCALE IN FEET.

10 0 10 20

C 4305

FIG. 3.

Chapter 7

Description of mining operations

A. Introduction

Two seams of blue asbestos, each aggregating 2 in. to 3 in. of fibre, outcrop high on the side of the Colonial Gorge wall.

The main mine development work is planned to enable both seams to be worked simultaneously where the grade of ore warrants this. The dip of the seams is in the order of 8 degrees and a main adit, 16 ft. wide, has been driven into the cliff face on the dip and under the lower seam. Twenty feet above the main adit, 9 ft. by 7 ft. haulage drives at right angles to the main adit. Access is gained to the haulage drives of levels one to five, from the main adit by means of an incline, "(turn-out)", and man-ways and ore chutes are cut between the haulage drives and the ore bodies. Stopes are opened up to be worked to approximately 400 ft. by 300 ft.

On 6, 7 and 8 levels, however, access is by man-ways only from the incline or internal adits.

The fibre occurs in a formation approximately 18 in. thick and consequently any barren rock broken in access of 18 in. adds to the dilution of the ore. However, the minimum practical stope height is controlled to 38" to 42". Because of the stratified nature of the formation, the cleavage, both on the floor and back, is clean and smooth. Pillars amounting to 12 per cent. of the total area are left, at about 24 ft. centres and all other broken rock is taken to the treatment plant as ore. No support, other than the pillars has been necessary with the mining methods used so far.

Handling of the ore to chutes is by scraper haulers, recently assisted by small bulldozers, to the ore chutes to a train of Granby cars hauled by battery locomotives, which dump the ore into ore pockets, situated immediately over the main adit. "Ross" feeders control the flow of ore from the pockets onto a series of three 30 in. belt conveyors, which deliver the ore into a bin or "Pocket" from which another belt conveys it to the mill.

It is appropriate to record in this section that the original Wittenoom mine, about a mile away, after some fourteen years of operation entered a major fault area, in which "dead" or oxidised fibre was encountered and severely limited the number of working places from which suitable fibre could be won.

Outcrop assays and diamond drill results up to 1,000 ft. back from the cliff face had indicated that a richer zone of fibre existed in the Western section of Colonial Gorge and it was decided to develop the area to supplement ore taken from the Wittenoom mine.

As values in the Wittenoom mine deteriorated while those in the new Colonial Gorge development improved, a decision was taken to erect a new mill in Colonial Gorge. This was started up in June, 1958, using only one treatment line while the two crushing sections were designed and built to handle sufficient ore for three such treatment lines.

C 4307

The last deliveries of ore from the Wittenoom mine to the old Wittenoom mill were made in October, 1958. Colonial Gorge ore was delivered to Wittenoom until January, 1959, the ore being drawn by chute from the 1,500 ton ore bin and transported by lorry.

The second treatment leg came into operation on 7th January, 1959 at Colonial Mill and the third leg on 1st July, 1959.

The primary crushing section at Colonial Gorge commenced operations in June, 1958.

Secondary crushing and one treatment leg were commenced in July, 1958.

A road cut into the cliff face gives access to the so-called Mine Bench at an elevation of approximately 250 feet above the floor of the Gorge, which provides a platform on which are located the underground office, the mine store, change rooms, ambulance room, transformer station and Mine Bench Workshop. It also provides entrance to the mine adit in the cliff face, an opening 16 ft. wide and 7 ft. high, being the portal of a tunnel or adit or "drift" sloping downgrade at approximately 1 ft. in 12 ft. or about 8°, parallel to and underneath the two main fibre seams which themselves are parallel and about 21 ft. apart. Stratigraphically, they are referred to as the "Upper Seam" and the "Lower Seam".

B. Description of the workings

The mine essentially consists of four elevations:-

(i) The main adit or incline
(ii) The haulage levels
(iii) The lower seam stopes
(iv) The upper seam stopes.

(This is illustrated in Sketch No. 1, "Generalised section through the main incline", showing the position of working levels.)

Note: all sketches referred to are at the end of the chapter.

(i) The main adit

This is the main artery of the operations and provides for access to the workings; for the transport of broken ore and waste rock and for all services to the various sections of the mine.

This adit has been driven a total length of 3,000 ft. and is approximately parallel to the "dip" of the ore-body and is positioned

70 to 80 ft. below the Upper Seam horizon.

(Sketch No. 2 gives a "Typical cross-section view of the main adit".)

(ii) Haulage levels

These are spaced at 400 ft. centres along the main adit, (more or less at right angles to it).

These haulage-ways are excavated 9 ft. wide x 7 ft. high and are driven along the contours of the bedding planes to provide an acceptable grade for the tram-lines and an adequate amount of head room for ore storage "pockets" below the Upper and Lower Seams.

The primary function of these levels is for access and for the transport of broken ore from the working places or "stopes" to the ore transfer pockets located over the ore conveyor belt in the main incline.

Access to the haulage-ways from the main adit is gained by 1 ft. in 10 ft. grade "turn-outs" driven to the northern side of the Adit.

(Sketch No. 2A shows a "Typical cross section of a 9 ft. x 7 ft. haulage level".)

There are turn-outs at levels 1 to 5.

(The general impression is seen in Sketch No. 1A.)

(iii) Lower seam stopes

Access is gained into the stopes by man-ways placed at 300 ft. centres along the haulage level. Broken ore in the stopes is won by scraper hoists to a chute or pocket positioned 15 feet from the man-way, which is also adjacent to the haulage-way.

(iv) Upper seam stopes

Access and broken ore removal methods are the same as for the Lower Seam and utilise the same man-way and ore chute rises.

(Sketch No. 3 depicts the "Plan and sections of such a typical man-way and ore chute".)

C. Mine development system

(i) Main adit

From the full opening 16 ft. x 7 ft., a pilot drive 9 ft. wide x 7 ft. high is advanced 10 ft. ahead of a 7 ft. wide stripping face in the dip of the bedding planes as shown in Sketch No. 4: "Plan of main incline development method".

The equipment used in this work is:

2 Atlas BBC 23W(Lions) rockdrills using B.H.T. 51 airlegs and integral tungsten carbide tipped chisel bits.

1 - 35 h.p. Ingersoll Rand Double Drum Scraper Hoist and 4 ft. Box-type Scraper Hoe.

Shifts worked:	Day and night shifts.
Number of men:	3.
Length of round drilled:	5 ft. 3 ins.
Type of drive cut:	9 hole burn.
Advance per round including stripping:	5 ft.
Advance per 4 weeks:	90 to 100 ft.
No. of holes per round:	45 to 50.
Explosives:	AN/FO., A.N.60% primers, No. 6 detonators and safety fuse plus slow "Ignitercord".
Consumption of explosives:	18 lbs. per ft. advance.
Mucking operations:	Night shift. Scraping of broken muck by hauler unit over a ramp onto No. 3 underground conveyor belt. Mullock disposal is from the ore pocket at the commencement of day shift.
Working cycle:	Bore and fire on day shift and muck out operation on night shift.

(ii) Haulage Levels and adits

Adits are the inclined cross-cuts between haulage levels.

The normal size - 9 ft. x 7 ft.

The equipment used is:

1 Atlas BBC 23W (Lion) rockdrill with B.H.T. 51 air-leg.

Integral tungsten carbide steel chisel bits.

Eimco 12B mechanical loader of 20c.ft. capacity, also side tipping trucks, and a 7 ton Mancha battery-operated Hercules locomotive.

C 4310

The method of operation is:

Shifts worked	Day and afternoon shifts.
Number of men	3
Number of miners	1
Bogging crew	2, consisting of loco-driver and a mechanical loader operator.
Length of round drilled	5'3 ins.
Type of cut	9 hole burn.
Advance per round	4'6 ins.
Advance per 4 weeks	75 to 90 ft.
Number of holes per round	32 to 34.
Explosives	AN/FO., A.N. 60% primer, No. 6 detonators, safety fuse, "slow Ignitercord".
Consumption	12 lbs. per foot advance.
Working cycle	Bore and fire on one shift and muck out the next shift.

(iii) Rises

Normal size	7 ft. x 5 ft.		
Equipment	Atlas BBD 46 W.S.8 (Falcon) stoper.		
	Integral tungsten carbide steel chisel bits.		
	8 in. x $1\frac{1}{2}$ in. staging and 4 in. x 4 in. bearers on bearer pins.		
Operation	Shifts worked	-	Day or afternoon.
	Number of men per shift	-	1
	Number of rock drills	-	1
	Length of round drilled	-	5 ft. 3 ins.
	Type of cut	-	6 or 7 hole burn.
	Number of holes per round	-	26
	Feed advance per shift	-	2 ft. 6 ins.
	Explosives	-	as for haulage levels.
	Consumption	-	9 lbs. per ft. of advance.

D. Stope preparation system

Initially, two rises: i.e. a man-way and an ore chute, are excavated, 15 feet apart and a connecting drive, 6 ft. x 5 ft. is then advanced in the Upper Seam from the man-way, across to the chute. This connection is then stripped out to a height of 6 ft. and a width of 12 ft. around the chute to allow sufficient space for the installation of a scraper-hauler unit. Stope preparations (or drives) are then commenced in eastward and westward directions towards adjacent haulage levels, in the plane of the seams.

These stope preparation headings primarily serve a threefold purpose:-

(i) Ventilation by inter-connection between stopes of adjacent levels.

(ii) Evaluation of fibre content of a block of ore.

(iii) Drainage of drilling water from the stoping operations.

Two systems of advancing preparation headings are used:

(i) 6 ft. x 5 ft. drive for rapid advance.

(ii) 24 ft. wide. 40 ins. high heading for production purposes.

(See Sketch No. 5: "Typical stope preparation layout".)

E. Ore breaking

(i) Method

Bord and pillar mining at an average stope height of 40 ins. is used for the extraction of the fibre seams.

Both seams are stoped where the grade of ore warrants it. Commencing initially from the preparation headings 10 ft. x 10 ft. pillars, 24 ft. apart are left behind as 24 ft. "flitches" are advanced. Each miner works two or three "flitches" (approximately 100 ft. for three faces) depending on the individual ability and the working area available. Miners are so placed to avoid broken ore being thrown into areas in which the following shift miners are to work.

(ii) Tools in use

C 4312

Equipment in use is 1 Holman "Silver Three" rockdrill and air leg per miner, using integral tungsten carbide steel chisel bits.

The broken ore is recovered by, 15 to 25 h.p. double-drum, electric scraper hoists, the size depending on the distance the broken ore has to be scraped.

The rope used is 1-5/8" circumference 6 x 9 x 9 x 1 preformed Langslay hemp core wire rope.

36" or 48" box type hoes with replaceable manganese wear plates and

8" diameter sheave blocks are used.

Drilling:	Miners per rock drill	-	1
	Maximum number of miners per stope	-	4
	Maximum number of miners per shift per stope	-	2
	Shifts worked - day and afternoon shifts	-	Nil
	Length of hole drilled	-	5'3" or 5'11".
	Average holes drilled per shift	-	22
	Average ore broken per hole	-	0.57 sq. yds.
Blasting:	Explosives used: A N /F O., A.N. 60% primer.		
	No. 6 detonator, safety fuse.		
	Consumption	-	1.1 lbs. per ton
	Working cycle	-	Bore and fire on day shift or after-noon shift, with th scraping operatior on the opposite sh

(Refer to sketch No. 6 for a "Typical layout of working faces" (four miners).

(iii) Ore transport

(a) From the face

Broken ore at the face is initially mucked (hand shovelled) back and then hauled by the scraper units to the ore chute. One or two men can handle the production of two miners, but this is dependent on individual ability and the scraper distances involved at the time.

C 4313

(Sketch No. 7 is a line "Diagram of ore removal" from the face to the mill.)

(b) Ore haulage

Broken ore from the chutes is loaded into rakes of 5 66 cu.ft. or 100 cu. ft. bottom dumping Granby cars, hauled by either a 5 ton or 7 ton storage battery locomotive to the ore transfer pockets.

The broken ore in the Granby cars is emptied by an automatic tipping device positioned opposite the level transfer.

(c) Grizzly

Broken rock is spalled through 14 in. x 10 in. openings on a grid grizzly located over the ore transfer chute or pocket.

The purpose of the grid grizzly is to control the size of the larger rocks and thus reduce the extent of the subsequent damage and wear and tear of ore chutes and the ore conveyor belts.

(iv) Main ore conveyor belts

The broken ore is fed from the transfer pockets to the conveyor belts by means of steel chutes equipped with Ross Feeders. These feeders are essentially a slowly rotating curtain of 1½" or 2" stud link chains designed to control the rate of flow or "rill" of the ore onto the conveyor belt.

There are three 30 in. conveyor belts in series and they deliver the ore to the main mine pocket which is located above a tunnel about 100 ft. long, which emerges at the cliff face above the treatment plant.

Some details of the belts are:

BELT	LENGTH	SPEEDS	MOTORS
No. 1 conveyor	1,100 feet	300 ft. per min.	60 h.p. A.E.I.
No. 2 conveyor	1,300 feet	420 ft. per min.	60 h.p. A.E.I.
No. 3 conveyor	400 feet	420 ft. per min.	20 h.p. A.E.I.

The belting is 30 in. wide, 6 ply cotton nylon fibre CN50.

Capacity: Maximum 240 tons per hour. (This is controlled by No. 1 conveyor, currently being operated with a relatively slow reduction gear).

Ross Feeders:

Chute width	:	24 inches
Height from belt	:	13 inches
Chain links	:	12" x 6" x 1¾"
Drum speed	:	7 r.p.m.
Angle of chute	:	50°

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(v) Waste removal

Muck from development ends is hauled by locomotive and 20 cu. ft. capacity side tipping trucks to mullock passes, opposite the ore transfer pockets. The muck is transported by the main conveyors to the mine ore pocket which has been previously emptied, and conveyed by the mill No. 1 conveyor belt and discharged through a by-pass chute for disposal by motor truck.

F. Equipment and services

(i) Main mining equipment:

a) Rock drills

Type	Number in use	Task
Atlas BBC 23 W	11	Development
Atlas BBD 64 W.S.8.	5	Rising
Atlas BBD 43	2	Stoping
Holman Silver Three	45	Stoping

b) Drill steel

Coromant C.L. 426	714-1633	(5'3") Development and stoping.
Coromant C.L. 426	714-1833	(5'11") Stoping
Width of insert -	33 m.m.	
Average drill steel life-	240 feet.	

c) Drill sharpening

Grinders: 2 x Sandvik Coromant 1400.
One - air driven reserve.
One - electric - in use.
Air motor - 3300 r.p.m.
Electric motor - 2800 r.p.m.

d) Grinding wheels for drill steel

Type used: "Cup wheel" 37 - C46 -K.V.K.
Average number of steel grinds per wheel - 35
Average number of steel sharpened daily - 220

e) Fans:

Primary ventilation

1 Richardson 60 A.F. fan driven by a 50 h.p. motor at 720 r.p.m. It exhausts 72,000 c.f.m. at 1.25 ins. water gauge.
1 Richardson 60 V.A.C. fan driven by a 50 h.p. motor at 960 r.p.m. It exhausts 74,000 c.f.m. at 0.8 ins. water gauge.

Secondary ventilation

17 x Meco E.F. 4 fans.	Output	5000 - 6000	c.f.m.
2 x Meco E.F. 6 fans.	"	12000 - 13000	c.f.m.
8 x Richardson 2D fans.	"	1500 - 2000	c.f.m.
4 x Richardson 2½ SD fans.	"	5000 - 6000	c.f.m.
4 x Richardson 4 SD fans.	"	7000 - 8000	c.f.m.
4 x Richardson 3D fans.	"	6000	c.f.m.

Ventilation ducting

10 in. x 16 in. canvas ducting - in the stopes.
18 in. "Visqueen" and 16 in. canvas ducting - to development ends.

f) Cars and trucks

8 - 100 cu. ft. (Bottom dump type) - Granby.
12 - 66 cu. ft. " " " - "
28 - 20 cu. ft. Side tipping trucks.

g) Mechanical loaders

6 - Eimco 12 B. "Boggers" or loaders powered by 2 x 10 h.p. air motors. Bucket capacity is 3½ cu. ft.

h) Scraper hoist units

1. 14-Joy type N211.

   25 h.p. double drum scraper haulers.
   Rope speed: 250 ft. per minute.
   Rope pull : 4,600 lbs.
   Drum capacity: 408 ft. 9/16" loose coiled rope.

2. 9-Joy type J211.

   15 h.p. double drum scraper haulers.
   Rope speed: 250 ft. per minute.
   Rope pull: 1,800 lbs.
   Drum capacity: 154 ft. 9/16" loose coiled rope.

3. 2-Joy type B2F 311.

   30 h.p. triple drum scraper hoists.
   (Note: only two of the drums are operated)
   Adaptable for remote or manual control.
   Rope speed: 300 ft. per minute.

4. 4-Holman type SJ 23/236.

   25 h.p. double drum scraper haulers.
   Adaptable for remote or manual control.
   Rope speed: 190 - 360 ft. per minute.
   Rope pull: 3,840 lbs.
   Drum capacity: 280 ft. 9/16" loose coiled rope.

C 4316

5. 1-Ingersoll Rand.

   35 h.p. double drum scraper hauler.
   Capacity: 650 ft. 9/16" loose coiled rope.

6. Scraper hoes.

4 ft. wide box type. Capacity 15 cwt.
3 ft. wide box type. Capacity 6-8 cwt.
Both types of hoes are fitted with replaceable manganese wear plates.

j) Tractor-dozers

2 x Eimco 630 bulldozers powered by 2 -12 h.p. and 1 - 7½ h.p. compressed air motors. Weight 7,980 lbs.
1 x Alimak Alirobot bulldozer powered by 1 - 8½ h.p. air motor. Weight 3,850 lbs. (The use of these machines is being developed to simplify the scraping operations. Their function would be to push the broken ore to the fixed lines along which the scrapers operate).

k) Scraper rope

1-5/8" circumference 6 x 9 x 9 x 1 hemp core preformed Langslay wire rope.

l) Pumps

2 x Consolidated pneumatic type C.P. 41.
Discharge: 100 gallons per minute against 40 ft. static head. Used for pumping drainage water from development ends and stope headings.
1 x Holman sludge pump. Static head 50 ft.
Discharge: 35 gallons per minute.
1 x Worthington (type W.S.)

m) Haulage-way tracks

Rails are 24 ft. and 30 ft. lengths and 45 lbs. per yard. Sleepers are 4ft. - 6 ins. x 4 ins. muiga.

G. Electrical services

(i) Change rooms and cap lamp room

There are 3 - 110V - 3 phase rectifiers for cap lamp racks.

(ii) Cap lamps

These are 4.5 volt Edison electric cap lamps. Model L.

(iii) Underground belt conveyors

Numbers 1 and 2 conveyor belts are driven by 60 h.p. 440V motors started by direct-on-line starters. Number 3 belt is driven by a 20 h.p. - 440V motor started by a star-delta starter.

(iv) Ross feeders

C 4317

The feeders are controlled by D.O.L. starters and the three conveyors and the feeders are interlocked. These feeders have 3 h.p. 1440 r.p.m., - 440V motors driven through reduction gears.

The remaining feeders (at No. 8 level), have the same interlocking system with 3 h.p. 710 r.p.m. - 440V motors transmitting through reduction gears.

(v) Main exhaust fans

These are driven by 50 h.p. motors controlled by auto-transformer starters.

(vi) Secondary ventilation

This is provided by two main types of fans using various h.p. motors.

(vii) Hauler units

These are driven by 35 h.p., 25 h.p. and 15 h.p. - 440V motors controlled by D.O.L. O.J. 50 starters.

(viii) Richardson fans

These are driven by 440V motors and range from 3 to 25 h.p.

(ix) Meco fans

These are driven by 5 and 10 h.p. motors all D.O.L. started.

Power at the Mine Bench is supplied through a 500 kVA transformer stepping down 11,000V to 440V.

The supply is controlled by a 600 amp oil circuit breaker, for the bench supply and Nos. 1 and 2 underground conveyors and for Nos. 1 and 2 loco charging stations.

(x) Underground supply

An 11,000V feed cable runs underground to a sub-station at No. 5 level. From this position a 500 kVA transformer provides power at 440V to Nos. 5, 6, 7 and 8 levels.

Nos. 5 and 6 levels are protected by a 600 amp oil circuit breaker with 300 amp H.R.C. fuses for each level.

Nos. 7 and 8 levels are protected by a 400 amp oil circuit breaker with a 300 amp H.R.C. fuse for each level.

(xi) Locomotives

3 x Mancha type Hercules M.B.1. Rating 7 tons. h.p. 30.
6 x Batteries boxes - battery type 48K.A. 33/2. Each box consists of 12 batteries of 4 cells each. Make: Exide lead acid Kathanode cells. Capacity 512 amp-hours.
1 x English Electric. Type 1A.
2 x Battery boxes - type 48KCL. 19/2. Capacity 378 amp-hours. Group - 6 batteries of 8 cells each to a box.

(xii) Charging

Rectifiers: 3 x Westinghouse. Type B.V.J. 48/100 A.C. input 415V. No. of cells 48.
Charging rate:- Main starting current 103 amps, finishing current 21 amps, equalising at 14 amps.
1 x Lancashire D.C. Generator 110V, 120 amps driven by a 25 h.p. 3 Brook motor at 1460 r.p.m.
1 x English Electric D.C. Generator 110V, 72 amps.

H. Underground staff and training

(i) Underground staff

underground manager
mine foreman
chief surveyor
mine surveyor
geologist
technical officer
6 underground shift bosses
storeman/first aid officer.

(ii) Underground labour

stope miners	35
development miners	12
bogging crews	8
loco crews	10
belt crew	3
grizzly-men	6
platelayers	3
pipefitters	2
survey assistants	2
sampler	1
underground clerk	1
steel sharpeners	1
ventilation	2
magazine	3
"toolie"	1
hygiene	2
cap lamp attendant	1
timbermen	4
welders	3
fitters	4
fitters' assistants	2
electrical	4
electrical apprentice	1
	116

C 4319

(iii) Training

Experienced labour underground has always been difficult to obtain. This is accentuated when increases in production are required or sustained high production rates demanded.

Two methods of training are employed:-

a) After a short familiarization period underground the new men attend a miner or scraperman school depending on where their aptitude lies. Safety, and the requirements of the Mines Regulation Act are especially emphasized.

b) In some instances selected recruits are put to work with trusted and experienced miners or scraper men.

Good results have been obtained by applying both methods of training.

I. Ventilation

The mine is ventilated by two large Richardson exhaust fans, which deliver all intake air down-cast through the main incline. The air is delivered along the various haulage levels from the incline, through service rises and thence through the stopes and back to the exhaust fans, positioned on No. 4 level, exhausting to the cliff face, also up the rise to Colonial Gorge by an exhaust fan located at the southern end of No. 5 level.

The total intake has been measured as 103,000 c.f.m. and the exhaust at 146,000 c.f.m., the difference being due to air leakages into the mine.

Secondary ventilation for development and for the stopes is provided by electrically driven Meco fans of 12 in. or 16 in. diameter and by a variety of Richardson fans, depending on the requirements of the local area. The air is delivered to the working faces through plastic or canvas ducting of 10 in., 16 in. or 18 in. diameter.

J. Addendum

(i) Development of the use of ammonium nitrate - carbon mixtures in place of conventional jellied ammonium nitrate explosives.

Traditionally jellied explosives, consisting of ammonium nitrate crystals in grease-proof paper wrapped cartridges, have been used in mining operations.

About seven years ago changes, initiated overseas, were experimented with in Australia. These changes were basically the use of ammonium nitrate crystals, in powder and pelletised form, mixed with fuel oil, raw sugar or molasses.

The result of exploding a low propagation rate explosive (A.N., F.O. for example) in contact with a relatively high explosive (such as a nitro-glycerine-ammonium nitrate explosive) is to produce a nett explosive effect or propagation rate quantitatively more relative to the small amount of "high" explosive than to the low rate ammonium nitrate.

The ammonium nitrate crystals are mixed with fuel oil or sugar or molasses and delivered into the hole in contact with either detonating fuse and A.N. gelignite in quarries, or with commercial gelignite in the case of short underground holes.

The initial developments were made in "down" holes, i.e., vertical or inclined vertical holes in quarries but quite recent developments have been made in charging horizontal or inclined upward holes by the use of equipment such as "Analoaders" which assist the explosive mixture or slurry into the more-difficult-to-charge horizontal and "upper" holes.

The method used at present is to insert a standard plug or cartridge of A.N.60 gelignite in the bottom of the hole and to use a No. 6 detonator connected through safety fuse, the hole being charged with the A.N., F.O. mixture. In firing a face, the safety fuses are connected to a line of "Slow Ignitercord" to the end of which is connected a few feet of safety fuse.

This is lit using a fuse igniter and the succession of holes in the face is detonated thereby with relatively short interval delays between holes.

By using A.N./F.O. instead of traditional commercial explosives annual savings are expected to be to the order of not less than £30,000 per annum.

(ii) Gauge of drill steel

The introduction of A.N./F.O. has led to a reduction in drill steel diameter from 33 m.m. to 28 m.m. At this gauge, indicated increased rates of boring are up to 30 per cent and it looks like an increase of 10 per cent, or minimum increase from 20 to 22 holes bored per miner shift in the stoping operations.

(iii) Long wall mining experiments

The method of working the mine for many years past may be described as open stoping, leaving behind approximately ten per cent of the ore in the form of a symmetrical pattern of rock pillars to support the roof or "back".

At the best, this means that only 90 per cent of the extractable ore developed is won and the pillars present sizeable physical problems in the recovery of the ore broken because they foul scraper rope lines and entail time and money in rigging tail sheaves and "snatch" blocks and cause severe wear on scraper ropes and the scraper hoes.

A method developed for the not dissimilar winning of coal in a coal mine is the long wall system. Broadly, the ore (or coal) is attacked on a long face and the roof behind is either permanently supported by timber or allowed to collapse, under control and with safety.

In October, 1960 a long face was developed between the Nos. 2 and 3 levels on the Lower Seam and artificial baulks of old 30 lb. rails were "pig stied" to support the back. This development looked promising but was terminated by the "cave-in" caused by the earth tremor. However, valuable lessons were learned from this experience and related to the earth tremor experience.

Accordingly, the southern end of the No. 6 level was determined as the locale of the next stage of development and the assistance of people expert in long-wall techniques was enlisted, notably South Africans.

Prior to this, investigation of retrievable steel hydraulic props in place of static irretrievable baulks of timber, or steel had been given preliminary consideration as a means of controlled roof collapse and this will be a main feature of the present long wall project.

The use of hydraulic retrievable props is a sophisticated technique of quite high engineering standard, from a practical point of view. Because it is a sophisticated technique it demands sound engineering thinking in any new location or application.

C 4322. (This problem of stresses in rocks has been attacked by the Snowy Mountains Authority on a really big scale, in the investigation of the techniques of roof-bolting in tunnels and underground power house excavations).

However, a layout for the second stage experiment in long wall stoping is illustrated in the plan at the end of this chapter. The general principle is to provide on each flank of an advancing stope, a development and servicing drive amply supported and roof bolted, and a long wall of solid rock or adequate artificial supports to act as a barrier to stop any major roof collapse between stopes.

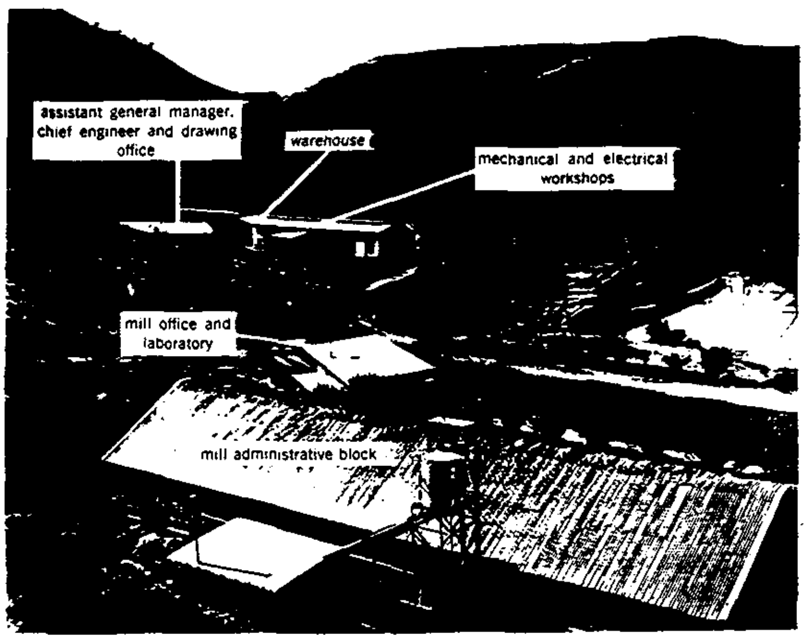
This drive is kept only a few feet in advance of the working face so that roof collapse control is kept more or less on straight lines behind and parallel to the working face.

The general principle of "propping" is to set up 3 lines of props, and in succession, as the face advances the rear row is retrieved to allow the roof to collapse and the retrieved row set up again in front of the foremost row as the face advance is made - a "leap frogging" exercise.

The technique will require continued close and highly-skilled full time study by some competent person.

It will be costly initially for the necessary number of hydraulic props and such ancillary equipment as strain and pressure gauges. The rewards could be 100 per cent extraction of the ore, reduction of the present stope preparation costs, and an improvement in face ventilation conditions.

A.B.A's blue asbestos mine at Wittenoom



View looking back from above mill administrative block (see top photo).

Underground operations

Granby cars tipping ore.

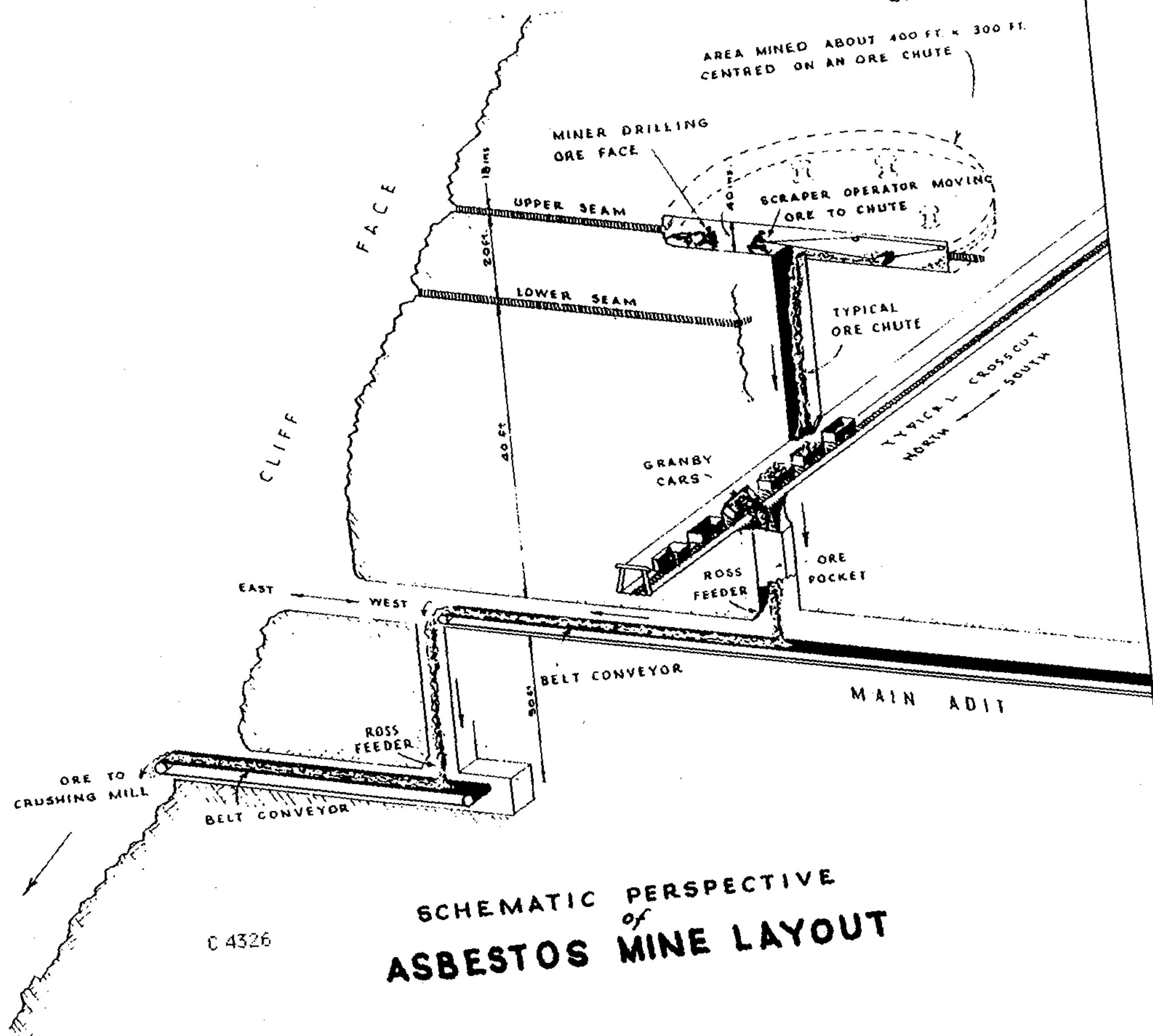
Operating a rock drill and air leg in a typical 40-inch-high stope.

Air-operated midget size Eimco bulldozer being operated by remote control.

"Ana-loading" holes with ammonium nitrate-fuel oil mixture. The close pattern of holes in the centre is a feature of the "burn cut" where the maximum explosive effort is applied. The surrounding holes are referred to as "easers"—they help to break the face cleanly to the required dimensions.

C 4325

CHART N° 15 A

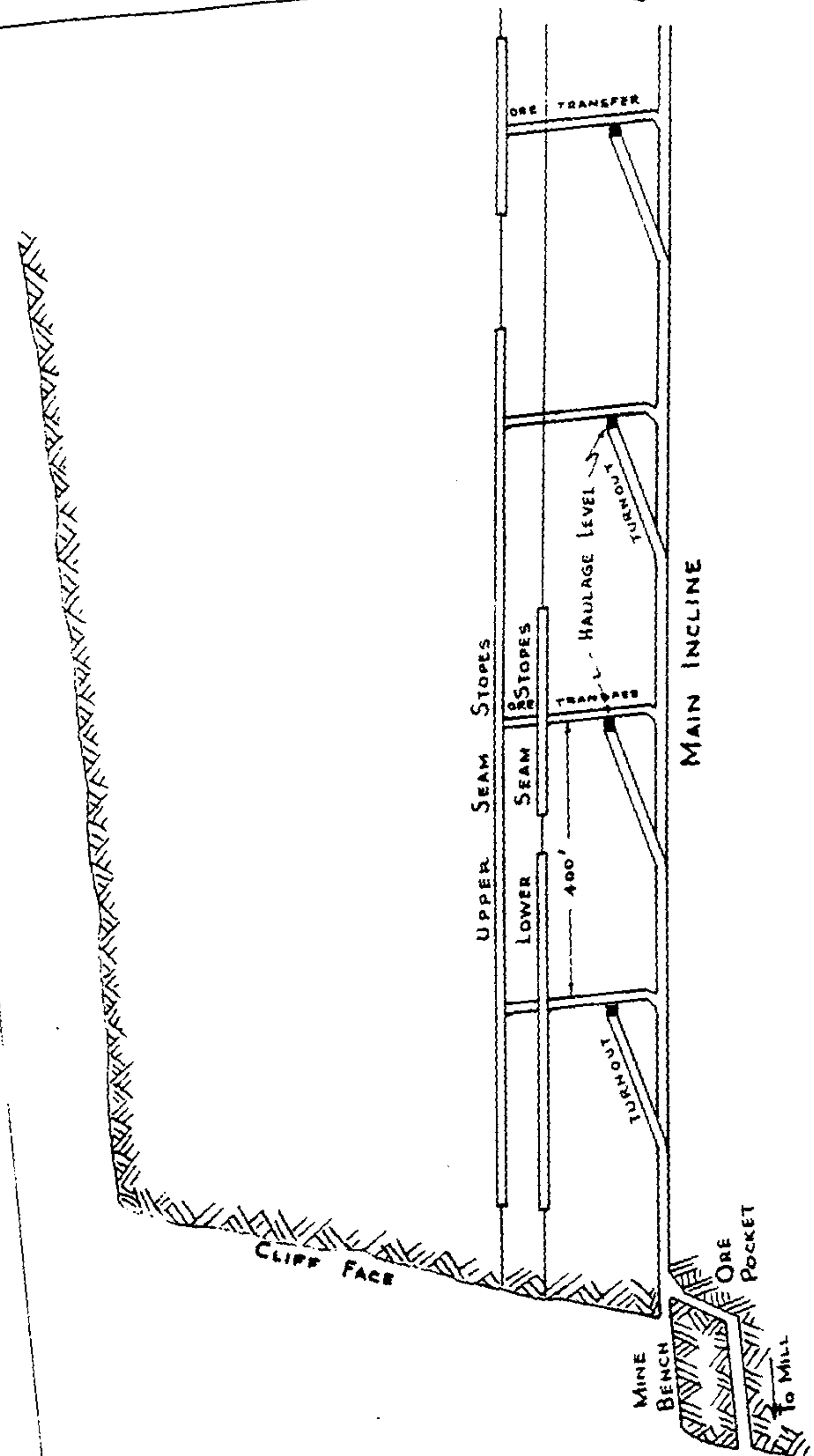


SCHEMATIC PERSPECTIVE of ASBESTOS MINE LAYOUT

C 4326

CHART NO 15

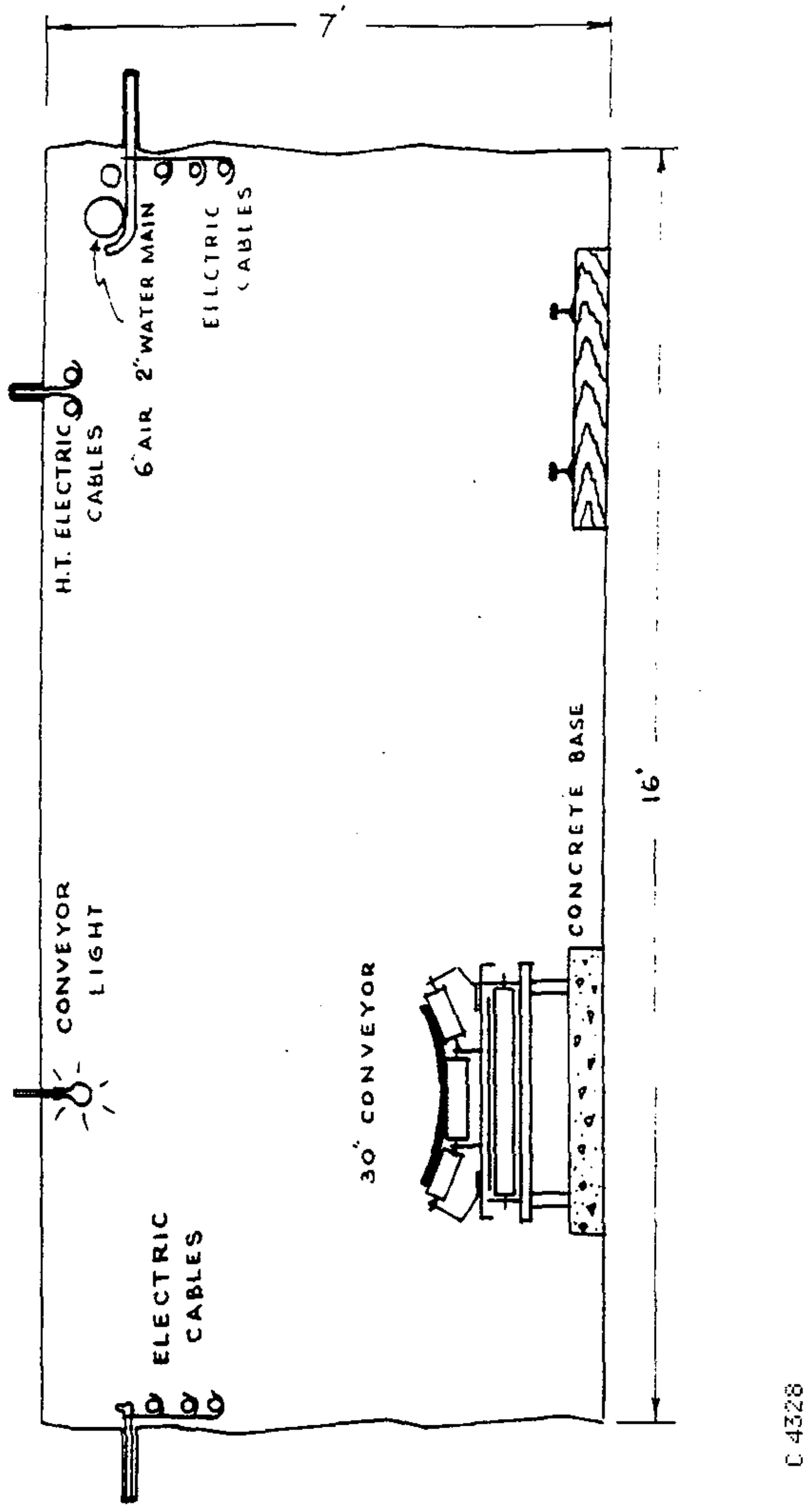
Sketch No 1



C 4327

Scale:	GENERALISED SECTION THROUGH

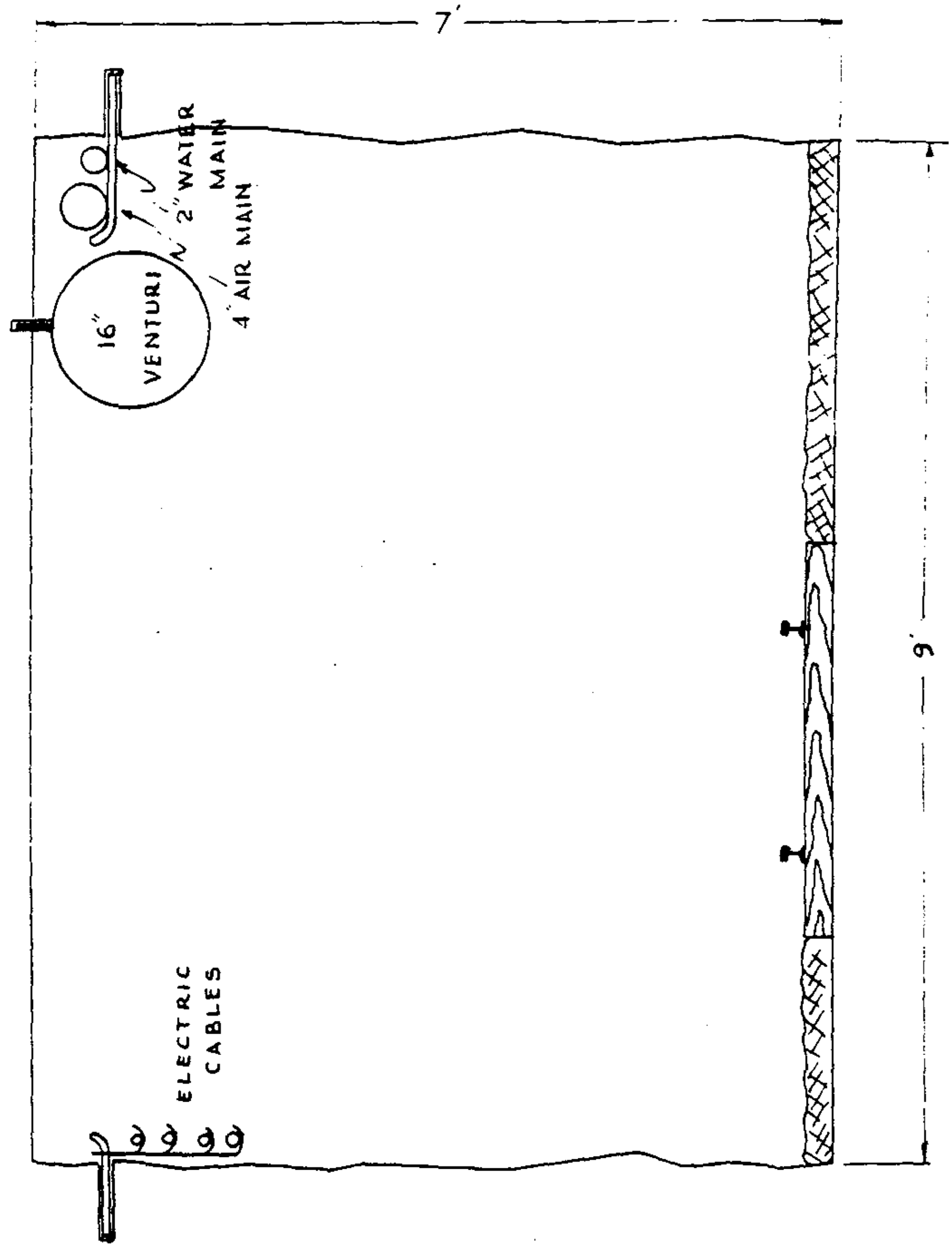
Sketch No. 2



Scale: Not To Scale	TYPICAL CROSS SECTION

CHART NO 17

Sketch No 2A



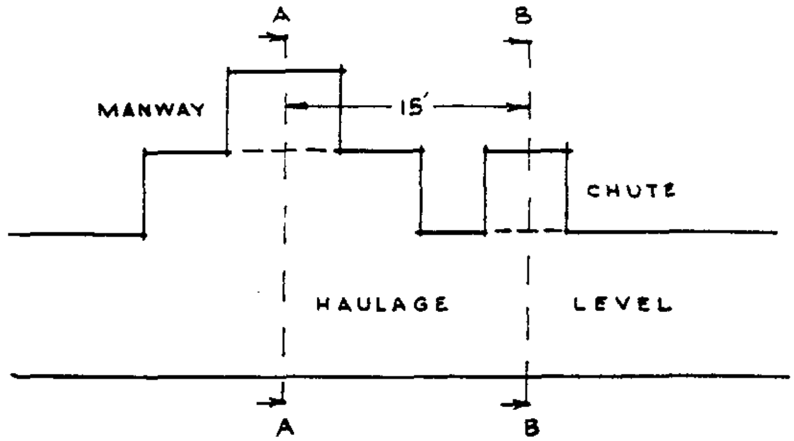
C 1329

Scale:

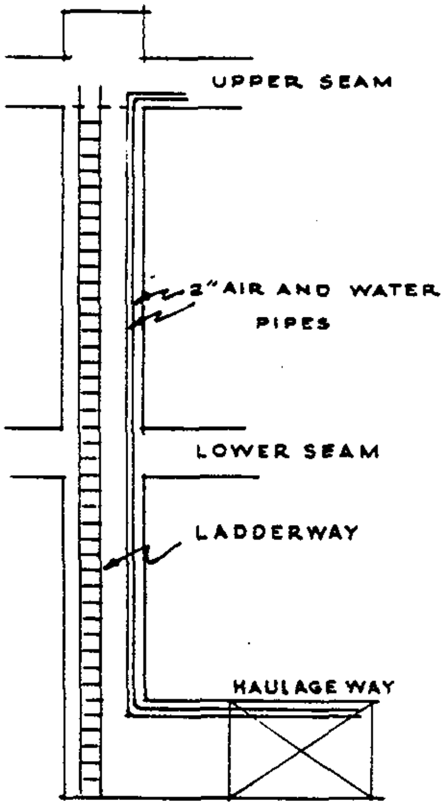
TYPICAL CROSS SECTION

CHART NO 18

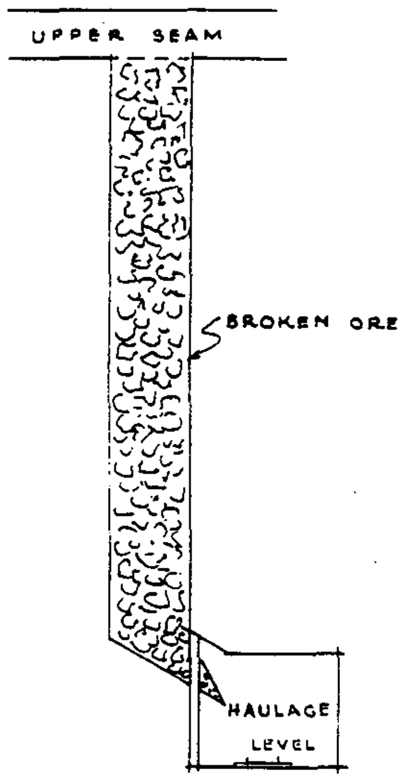
Sketch No. 3



PLAN



SECTION ON A-A
MANWAY



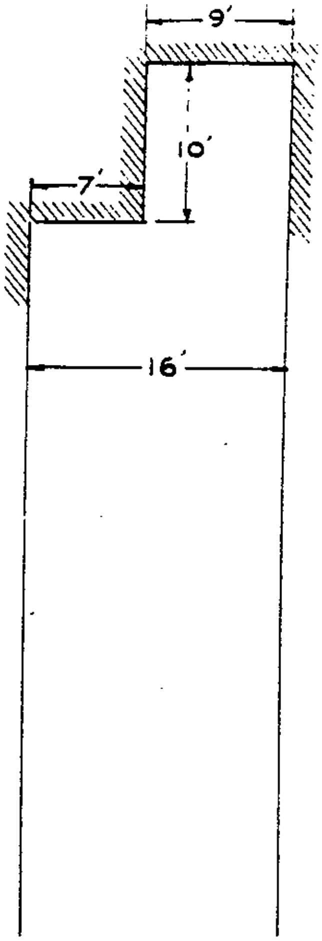
SECTION ON B-B
CHUTE

C 4330

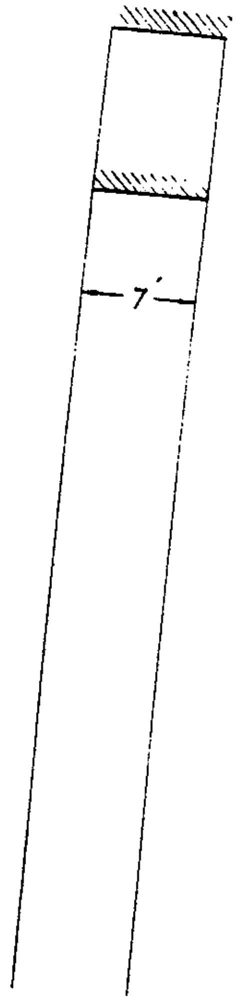
Scale:

PLAN AND SECTIONS OF A

Sketch No 4



PLAN



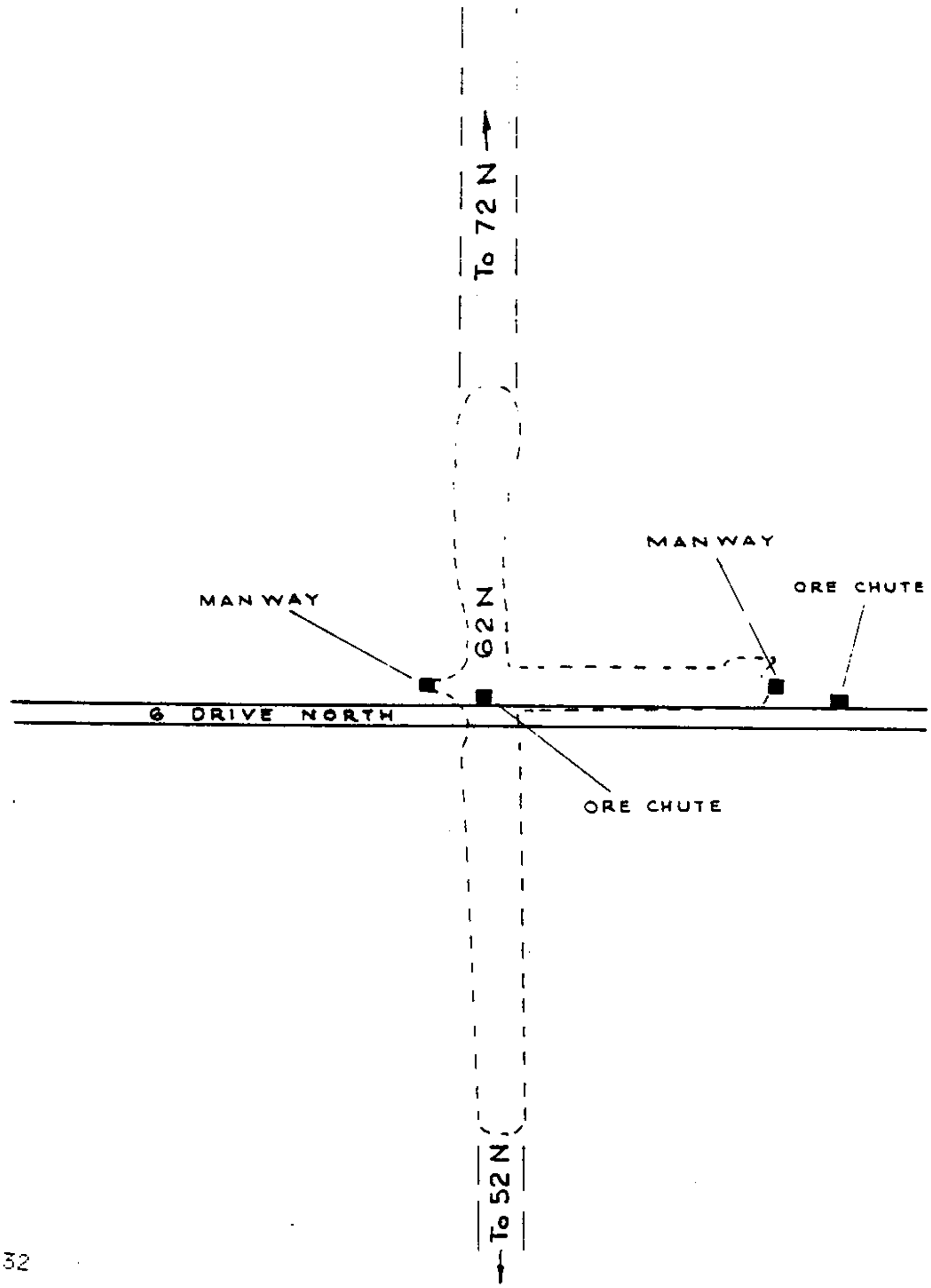
SECTION

C 4331

Scale:

CHART NO 20

Sketch No. 5

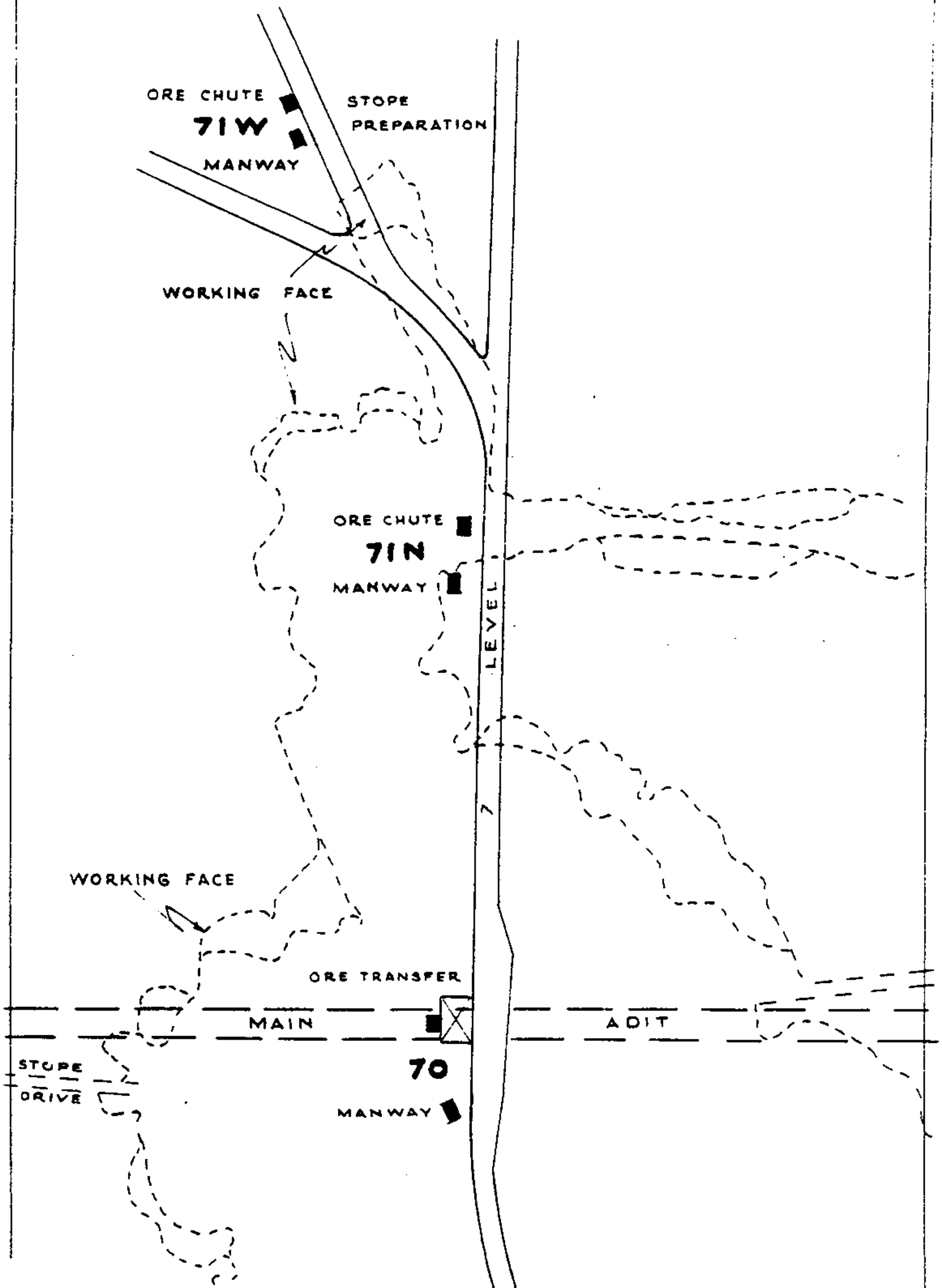


C 4332

Scale: 60 ft. to an inch	TYPICAL STOPE

CHART NO 21

Sketch No. 6

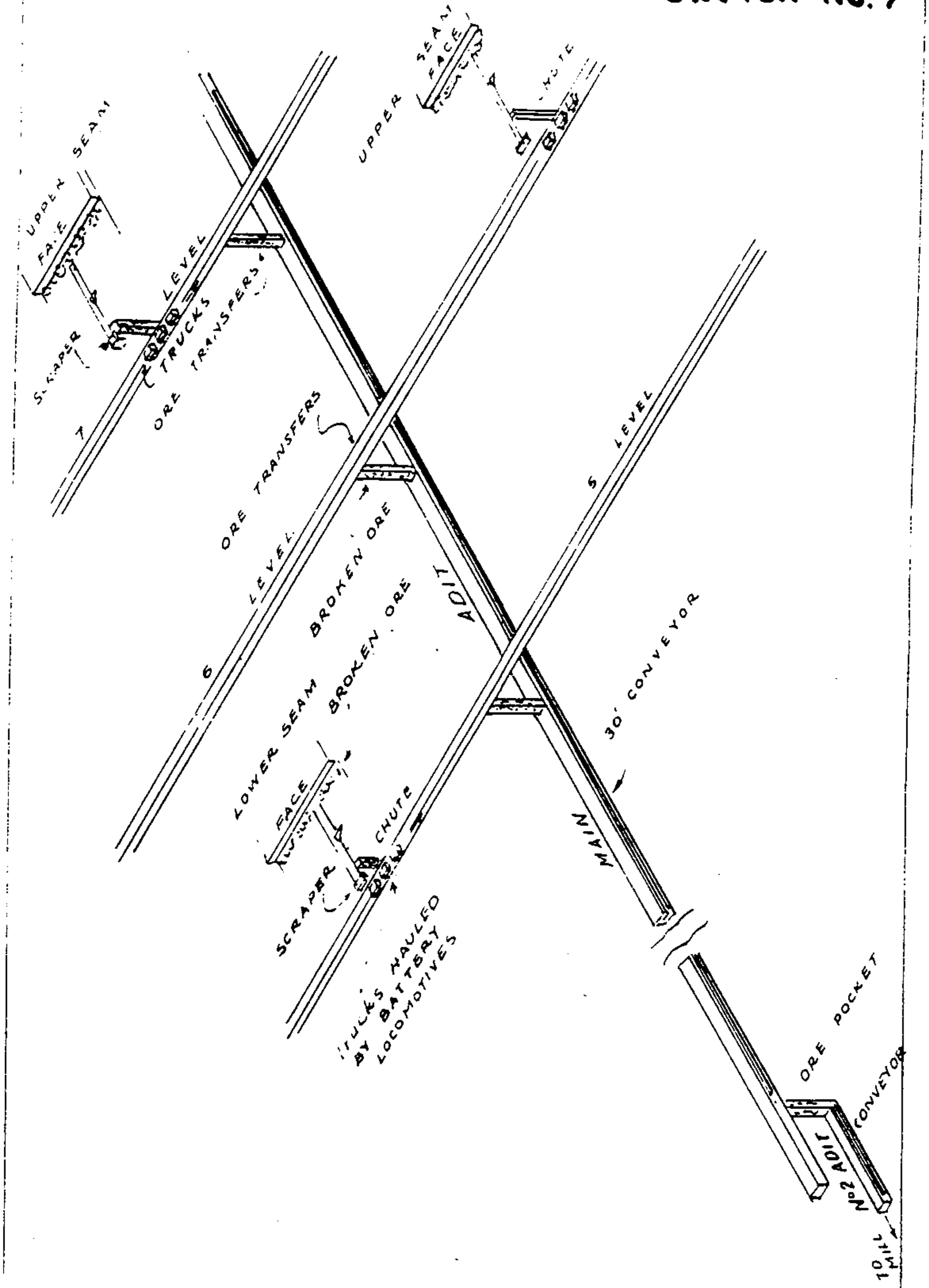


C 4333

Scale:

CHART NO 22

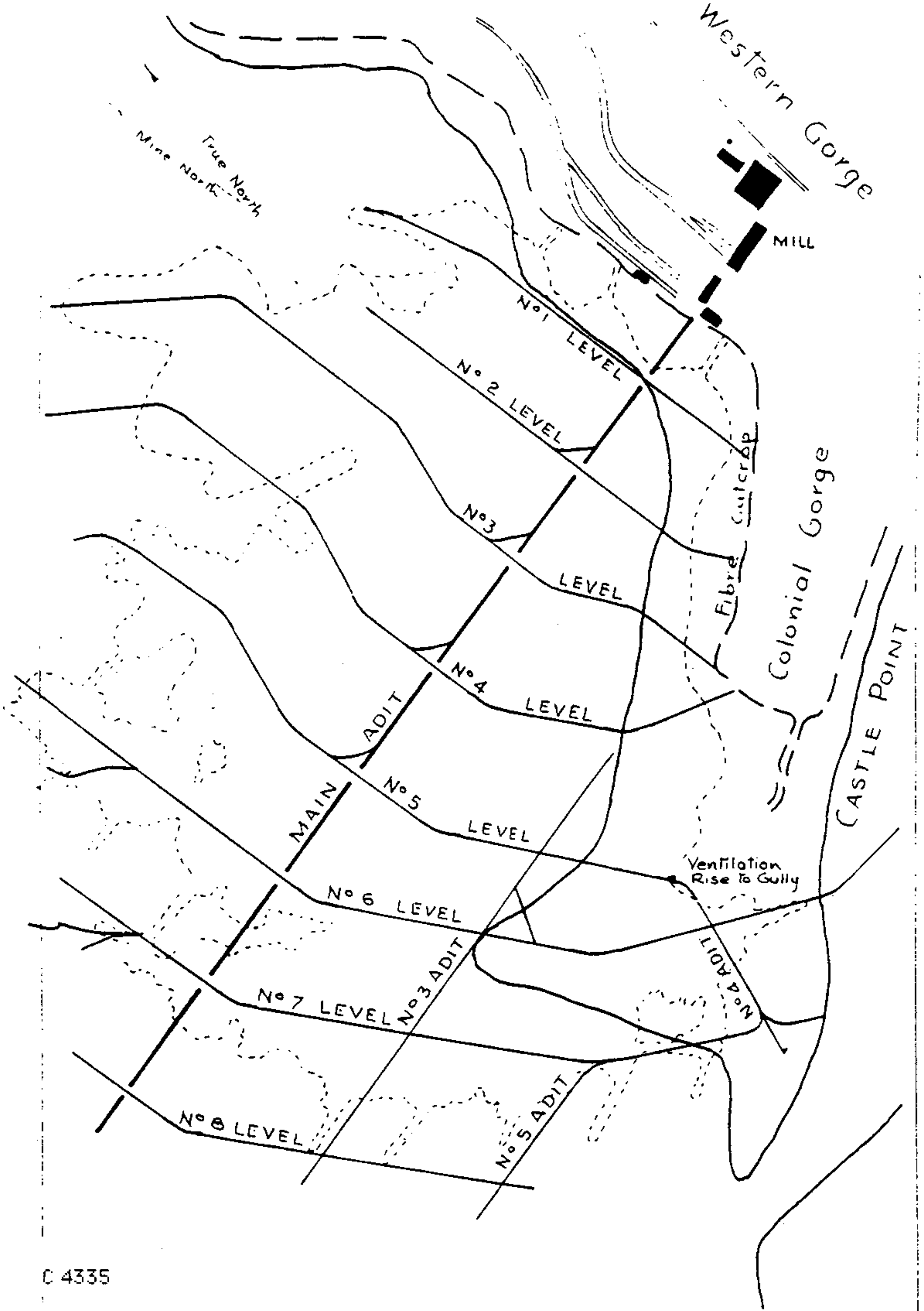
Sketch No. 7



C 4334

Scale :

Sketch No 8

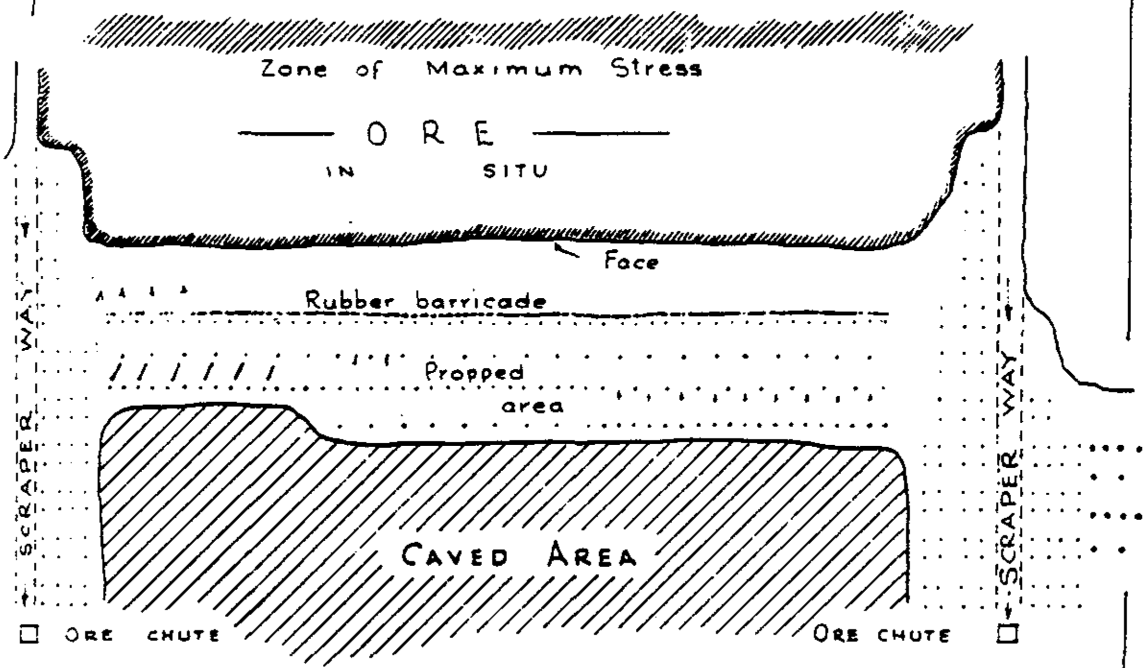


C 4335

Scale:

PLAN SHOWING EXTENT

CHART № 24.



LONGWALL - PROP & CAVING METHOD

C 4336

Chapter 8

Treatment operation
(The Mill)

A. Introductory - Ore treatment and fibre recovery

The blue asbestos ore is crushed in several stages. At suitable points the fibre is separated from the rock particles, by aspiration, and subsequently cleaned by trommelling.

The general principle is to remove fibre as soon as it is in an open or fibreised form to reduce fibre damage. Fines are by-passed before each stage of crushing to reduce contamination of fibre by dust.

The treatment plant is disposed below the mine adit, with the primary and secondary crushing sections and surge bins occupying positions down the steep face of the Gorge, thereby making maximum use of gravity flow of the materials.

The main treatment section is located below, on the floor of the Gorge, as are the mill office, changerooms, first aid centre and in a separate new block, the Mill Superintendent's office and the testing laboratory.

The Rotoclone dust collecting equipment is also located on this level, as well as the tailings treatment plant and the tailings disposal bin.

B. Crushing section

C 4337

Ore from the mine is delivered by the underground Nos. 1, 2 and 3 series conveyor belts in series to a 100 ton capacity ore "pocket". From this pocket the ore is fed by a

Ross chain feeder to the No. 1 conveyor of the treatment plant, and this belt emerges from the face of the Gorge from a 100 ft. long tunnel.

This conveyor is 163 ft. long, 30 in. wide and travels at 200 ft. per minute. It discharges to a 3 ft. x 3 ft. live roll grizzly fitted with four shafts, of which only two are operated at present. This is done to increase the proportion of rock passing to the sorting belt. The grizzly apertures are approximately $1\frac{1}{2}$ in. diameter. The grizzly undersize material gravitates to a 24 in. wide belt and the oversize to a picking or sorting belt, 19 ft. long, 42 in. wide and travelling at 55 ft. per minute.

Six men are employed as pickers on each shift, three on each side of the belt and they inspect the ore visually and throw out as much waste rock as possible in the available time. The rejected rock falls down chutes to a motor truck below. (Raises grade to 8%. based on 18% picking and 2.7 in. grade).

At present 18-19 per cent of the total feed is sorted as waste and is practically free of fibre. The rule is that no rock is rejected if it shows any fibre. Usually 14-16 truck loads, each of 10 tons is carted away each shift, at a cost of £1 per load or 2/- per ton of reject or 5d. per ton of ore fed to the plant. (8/- per ton of fibre).

The rejected rock is dumped over the side of the access road to the mine bench within about a quarter of a mile of the plant and this serves a useful purpose in widening the narrow track to the bench.

From the picking belt (No. 2 conveyor) the ore discharges to a 36 in. x 24 in. Kue Ken jaw crusher set to 4 in. and driven by a 50 h.p. motor. The crushed ore gravitates to No. 4 conveyor which is 34 ft. long, 24 in. wide and travels at 270 ft. per minute and thus joins the rolls grizzly undersize on this belt. (Note: there is no No. 3 conveyor - this number is reserved for possible extension of the picking system).

No. 4 conveyor delivers the ore to a 70 in. x 40 in. Symons vibrating bar grizzly which has fixed bar apertures, 1 in. wide. The grizzly undersize gravitates to No. 5 conveyor 90 ft. long, and 24 in. wide running at 270 ft. per minute and the oversize to a $4\frac{1}{4}$ ft. standard Symons crusher fitted with a coarse bowl normally set to $1\frac{1}{2}$ in. and driven by a 175 h.p. synchronous motor. Bowl and mantle

The vibrating bar grizzly and the Symons crusher discharge gravitate to No. 5 conveyor 90 ft. long, 24 in. wide and travelling at 270 ft. per minute, for delivery to an "air blast separator" situated over a nominal 1,500 ton ore bin. The ore from No. 5 conveyor is transferred to No. 5X, a short transverse conveyor, installed to facilitate central loading of the bin. At the transfer point where the crushed ore stream flows from No. 5 belt to No. 5X belt, an air blast supplied by a 2½ S D Richardson fan, through two nozzles 6 in. apart vertically, creates two jets directed at the ore stream.

Fines, containing free fibre, are blown over an adjustable blade and diverted through a chute to a 150 ton "fines" surge bin, situated at the lower, (secondary crusher) level.

The heavier particles fall freely on the near side of the adjustable plate, into the main 1500 ton bin.

The discharge of ore from the bin is regulated by 2 - 12 ft. x 30 in. Perrot Vance apron feeders from four bin openings. The speed of the feeders can be regulated in the range 2 ft. - 11 ft. per minute by the use of a Reeves speed reducer.

Both feeders discharge to No. 6 conveyor belt, 38 ft. long, 24 in. wide travelling at 164 ft. per minute, which conveys the ore to a transfer point, to No. 8 conveyor 68 ft. long, 24 in. wide and 164 ft. per minute.

At this transfer point a second air blast separator is located.

The loose fibre and fines from the first air blast separator are fed from the 150 ton bin, using a small push plate feeder, to No. 7 conveyor belt, a 68 ft. long 18 in. belt running at 164 ft. per minute. The fines and fibre separated by the second air blast are also handled by this conveyor which delivers the mixture of loose, generally damp, fibre and fine rock particles (through ¾ in.) to the rotary drier.

This drier is direct oil fired, parallel air/ore flow 4 ft. 9 in. diameter x 59 ft. long and operates at a slope of 2° at 6 r.p.m.

It has 10 sets of lifters arranged staggered and the first section is 10 ft. long. This set is truly radial and the succeeding sets are bent.

C 4339

The burner, using diesel fuel at the rate of up to 16 gallons per hour, is a Major U16.

Inlet gas temperatures run up to 800°F the exit temperature maximum should be 160°F, and the gas flow 4,000 c.f.m.

The coarse ore fraction separated at the second air blast is conveyed by No. 8 conveyor to a 4 ft. Symons short head crusher, fitted with a fine bowl, usually set to ¾ in. and driven by a 200 h.p. motor.

The 4 ft. Symons is located over No. 9 conveyor belt 14 ft. long, 24 in. wide, 164 ft. per minute and discharges to it for delivery to the first stage of screening. Also, the dried material from the drier is conveyed by a parallel (un-numbered) conveyor belt to this first stage of screening.

By means of a splitting chute and a transverse conveyor, both the crushed and the dried products are fed to 2 12 ft. x 4 ft. Nordberg Symons screens, fitted with 3/8 in. aperture screen cloths.

The screen undersize material is delivered by an 18 in. belt to a 4 ft. 6 in. x 14 ft. long cleaning trommel rotating at 9 r.p.m. The trommel screen apertures are 3/32 in.

The trommel undersize, ("grit") is a reject and is conveyed, by a declined conveyor belt (18 in. wide) to the main tailings conveyor (No. 17), which delivers tailings from the plant to the tailings bin.

The oversize material from the Nordberg Symons screens gravitates to 2 - 3 ft. Symons short head crushers, fitted with fine bowls and usually set to 1/8 in. and driven by 75 h.p. motors.

The discharge from both crushers is conveyed to the fine ore surge bin, (1,500 tons nominal capacity) 31 ft. diameter x 48 ft. high, by No. 10 conveyor, which is 66 ft. long and is 24 in. wide and travels at 264 ft. per minute.

The oversize from the 4 ft. 6 in. x 14 ft. trommel is also discharged to, and conveyed by, this conveyor to the surge bin.

To this stage, the ore has been reduced to generally less than 3/8 in. and is a mixture of rock and loosened fibre. Some particles of rock are still attached to the ends of crude lumps of fibre requiring further treatment.

C 4340

C. Treatment section

From the 1,500 ton surge bin the ore is fed to three parallel and practically identical treatment lines or "legs".

Each leg has a maximum capacity of 25 - 30 tons of ore per hour, the normal rate being 18 - 20 tons per hour and the total fibre production from all three legs is from 3.2 - 3.5 tons of fibre per hour from average grade ore. (8%).

At 90 per cent operating time this is equivalent to 380 tons per 6 day continuous-operation-week (approximately 20,000 tons of fibre per annum).

There are three conveyor belts, 18 in. wide, running at 214 ft. per minute, numbered 11A, 11B and 11C respectively and one Wiluna type gravity type feeder, located over each belt, regulates the feed of ore from the bin.

To simplify the description of the flow sheet from this point, only one leg is described. For example, one of the No. 11 conveyors delivers to a Kubit mill, which is an impact mill, but in fact is used as a fibreiser and is driven by a 25 h.p. motor. In this mill, the rock-fibre mixture is subjected to impact by rotating manganese steel beaters flailing the material against manganese steel anvils. To some degree, further reduction of the rock particles is obtained, but the principal function is to detach and "open up" the crude lumps of fibre. Wear and tear on beaters and anvils is extremely severe and replacement costs for wear parts very high.

The Kubit mill discharges onto No. 12 conveyor which is 6 ft. 6 in. long, 24 in. wide and travels at 194 ft. per minute and this conveyor delivers the ore to the boot of a bucket elevator, fitted with 12 in. x 6 in. buckets. The speed of the elevator is 415 ft. per minute and it elevates the ore 14 ft. to 2 12 ft. x 4 ft. Nordberg Symons screens, fitted with 3/32 in. aperture screen cloths.

The undersize material from the 12 ft. x 4 ft. screens passes direct to tailings on the (No. 17) tailings conveyor. The screen oversize gravitates to a Hazemag fibreising mill, in which the most substantial part of the fibreisation is accomplished. The rotor of this unit is 34 in. diameter and is fitted with 6 manganese steel beaters ("blow bars"), each 26 in. wide, bolted to brackets

C 4341

on the periphery of the rotor. The cost of replacement wear parts in the Hazemag mill is extremely high.

The material entering the mill is picked up by the rotating beaters and impacted against the adjustable steel striking plates, slung from the roof of the casing, which encloses the rotor. These striking plates, being adjustable, can give varying degrees of fibreisation, as required.

The Hazemag mill discharge is conveyed by a short conveyor, (No. 13) 8 ft. long, 24 in. wide, travelling at 194 ft. per minute to a second bucket elevator, identical to the one described earlier. From this elevator the ore discharges to 2 - 12 ft. x 4 ft. Nordberg Symons screens having 3/32 in. mesh, which combine the functions of separating grit and fibre and aspiration (or withdrawal) of fibre from the screen deck.

This is accomplished by a suction hood located near the discharge end of the screen. This hood has a 30 in. x 9 in. pick up area, transversely across the screen, under suction to a 6,000 c.f.m. cyclone separator and assisted by a Venturi design incorporated between the pick up mouth and the 8 in. square ducting delivering to the cyclone.

The cyclone fan is a Richardson 3 SD unit. The upper section of the cyclone is 4 ft. 9 in. D. x 4 ft. 6 in. high and the conical bottom section is 4 ft. 9 in. D. x 9 ft. long.

The cyclone separates a substantial part of the fine dust from the fibre and the air flow transfers it to the main dust collection system.

Discharge of fibre from the apex of the cone is regulated by a Turner rotary air valve, to No. 18 conveyor 51 ft. long, 24 in. wide, speed 214 ft. per minute, for transfer to the cleaning section.

The 12 ft. x 4 ft. screen undersize and aspirated oversize material gravitates to No. 14 conveyor, 24 ft. 9 in. long, 24 in. wide, speed 214 ft. per minute and transfers to Nos. 15 and 16 conveyors also 24 in. and 214 ft. per minute, to deliver the material to the tailings treatment plant.

At this stage of the treatment practically the bulk of the fibre has been separated from the rock.

No. 18 conveyor feeds 2 - 12 ft. x 3 ft. Nordberg cleaning screens fitted with 1/16 in. aperture screen cloths, for the removal of further grit, and a second stage of aspiration, similar to the previous one.

In this case the fibre is aspirated from the screens and passes to Prosser fibreisers and thence to a cyclone unit of 4000 c.f.m. capacity. It is 4 ft. 9 in. diameter and 11 ft. 6 in. overall height. The discharge from the cyclone goes to a cleaning trommel 4 ft. 6 in. diameter x 14 ft. long operating at a slope of 3°. The trommel cloth has 1/8 in.and 1/16 in. apertures and trommel the undersize is conveyed to tailings as a reject.

The Prosser fibreiser runs at 2000 r.p.m. and is essentially a 30 in. rotating disc 1½ in. wide. The periphery and sides of the Prosser wall casing are fitted with renewable corrugated manganese steel wear plates which contribute to the process of opening of the fibre.

Hot air delivered by a 2 D fan from a wood fire is delivered to the outside of the trommel cloth which is sheathed in a metal casing for this purpose and so the fibre receives its final drying.

At the No. 1 trommel discharge, the fibre is elevated to No. 2 trommel by a bucket elevator, 24 ft. 6 in. high having a belt 16 in. wide fitted with 16 in. x 6 in. buckets and travelling at 415 ft. per minute.

This is the final cleaning stage and this trommel is identical with the No. 1 trommel, except that the screen panels are 1/4 in. and 3/8 in. aperture and no hot air is employed.

In both Nos. 1 and 2 trommels, a beater shaft with beater arms has been installed to pick up the fibre and beat it against the trommel cloth, to liberate dust and grit.

The cleaned fibre passes to the bag press for bagging, and the undersize material from the No. 2 trommel is fed to the "Cobra" mill circuit.

The purpose of this circuit is to liberate further small pieces of rock which may still be attached to small "pencils" of fibre. The 1/4 in. - 3/8 in. mesh on the trommel No. 2 allows these small pencils to pass out of the system. The rock is separated from the pieces of fibre while passing through the Cobra mill

C 4343

fibreiser. The treated material passes back to Nos. 2 and 3 treatment circuits at the beginning of the cleaning stage and re-cycled.

Bags are filled to 100 lbs. nett by a hydraulically operated press or baler. Fibre is delivered to a weigh hopper by a 36 in. conveyor and is automatically weighed and dropped through pneumatically operated doors to the compression chamber.

Castrolite 20-W20-30 Castrol oil is used in the hydraulic circuit, which operates Nos. 1 and 2 rams to form the plug of asbestos, and the No. 3 ram ejects the plug into the bags.

A fourth pneumatically operated ram provides some resistance to the plug as it is forced into the bag and in this way the bag is tightly filled. Maximum press pressure is 1,800 p.s.i. on the final ram.

Bags are check-weighed after filling, and loaded onto pallets each holding 35 bags.

Palleted fibre is handled by fork lift truck, (Tow motor), having a 14 ft. lift and 5,000 lb. load at 24 in. centre.

A contractor hauls the bags of fibre to the shipping port at Point Samson using 28 ton loads, at a contract price of approximately £4.10.0. per ton, but some bagged fibre is transported by road to Perth as back-loading for the refrigerated road service van.

(i) Tailings treatment plant

This makes additional recovery of fibre as follows: All material, ore plus a small quantity of fibre, passing over Nos. 3 and 4 screens of the treatment section, after aspiration on all three treatment circuits, is retreated in this plant.

The material is elevated in a bucket elevator, 25 ft. high fitted with a 16 in. belt. 4 ft. 6 in. diameter and 12 in. buckets travelling at 415 ft. per minute and delivering to a rotating trommel, 14 ft. long.

The undersize passes through 1/8 in. mesh to a 10 ft. x 4 ft. vibrating screen and the fibre is aspirated to No. 2 cyclone of the first treatment circuit.

The oversize passes to a Hazemag fibreiser in which some of the crude lumps are fibreised, and delivered to a standard 12 ft. x 4 ft. Nordberg Symons screen. From this screen aspirated fibre passes to No. 1 cyclone of No. 1 treatment leg.

All of the remaining material passes to No. 17 (tailings conveyor for disposal to waste.

Tailing is trucked to dumps at convenient places in the Gorge by a contractor at the rate of 1/1½d. per ton up to 12,000 tons per 2 weeks; above 12,000 tons a flat rate of 1/- per ton.

The same contractor handles the mullock and bagged fibre to the coast.

D. Dust collection

(i) A Primary crushing section

The Warman "field" type collection unit is being replaced by the first unit of the new "Amerjet" system.

(ii) Secondary crushing section

At this point there is a 28N Rotocione wet collection unit powered by a 150 h.p. motor. A new Amerjet unit is being installed to collect dust from selected points in this area, i.e. the 4 ft. and 3 ft. Symons crushers, the vibrating screens, the cleaning trommel and No. 10 conveyor.

(iii) Treatment section

One 48N Rotoclone wet collection unit is connected to each treatment circuit to provide aspiration and to collect dust. The capacity of the three units is about 150,000c.f.m. and there is a 200 h.p. motor on each unit. Power consumption is a little more than 50% of the total h.p. consumed in the whole milling operation.

E. Sackmaking factory

All sacks used at Wittenoom are made at the mine. The work force consists of four women, two sewing, one cutting and one branding.

Hessian is passed across a cutting table three bags in length and a "Lightning" rotary cutter, electrically operated, is used to cut bags to correct length for sewing.

Two "Union" special sewing machines are used to sew the bottom and one side. Each machinist is capable of 1,000 sacks per working day.

C 4345 All bags are stencilled through a stencilling machine, the colour being coded to suit the particular grade of fibre. All work is carried out on a contract basis of 1¾d. per sack or at the basic wage, whichever is greater.

F. Wear steel

Life of Wear Parts.

The most severe wear occurs in the fibreising units.

Hazemag Impact Mill. (Three units in operation)

Manganese steel beaters - life is 48 hours at a throughput rate of 20 tons per hour equivalent to approximately 1,000 tons of ore. Each unit has six beaters and the weekly usage is 18 costing £8 each.

Kubit Impact Mill.

Beater life is 96 hours at a throughput rate of 20 tons per hour equivalent to 2,000 tons of ore. Four cutting edges are provided in this design. The beaters cost £8 each.

Prosser Fibreiser. (Two units in operation)

Beater life is 72 hours (fibre handling only). There are four beaters in each mill but the cost is only £1 each.

Crushing Units. Kue Ken Jaw Crusher. *

Both the swing jaw and the fixed jaw are for a single liner, each valued at £243. The liner life is approximately six months and handles about 150,000 tons of ore.

4½ ft. Symons Crusher. *

Four sets of mantles and bowl liners used per year. The life of each liner is about three months equivalent to approximately 75,000 tons of ore. Cost of the bowl liner is £304 and the mantle £216.

4 ft. Symons Crusher. *

Twelve sets of mantles and bowl liners used per year. Each set lasts about one month equivalent to approximately 25,000 tons. Cost of the bowl liner is £240 and the mantle £224.

3 ft. Symons Crushers. (Two operating)

Fourteen sets of mantles and bowl liners used per year and the life is about 26 days equivalent to approximately 10,000 tons crushed. The liners cost £110 each.

* Less the tonnage by-passed by the grizzlies which would be in excess of 30% of the crushing station throughput.

G. Power consumption

The total power consumption in the mill is as follows:

primary crushing section	4.1%
secondary " "	16.0%
treatment section	20.7%
dust collection and aspiration	51.5%
tailings treatment	6.5%
bagging plant	1.2%
	100%

Of the total power generated in the power house for the whole of the mine and the town, the milling operations consume about 60%.

Some power consumption details are tabulated on the following page, showing the range of kWh per ton of fibre, at varying rates of throughput, together with the percentage of total power generated.

Fibre production per week	Kilowatt hours per ton fibre (Mill)	% Total power generated in Power House
450	340	54%
400	400	60%
350	450	68%

H. Staffing and Labour

The breakdown of mill staff and labour based on normal operations of three shifts per day is :

Staff:
- 1 mill superintendent
- 1 mill foreman
- 1 quality control officer
- 3 shift bosses.

Total = 6 men

Labour: (a) Day work

1 clerk
1 quality control officer's asst.
1 greaser
1 hygiene man
1 fitter
1 welder
1 sheet metal worker
2 fibre loading
* 4 fibreiser maintenance crew.

Total = 13 men

* (Semi-skilled men who receive operators rate of pay).

(b) Shift work

Primary crushing: 2 shifts only
(day and afternoon shifts)

8 men per shift as follows:

1 leading hand
1 Ross chain feeder hand
6 pickers

Total = 2 shifts
16 men

Secondary crushing: 3 shifts

3 men per shift

1 leading hand
1 leading hand's asst.
1 cleaner

Total = 3 shifts
9 men

Treatment section: 3 shifts

10 men per shift

3 circuit operators
3 bag press (includes 1 fork-lift truck driver)
1 Rotoclone operator
2 cleaners
1 quality sampler

Total = 2 shifts
30 men

C 4348

Total labour is 68 men

Total staff is 6 men

(Labour: 60% Italian, 25% Australian, 15% other nationalities).

Treatment and bagging operations

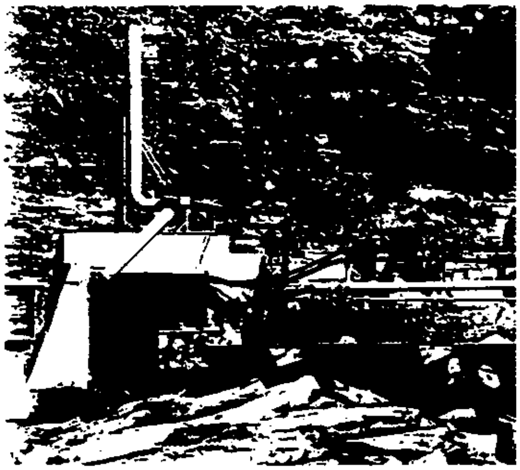
Prosser Fibreiser and cyclone unit.

Hydraulic baler, check weigh scale and sewing machine. Sacks are loaded on to a fork-lift truck pallet.

Fork-lift truck takes bagged fibre to conveyor for loading on to motor lorries.

Three women cut, sew and brand 2.500 sacks per day.

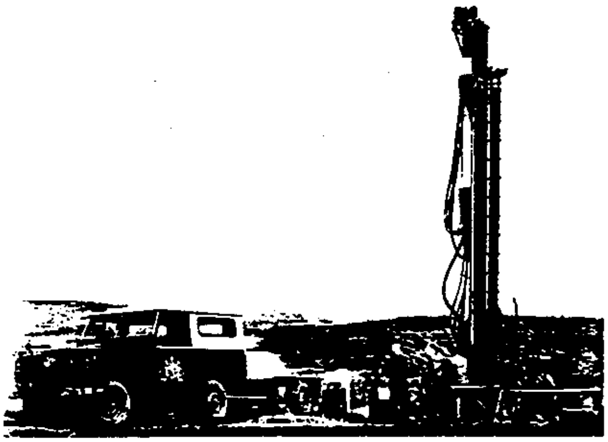
C 4349



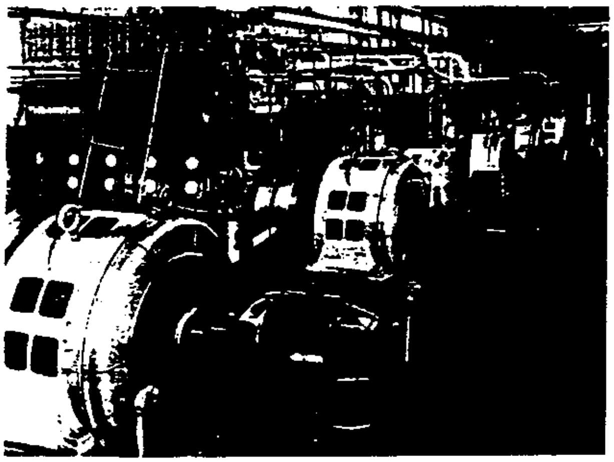
This is a view of the portal of the main adit showing a battery locomotive shunting a rake of empty trucks out on to the mine bench.

The fan and ducting above the portal takes dust from the mine pocket where the ore is transferred from underground to the mill.

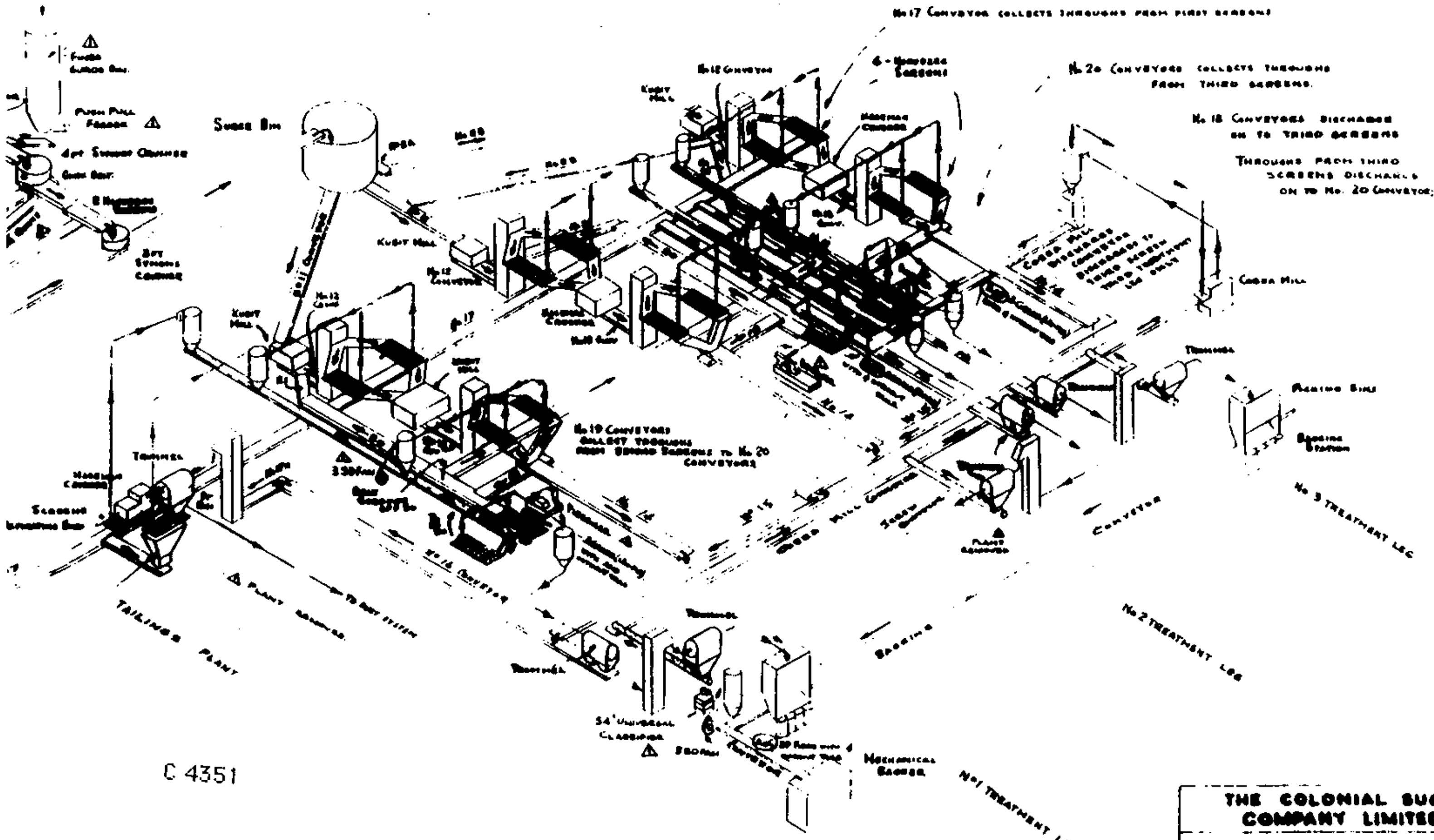
The timber in the foreground was for support of the roof underground in areas affected by the recent fall.



Exploratory drilling: one of the Schramm drill rigs drilling Hole No. 34 on "Drillers' Range."



Power supply: alternator sets in the foreground and the air compressors in the background.



C 4351

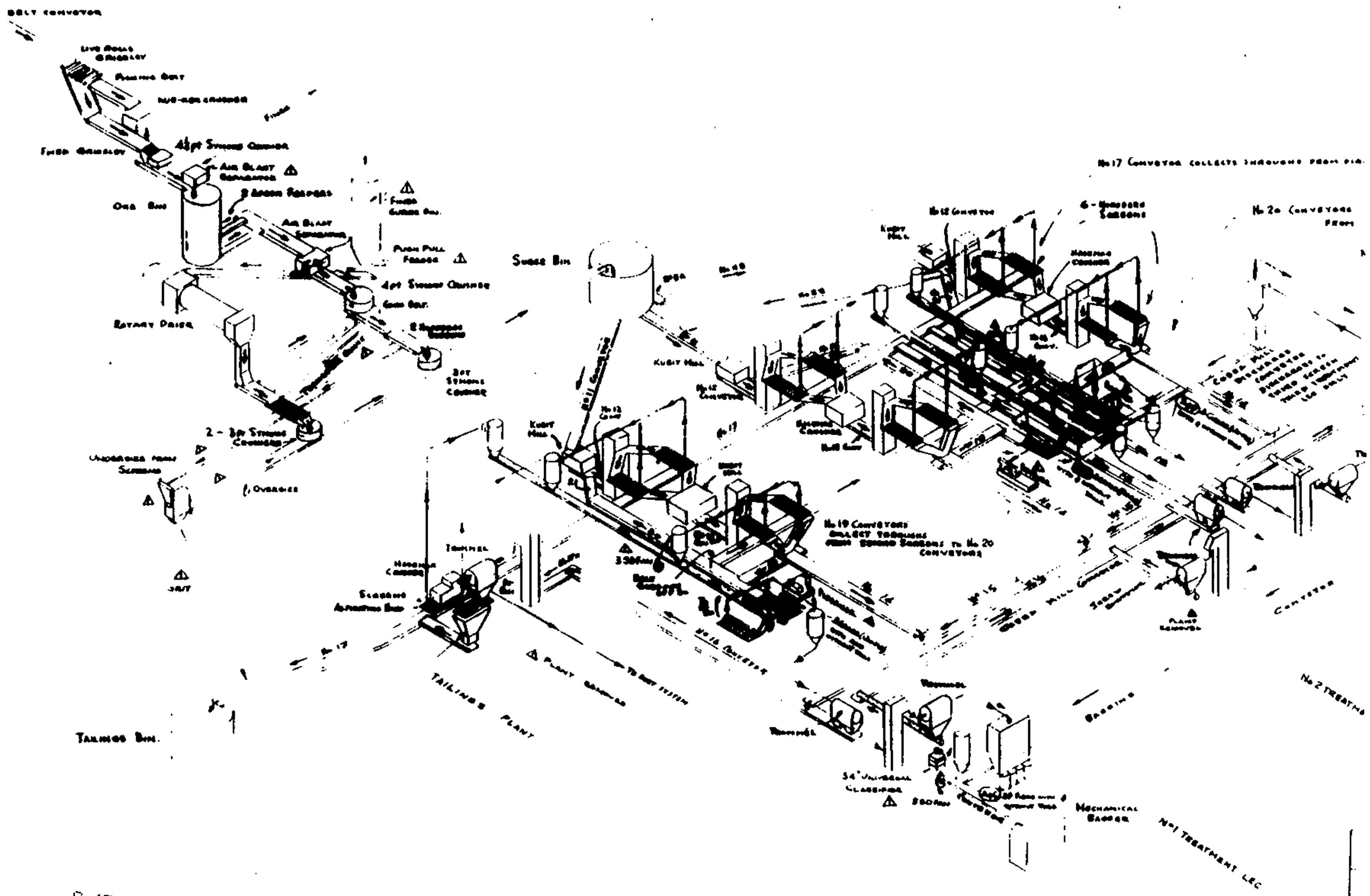
COLOUR LEGEND
- = ORE
- = FIBRE
- = TAILINGS
- = COBRA MILL CIRCUIT.

NOTE ~ DUST COLLECTING DUCTING NOT SHOWN.

THE COLONIAL SUGAR REFINING COMPANY LIMITED - SYDNEY

SCHEMATIC LAYOUT
COLONIAL GORGE MILL
AUSTRALIAN BLUE ASBESTOS

C BMD14530



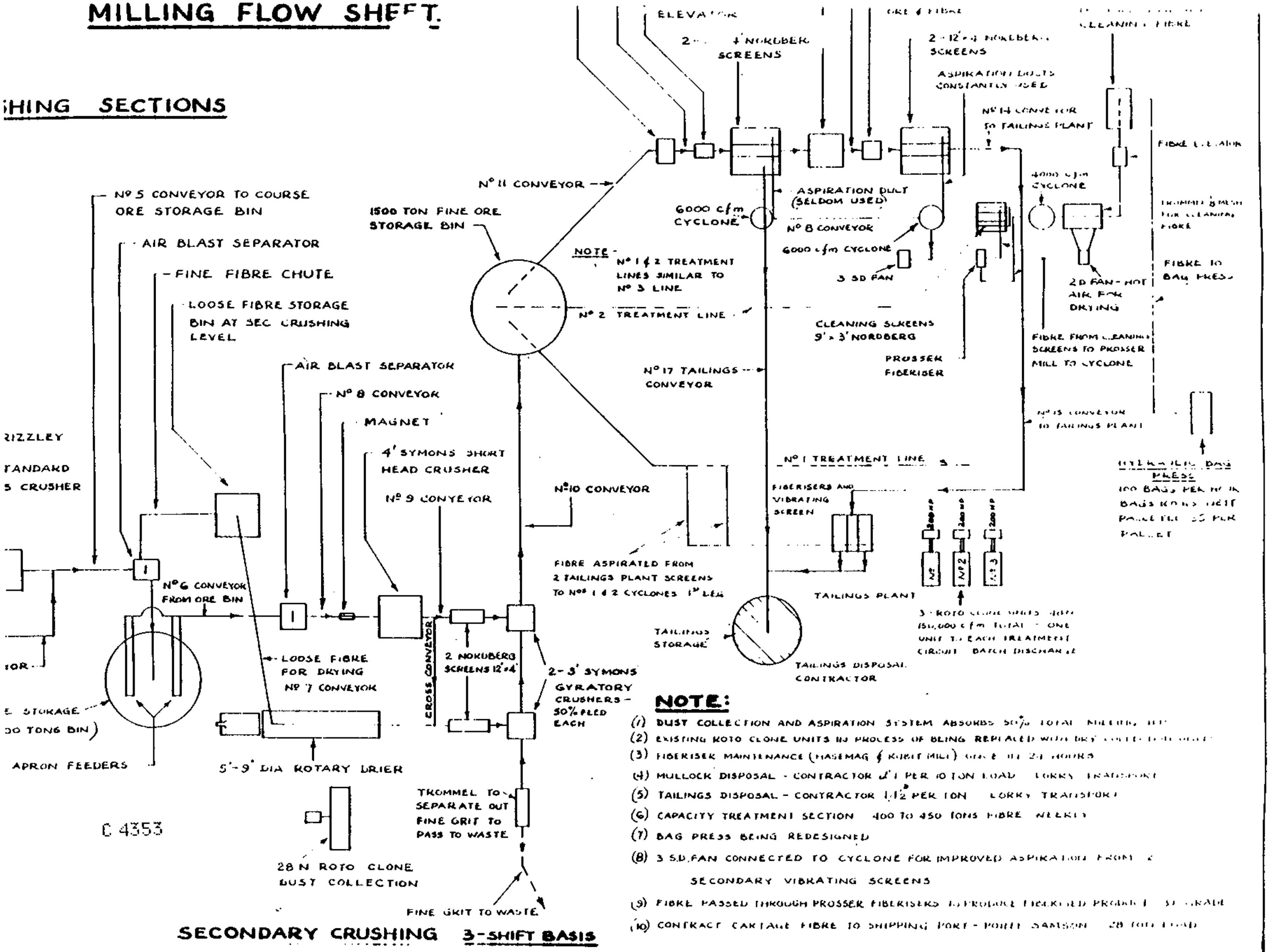
C 4352

COLOUR LEGEND
= Ore
= Fibre
= Tailings
= Cobra mill circuit.

Note — Dust collecting ducting not shown.

MILLING FLOW SHEET.

HING SECTIONS



C 4353

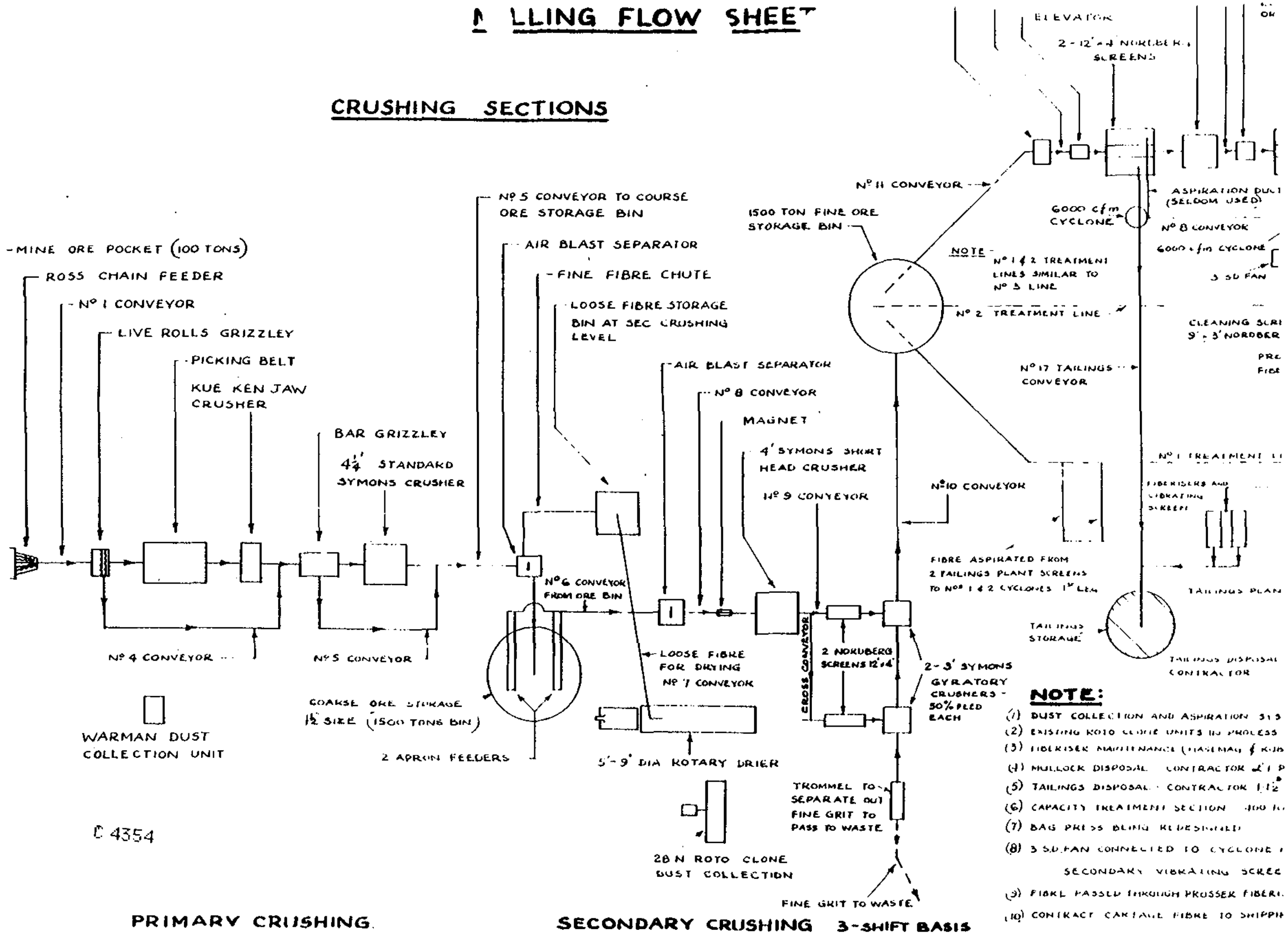
SECONDARY CRUSHING **3-SHIFT BASIS**

NOTE:

(1) DUST COLLECTION AND ASPIRATION SYSTEM ABSORBS 50% TOTAL MILLING ...
(2) EXISTING ROTO CLONE UNITS IN PROCESS OF BEING REPLACED WITH DRY COLLECTION ...
(3) FIBERISER MAINTENANCE (HASEMAG & KOBIT MILL) ONCE IN 24 HOURS
(4) MULLOCK DISPOSAL - CONTRACTOR £1 PER 10 TON LOAD LORRY TRANSPORT
(5) TAILINGS DISPOSAL - CONTRACTOR 1/12 PER TON LORRY TRANSPORT
(6) CAPACITY TREATMENT SECTION 400 TO 450 TONS FIBRE WEEKLY
(7) BAG PRESS BEING REDESIGNED
(8) 3 S.D. FAN CONNECTED TO CYCLONE FOR IMPROVED ASPIRATION FROM 2 SECONDARY VIBRATING SCREENS
(9) FIBRE PASSED THROUGH PROSSER FIBERISERS TO PRODUCE ... PRODUCT ... GRADE
(10) CONTRACT CARTAGE FIBRE TO SHIPPING PORT - PORT SAMSON 28 TON LOAD

Ɲ LLING FLOW SHEET

CRUSHING SECTIONS



Chapter 9

Engineering department

A. Responsibilities

The engineering department generally is responsible for the maintenance of all plant and machinery in the mine, mill, power house and garage, and all buildings in the settlement and town. It is also responsible for all internal road, water supplies, drainage and sewerage, the generation and distribution of power and the supply of compressed air for underground operations.

It is required to plan for future development; undertake all alterations, improvements and installations, except anything on a major scale, which is usually done on contract, but is still supervised by the Chief Engineer.

Each engineering department has a staff foreman who is responsible to the Chief Engineer for the running of his own department.

The engineering staff and personnel strength is usually around 120.

Trade groups represented are:

fitters and turners,
electrical trades,
welders,
carpenters,
painters,
plumbers,
engine drivers.

C 4355

The Engineering Department is responsible for the generation and distribution of power and for the supply of compressed air for the

a) MT. GOLDSWORTHY GROUP.

- Consolidated Goldfields (Aust.) Pty. Ltd., A.C.T., Australia.
- Utah Construction & Mining Co., Delaware, U.S.A.
- Cyprus Mining Corporation, New York, U.S.A.

Head Office:	15 O'Connell Street, Sydney.
W.A. Office:	R. Belliveau, C.M.L. Building, St. George's Terrace, Perth.
Shareholding:	Equal percentage each company.
Area under Reserve:	2,062 square miles.
Location of Reserve:	Port Hedland - Goldsworthy West of Marble Bar. Roebourne - Pt. Samson area.
Plan reference:	Sheet 14 of the DeGrey area. Sheet 13 of the Onslow area.
Anticipated town facilities	Reported to be considering two settlements - (a) Mine (b) Port.
Port facilities:	Regard Depuch Island as most likely.
Haulage:	Rail from mine to port site - probably 125 miles.
Other information:	Copy of newspaper cuttings regarding Export Licence. Copy of Iron Ore (Mt. Goldsworthy) Agreement.

An agreement has been entered into between the Mt. Goldsworthy group and the State of Western Australia which provides £291,000 to be spent on geological exploration and investigation of townsites, port sites, rail line, overall economics, etc. This to be completed inside two years. If at the end of two years the group decides to continue they must build townships, construct a port and a railroad etc. Payments to Government are to be 7½% of f.o.b. price of ore as a royalty (min. 4/6 per ton), and 2/6 per ton or minimum £75,000 per annum as charges for rental of land on which port facilities will be erected.

C 4356

The present idea is a causeway three miles long from the mainland to Depuch Island, a port on the island for 40,000 ton ships and a railway from Mt. Goldsworthy to Depuch Island.

Capital cost is expected to be £23 million to £30 million.

The group has been granted a licence to export a total of 64,000,000 tons of ore. Rate of export is hoped to be 4 - 5,000,000 tons per annum.

b) HAMERSLEY IRON PTY. LTD.

- Rio Tinto Southern Pty. Ltd.
- Kaiser Corporation, U.S.A.
- Conzinc Ltd.

Head Office:	Conzinc Rio Tinto (Aust.) Pty. Ltd. 95 Collins Street, Melbourne.
W.A. Office:	J. Hohnen, T. & G. Building, St. George's Terrace, Perth.
Shareholding:	Equal proportion each Company.
Area under Reserve:	1,168 square miles.
Location of Reserves:	To west of Wittenoom, approximate 60 miles. This is the nearest deposit to Wittenoom.
Plan reference:	Sheet 14 of the DeGrey area. Sheet 13 of the Onslow area.
Anticipated town facilities:	Dependent upon location of port but currently investigating the availability of land in the Roebourne area.
Port facilities:	This is still the subject of conjecture and thorough investigation. Pt. Samson -Cossack area not discarded at this stage.
Haulage:	Understood to be by rail.
Current activities:	Intense surface drilling programme at Boolgeeda (area 60 miles West of Wittenoom). 100 men engaged on site. Negotiating Iron Ore Agreement with W.A. Government. Over £300,000 has been spent to date on exploration etc.

C 4357

c) BROKEN HILL PROPRIETARY CO.

- Operating as a single company.

Head Office:	Melbourne
Perth Office:	Mr. Chessel, T. & G. Building, St. George's Terrace, Perth.
Area under Reserve:	1,330 square miles.
Location of Reserves:	Deepdale area east of Onslow, Roy Hill.
Plan reference:	Sheet 14 of the DeGrey area. Sheet 13 of the Onslow area.
Town and port facilities:	Yet unknown but understand survey of coast line just completed. Probably aim to locate port with minimum haulage between mine and harbour.
Current activity:	Surface exploration and drilling.

d) A.S. HILDITCH & C.H. WARMAN.

- Details of company formation unknown.

Head Office:	C/- Jackson McDonald & Co., 55 St. George's Terrace, Perth.
Shareholding:	Unknown.
Area under Reserve:	1,349 square miles.
Location of Reserve	South of Roy Hill Station in the Ophthalmia Ranges.
Plan reference:	Sheet 14 of the DeGrey area.
Other information:	Unknown.

e) BASIC MATERIALS CO. PTY. LTD.

- Garrick Agnew Pty. Ltd.

- Cleveland Cliffs of America.

Head Office:	167 St. George's Terrace, Perth.
Shareholding:	Unknown.
Area under Reserve:	246 square miles.
Location of Reserves:	East of Onslow and South of Roebourne.

C 4358

Plan reference: Sheet 13 of the Onslow area.

Other information: Unknown.

(iii) Other iron ore reserves granted throughout the State.

Bell Bros. - Guildford, W.A.
100 sq. miles in the Kimberley Division.

A. McDonald - South Perth, W.A.
49 sq. miles in the Yalgoo area.

Hancock Prospecting - Victoria Avenue, Perth W.A.
Area not known but located south of Onslow.

R. Batchelor - Claremont, W.A.
293 sq. miles in the Derby area.

H. B. Moncrieffe - Mullewa, W.A.
1 sq. mile in the Yalgoo area.

R. Synott - Esperance, W.A.
4 sq. miles, Joyner's Find area.

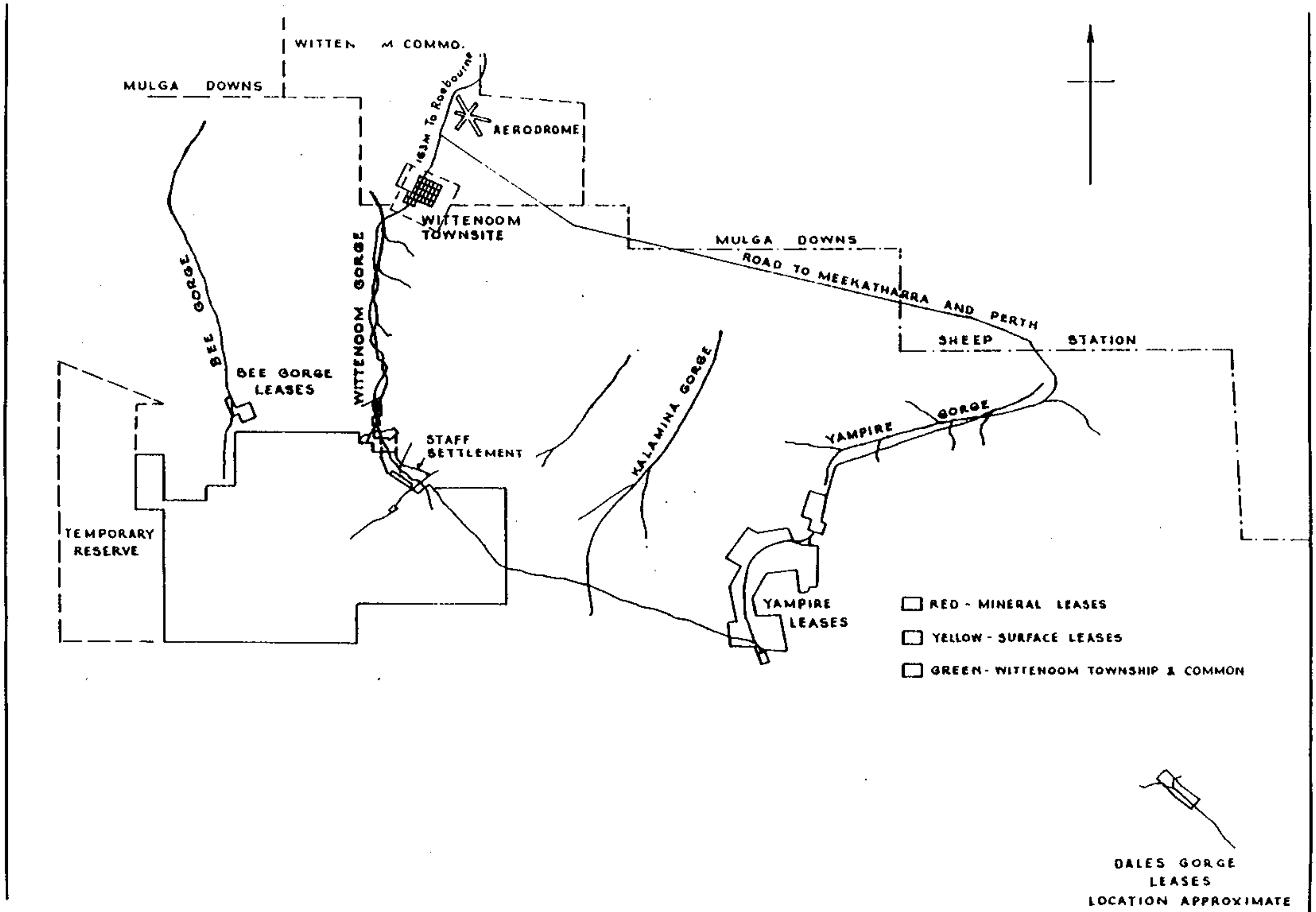
A. Acton - Ravensthorpe, W.A.
2 sq. miles, Ravensthorpe area.

H. Young - Wyndham, W.A.
50 sq. miles, Kimberley area.

E. Rick - Perth, W.A.
11 sq. miles, Marble Bar area.

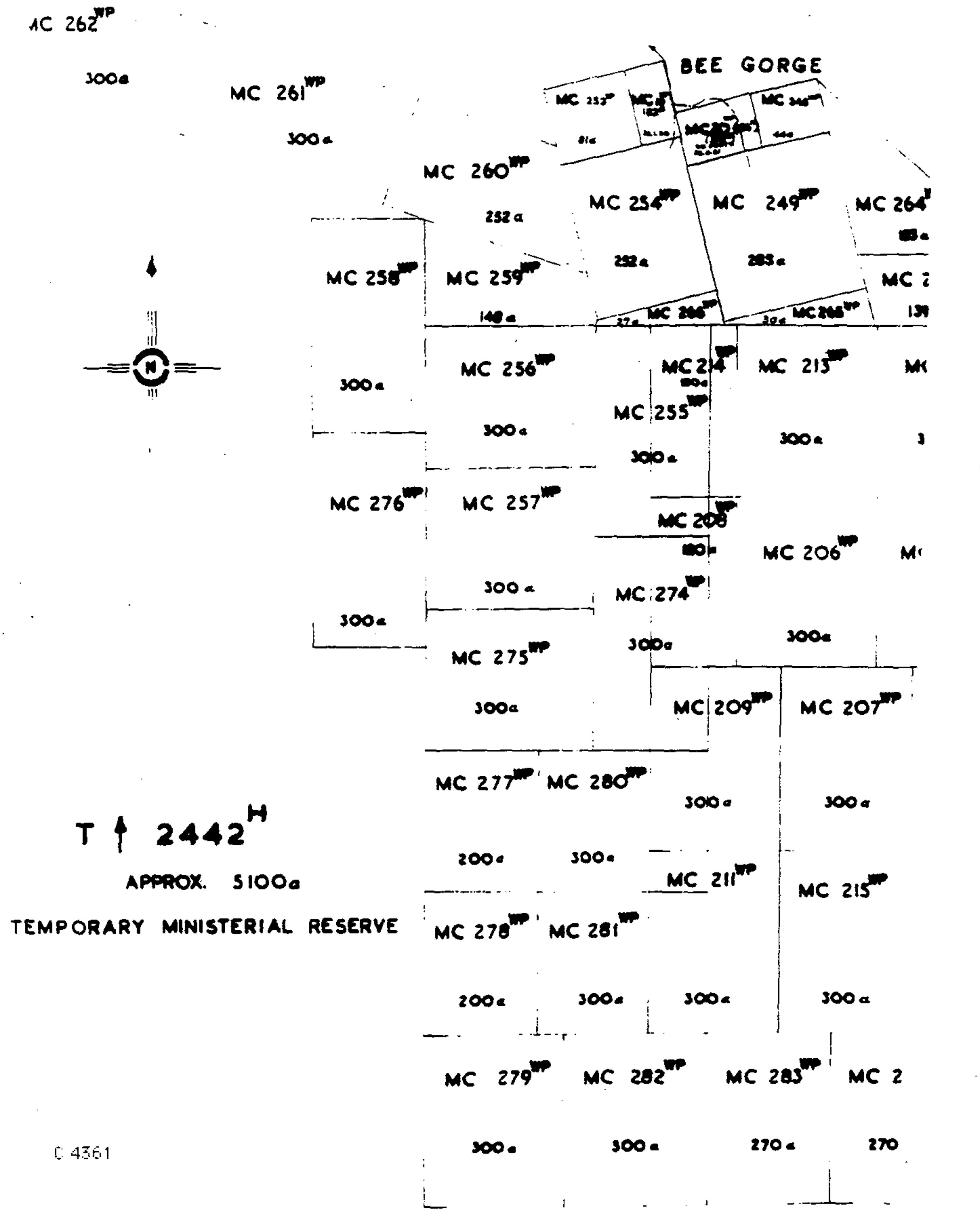
Metal Traders (Aust.) Pty. Ltd. - Perth, W.A.
50 sq. miles, Hamersley Range area.

(14th June, 1963).



C 4360

Scale: 9000' to 1"	MINING AND OTHER LEASES
Drawn: / Traced: A.E.F / Date: 26.6.63.	
AUSTRALIAN BLUE ASBESTOS	ABA 1062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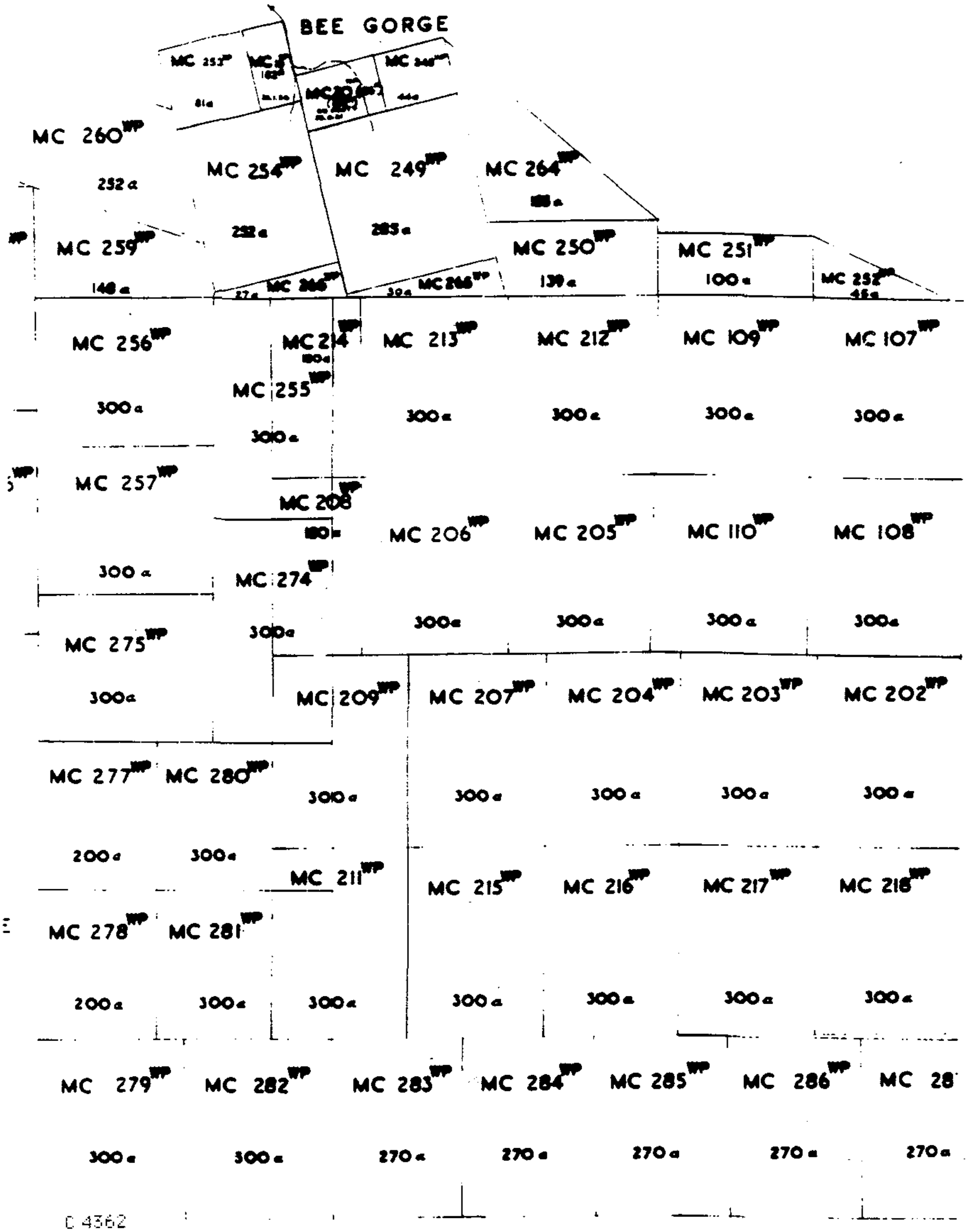
TEMPORARY MINISTERIAL RESERVE

C 4361


BEE GORGE
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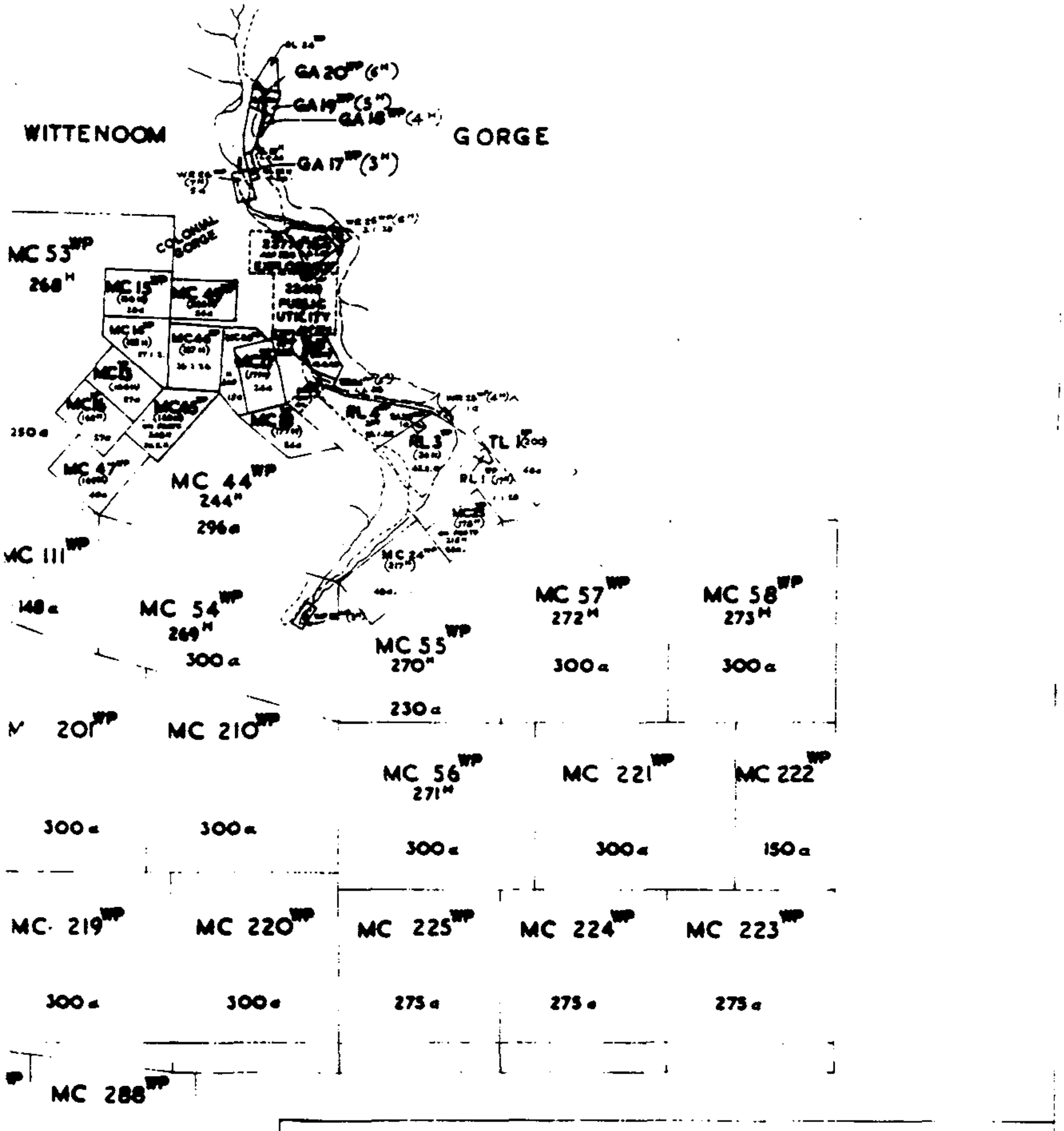
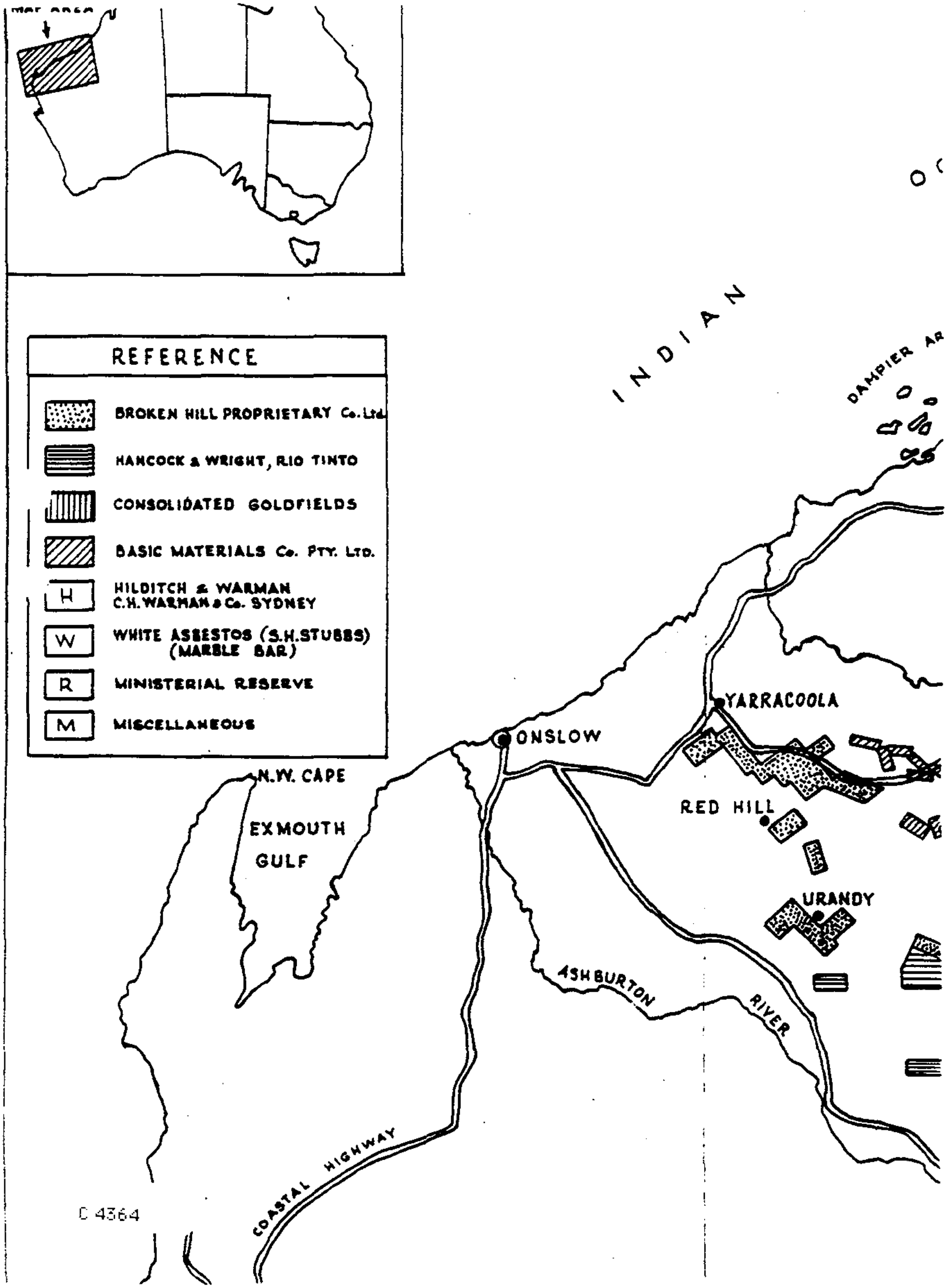
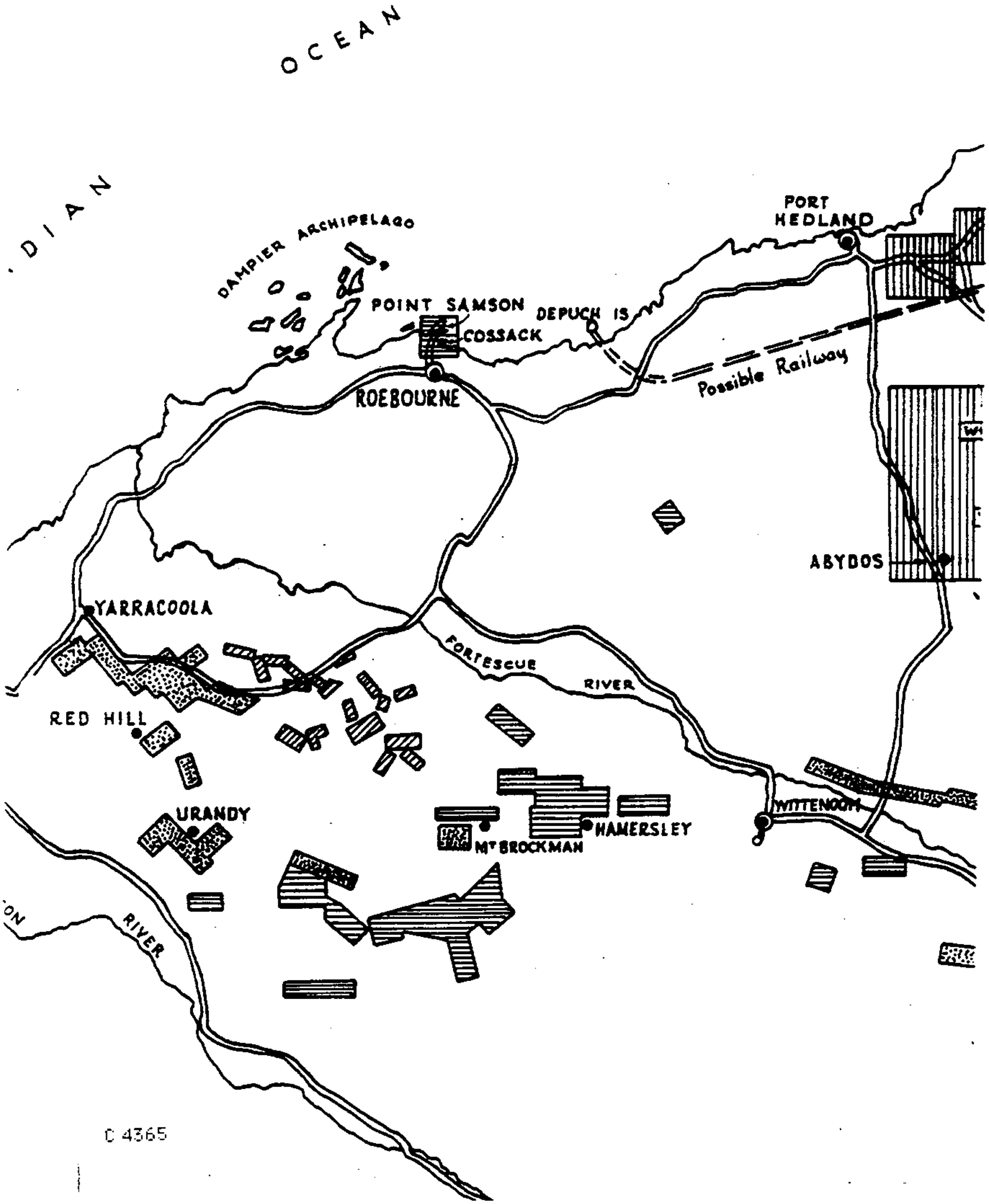


C 4363

LEASES HELD BY AUSTRALIAN BLUE ASBESTOS PTY. LTD. AT JUNE 1963

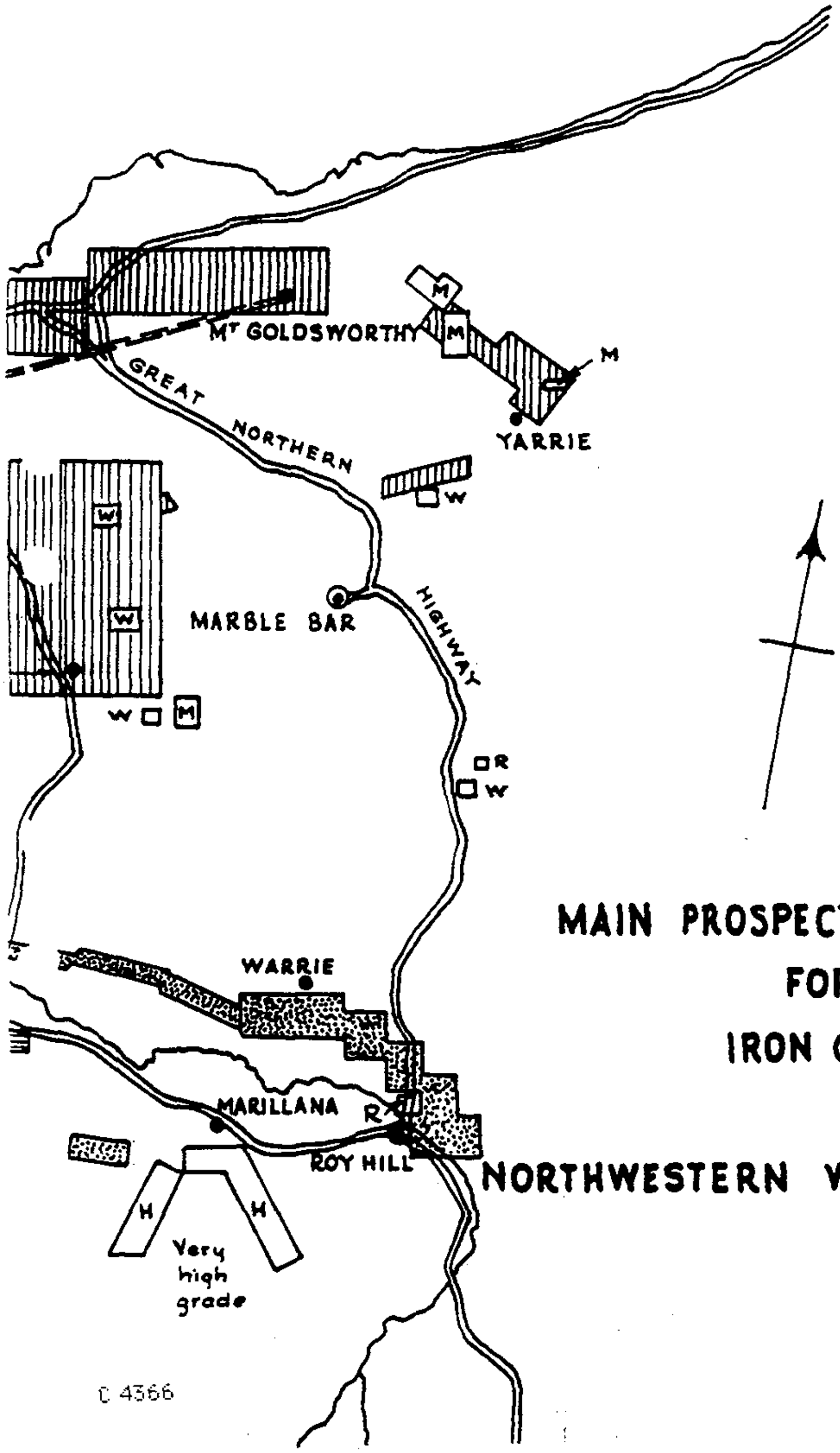
NOTE:– THE LEASES OUTLINED IN RED ARE THOSE


REFERENCE
BROKEN HILL PROPRIETARY Co. Ltd.
HANCOCK & WRIGHT, RIO TINTO
CONSOLIDATED GOLDFIELDS
BASIC MATERIALS Co. PTY. LTD.
H HILDITCH & WARMAN C.H. WARMAN & Co. SYDNEY
W WHITE ASBESTOS (S.H.STUBBS) (MARBLE BAR)
R MINISTERIAL RESERVE
M MISCELLANEOUS
INDIAN
DAMPIER
YARRACOOLA
ONSLOW
N.W. CAPE
EXMOUTH GULF
RED HILL
URANDY
ASHBURTON RIVER
COASTAL HIGHWAY
C 4364



OCEAN
DIAN
DAMPIER ARCHIPELAGO
POINT SAMSON
COSSACK
DEPUCH IS
PORT HEDLAND
ROEBOURNE
Possible Railway
ABYDOS
YARRACOOLA
FORTESCUE
RIVER
RED HILL
URANDY
Mt BROCKMAN
HAMERSLEY
WITTENOOM
RIVER

C 4365



MAIN PROSPECTING AREAS FOR IRON ORE

NORTHWESTERN WEST AUSTRALIA

C 4366

Chapter 6
Geology

Geology of the blue asbestos deposits

of the

Hamersley Ranges

by K. J. Finucane, Consultant Geologist
June, 1963

Introduction

The Hamersley Ranges are located in the North-West Division of Western Australia and extend, approximately, between latitudes 21° 30' to 23°S and longitudes 117° to 120°E. Their mean height above sea level is 2,000 feet and they rise from 600 to 800 feet above the general level of the tableland extending south-east from the coastal town of Roebourne. Mt. Bruce, the highest peak, rises to 4,024 feet above sea level. The ranges are intersected by numerous north-flowing streams, dry during the greater part of the year, which over the ages have carved deep gorges and it is in these that the principal deposits of crocidolite outcrop.

The presence of the mineral had been known for many years, the first official record being in 1917, when reports of a strong market demand for crocidolite, in 1937-38, resulted in considerable prospecting and mining activity, particularly in Yampire, Wittenoom and Dale's Gorges. It was further established that the blue asbestos belt extended from Willi Wolli Springs north-west to Millstream Station, i.e. over a length of 180 miles and a width of 20 to 30 miles. A number of attempts were made to develop and treat the Yampire and Wittenoom Gorge occurrences from 1939 through to 1945 but for a variety of reasons none of these proved successful.

Production by Australian Blue Asbestos commenced in 1944 and has continued since then. Operations have been concentrated in Wittenoom Gorge, initially in the Wittenoom Mine and since January, 1959, in the Colonial Mine, there being a transition period in the transfer of production from one mine to the other. Details of ore production are shown in Appendix 1 to this chapter.

Previous investigations

A number of scientific papers, geological and mining reports have been published on the crocidolite deposits by State and Commonwealth Government officers and various investigations have been made by officials of Australian Blue Asbestos Ltd. The results of these are summarised below and, while the knowledge of the deposits is steadily accumulating, the total available only emphasises the need for a more thorough and complete study than has been undertaken previously.

In 1929, a brief paper on the occurrence of blue asbestos in the Hamersley Ranges was presented before the Royal Society of W.A. by the late Dr. E.S. Simpson, who was then State Government Analyst and Mineralogist and had an extensive knowledge of Western Australian minerals.

A report on crocidolite occurrences in Yampire Gorge was made by Mr. F.G. Forman, then Government Geologist, in 1937 and is published in the Annual Report of the Geological Survey for that year. In the following year, Mr. J.S. Foxall examined the workings in Wittenoom Gorge and his description of the Upper and Lower Seams and the Knapping Seam and workings thereon are contained in the Annual Report of the Mines Department for 1938.

A more detailed report was made on behalf of the Aerial, Geological and Geophysical Survey of Northern Australia by the writer, in 1938, and covered Yampire, Dale's and Wittenoom Gorges. The primary object of this was to draw attention to the nature and extent of the deposits and their economic possibilities. Limited staff and time made it impossible to concentrate on other than the essential features.

In 1942 the W.A. Geological Survey published Bulletin 100 in which Dr. Keith Miles dealt in considerable detail with the petrology, mineralogy and microscopic characteristics of the crocidolite and associated rocks, while Mr. J.S. Foxall described Yampire, Dale's and Wittenoom Gorges and also the Marramamba area. In addition Mr. Foxall dealt with economic aspects of the deposits and drew attention to their size and the prospects of establishing an industry based on the production of blue asbestos.

C 4368

Reports on the occurrences at Willi Wolli Springs, Marramamba and Yampire Gorge have been made also by technical officers of Australian Blue Asbestos Pty. Ltd. and detailed sampling plans are available of most of the Main Yampire workings and of part of the Intermediate Series. These form part of mine records.

Geological work over the past three years has been concentrated in the area north and south of the Colonial and Wittenoom Mines and west beyond Bee Gorge with the object of delineating key marker horizons to aid the drilling programme and ultimately establish an accurate structure-contour plan of the area.

A limited amount of broader reconnaissance work has been carried out in Yampire and Dale's Gorges and near Joffre Creek in order to consolidate the background and regional aspects of the geological investigation.

The stratigraphy and sequence of beds over a thickness of 500 to 600 feet has been reasonably well established in the immediate host rocks of the crocidolite seams but it has not been possible to extend the scope of the work beyond the immediate mine environment or to delineate the detailed structural features of the Wittenoom - Colonial Mine area; nor has it been possible to correlate the Wittenoom-Yampire-Dale's group with a view to delineation of favourable areas for exploratory drilling. Lack of time and the need to consolidate the Colonial Mine operation have precluded any major attempt to expand the scope of the work with the staff available.

Geology

Rock types throughout the ranges comprise an appreciable thickness of almost horizontally bedded ferruginous or hematite quartzites, quartzites, shales, calcareous shales, dolomites and bands of limestone, together with thin bands of riebeckite rock. These form part of the Nullagine Series, of Proterozoic age, and probably represent the upper portion of it.

The crocidolite occurs as conformable seams of cross fibre and the immediate host rocks constitute a reasonably well defined horizon, possibly 400 to 450 feet thick with the principal bands of fibre concentrated in the lower section. Generally, it occurs in hematite quartzites in proximity to beds of dolomite or calcareous shale or to thin beds of bluish coloured, fine grained riebeckite rock.

Light coloured, thinly bedded shales, with occasional limestone beds a few feet thick, occur below the fibre zone and these are well evidenced in road cuttings and in creek and talus exposures. They are softer and less resistant than the quartzites. Outcrops in the higher country, above the fibre zone, comprise quartzites with occasional beds of shale in which there is rather less iron than is characteristic of the rock types in closer proximity to the productive beds.

In general the beds are horizontal or only gently dipping but there is a definable amount of warping in some areas, with short, restricted zones of buckling, folding and faulting. The average range of dips varies from horizontal up to 4° with maximum readings between 8° and 10°.

It is difficult to assess the extent to which warping and flexing may have influenced the formation of better grade fibre zones. The most widely accepted hypothesis regarding the genesis or origin of the deposits is that in some places the crocidolite was formed by growth of fibre in situ along the margins of beds having a similar chemical composition to that of the crystalline fibre, while, in others, the original beds contained iron and silica in similar relative proportions to those required in the formation of fibre, with soda and magnesia being introduced from adjacent beds. The heat and pressure necessary to effect the crystalline growth could have been produced by burial of the rocks under other strata. As the presence of water or aqueous solutions would be an essential condition of growth, it is probable that flexing of the beds would lead to greater volume and freedom of circulation and hence to greater deposition of crocidolite.

The consistent association of fibre with a definite sequence of beds or rather with a particular group of rock types indicates that the Hamersley occurrences are probably restricted to a definite lithological group or stratigraphic horizon in the upper portion of the Nullagine Series. However, the precise conditions which govern the distribution of the better grade mine-able zones are not apparent, possibly they depend partly on the chemical composition of the host rocks and partly on structure.

Systematic structural mapping is required to correlate the several deposits described below but their general associations are broadly comparable, though they vary in the actual detail of fibre width, vertical interval between seams and immediate or contiguous host rocks.

The deposits

Principal among the known deposits are those of Wittenoom, Yampire, Bee and Dale's Gorges. Fibre also occurs at Willi Wolli Springs near the known eastern limit and leases are held at Marramamba some seventy miles due west of Wittenoom. Their distribution is illustrated on the accompanying plan, Fig. 1.

(i) Wittenoom Gorge

Examination of cliff faces and of the underground workings of the Colonial and Wittenoom Mines shows that the crocidolite occurs in three main seams or bands covering a vertical range of 42 to 46 feet. The Upper or No. 1 Seam comprises a band of hematite-quartzite from 15 to 18 inches thick containing lenses and veins of fibre varying from a fraction of an inch up to 1.5 inches and aggregating 3.0 to 3.5 inches. A foot below this and separated by barren quartzite there is a bed of calcareous shale, 9 to 12 inches thick, which persists throughout the gorge, but which fades north of the Colonial Mine. The Lower or No. 2 Seam occurs from 21 to 22 feet below the Upper, with quartzites intervening, and is almost identical except that the aggregate thickness of fibre is about 2.6 inches. About three feet below the "Lower Seam" there is a bed of crystalline dolomite which grades gradually into black, calcareous or dolomitic shale, particularly in the northern workings of the Colonial Mine. This is succeeded by a 6 to 9 inch bed of quartzite below which there is a lenticular knapping seam showing from 0.5 to 1.5 inches of fibre and which, at times, may be totally absent. The Lowest or No. 3 Seam occurs from 42 to 44 feet below the top of the "Upper Seam" and consists of lenses and veins of fibre aggregating 1.5 to 2.0 inches and extending over a thickness of two feet; the intervening beds are quartzites. Thin veins of fibre occur between the three principal seams but these are of no economic significance. Narrow bands of calcareous rock, an inch or two thick, are interbedded with the quartzites adjacent to the fibre bands. A typical section illustrating the relationship of the various seams and associated beds is shown in Fig. 2.

The Colonial Mine workings cover a length of 2,900 feet extending west from the cliff outcrop and an average width from north to south of about 2,000 feet. They follow the dip of the bedding into the hillside at an average inclination of 4^{o} west. Both the Upper and Lower, or No. 2 Seam have been mined extensively but No. 3 Seam is too low grade to be worked economically. The Wittenoom Mine is currently inoperative but the overall fibre relationships are similar to those of the Colonial Mine except that average fibre content of the Upper and Lower Seams is less; workings cover a length of about 2,000 feet from east to west and a width of 1,000 feet. A wide zone of faulting and barren fibre occurs along the northern periphery of the Wittenoom workings and appears to extend northwards for some 2,000 feet towards the Colonial Mine. The southern faces of the Wittenoom Mine have been check sampled.

A number of key stratigraphic beds or markers have been established in the Wittenoom-Colonial area principal among these being:-

Green quartzite 9 in.- 12 in. thick, above the Upper Seam, at a depth of 460 ft.

Grey quartzite breccia 12 in. plus or minus, above the Upper Seam, at a depth of 300 ft.

Two shale bands of 12 in. and 6 in. from 15 ft. to 17½ ft. and 12 in. to 18 in. thick at 75 ft. below the Upper Seam.

These define the productive zone within close limits and materially assist in drilling.

(ii) Bee Gorge

Fibre occurs in Bee Gorge about three and a half miles north-west of the Colonial Mine and has been exposed along a series of east-west benches over a length of 240 feet. These show from 1 to 2 inches of high grade crocidolite associated with bands of quartzite and riebeckite. Fourteen feet above there is a narrow seam, from 6 to 18 inches thick, containing three or four narrow veins of fibre aggregating 1.0 to 1.75 inches. A third seam is located 28 feet below the main benches but this rarely exceeds 0.5 of an inch. The total vertical range is 42 feet, a number of bands of riebeckite are associated with the fibre and the general occurrence is broadly comparable with that of the northern peripheral area of the Colonial Mine. However, the beds of calcareous shale and dolomite, so characteristic of both the Wittenoom and Colonial Mines, appear to be absent.

Economically, Bee Gorge is not attractive on its present showing. Reconnaissance work to the south and west of it show outcrops of the grey quartzitic breccia mentioned above and, provided reasonable structural conditions can be established, exploratory drilling could be undertaken south of Bee Gorge and on the western prolongation of the Colonial Mine.

(iii) Yampire Gorge

This is located about twelve miles south-east of Wittenoom. Fibre has been mined from a series of shallow benches and scattered workings which extend over a distance of three miles. Three main horizons have been established, viz., the Main Yampire Series, an Intermediate Series and a Top Horizon which is from 150 to 200 feet stratigraphically above the main seam.

The principal occurrences are at the southern end of the gorge where the Main Yampire Series outcrops over a length of 3,000 to 4,000 feet in a broad anticlinal structure. Here there is a total of 3.5 to 5 inches of fibre in several seams of varying thicknesses over a vertical height of 8 to 9 feet. Bands of riebeckite rock are associated with the fibre. The beds dip gently to the north and pass below the surface but reappear with a change of dip towards the northern entrance of the gorge.

Comparatively little work has been done on the Intermediate Series which showed promise in places but scattered workings on the Top Horizon over a length of several thousand feet give an average thickness of 2 inches of crocidolite over a vertical height of 2 to 4 feet. There is a consistent bed of riebeckite rock associated with the Top Horizon and a thick bed of dolomitic limestone occurs between the Main Yampire and the Intermediate Series.

Mr. J. Young's sampling of the Main Yampire Series gave an average of 4.59 inches of fibre over a vertical height of 8'6" for an outcrop length of 4,760 feet. The best exposures occur in the old workings on the eastern side of the gorge where 3,210 feet sampled averaged 4.9 inches over 9 feet. The west wall gave 3.67 inches over 8 to 9 feet for a sampled length of 1,550 feet. These results were checked by Mr. J. Shanahan.

(iv) Dale's Gorge

Located about 9 miles east of Yampire Gorge, the fibre occurrences in Dale's Gorge extend over a length of one and a half miles and present some contrasting features. Two definite dolomite beds, each from 6 to 10 inches thick, may be seen in the cliff faces. These are 20 feet apart and the following asbestos seams are associated with them:-

(a) The Top Seam, 10 feet above the upper dolomite bed and containing from 1.2 to 1.5 inches of fibre.

(b) Mahlberg's Seam 15 feet below the upper dolomite and containing from 0.5 to 2.5 inches.

(c) The Main Bottom Seam, 10 feet below the lower dolomite, with 0.5 to 1.5 inches,

and

(d) A small seam known as the "Stringer" 7.5 feet below the lower dolomite.

All of these are mainly single seams which were benched by prospecting parties in a search for long fibre. Fig. 3 illustrates their occurrence. Their immediate importance is limited.

(v) Marramamba

These deposits are described by J.S. Foxall in W.A.G.S. Bulletin 100. Outcrops of fibre occur at intervals along a range of low hills, trending approximately east and west, and cover a total length of about 9.5 miles.

At the western end, the crocidolite formation is reported to be 7 feet thick with an aggregate of 6 inches of fibre in seams from 0.12 to 1.0 inches. It is lenticular in habit and the beds dip east into a hillside at 15°.

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From four to six miles east of the above two horizons have been exposed of which the upper carries from 2 to 3 inches of fibre and the lower about 2 inches in two seams. These are about 20 feet apart stratigraphically and dip north-east at 25°.

One mile further east there is a cliff face outcrop showing 9 to 10.5 inches over 8 to 8.5 feet, the dip being 10° north-east.

About two miles south-east, on M.C. 201 H, fibre with an aggregate length of 4.5 inches occurs in a formation three feet wide. The dip is east or north-east.

Unfortunately little is known of the stratigraphic association at Marramamba.

There has been no opportunity to examine the Marramamba leases or to make any assessment of their aggregate potential. Foxall's description of them presents an attractive picture as to width of fibre over a given vertical range in the exposures he examined. However, it is not known whether linear continuity can be established such as would be necessary for a continuous mining operation. The only course open at present is to map and check sample the various outcrops and workings and carry out such initial test work as may be necessary to establish continuity.

Summary

Summarising the overall position in relation to ore prospects, mill and townsite location, access facilities and in the light of current knowledge, I would place the priority of investigational work and drilling as under:-

(i) Consolidation of the Wittenoom-Colonial area by extending geological mapping and drilling west of the Colonial Mine and south of the Wittenoom Mine.

(ii) Structural mapping and some preliminary drilling of the Main Yampire Series, i.e. the lower fibre occurrences, and

(iii) Investigation of the Marramamba area with a view to establishing structural continuity and layout of a preliminary test programme.

A good deal of progress has been made with the geological programme, check sampling, preparation of assay plans and the establishment of the precise stratigraphic succession in the mine environment but the demands of the drilling programme have limited the time available for detailed field mapping and the most pressing need at present is to try and establish by structure contour mapping, or other line of attack, the factors controlling distribution of the better grade fibre zones and to establish a technique for delineating them.

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Finucane K. J., 1939. The Blue Asbestos Deposits of the Hamersley Ranges. A.G.G. Survey of Northern Australia Report Western Australia No. 49.

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Miles K. R. and Foxall J. S., 1942. W.A. Geol. Surv. Bulletin 100. The Blue Asbestos Bearing Banded Iron Formations of the Hamersley Ranges and *The Blue Asbestos Deposits of the Hamersley Range and Their Economic* Importance with appendices by F. G. Forman (1937) and J. S. Foxall (1938).

APPENDIX I

(to Chapter 6)

AUSTRALIAN BLUE ASBESTOS PTY. LTD.

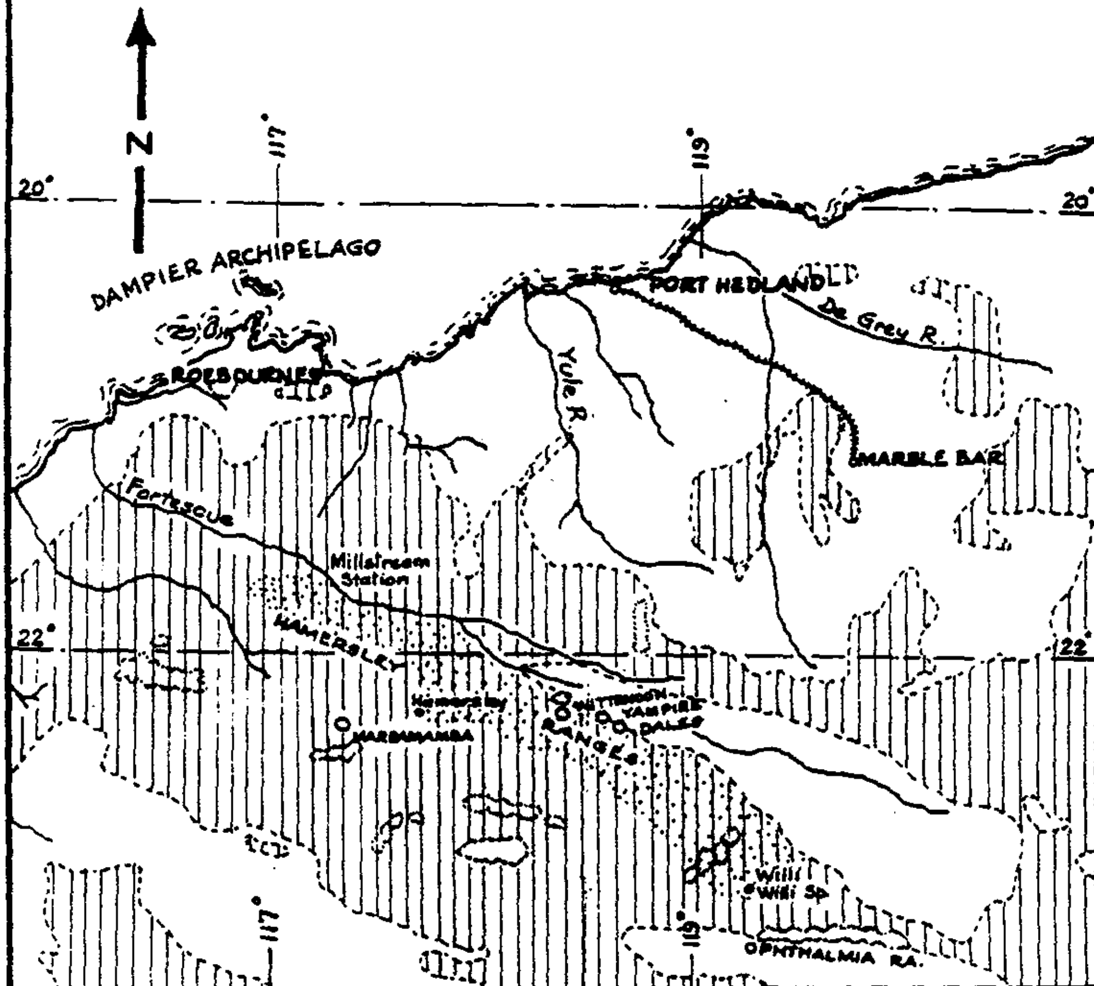
Fibre Production

Year Ended	Ore Long Tons	Fibre therefrom Long Tons	%
Dec. 1946	6,567	601.82	9.2
1947	14,406	895.10	6.2
1948	13,296	759.07	5.7
1949	18,477	993.75	5.4
1950	20,756	1031.58	5.0

Note: Some hand sorting 1948-1950.

Year Ended	Ore Short Tons	Fibre therefrom Short Tons	%
Dec. 1951	42,015	1,398.98	3.3
1952	97,076	3,133.34	3.2
1953	130,805	4,253.97	3.3
1954	126,374	4,248.92	3.4
1955	89,610	4,845.67	5.4
1956	124,611	8,160.34	6.5
1957	184,906	12,222.19	6.6
1958	212,896	13,313.57	6.3
1959	277,180	16,416.65	5.9
1960	262,400	14,472.22	5.5
1961	295,878	15,777.00	5.3
To June 1962	152,264	7,844.78	5.2

CHART N° 12



— LEGEND —

Crocidolite Belt

Areas occupied by Rocks of Nullagine Age

LOCALITY MAP

SHOWING DISTRIBUTION OF CROCIDOLITE

SCALE IN MILES

50 0 50 100

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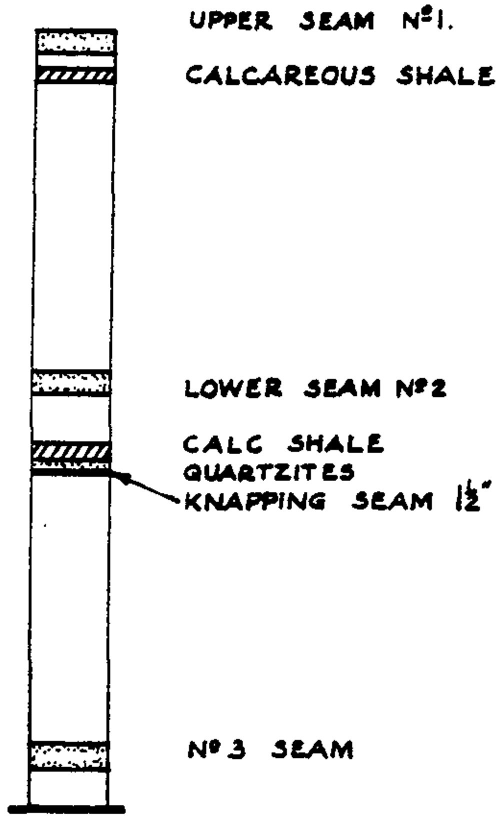

VERTICAL SECTION
SHOWING OCCURRENCE OF CROCIDOLITE SEAMS
WITTENOOM GORGE

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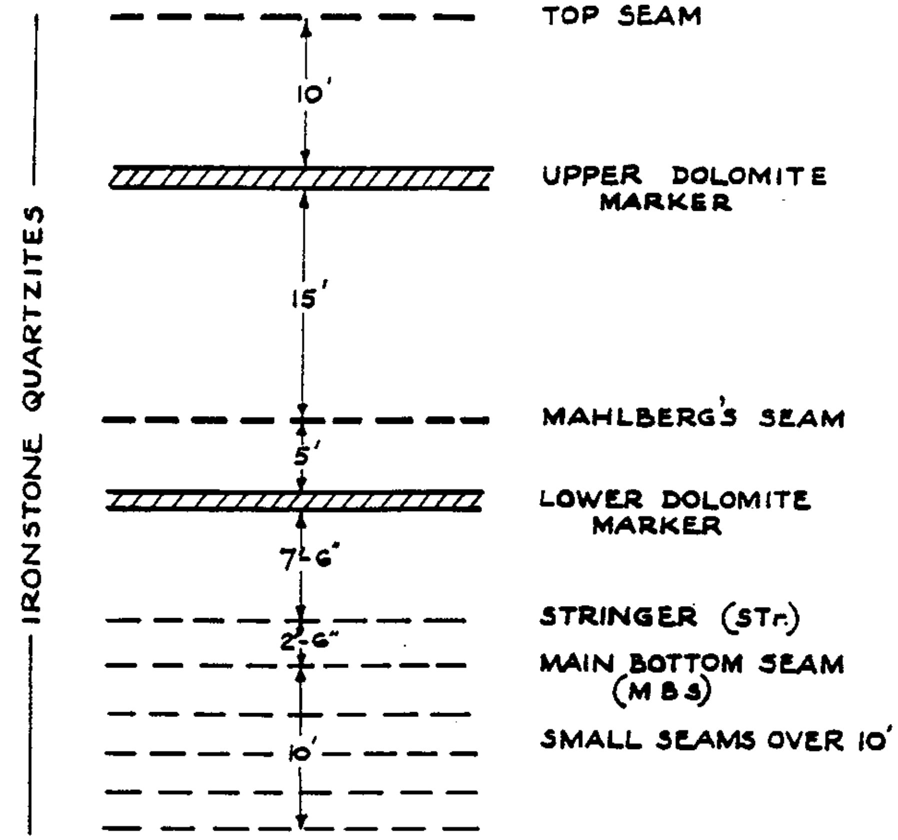
FIG. 21

CHART N° 14



VERTICAL SECTION
SHOWING OCCURRENCE OF CROCIDOLITE SEAMS
DALE'S GORGE

SCALE IN FEET.

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Chapter 7

Description of mining operations

A. Introduction

Two seams of blue asbestos, each aggregating 2 in. to 3 in. of fibre, outcrop high on the side of the Colonial Gorge wall.

The main mine development work is planned to enable both seams to be worked simultaneously where the grade of ore warrants this. The dip of the seams is in the order of 8 degrees and a main adit, 16 ft. wide, has been driven into the cliff face on the dip and under the lower seam. Twenty feet above the main adit, 9 ft. by 7 ft. haulage drives at right angles to the main adit. Access is gained to the haulage drives of levels one to five, from the main

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adit by means of an incline, "(turn-out)", and man-ways and ore chutes are cut between the haulage drives and the ore bodies. Stopes are opened up to be worked to approximately 400 ft. by 300 ft.

On 6, 7 and 8 levels, however, access is by man-ways only from the incline or internal adits.

The fibre occurs in a formation approximately 18 in. thick and consequently any barren rock broken in access of 18 in. adds to the dilution of the ore. However, the minimum practical stope height is controlled to 38" to 42". Because of the stratified nature of the formation, the cleavage, both on the floor and back, is clean and smooth. Pillars amounting to 12 per cent. of the total area are left, at about 24 ft. centres and all other broken rock is taken to the treatment plant as ore. No support, other than the pillars has been necessar with the mining methods used so far.

Handling of the ore to chutes is by scraper haulers, recently assisted by small bulldozers, to the ore chutes to a train of Granby cars hauled by battery locomotives, which dump the ore into ore pockets, situated immediately over the main adit. "Ross" feeders control the flow of ore from the pockets onto a series of three 30 in. belt conveyors, which deliver the ore into a bin or "Pocket" from which another belt conveys it to the mill.

It is appropriate to record in this section that the original Wittenoom mine, about a mile away, after some fourteen years of operation entered a major fault area, in which "dead" or oxidised fibre was encountered and severely limited the number of working places from which suitable fibre could be won

Outcrop assays and diamond drill results up to 1,000 ft. back from the cliff face had indicated that a richer zone of fibre existed in the Western section of Colonial Gorge and it was decided to develop the area to supplement ore taken from the Wittenoom mine.

As values in the Wittenoom mine deteriorated while those in the new Colonial Gorge development improved, a decision was taken to erect a new mill in Colonial Gorge. This was started up in June, 1958, using only one treatment line while the two crushing sections were designed and built to handle sufficient ore for three such treatment lines.

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The last deliveries of ore from the Wittenoom mine to the old Wittenoom mill were made in October, 1958. Colonial Gorge ore was delivered to Wittenoom until January, 1959, the ore being drawn by chute from the 1,500 ton ore bin and transported by lorry.

The second treatment leg came into operation on 7th January, 1959 at Colonial Mill and the third leg on 1st July, 1959.

The primary crushing section at Colonial Gorge commenced operations in June, 1958.

Secondary crushing and one treatment leg were commenced in July, 1958.

A road cut into the cliff face gives access to the so-called Mine Bench at an elevation of approximately 250 feet above the floor of the Gorge, which provides a platform on which are located the underground office, the mine store, change rooms, ambulance room, transformer station and Mine Bench Workshop. It also provides entrance to the mine adit in the cliff face, an opening 16 ft. wide and 7 ft. high, being the portal of a tunnel or adit or "drift" sloping downgrade at approximately 1 ft. in 12 ft. or about 8°, parallel to and underneath the two main fibre seams which themselves are parallel and about 21 ft. apart. Stratigraphically, they are referred to as the "Upper Seam" and the "Lower Seam".

B. Description of the workings

The mine essentially consists of four elevations :-

(i) The main adit or incline

(ii) The haulage levels

(iii) The lower seam stopes

(iv) The upper seam stopes.

(This is illustrated in Sketch No. 1, "Generalised section through the main incline", showing the position of working levels.)

Note: all sketches referred to are at the end of the chapter.

(i) The main adit

This is the main artery of the operations and provides for access to the workings; for the transport of broken ore and waste rock and for all services to the various sections of the mine.

This adit has been driven a total length of 3,000 ft. and is approximately parallel to the "dip" of the ore-body and is positioned

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70 to 80 ft. below the Upper Seam horizon.

(Sketch No. 2 gives a "Typical cross-section view of the main adit".)

(ii) Haulage levels

These are spaced at 400 ft. centres along the main adit, (more or less at right angles to it).

These haulage-ways are excavated 9 ft. wide x 7 ft. high and are driven along the contours of the bedding planes to provide an acceptable grade for the tram-lines and an adequate amount of head room for ore storage "pockets" below the Upper and Lower Seams.

The primary function of these levels is for access and for the transport of broken ore from the working places or "stopes", to the ore transfer pockets located over the ore conveyor belt in the main incline.

Access to the haulage-ways from the main adit is gained by 1 ft. in 10 ft. grade "turn-outs" driven to the northern side of the Adit.

(Sketch No. 2A shows a "Typical cross section of a 9 ft. x 7 ft. haulage level".)

There are turn-outs at levels 1 to 5.

(The general impression is seen in Sketch No. 1A.)

(iii) Lower seam stopes

Access is gained into the stopes by man-ways placed at 300 ft. centres along the haulage level. Broken ore in the stopes is won by scraper hoists to a chute or pocket positioned 15 feet from the man-way, which is also adjacent to the haulage-way.

(iv) Upper seam stopes

Access and broken ore removal methods are the same as for the Lower Seam and utilise the same man-way and ore chute rises.

(Sketch No. 3 depicts the "Plan and sections of such a typical man-way and ore chute".)

C. Mine development system

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(i) Main adit

From the full opening 16 ft. x 7 ft., a pilot drive 9 ft. wide x 7 ft. high is advanced 10 ft. ahead of a 7 ft. wide stripping face in the dip of the bedding planes as shown in Sketch No. 4: "Plan of main incline development method".

The equipment used in this work is:

2 Atlas BBC 23W(Lions) rockdrills using B.H.T. 31 airlegs and integral tungsten carbide tipped chisel bits.

1 - 35 h.p. Ingersoll Rand Double Drum Scraper Hoist and 4 ft. Box-type Scraper Hoe.

Shifts worked:	Day and night shifts.
Number of men:	3.
Length of round drilled:	5 ft. 3 ins.
Type of drive cut:	9 hole burn.
Advance per round including stripping:	5 ft.
Advance per 4 weeks:	90 to 100 ft.
No. of holes per round:	45 to 50.
Explosives:	AN/FO., A.N.60% primers, No. 6 detonators and safety fuse plus slow "Ignitercord".
Consumption of explosives:	18 lbs. per ft. advance.
Mucking operations:	Night shift. Scraping of broken muck by hauler unit over a ramp onto No. 3 underground conveyor belt. Mullock disposal is from the ore pocket at the commencement of day shift.
Working cycle:	Bore and fire on day shift and muck out operation on night shift.

(ii) Haulage Levels and adits

Adits are the inclined cross-cuts between haulage levels.

The normal size - 9 ft. x 7 ft.

The equipment used is:

1 Atlas BBC 23W (Lion) rockdrill with B.H.T. 31 air-

C 4384 leg.

Integral tungsten carbide steel chisel bits.

Eimco 12B mechanical loader of 20c.ft. capacity, also side tipping trucks, and a 7 ton Mancha battery-operated Hercules locomotive.

The method of operation is:

Shifts worked	Day and afternoon shifts.
Number of men	3
Number of miners	1
Bogging crew	2, consisting of loco-driver and a mechanical loader operator.
Length of round drilled	5'3 ins.
Type of cut	9 hole burn.
Advance per round	4'6 ins.
Advance per 4 weeks	75 to 90 ft.
Number of holes per round	32 to 34.
Explosives	AN/FO., A.N. 60% primer, No. 6 detonators, safety fuse, "slow ignitercord".
Consumption	12 lbs. per foot advance.
Working cycle	Bore and fire on one shift and muck out the next shift.

(iii) Rises

Normal size	7 ft. x 5 ft.
Equipment	Atlas BBD 46 W.S.8 (Falcon) stoper.
	Integral tungsten carbide steel chisel bits.
	8 in. x 1½ in. staging and 4 in. x 4 in. bearers on bearer pins.
Operation	Shifts worked - Day or afternoon.
	Number of men per shift - 1
	Number of rock drills - 1
	Length of round drilled - 5 ft. 3 ins.
	Type of cut - 6 or 7 hole burn.
	Number of holes per round - 26
	Feed advance per shift - 2 ft. 6 ins.
	Explosives - as for haulage levels.
	Consumption - 9 lbs. per ft. of advance.

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D. Stope preparation system

Initially, two rises: i.e. a man-way and an ore chute, are excavated, 15 feet apart and a connecting drive, 6 ft. x 5 ft. is then advanced in the Upper Seam from the man-way, across to the chute. This connection is then stripped out to a height of 6 ft. and a width of 12 ft. around the chute to allow sufficient space for the installation of a scraper-hauler unit. Stope preparations (or drives) are then commenced in eastward and westward directions towards adjacent haulage levels, in the plane of the seams.

These stope preparation headings primarily serve a threefold purpose:-

(i) Ventilation by inter-connection between stopes of adjacent levels.

(ii) Evaluation of fibre content of a block of ore.

(iii) Drainage of drilling water from the stoping operations.

Two systems of advancing preparation headings are used:

(i) 6 ft. x 5 ft. drive for rapid advance.

(ii) 24 ft. wide. 40 ins. high heading for production purposes.

(See Sketch No. 5: "Typical stope preparation layout".)

E. Ore breaking

(i) Method

Bord and pillar mining at an average stope height of 40 ins. is used for the extraction of the fibre seams.

Both seams are stoped where the grade of ore warrants it. Commencing initially from the preparation headings 10 ft. x 10 ft. pillars, 24 ft. apart are left behind as 24 ft. "flitches" are advanced. Each miner works two or three "flitches" (approximately 100 ft. for three faces) depending on the individual ability and the working area available. Miners are so placed to avoid broken ore being thrown into areas in which the following shift miners are to work.

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(ii) Tools in use

Equipment in use is 1 Holman "Silver Three" rockdrill and air leg per miner, using integral tungsten carbide steel chisel bits.

The broken ore is recovered by, 15 to 25 h.p. double-drum, electric scraper hoists, the size depending on the distance the broken ore has to be scraped.

The rope used is 1-5/8" circumference 6 x 9 x 9 x 1 preformed Langslay hemp core wire rope.

36" or 48" box type hoes with replaceable manganese wear plates and

8" diameter sheave blocks are used.

Drilling:	Miners per rock drill	-	1
	Maximum number of miners per stope	-	4
	Maximum number of miners per shift per stope	-	2
	Shifts worked - day and afternoon shifts	-	Nil
	Length of hole drilled	-	5'3" or 5'11".
	Average holes drilled per shift	-	22
	Average ore broken per hole	-	0.57 sq. yds.
Blasting:	Explosives used: A.N /F O., A.N. 60% primer. No. 6 detonator, safety fuse.		
	Consumption	-	1.1 lbs. per ton
	Working cycle	-	Bore and fire on day shift or after-noon shift, with the scraping operation on the opposite shift

(Refer to sketch No. 6 for a "Typical layout of working faces" (four miners).

(iii) Ore transport

(a) From the face

Broken ore at the face is initially mucked (hand shovelled) back and then hauled by the scraper units to the ore chute. One or two men can handle the production of two miners, but this is dependent on individual ability and the scraper distances involved at the time.

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(Sketch No. 7 is a line "Diagram of ore removal" from the face to the mill.)

(b) Ore haulage

Broken ore from the chutes is loaded into rakes of either a 5 ton or 7 ton storage battery locomotive to the ore transfer pockets.

The broken ore in the Granby cars is emptied by an automatic tipping device positioned opposite the level transfer.

(c) Grizzly

Broken rock is spalled through 14 in. x 10 in. openings on a grid grizzly located over the ore transfer chute or pocket.

The purpose of the grid grizzly is to control the size of the larger rocks and thus reduce the extent of the subsequent damage and wear and tear of ore chutes and the ore conveyor belts.

(iv) Main ore conveyor belts

The broken ore is fed from the transfer pockets to the conveyor belts by means of steel chutes equipped with Ross Feeders. These feeders are essentially a slowly rotating curtain of 1½" or 2" stud link chains designed to control the rate of flow or "rill" of the ore onto the conveyor belt.

There are three 30 in. conveyor belts in series and they deliver the ore to the main mine pocket which is located above a tunnel about 100 ft. long, which emerges at the cliff face above the treatment plant.

Some details of the belts are:

BELT	LENGTH	SPEEDS	MOTORS
No. 1 conveyor	1,100 feet	300 ft. per min.	60 h.p. A.E.I.
No. 2 conveyor	1,300 feet	420 ft. per min.	60 h.p. A.E.I.
No. 3 conveyor	400 feet	420 ft. per min.	20 h.p. A.E.I.

The belting is 30 in. wide, 6 ply cotton nylon fibre CN50.

Capacity: Maximum 240 tons per hour. (This is controlled by No. 1 conveyor, currently being operated with a relatively slow reduction gear).

Ross Feeders:

Chute width	: 24 inches
Height from belt	: 13 inches
Chain links	: 12" x 6" x 1¾"
Drum speed	: 7 r.p.m.
Angle of chute	: 50°

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(v) Waste removal

Muck from development ends is hauled by locomotive and 20 cu. ft. capacity side tipping trucks to mullock passes, opposite the ore transfer pockets. The muck is transported by the main conveyors to the mine ore pocket which has been previously emptied, and conveyed by the mill No. 1 conveyor belt and discharged through a by-pass chute for disposal by motor truck.

F. Equipment and services

(i) Main mining equipment:

a) Rock drills

Type	Number in use	Task
Atlas BBC 23 W	11	Development
Atlas BBD 64 W.S.8.	5	Rising
Atlas BBD 43	2	Stoping
Holman Silver Three	45	Stoping

b) Drill steel

Coromant C.L. 426 714-1633 (5'3") Development and stoping.
Coromant C.L. 426 714-1833 (5'11") Stoping
Width of insert - 33 m.m.
Average drill steel life - 240 feet.

c) Drill sharpening

Grinders: 2 x Sandvik Coromant 1400.
One - air driven reserve.
One - electric - in use.
Air motor - 3300 r.p.m.
Electric motor - 2800 r.p.m.

d) Grinding wheels for drill steel

Type used: "Cup wheel" 37 - C46 -K.V.K.
Average number of steel grinds per wheel - 35
Average number of steel sharpened daily - 220

e) Fans:

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Primary ventilation

1 Richardson 60 A.F. fan driven by a 50 h.p. motor at 720 r.p.m. It exhausts 72,000 c.f.m. at 1.25 ins. water gauge.
1 Richardson 60 V.A.C. fan driven by a 50 h.p. motor at 960 r.p.m. It exhausts 74,000 c.f.m. at 0.8 ins.

Secondary ventilation

17 x Meco E.F. 4 fans.	Output	5000 - 6000	c.f.m.
2 x Meco E.F. 6 fans.	"	12000 - 13000	c.f.m.
8 x Richardson 2D fans.	"	1500 - 2000	c.f.m.
4 x Richardson 2½ SD fans.	"	5000 - 6000	c.f.m.
4 x Richardson 4 SD fans.	"	7000 - 8000	c.f.m.
4 x Richardson 3D fans.	"	6000	c.f.m.

Ventilation ducting

10 in. x 16 in. canvas ducting - in the stopes.
18 in. " Visqueen" and 16 in. canvas ducting - to development ends.

f) Cars and trucks

8 - 100 cu. ft. (Bottom dump type) - Granby.
12 - 66 cu. ft. " " " - "
28 - 20 cu. ft. Side tipping trucks.

g) Mechanical loaders

6 - Eimco 12 B. "Boggers" or loaders powered by 2 x 10 h.p. air motors. Bucket capacity is 3½ cu. ft.

h) Scraper hoist units

1. 14-Joy type N211.

   25 h.p. double drum scraper haulers.
   Rope speed: 250 ft. per minute.
   Rope pull : 4,600 lbs.
   Drum capacity: 408 ft. 9/16" loose coiled rope.

2. 9-Joy type J211.

   15 h.p. double drum scraper haulers.
   Rope speed: 250 ft. per minute.
   Rope pull: 1,800 lbs.
   Drum capacity: 154 ft. 9/16" loose coiled rope.

3. 2-Joy type B2F 311.

   30 h.p. triple drum scraper hoists.
   (Note: only two of the drums are operated)
   Adaptable for remote or manual control.
   Rope speed: 300 ft. per minute.

4. 4-Holman type SJ 23/236.

   25 h.p. double drum scraper haulers.
   Adaptable for remote or manual control.
   Rope speed: 190 - 360 ft. per minute.
   Rope pull: 3,840 lbs.
   Drum capacity: 280 ft. 9/16" loose coiled rope.

5. 1-Ingersoll Rand.

6. Scraper hoes.

4 ft. wide box type. Capacity 15 cwt.
3 ft. wide box type. Capacity 6-8 cwt.
Both types of hoes are fitted with replaceable manganese wear plates.

j) Tractor-dozers

2 x Eimco 630 bulldozers powered by 2 -12 h.p. and 1 - 7½ h.p. compressed air motors. Weight 7,980 lbs.
1 x Alimak Alirobot bulldozer powered by 1 - 8½ h.p. air motor. Weight 3,850 lbs. (The use of these machines is being developed to simplify the scraping operations. Their function would be to push the broken ore to the fixed lines along which the scrapers operate).

k) Scraper rope

1-5/8" circumference 6 x 9 x 9 x 1 hemp core preformed Langslay wire rope.

l) Pumps

2 x Consolidated pneumatic type C.P. 41.
Discharge: 100 gallons per minute against 40 ft. static head. Used for pumping drainage water from development ends and stope headings.
1 x Holman sludge pump. Static head 50 ft.
Discharge: 35 gallons per minute.
1 x Worthington (type W.S.)

m) Haulage-way tracks

Rails are 24 ft. and 30 ft. lengths and 45 lbs. per yard. Sleepers are 4ft. - 6 ins. x 4 ins. muiga.

G. Electrical services

(i) Change rooms and cap lamp room

There are 3 - 110V - 3 phase rectifiers for cap lamp racks.

(ii) Cap lamps

These are 4.5 volt Edison electric cap lamps. Model L.

(iii) Underground belt conveyors

Numbers 1 and 2 conveyor belts are driven by 60 h.p. 440V motors started by direct-on-line starters. Number 3 belt is driven by a 20 h.p. - 440V motor started by a star-delta starter.

(iv) Ross feeders

The feeders are controlled by D.O.L. starters and the three conveyors and the feeders are interlocked. These

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The remaining feeders (at No. 0 level), have the same interlocking system with 3 h.p. 710 r.p.m. - 440V motors transmitting through reduction gears.

(v) Main exhaust fans

These are driven by 50 h.p. motors controlled by auto-transformer starters.

(vi) Secondary ventilation

This is provided by two main types of fans using various h.p. motors.

(vii) *Hauler units*

These are driven by 35 h.p., 25 h.p. and 15 h.p. - 440V motors controlled by D.O.L. O.J. 50 starters.

(viii) Richardson fans

These are driven by 440V motors and range from 3 to 25 h.p.

(ix) Meco fans

These are driven by 5 and 10 h.p. motors all D.O.L. started.

Power at the Mine Bench is supplied through a 500 kVA transformer stepping down 11,000V to 440V.

The supply is controlled by a 600 amp oil circuit breaker, for the bench supply and Nos. 1 and 2 underground conveyors and for Nos. 1 and 2 loco charging stations.

(x) Underground supply

An 11,000V feed cable runs underground to a substation at No. 5 level. From this position a 500 kVA transformer provides power at 440V to Nos. 5, 6, 7 and 8 levels.

Nos. 5 and 6 levels are protected by a 600 amp oil circuit breaker with 300 amp H.R.C. fuses for each level.

Nos. 7 and 8 levels are protected by a 400 amp oil circuit breaker with a 300 amp H.R.C. fuse for each level.

(xi) Locomotives

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3 x Mancha type Hercules M.B.1. Rating 7 tons. h.p. 30.
6 x Batteries boxes - battery type 48K.A. 33/2. Each box consists of 12 batteries of 4 cells each. Make: Exide lead acid Kathanode cells. Capacity 512 amp-hours
1 x English Electric. Type 1A.
2 x Battery boxes - type 48KCL. 19/2. Capacity 378 amp-hours. Group - 6 batteries of 8 cells each to a box.

(xii) Charging

Rectifiers: 3 x Westinghouse. Type B.V.J. 48/100 A.C. input 415V. No. of cells 48. Charging rate:- Main starting current 103 amps, finishing current 21 amps, equalising at 14 amps.
1 x Lancashire D.C. Generator 110V, 120 amps driven by a 25 h.p. 3 Brook motor at 1460 r.p.m.
1 x English Electric D.C. Generator 110V, 72 amps.

H. Underground staff and training

(i) Underground staff

underground manager
mine foreman
chief surveyor
mine surveyor
geologist
technical officer
6 underground shift bosses
storeman/first aid officer.

(ii) Underground labour

stope miners	35
development miners	12
bogging crews	8
loco crews	10
belt crew	3
grizzly-men	6
platelayers	3
pipefitters	2
survey assistants	2
sampler	1
underground clerk	1
steel sharpeners	1
ventilation	2
magazine	3
"toolie"	1
hygiene	2
cap lamp attendant	1
timbermen	4
welders	3
fitters	4
fitters' assistants	2
electrical	4
electrical apprentice	1
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(iii) Training

Experienced labour underground has always been difficult to obtain. This is accentuated when increases in production are

Two methods of training are employed:-

a) After a short familiarization period underground the new men attend a miner or scraperman school depending on where their aptitude lies. Safety, and the requirements of the Mines Regulation Act are especially emphasized.

b) In some instances selected recruits are put to work with trusted and experienced miners or scraper men.

Good results have been obtained by applying both methods of training.

I. Ventilation

The mine is ventilated by two large Richardson exhaust fans, which deliver all intake air down-cast through the main incline. The air is delivered along the various haulage levels from the incline, through service rises and thence through the stopes and back to the exhaust fans, positioned on No. 4 level, exhausting to the cliff face, also up the rise to Colonial Gorge by an exhaust fan located at the southern end of No. 5 level.

The total intake has been measured as 103,000 c.f.m. and the exhaust at 146,000 c.f.m., the difference being due to air leakages into the mine.

Secondary ventilation for development and for the stopes is provided by electrically driven Meco fans of 12 in. or 16 in. diameter and by a variety of Richardson fans, depending on the requirements of the local area. The air is delivered to the working faces through plastic or canvas ducting of 10 in., 16 in. or 18 in. diameter.

J. Addendum

(i) Development of the use of ammonium nitrate - carbon mixtures in place of conventional jellied ammonium nitrate explosives.

C 4394

Traditionally jellied explosives, consisting of ammonium nitrate crystals in grease-proof paper wrapped cartridges, have been used in mining operations.

About seven years ago changes, initiated overseas, were experimented with in Australia. These changes were basically the use of ammonium nitrate crystals, in powder and pelletised form, mixed with fuel oil, raw sugar or molasses.

The result of exploding a low propagation rate explosive (A.N./F.O. for example) in contact with a relatively high explosive (such as a nitro-glycerine-ammonium nitrate explosive) is to produce a nett explosive effect or propagation rate quantitatively more relative to the small amount of "high" explosive than to the low rate ammonium nitrate.

The ammonium nitrate crystals are mixed with fuel oil or sugar or molasses and delivered into the hole in contact with either detonating fuse and A.N. gelignite in quarries, or with commercial gelignite in the case of short underground holes.

The initial developments were made in "down" holes, i.e., vertical or inclined vertical holes in quarries but quite recent developments have been made in charging horizontal or inclined upward holes by the use of equipment such as "Analoaders" which assist the explosive mixture or slurry into the more-difficult-to-charge horizontal and "upper" holes.

The method used at present is to insert a standard plug or cartridge of A.N.60 gelignite in the bottom of the hole and to use a No. 6 detonator connected through safety fuse, the hole being charged with the A.N./F.O. mixture. In firing a face, the safety fuses are connected to a line of "Slow Ignitercord" to the end of which is connected a few feet of safety fuse.

This is lit using a fuse igniter and the succession of holes in the face is detonated thereby with relatively short interval delays between holes.

By using A.N./F.O. instead of traditional commercial explosives annual savings are expected to be to the order of not less than £30,000 per annum.

(ii) Gauge of drill steel

The introduction of A.N./F.O. has led to a reduction in drill steel diameter from 33 m.m. to 28 m.m. At this gauge, indicated increased rates of boring are up to 30 per cent and it looks like an increase of 10 per cent or minimum increase from 20 to 22 holes bored per miner shift in the stoping operations.

C 4395

underground operations. It is also responsible for the maintenance of all machines, equipment, vehicles, buildings etc. and for all construction work.

B. Power and air supply

(i) Power House

This is situated at the junction of Eastern Creek and the main Wittenoom Gorge. The site is above flood level, but access to the power house can be denied when the Gorge is in flood. (As a matter of interest, emergency rations are maintained in the power house during the wet season, so that the driver and greaser on shift do not suffer undue hardship in maintaining power and air supplies).

The site was chosen as the most suitable, in the vicinity of the old Wittenoom mine but the fact that it is now somewhat remote from the Colonial Mine is not disadvantageous, except that the compressed air delivery line is much longer than usual (10,250 ft.) and is of larger diameter 10 in., in order to avoid undue loss of air pressure in transit.

The diesel alternator sets and diesel compressor sets are housed in a building 227 ft. long x 45 ft. wide, with a lean-to structure at the front, to accommodate the switchboard and a similar structure at the rear housing the blowers and cooling water pumps.

The six alternators occupy the northern end of the main building and the eight compressors the remainder of the building. The total installed generating capacity is 3,225 kVA site rated.

The following is a description of the alternator sets:

Nos. 1 and 2 sets:

Ruston 6 V.L.B.X. 4-stroke diesel engines supercharged by Napier turbo-blowers, size T.S. 300, type T.S. 3004, direct-coupled to Lancashire Dynamo and Crypto alternators and running at 375 r.p.m. Site rating 910 kVA.

No. 3 set:

Crossley 2-stroke diesel, supercharged by "Rootes" type blower size 3, motor driven through vee-belts. The engine is direct-coupled to a Brush alternator and the speed is 500 r.p.m. Site rating is 330 kVA.

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No. 4 set:

Crossley H.S.L. 6 - 2 - stroke diesel engine, supercharged as No. 3 set. direct-coupled to a Brush alternator running

No. 5 set:

> Crossley H.S.L. 6 diesel engine, supercharged, identical with Nos. 3 and 4 sets. Direct-coupled to a Brush alternator. Speed 500 r.p.m. Site rating 375 kVA.

No. 6 set:

> 6 V.E.B.X. Ruston engine, supercharged by Brown-Boveri turbo-blower, size and type V.T.R. 200/55. Direct-coupled to a Lancashire and Crypto alternator. Speed 500 r.p.m. Site rating 250 kVA.

All alternators generate at 440 V, 3 phase, 50 cycles.

Power is controlled and distributed from the main switchboard, to a bank of transformers adjacent to the power house and stepped up to 11,000 volts for transmission through overhead steel-aluminium conductors to the treatment plant, the mine and to the town. At these distribution centres, the power is transformed down to 440 volts with subsequent steps - down to 250 volts and 32 volts, where required.

(ii) Air compressors

Total installed compressor capacity is 7,850 c.f.m. (approximately 7,000 c.f.m. site rated).

No. 1 set:

> Atlas Copco E.R. 8, rated capacity 2,250 c.f.m., driven by a Ruston 4-stroke diesel engine, 6 V.E.B.X., running at 500 r.p.m., direct-coupled.
>
> Engine supercharged by a Napier turbo-blower, size and type T.S. 100/5.

Nos. 2, 3 and 4 sets:

> Alley-McLellan "Sentinel" 45B, rated capacity 1,000 c.f.m. Each driven by Crossley 2-stroke diesel engine, HSL 3, running at 430 r.p.m., direct-coupled.
>
> These engines, are not supercharged in the true sense, but are fitted with a built-in reciprocating compressor, which supplies scavenging and combustion air.

No. 5 set:

> Alley-McLellan "Sentinel" 23B, rated capacity 800 c.f.m., driven by a Crossley 4-stroke diesel engine, SVD 3, running at 374 r.p.m., direct-coupled.

Nos. 6, 7 and 8 sets:

> Browett and Lindley, rated capacity 600 c.f.m. each, vee belt driven by electric motors, 120; 125 and 130 h.p. respectively. All compressors are 2 stage double-acting, with intercoolers, but no after-coolers.

There are two air-starting compressors, one a "Sonnerdale" 14 c.f.m. and the other a "Broomwade" 20 c.f.m. These pump into 3 receivers which are maintained at 275 lbs. per sq. in.

The compressors deliver air into a 230 cu.ft. receiver which is situated alongside the power house. The receiver is connected to a 10" steel, all welded air main, the operating pressure being 100 p.s.i.

This air main is 10,250 ft. long, and delivers the air to the mine bench. At this point the pipeline is reduced to 6" and is carried down the incline (adit) approximately 3,000 feet, to a 145 cu. ft. air receiver at No. 7 ore pocket. Underground reticulation is by 4" distribution pipes, from which 2" lines are branched off as required.

The engines driving the alternators and compressors run on diesel fuel of S.G. 0.87, the consumption being 0.0625 gallons per kWh. The fuel oil at present costs 2/- per gallon, landed at Wittenoom.

This fuel is supplied by ship to the sea port, Point Samson, where it is pumped from the ship to a 3,000 ton (approximately 773,000 gallons), storage tank. The fuel is delivered from this tank and carted by returning empty fibre trucks in 1,200 gallon steel underslung tanks, by road to Wittenoom. Here the fuel is gravitated to two storage tanks which are situated adjacent to the power house. One tank has a capacity of 400 tons (103,000 gallons), and the other 200 tons (51,500 gallons).

When required, the fuel is transferred by pump to two settling tanks, each of 6,000 gallons capacity. From the settling tanks the fuel is pumped to the engine supply tanks, (one for each engine), through a large Vokes filter. Twin Vokes filters are fitted in each engine fuel line, and the fuel is metered separately to each engine.

C 4398

Lubricating oil is supplied in 44 gallon drums, and all engine sumps use Vacuum D.T.E. S.240. "Velocite" is used for all 4-stroke valve stems, and D.T.E.103 is used for the compressors.

One Sharpies centrifuge, is used for clarifying the lubricating oil in Nos. 1 & 2 alternator engines.

Two trolley mounted De Laval centrifuges serve the other alternator sets. Due to lack of equipment, no centrifuging is done on the compressor engine lubricating oil, and this oil is changed every 1,000 running hours.

Frequent samples of centrifuged oil are sent to Perth for check analysis.

The water used for the engines and compressor cooling system is treated by the "Permutit" process, and there are two systems of supply. The cooling pond, 50,000 gallon capacity, is divided into a hot and cold side, and is located behind the power house on an elevated site, about 36 feet above the power house floor.

Water from the cool side of the pond is used for the compressors and oil coolers, the engines using the water from the "hot" side. All water from the compressors and engines is returned to the pond by pump, through elevated sprays set in a slatted tower, situated above the pond, except for a small quantity which is by-passed to the "hot" side, to maintain the engine cooling water at a temperature of 110°F.

The sprays help to maintain the "cold" side of the pond at a reasonably low temperature.

The power house is staffed by an engine driver and greaser on each shift, with a staff foreman, 5 fitters, stand-by driver and greaser and one cleaner on day shift.

Power is generated at a cost of approximately 2.9d. per kWh and is distributed to the mine department at cost.

Power is supplied for domestic purposes at 6d. per unit for the first 75 units and at 1/- for each subsequent unit. Company employees are granted a concession of the first 100 units per 4 weeks free. Business rates in the town vary from 6d. to 8d. per unit.

Until recently, air was not metered, so that the cost per cu. ft. is not known. However, the cost to produce air per ton of ore broken is known, and for the past 18 months has averaged £0.144 per ton.

C 4399

C. Workshops

The Engineering Workshop is situated in Colonial Gorge, about 300 yards north of the mill, and is a new building 165 ft. long by 39 ft. wide. Nine bays are occupied by the mechanical workshop and the remaining two by the electrical workshop.

The mechanical section is served by an overhead 10 ton hand-operated gantry crane and the workshop equipment is as follows:

1	8½" Nutall lathe
1	18" shaper
1	14" pedestal grinder
1	200 ton hand operated hydraulic press
1	shearing machine
1	¾" plate bending roll, hand operated
3	electric welders
5	oxy-acetylene sets
1	Lincoln portable petrol-driven welder
1	9/16" post drill
1	electric vulcanising plant
1	small electrically driven, direct-coupled air compressor.

More adequate equipment is being installed now.

There is no installed equipment in the electrical workshop except for a few hand tools.

Near the workshop is another new building 120 ft. by 25 ft., which houses the Assistant Manager, the Chief Engineer, the drawing office, change-house and shower rooms as well as a "crib" room.

D. Transport

The Transport Department is situated at the southern end of the Wittenoom township. The transport fleet consists of:

2 cars
2 vans
1 25-cwt. flat top truck
1 5-ton tipping truck
1 7½-ton tipping truck
2 Landrovers
1 5-ton mobile crane

1 Ferguson wheel tractor
1 D.6 Cat. bulldozer
1 D.8 Cat. bulldozer
1 Ford bus
5 Leyland buses
2 Schramm diamond drilling rigs
1 fork lift truck
1 V.W. - Kombi Van

Total 23 vehicles

E. Water supply

The water supply is drawn from rock pools and a natural spring in Colonial Gorge which are kept fresh all the year round, by inflow from underground streams.

The mill and mine are supplied by water from the spring, and this supply is augmented, as required, by water pumped from the rock pool at the "market garden". (Approximately $\frac{1}{2}$ mile north of the mill).

The power house is supplied by water pumped from the rock pool in the main gorge, opposite the old mill (approx. 1 mile south of the power house). The staff settlement supply is pumped from an open well, known as the "Windmill Well", situated in the main gorge, approximately $\frac{3}{4}$ mile north of the power house. The water is pumped to an elevated storage tank on the hillside, and is gravity fed to the settlement through a 4" main.

This supply can be augmented from a rock pool, about half a mile further north and in case of emergency, the power house, settlement and mill water supply pipes can be inter-connected.

The Wittenoom township water supply is administered and controlled by the Public Works Department but the town was formerly supplied by water piped from the spring at Colonial Gorge. With the growth of the town, this supply became inadequate, and 4 bores were sunk by the Department, approximately 4 miles north of the town.

During the 1961 cyclone, the pipeline from the spring to the town was washed away, and the town is now entirely supplied by water from the bores pumped into a collector tank. From there the water is transferred to a 150,000 gallon head tank, situated on the hill behind the A. B. A. garage, by a 5 stage centrifugal pump against a total head of 350 ft., at a rate of 10,000 gallons per hour.

The present reticulation is by gravity through a 4" main. but it is proposed that this will be replaced by a 6" main in the near future.

C 4402

Chapter 10

Industrial and safety

A. General conditions of employment

The following are the general conditions affecting employment and living at Wittenoom:

(i) Where applicable the air fares, Perth to Wittenoom, for employees are advanced by the company and repaid by the employee at the rate of £3 per pay.
The amount repaid by the employee in respect of his fare is refunded to him upon completion of a half-year's continuous service.
Fares for the families of employees may be advanced if approved by the Manager at Wittenoom. These fares are repaid by the employee at a rate not exceeding £4 per pay, inclusive of repayment of his own fare. No refund is made in respect of the fares of families.

(ii) Taxation zone allowance is £270 per annum and 150% of the dependants' usual allowance.
The district allowance is £2.5.0. per week.

(iii) Transport to and from work is covered by a bus service at a low fortnightly charge to the employee.

C 4403

(iv) Housing is provided for married employees. Houses have a living room, kitchen, bathroom, sleepout, two bedrooms, with verandahs on three sides, designed for the area and constructed by the State Housing Commission, at a rental, at present, of 65/- per week (but the rate is £4 per week for the more recent plaster houses). All houses have their own dry well septic system and running water. The town supply of water comes under the jurisdiction of the Public Works Department. (48,000 gallons per calendar year free of cost to the householder. Excess is charged at 2/6d. per 1,000 gallons).

No charge is made for electric power up to 100 units per four weeks. (250 V. 50 cycle A.C.). Refrigerators and basic furniture may be purchased on an easy payment scheme. Single men's board and lodging is £5.10.0. per week at present. Bedding, etc. is available at reasonable prices. Furnished houses are now available at £1.10.0. extra per week and include all basic needs plus refrigerator and stove.

(v) The Company-owned store provides good coverage of all lines of groceries, meat, aerated waters, bread, clothing etc.
Prices are based on gazetted prices.
Greens and fruit are available at the store.
There is a weekly refrigerated van delivery from Perth by road.

(vi) There is a modern state school, a hotel, cafe, post office and a convent school.

(vii) There is a modern hospital and a resident doctor.

(viii) Organisations include: C.W.A., Parents and Citizens, R.S.L., R.A.O.B., Boy Scouts, pre-school kindergarten, A.W.U. Social Fund and Masonic Lodge.

(ix) Picture Gardens: 35mm. programmes are screened three times weekly. The charge is 5/-.

C 4404

(x) Sports include swimming in the natural pools. For tennis there are three floodlit courts available. There is an Annual Racing Round each September.

For golfers there is a nine hole course with sand greens. A synthetic bowling green is being prepared and plans for a country club are being considered. A basketball court and club is in operation also.

A good small bore rifle club and pistol shooting range is also available.

B. <u>Payments to employees</u>

(i) Basic wage and district allowance:

Basic wage: £14.14.4. per week plus district allowance: £2.5.0. per week.

(ii) Unions concerned:

Australian Workers' Union
Amalgamated Engineering Union
Electrical Trades Union
Federated Engine Drivers & Firemen's Union
Amalgamated Society of Carpenters & Joiners
Operative Painters & Decorators Industrial Union
W.A. Barmaids' and Barmen's Union of Workers
Hotel, Club, Caterers, Tea Room & Restaurant Employees.

(iii) Contract rates and earnings generally:

Miners	:	£10.10.0. per shift (average)
Scrapers	:	£ 9. 0.0. per shift (average)
Tradesmen	:	£ 4. 6.9. per shift (award)
Trades Assts.	:	£ 3.15.6. per shift (award)

(iv) Comment:

In mining generally and in the outback (and with the A.W.U. in mind in particular), there is a relative lack of "industrial sophistication" and it is still relatively easy to deal with unions and with union matters, in a very direct way.

Spontaneous issues, which can cause major strikes in the capital cities are settled in a few minutes by plain "down-to-earth" direct, on-the-job talks in places like Wittenoom. Kalgoorlie has a virtually strike free record and Wittenoom, literally has no record of a strike.

There are no major national issues at stake if gold or asbestos production stops. The big unions have nothing to gain in

C. Safety

The lost time accident frequency rate (number of lost time accidents per million man-hours worked) is set out below on a yearly basis, since the collection of statistics in 1957. Each figure is the average rate for the 12 month periods. (All lost time accidents recorded in the average rates are industrial injuries).

1957	229
1958	279
1959	255
1960	42
1961	76
1962	121
1963 to date	122 (average for 12 months ended May, 1963)

The collection of accident statistics on a C.S.R. Company organised basis commenced at Wittenoom during 1956, when this was commenced throughout the C.S.R. generally. At the same time, A.B.A. management was given direction in lines of safety control and recording.

In 1959 a visit was made by a Sydney based C.S.R. personnel officer to project an organised safety campaign and to commence a scheme of training supervisors in safety supervision.

At the same time, a Safety/Personnel Officer was appointed at the mine, and a safety committee set up.

The Safety/Personnel Officer was given practical training in Sydney in the personnel officer and safety officer functions. He attended a Work Simplification Course and also visited the Zinc Corporation Plant at Broken Hill and resumed his new duties at Wittenoom in October, 1959.

1960 showed a very big reduction in accident frequency rate.

A new appointee to the position of Safety/Personnel Officer has completed a five weeks' training course in Sydney, organised and directed by the Industrial Department of the C.S.R. Company and assumed duties on a full time basis in July at Wittenoom. This should ensure that a company-trained and capable officer will be giving his close attention to personnel and principal safety matters at Wittenoom from now on.

D. Health aspects

One of the principal hazards in hard rock mining, (usually metalliferous mining) is the development by the miners, of the so-called "miners complaint" or silicosis which may lead to tuberculosis and, in the past, to a high mortality rate. However, under modern conditions of effective ventilation, dust suppression and hygiene, silicosis has been reduced to acceptable terms within the mining industry.

At Wittenoom, as well as a high silica content of the rocks there is an additional pulmonary hazard in the asbestos fibre causing a disease known as asbestosis.

The dangers of asbestos came to light suddenly in 1900, in England, when attention was focussed on an asbestos carding factory in which ten men had died of lung disease, all at about the age of 30.

Broadly speaking, the length of time which may elapse between initial exposure to the dust and the development of recognized radiological symptons is said to be considerably less than that for silicosis.

Already, Wittenoom has compiled an impressive record of confirmed silicosis - asbestosis cases, mainly in people who worked in the old Wittenoom mine and mill which was extremely dusty, and partly, people who had worked underground elsewhere in metalliferous mines before going to Wittenoom.

Working in close concert with the West Australian Department of Mines and the W.A. Department of Health, every effort is made to provide safe conditions underground and in the mill by very close attention to adequate ventilation and by regular dust particle counts, which are checked frequently by the Department of Mines.

Currently, the first stage of a 5 stage plan to replace the present dust collection system ("Rotoclone") is being constructed.

The estimated cost of the complete scheme is at least £100,000. The first stage costing £15,000 is being installed at the drier level to handle the dust from the secondary crushing station before proceeding with the main installation at the treatment plant.

C 4407

Chart No. 27

STANDARD FORM

CONDITIONS OF EMPLOYMENT

I, ______________________________ engage to serve your Company at the Company's present and future asbestos mines in the Hamersley Ranges.

My engagement shall be on the terms of the award from time to time covering the Blue Asbestos Industry and subject also to the following conditions:-

1. Your Company shall advance to me the sum of £________ to cover my fare by air from Perth to Wittenoom to enable me to take up my engagement.

2. I authorise the Company to deduct the sum of at least £1.10.0. per week from my wages until the advance made for my fare has been paid.

3. If my employment is terminated from any cause whatever prior to my refunding the total fare advanced the outstanding balance shall be deducted in a lump sum from the final payment due to me by the Company

4. If such final payment is insufficient to discharge the outstanding balance the amount still unpaid shall be payable by me on demand after termination of my services and be recoverable by you.

5. The sum to be repaid by me in respect of such advance shall not exceed £__________ unless I fail to travel on the day specified, causing the Company to pay an additional fare for my transport to Wittenoom, when the amount shall cover the two fares incurred.

6. If I complete six calendar months continuous service with the Company, the Company shall refund to me the sum recovered for the fare, such refund not to exceed £________ PROVIDED FURTHER AND IT IS HEREBY EXPRESSLY AGREED that 130 continuous ordinary time shifts worked by me shall be equal to and can be read for and in place of the words "six calendar months continuous service" credit being given by the Company for time lost by me due to sickness recognised by the Company, work caused accidents and such paid holidays for which I will be entitled to payment during the term of this agreement but for no other cause.

7 I further authorise the Company to deduct from my wages 9d. per pay and to pay such deductions as subscriptions by me for benefits under the Flying Doctor Ambulance Fund.

8. I further authorise the Company to deduct from my wages per pay and to pay such deductions as subscriptions by me to The Hospitals Benefit Fund of Western Australia.

9. Four hours' travelling time only will be paid irrespective of mode and time of transport and furthermore this will only be paid if and when I complete six calendar months' continuous service with the Company.

10. If I fail to take up my engagement the fare or fares advanced to me shall be payable by me on demand and be recoverable by you.

11. Whilst employed by the Company I agree to wear footwear and clothing of a style and pattern to be approved by the management. I hereby expressly agree that I will wear miner's safety boots and safety helmet whilst employed underground and that whenever I am working for the Company, at no time will I wear sandals or sandshoes during working hours.

12. If on completion of my six months' continuous service I elect to leave the Company's service I shall not as of right be entitled to re-engagement such entitlement only accruing pursuant to the relative clauses appertaining to Annual Leave of the award currently in force between the Company and the respective union applicable to my trade or calling.

13. I undertake to become a member of the Australian Workers' Union within one month of my employment with Australian Blue Asbestos Pty. Limited.

Dated the ______________________ day of ______________________ 196__

C 4408

____

Signature of Worker

____

Confirmed for Australian Blue Asbestos Pty. Limited.

CHAMBER OF MINES OF W.A. (INCORP.)

ACCIDENT STATISTICS

INJURED MEMBER - 6 & 7 PERIODS TO 4TH & 18TH DECEMBER, 1962.

Company	Finger	Hand	Arm and Wrist	Shoulder	Toes	Foot and Ankle	Leg and Knee	Thigh	Head and Face	Chest and Ribs	Stomach	Back	Eyes	Multiple Injuries	Misc.	Fatal	TOTAL
Australian Blue Asbestos	6	2	1	-	1	9	7	3	2	2	-	4	3	1	3	-	45
Central Norseman Gold Corp.	12	2	5	-	2	6	2	4	1	1	-	6	11	3	2	-	60
Great Boulder Gold Mines	28	7	10	7	4	7	13	6	7	7	5	13	17	-	2	1	131
Great Western Consolidated	8	1	3	1	1	3	1	-	4	1	1	4	3	-	-	-	30
Gold Mines of Kalg. (Aust.)	28	15	7	7	4	15	17	2	8	6	3	35	12	-	3	1	163
Hill 50 Gold Mine	31	11	6	3	-	2	8	3	3	1	1	19	8	3	-	-	88
Lake View and Star	53	17	32	8	12	33	36	8	8	11	6	43	18	3	-	-	286
Moonlight Wiluna Gold Mines *	8	1	3	-	-	1	2	3	3	1	-	4	2	-	-	-	33
Norseman Gold Mines	1	1	1	-	-	1	1	-	-	-	-	3	-	-	1	-	9
North Kalgurli (1912) Ltd.	16	5	13	4	4	8	11	2	2	4	1	10	8	-	-	1	85
Ravensthorpe Copper Mines	13	4	2	-	1	13	5	-	3	2	-	4	3	-	1	-	48
Sons of Gwalia	10	4	11	6	7	3	8	2	1	1	1	6	8	-	1	-	74
Western Mining Corporation ∮	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Totals	202	67	92	33	37	88	112	30	40	38	18	133	88	10	13	3	1,014
%	19.92	6.61	9.07	3.25	3.65	8.68	11.04	2.96	3.94	3.75	1.78	13.12	8.68	0.99	1.28	0.30	100

* A very small mine.
∮ Not an operating mine.

SUMMARY - 6 & 7 PERIODS TO 4TH & 18TH DECEMBER, 1962

Company	Shifts Worked				Number of Accidents			
	U/G	T/P	Sfce.	Total	U/G	T/P	Sfce.	Total
Australian Blue Asbestos	28,189	11,699	21,574	61,462	38	3	4	45
Central Norseman Gold Corp.	26,833	4,968	15,048	46,849	50	4	6	60
Great Boulder Gold Mines	51,844	13,183	28,992	94,020	111	7	13	131
Great Western Consolidated	9,594	5,477	9,558	24,629	20	5	5	30
Gold Mines of Kalg. (Aust.)	54,551	14,226	32,348	101,125	141	1	11	153
Hill 50 Gold Mine	15,563	3,954	10,588	30,108	57	2	9	68
Lake View and Star	71,283	16,881	41,213	129,387	254	13	19	286
Moonlight Wiluna Gold Mines	5,437	1,617	3,330	10,384	22	1	-	23
Norseman Gold Mines	3,720	2,878	7,898	14,496	4	3	2	9
North Kalgurli (1912) Ltd.	34,709	11,400	18,326	64,443	73	8	4	85
Ravensthorpe Copper Mines	7,414	1,804	3,915	13,133	45	2	2	49
Sons of Gwalia	18,831	2,375	10,897	32,103	47	3	24	74
Western Mining Corporation	1,968	-	9,600	11,568	1	-	-	1
Totals	329,866	90,480	213,383	633,829	863	53	98	1,014
Period to June 1962	305,323	88,603	194,974	588,684	743	44	105	892
Period to December 1961	350,333	94,044	213,133	658,500	831	70	113	1,014
Period to June 1961	309,795	81,556	189,008	610,358	716	64	91	871
Period to December 1960	331,235	89,188	215,070	635,498	774	43	106	923
Period to June 1960	294,470	77,614	198,411	568,495	758	54	111	923

Company	Accidents per 1,000 shifts				Days lost				Days lost per 1,000 shifts			
	U/G	T/P	Sfce.	Total	U/G	T/P	Sfce.	Total	U/G	T/P	Sfce.	Total
Australian Blue Asbestos	1.35	0.26	0.19	0.73	133	20	16	169	4.72	1.71	0.74	2.75
Central Norseman Gold Corp.	1.86	0.81	0.40	1.30	503	23	16	542	18.75	4.63	1.06	11.57
Great Boulder Gold Mines	2.14	0.53	0.45	1.39	1,096	173	288	1,557	21.14	13.11	9.93	16.56
Great Western Consolidated	2.08	0.91	0.52	1.22	286	20	60	358	29.81	3.65	6.23	14.45
Gold Mines of Kalg. (Aust.)	2.58	0.07	0.34	1.51	1,485	79	100	1,664	27.22	5.55	3.09	16.46
Hill 50 Gold Mine	3.66	0.51	0.85	2.26	272	18	77	367	17.48	4.55	7.27	12.18
Lake View and Star	3.56	0.77	0.46	2.21	2,736	178	249	3,163	38.46	10.54	6.04	24.68
Moonlight Wiluna Gold Mines	4.05	0.62	-	2.21	107	13	-	120	19.68	8.04	-	11.56
Norseman Gold Mines	1.08	1.04	0.25	0.62	17	4	27	48	4.57	1.39	3.38	3.38
North Kalgurli (1912) Ltd.	2.10	0.70	0.22	1.32	793	117	201	1,111	22.85	10.26	10.97	17.24
Ravensthorpe Copper Mines	6.07	1.11	0.51	3.73	300	16	3	319	40.46	8.86	0.77	24.29
Sons of Gwalia	2.50	1.26	2.20	2.31	281	16	116	413	14.92	6.74	10.65	12.86
Western Mining Corporation	0.60	-	-	0.09	52	-	-	52	26.38	-	-	4.49
Totals	2.62	0.57	0.46	1.60	8,081	677	1,143	9,901	24.49	7.48	5.36	15.62
Period to June 1962	2.43	0.51	0.54	1.52	6,723	311	1,022	8,056	22.02	3.51	5.38	13.73
Period to December 1961	2.37	0.74	0.53	1.54	8,630	809	857	10,296	24.65	8.60	4.04	15.60
Period to June 1961	2.30	0.78	0.48	1.43	7,431	687	895	9,013	24.79	8.42	4.74	15.60
Period to December 1960	2.34	0.48	0.49	1.45	8,838	440	1,332	10,610	26.66	4.93	6.19	16.70
Period to June 1960	2.57	0.70	0.57	1.62	8,334	442	1,101	9,877	28.29	5.69	5.61	17.37

Chart No. 28

C 4409

CHAMBER OF MINES OF W. A. (INCORP.)

ACCIDENT STATISTICS

UNDERGROUND - 6 & 7 PERIODS TO 4TH & 18TH DECEMBER, 1962.

Company	Falling	Falling Ground	Falling Material	Explosives	Fumes	Scats	Stones Falling on Rills	Stones From Chutes	Trucks Tipping Pushing Lifting	Jamming	Mishand. Tools & Materials	Elect. Shock	Salt Water	Burns and Scalds	Septic from Abrasions	Falling While Carrying Materials	Barring Down	Misc.	Fatal	TOTAL
Australian Blue Asbestos	1	9	1	1	2	3	.	.	1	2	16	.	.	.	1	.	1	.	.	38
Central Norseman Gold Corp.	7	1	1	1	-	8	.	2	-	2	12	2	3	.	.	-	4	7	-	50
Great Boulder Gold Mines	8	19	3	2	1	14	9	10	7	16	13	.	.	.	2	-	4	1	1	111
Great Western Consolidated	2	2	-	-	.	3	1	1	1	6	4	-	.	.	.	.	.	.	-	20
Gold Mines of Kalg. (Aust.)	22	7	2	-	4	11	8	5	19	13	33	-	1	-	.	.	11	4	1	141
Hill 50 Gold Mine	8	1	-	-	-	11	7	2	7	3	20	.	.	.	-	-	-	.	-	57
Lake View and Star	38	21	7	1	1	17	33	28	20	25	37	-	.	2	4	1	16	7	-	254
Moonlight Wiluna Gold Mines	4	6	-	-	.	2	-	1	2	2	5	-	.	-	.	.	.	.	-	22
Norseman Gold Mines N. L.	.	-	-	.	.	-	.	.	1	-	1	-	.	-	-	1	.	1	-	4
North Kalgurli (1912) Ltd.	11	2	5	-	2	8	5	8	15	6	6	-	-	.	-	.	9	-	1	73
Ravensthorpe Copper Mines	3	8	2	-	-	2	1	1	2	19	3	-	2	.	1	-	-	1	.	45
Sons of Gwalia	8	3	2	1	-	4	3	5	8	3	3	.	-	.	-	3	1	3	-	47
Western Mining Corporation	-	-	.	.	.	.	.	.	.	.	.	-	1	.	.	.	.	.	.	1
Totals	109	79	23	6	10	83	67	61	79	97	152	2	7	2	8	5	46	24	3	863
%	12.63	9.15	2.66	0.70	1.16	9.62	7.77	7.07	9.15	11.24	17.61	0.23	0.81	0.23	0.93	0.58	5.33	2.78	0.35	100

SURFACE - 6 & 7 PERIODS TO 4TH & 18TH DECEMBER, 1962.

Company	Felling	Falling Material	Moving Machinery	Moving Belts	Hot Materials	Electric Shock	Scats	Chemical Solutions	Mishand. Tools & Materials.	Misc.	Fatal	TOTAL
Australian Blue Asbestos	-	.	-	1	1	.	-	.	5	.	.	7
Central Norseman Gold Corp.	3	.	-	.	.	1	1	1	3	1	.	10
Great Boulder Gold Mines	4	3	2	.	.	-	3	1	6	1	.	20
Great Western Consolidated	2	2	1	1	.	.	.	.	4	.	.	10
Gold Mines of Kalg. (Aust.)	1	-	2	.	.	.	2	-	5	2	.	12
Hill 50 Gold Mine	2	-	-	-	1	.	1	-	6	1	-	11
Lake View and Star	6	2	1	.	-	1	4	-	14	4	.	32
Moonlight Wiluna Gold Mines Ltd.	-	-	-	-	.	-	-	-	1	.	.	1
Norseman Gold Mines	2	-	1	-	-	.	.	-	1	1	.	5
North Kalgurli (1912) Ltd.	1	2	.	.	-	-	.	-	9	-	.	12
Ravensthorpe Copper Mines	-	-	2	1	-	-	1	-	-	-	.	4
Sons of Gwalia	2	7	3	-	-	-	3	1	10	1	-	27
Western Mining Corporation	-	-	.	.	.	-	-	.	.	.	.	.
Totals	23	16	12	3	2	2	15	3	64	11	.	151
%	15.23	10.60	7.95	1.99	1.32	1.32	9.93	1.99	42.39	7.28	.	100

Chart No. 29

C 4410

Chapter 11
Exploratory drilling

A. Previous drilling
B. Present practice
C. The prospect

A. Previous drilling

In 1950, an attempt was made to explore ahead of the mine workings to confirm the quality of the fibre and to define the best direction in which the mine should develop.

Five holes were drilled with light diamond drill equipment, a Mindrill FD20, comparatively close to the cliff face at Colonial Gorge using "AX" and "EX" equipment. However, although subsequent mining confirmed closely the assessment from these holes, at the time, the results were uncertain, due to imperfect core recovery, losses of diamonds were almost prohibitive and the costs of drilling extremely high.

However, five holes were drilled in the vicinity of Nos. 3 and 4 levels with the following reported results:-

Hole No.	Upper Seam		Lower Seam	
	Depth	Assay	Depth	Assay
1007	418	3.40"	-	No Record
1010	389	4.25"	410	2.20"
1016	392	2.75"	413	3.45"
1002	321	2.50"	342	2.30"
1021	324	2.71"	345	2.42"

The exploratory drilling at Wittenoom is a most difficult undertaking for the following reasons:-

(i) The terrain is precipitous and very rugged and getting drilling equipment to the drill sites is rather hazardous and results in an unusual cost component in the total drilling costs.

C 4411

(ii) Water is not available on the "plateau", 600 ft. above the floor of the gorge and until recently dry drilling with its attendant disadvantages had to be accepted.

(iii) The quartzite-ironstone formations drilled are probably the hardest fine grained rocks likely to be encountered anywhere.

(iv) The existence of joints and "vugs" (or small caves), presents the problems of casing and cementing the holes to avoid loss of circulation of the drilling fluid, accompanied by the ever-present risk of jamming bits and other equipment down the hole and resulting in the loss of costly equipment, or costly recovery operations, in any case.

Two years ago (1961), the decision was made to purchase a pneumatic tyred tractor drill unit to make a fresh attack on the exploratory drilling task.

This was the American, Schramm "Rota-drill" No. 125 equipped with a 4-cylinder International diesel engine, direct-coupled to a 250 c.f.m. air compressor and having power take-off to a hydraulic system from which control is secured of the drill drive head: of positioning the drill mast and winch for raising and lowering the drill string; the "break-out" tools and the levelling jacks for the rig. This rig started work January, 1961.

Initially, the technique and procedure adopted was to use a Mission, "down-the-hole" percussion hammer and to change over to "NX" diamond drill bits, when the geological examination of the drill cuttings indicated close proximity to the upper fibre seam.

Both the percussion and diamond drilling was done dry and the hole was "air swept"; that is, air supplied by the compressor, through the bit, lifted the cuttings of rock to the surface to allow the bit to drill ahead.

C 4412

Due to this dry method and lack of experience of most of the drillers and the very slow rotation rate of the Schramm drill for diamond drilling purposes, progress was painfully slow and extremely costly and holes were abandoned incomplete and equipment damaged and lost.

At the time, a 4 in. drill stem was used coupled to a 4½" B37 - 1020 Mission hammer drill.

B. Present practice

Early this year, the drilling was re-organised under the enthusiastic direction of a new drilling superintendent, who had previous considerable contract drilling experience at Mount Isa and elsewhere.

The present highly successful technique employed is as follows:

(i) The hole is spudded in using a "Tri-Cone" bit to penetrate to solid rock.

(ii) The hole is then cased with a retrievable casing.

(iii) The collar is cemented in with a concrete block, approximately 2ft. x 2ft. and 3 ft. deep.

(iv) Drilling is resumed by dry percussion drilling, using "N" rods and an ASS-100-4in. Halco percussion hammer drill and the hole is drilled ahead to within a few feet of the fibre seams, the horizon of which can be accurately predicted by interpretation of the drill core log.

(v) Diamond drilling then takes over and "NX" casing is run and sealed with an "NX" casing shoe bit.

(vi) Drilling proceeds using circulating water and an "N" rod string and "NX" stationary core barrel.

(vii) Bits are made up to a special diamond setting of 8 to 10 carats, each being 80-110 "Hardcore" stones per carat.

(viii) A soluble oil "Dromus B" in the proportion of 1 gallon to 80 -100 galls. of water is added to make up the circulating water and the circulating water is pumped through the bit to the surface by a 750-1200 "Mindrill" pump.

Diamond drill core is recovered in either a 10 ft or a 20 ft. barrel and is logged by the geologist and stored in core trays for future reference.

C 4413

For holes up to 450 ft. the heavier Mission gear is still used, optionally, followed by diamond drilling as described for the ...

The soluble oil has been the principal reason for dramatically increased performance, overcoming the problem of drilling extremely hard rock at very slow drill speeds - (80 r.p.m.).

Other observed effects, attributable to the use of the oil are:-

(i) Considerably reduced rod vibration.

(ii) Reduction of water pressure.

(iii) Improved scouring of drill cuttings.

(iv) Reduced wear on the pump.

Other equipment used in the drilling operation is:

A Land Rover and trailer for servicing the drill. One 4 wheel drive, 3 ton truck with a removable 500 gall. tank plus storage tanks at drill site and a 10,000 candlepower Tilley flood light for night operations.

As a result of the development of this successful technique, a second Schramm drill-rig was hired and subsequently purchased to press on with the exploration programme, which included a "wild cat" programme in the area, as well as the investigation of the area immediately ahead of the present mine workings.

So far, seventeen holes have been drilled with the Schramm rigs. Initially, these proved that there was economic fibre ahead of the main adit but that there was dead fibre to the north and south of the mine. Several holes were put in to prove that the dead zone to the south was in fact a fault zone and would act as a southern barrier to the mine. It was also shown that this fault zone is the same as that encountered in the northern workings of the Wittenoom mine.

Drilling on the northern area was held up because at the time the technique of deep drilling with these rigs had not been developed.

Drilling then was concentrated on proving the value of the fibre ahead of the main adit. Good upper seam values were proved going in a westerly direction (see holes 15, 30 and 20). Holes 27 and 29 were sunk to delineate this ore to the north and did show marked deterioration.

C 4414

It is possible that the economic values may be bifurcated from 6 level, with one westerly limb and another to the north-west and hole 34 is currently being sunk to test this hypothesis.

The second Schramm rig has been put into service on areas remote from the Colonial Mine. The areas of particular interest are:

(i) The possible western extension of the Wittencom mine.

(ii) Values in the area adjacent to the Bee Gorge outcrops.

(iii) Values in the temporary reserve area some five miles west of the Colonial and Wittenoom mines.

(iv) Values in the Yampire Gorge area.

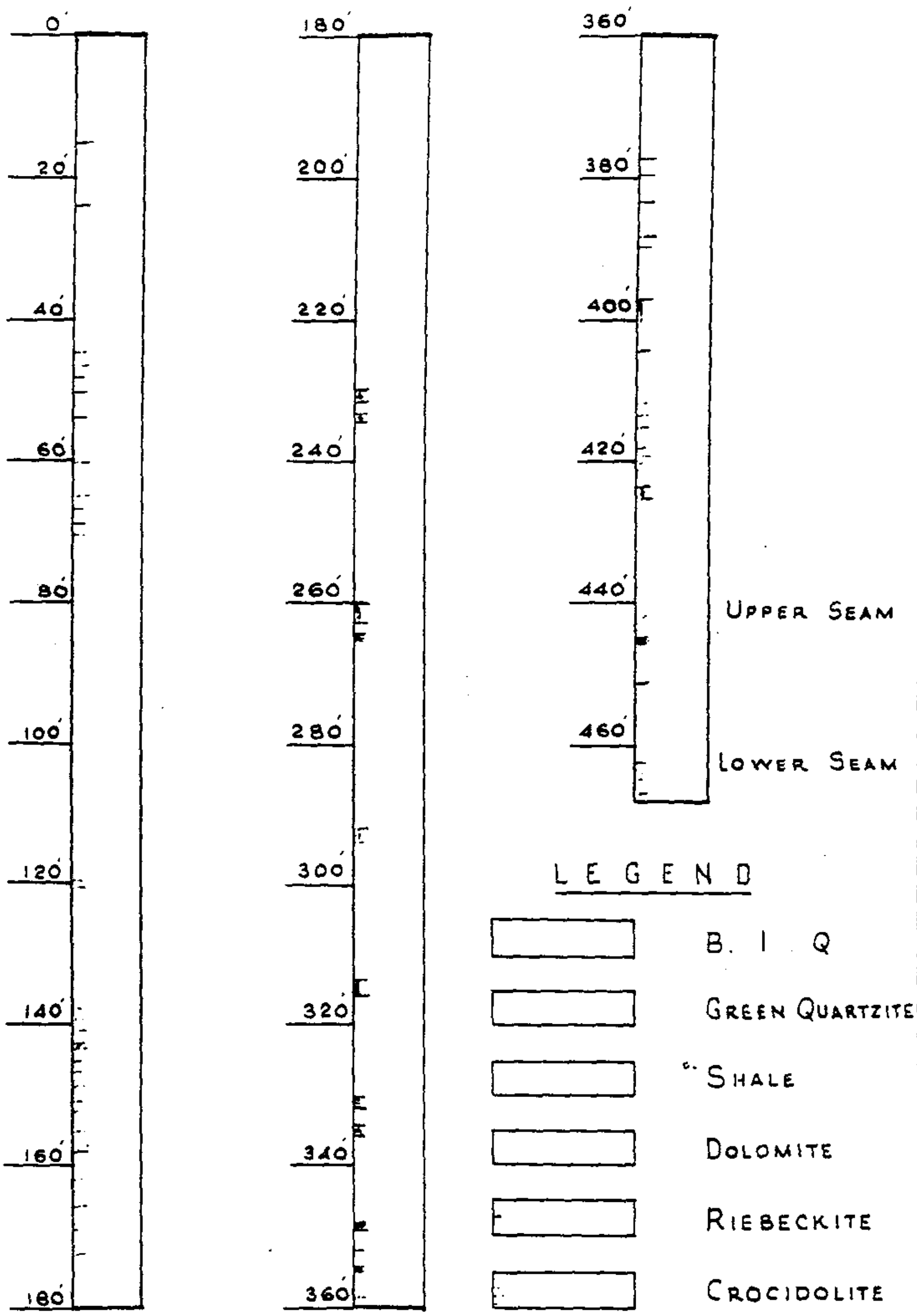
C. The prospect

As it stands at present, there appears to be no real evidence to cause concern about future fibre grades, nor,in fact,that the direction of pitch of the ore body will change,as far as mining operations are concerned.

The present hole, No. 34, is a critical one in this consideration.

Broadly, it could be said that on the extension of the axis of the main adit of the mine, there is an area which may be 3,000 to 5,000 ft. in length and has a width of probably 2,000 ft., in which a certain amount of drilling has been done, but until further drilling is carried out, it is impossible to assess the long term picture with any certainty.

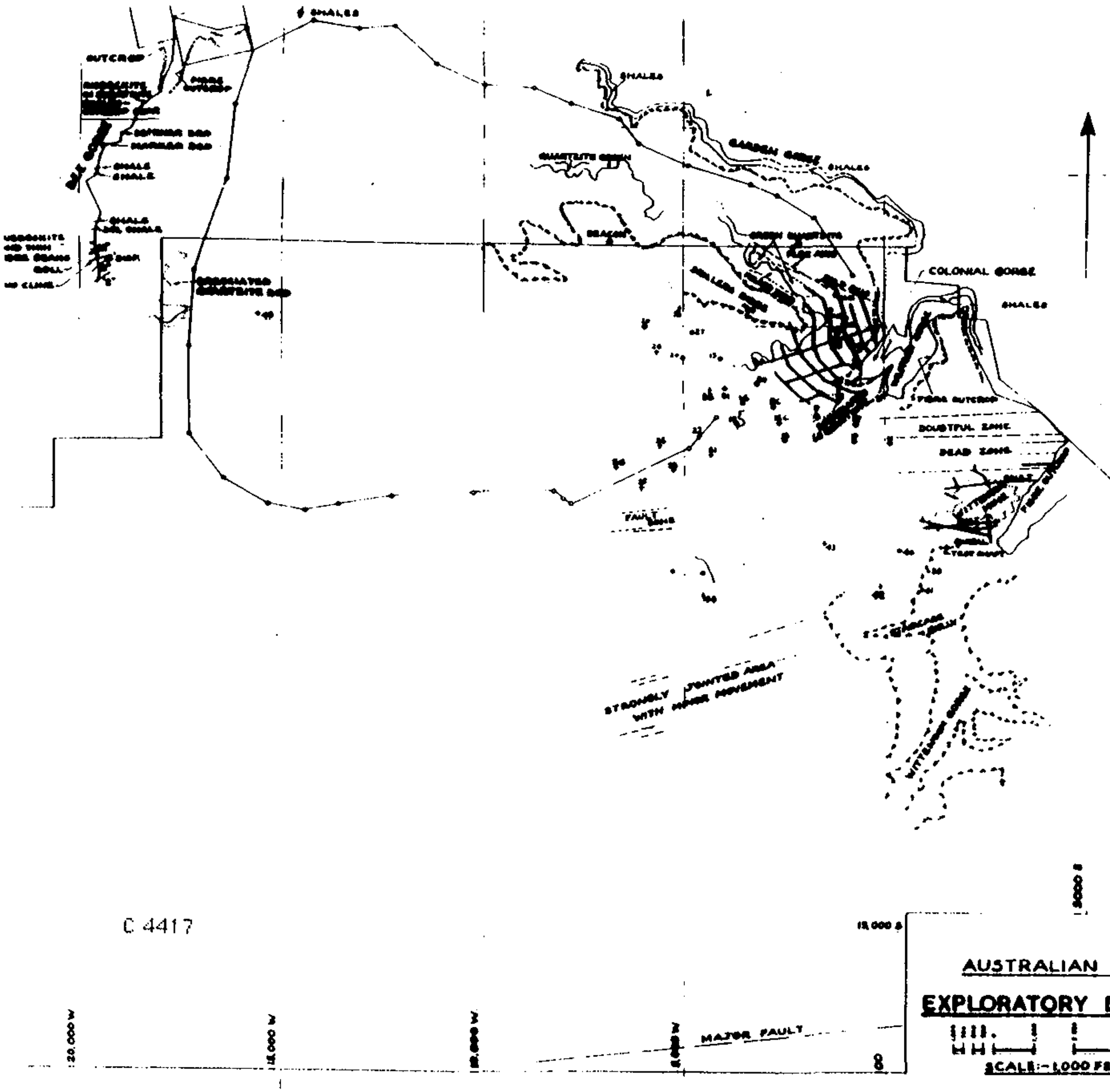
CHART No 30



C 4416

Scale : 1" = 20'

CROSS SECTION



7	[illegible]	[illegible]	[illegible]	[illegible]	
8	342	2 80	Not Cored		Seam Oxidised
9*	416	2 50	430	2·03	Upper Seam Value Estimated
10	365	0·30	374	1 23	[illegible]
11	403	1·86			Upper Dead
12*	390	2·04	410	0 9	K3 1 3 Lower & K3 Oxidised
14	465	1 72	475	1·45	
16	492	3·00	502	2·44	
30	446	3·63	470	2·41	
19	461	1·64	472	1·21	
20	562	3·11	572	1·18	No 3 Seam 0 70 at 596'
17	399	0·61	406	0 70	
21	527	1·69	547	2·91	
27	531	2·23	542	1·12	
23	611	1·96	636	1·04	
48	661	1·15	670	1·59	
[illegible]	419	2·40			Upper Seam Only
[illegible]	362	4·25	410	2·20	
[illegible]	396	2·75	413	3·46	
[illegible]	331	2·50	342	2·30	
[illegible]	334	2·71	345	2·42	

PROPOSED BOREHOLES SHOWN + 34

AUSTRALIAN BLUE ASBESTOS PTY. LTD.

EXPLORATORY DRILLING PROGRAMME

SCALE:- 1,000 FEET TO AN INCH.

ABA. 1055.

GREEN QUARTZITE
OUTCROP
LIMESTONE
& SHALES
SHALES
GARDEN GORGE
COLONIAL GORGE
BRECCIATED
QUARTZITE BED
DOUBTFUL ZONE
DEAD ZONE
FAULT ZONE
STRONGLY JOINTED AREA
WITH MINOR MOVEMENT
OUGH TERRAIN
EMPORARY RESERVE
WATER
COURSE
ALLUVIAL and LATERITIC
DEPOSITS
OUTCROPS VERY POOR
C 4418
WATER COURSE
120,000 W
MAJOR FAULT
AUSTR
EXPLORA
SCALE

Chapter 12
Markets

The marketing of asbestos (blue or white) follows a pattern different from other commodities and minerals. Each year between October and December most users contract for their requirements for the following year and very little tonnage is bought or sold during the year, other than the main contracts abovementioned.

To achieve sales, it is necessary to contact all users, individually towards the end of the year to discuss their requirements, the fibre quality and prices etc. Consequently buyers have become very selective and as price is still the main consideration the market is extremely competitive.

The main use for blue fibre is in the manufacture of asbestos cement pressure pipes and to a much lesser degree in asbestos cement sheets, corrugates and moulded products.

Until a few years ago, although flat sheets and corrugates were made in most parts of the world, pressure pipe manufacture was confined to comparatively few countries, the main producers being the U.S.A, several European countries, Australia and Japan. In recent years there has been a tremendous increase in the number of pipe manufacturing plants and there are now few countries in the world which do not have a pipe making industry in operation or planned. Because of this spread of manufacturing activity the job of selling fibre and keeping in contact with the users has grown in importance and magnitude in order to maintain sales in the face of keen competition from South African producers.

Asbestos cement factories in many cases lack good technical assistance, and fibre formulations have developed in accordance with someone's fancy or what is most easily used rather than on good technical foundations. Consequently it is rather difficult to convince a buyer that any particular grade of fibre has advantages over any other grade. This condition is changing, however, and standards are being introduced and more attention is being given to the particular properties of the different fibres. For this reason close attention to fibre quality is necessary and producers must be prepared to meet a customer's requirements regarding length of fibre and degree of fibreisation, if the maximum market is to be secured.

Current market for blue fibre has been adversely affected by:-

(i) Depressed conditions in the asbestos cement business in Japan.

(ii) Some slowing down in Europe as a result of the severe winter this year.

(iii) Over-production and price cutting by the South African producers.

Improvement in the market position for blue fibre can reasonably be expected because of:-

(i) The comparatively rapid lift in the standard of living in Eastern countries and in South America. This will call for a vast amount of water supply and sewerage work involving the use of asbestos cement pipes and building materials.

(ii) Many high pressure pipe plants have been established in recent years most of which are working part time. This condition will not be allowed to continue and sales of finished products will increase with proportional increase in fibre consumption.

A feature of the market could be a slackening off in production from the old established pipe plants due to loss of export market and a rapid increase in output from the new plants. Because of this local manufacture in many countries the main fibre market could move from Europe to countries in Asia, The Middle East and South America.

Chapter 13

Company organisation

A. Board of Directors

Australian Blue Asbestos Pty. Ltd.
1963

Chairman and
Managing Director

K.O. Brown

Directors

M.G. King
C.H. Broadhurst
A.C. Higgs
A.R. Johnston

Alternate Directors

H.R. Brennan for A.C. Higgs
A. Mackintosh for C.H. Broadhurst

Secretary

J. Notley

B. Mine staff organisation

Senior staff organisation as at October 1963 is:

General Superintendent	-	P.C. Thomas
Manager	-	O.A. Allan
Assistant Manager	-	H. Stevenson

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D. Previous senior staff appointments

GENERAL SUPERINTENDENTS (PERTH)

C.H. Broadhurst	(General Superintendent and Resident Director)	1956 - 1958
P.C. Thomas	(General Superintendent)	1959 to date

MANAGERS

L.G. Hancock	(called Superintendent)	1943
C.H. Broadhurst		1944 - 1947
D. Humphries		1948
A.W. Morgan		1949
P.H. Reagan		1950 - 1952
R.P. Luke		1952
C.H. Broadhurst		1953 - 1955
P.C. Thomas		1956 - 1958
O.A. Allan		1958 to date

UNDERGROUND MANAGERS

H. Marks	1945
D. Humphries	1947 - 1948
P.C. Thomas	1950 - 1957
K.J. Carter	1960 - 1962
J.P. Shanahan	1962 to date

MILL SUPERINTENDENTS

(Note from 1943 to 1950 the Chief Engineer was also the Mill Superintendent).

O.A. Allan	1950 - 1958
N. Whitford	1959 - 1960
D.W. Ebert	1960 - 1961
W.L. Gordon	1961 to date

CHIEF ENGINEERS

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G.P. Wallace	1943 - 1944
H.H. Cross	1945 - 1947
E.G. Morland	1948 - 1951

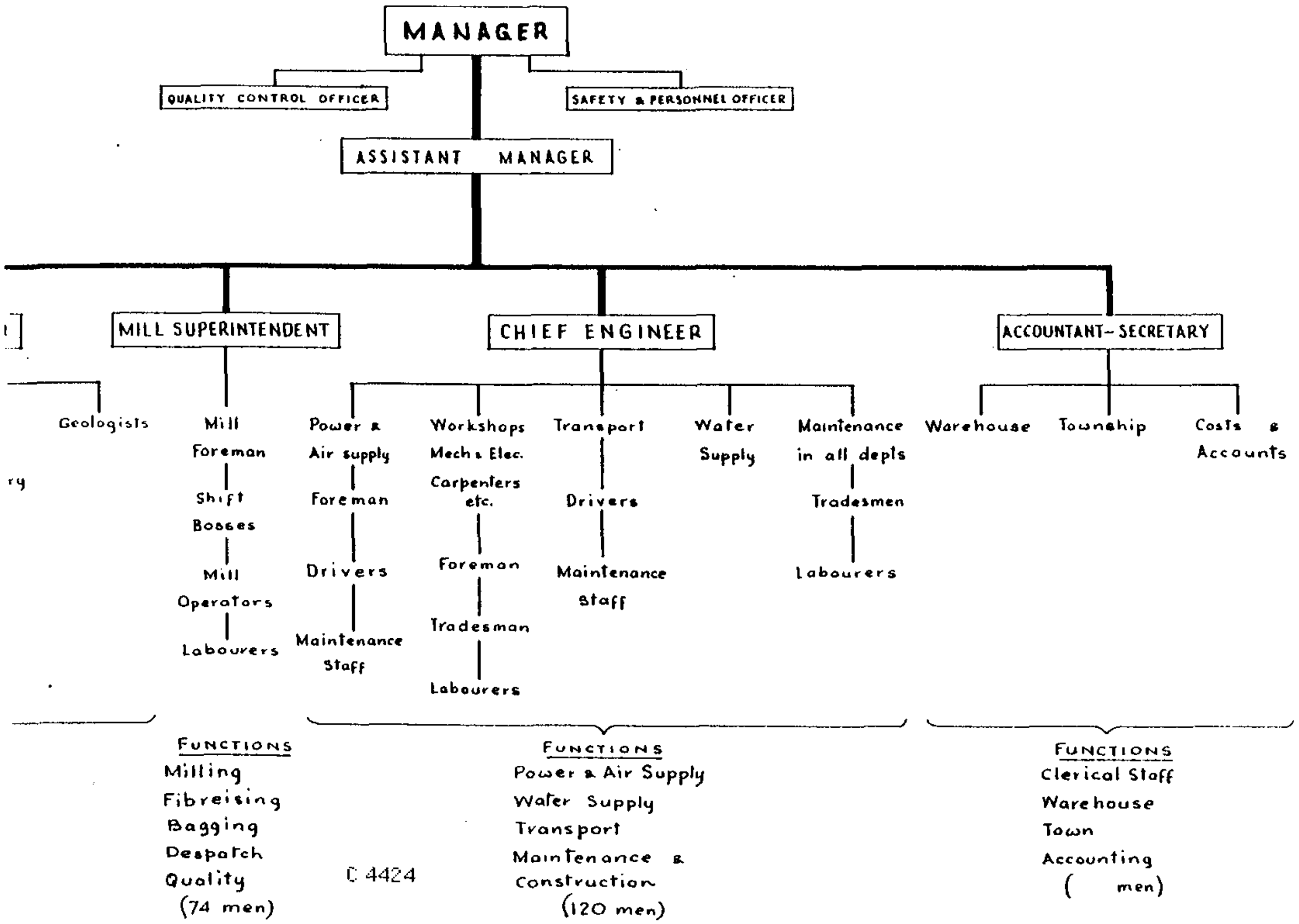
SECRETARIES

J.L. Tucker	Resident in Perth	Secretary	1943 - 1948
G. West			1948 - 1949
A.R. Johnston	At Wittenoom		1950 - 1953
F. Millington			1953 - 1958
W.M. Beith			1958 - 1962
J.S. Notley			1962 to date

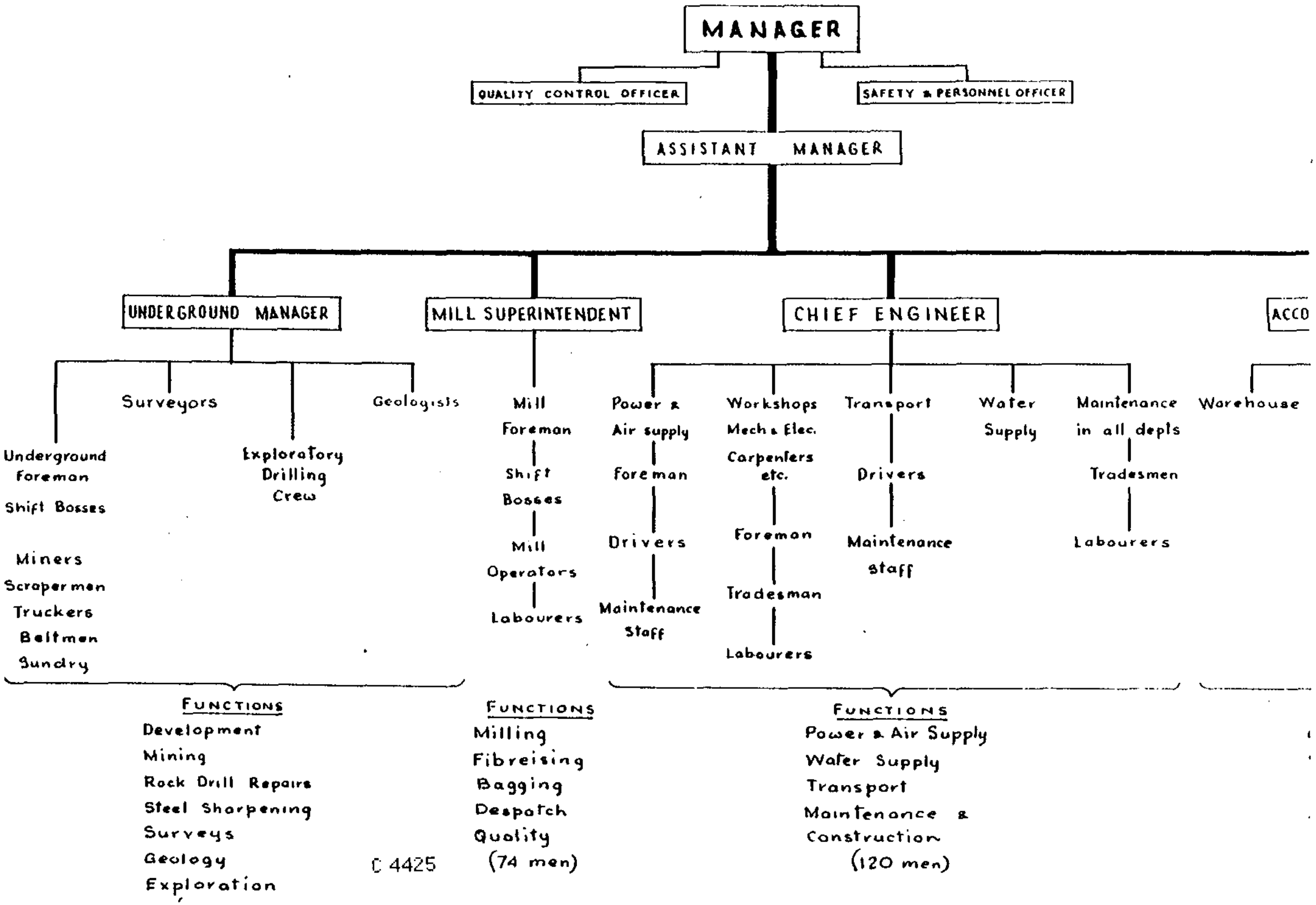
ACCOUNTANTS

J. L. Tucker	1943 - 1945
A.R. Johnston	1945 - 1953
F. Millington	1953 - 1958
W.M. Beith	1958 - 1962
J.S. Notley	1962 to date

MINE STAFF ORGᴬNIZATION CHART



MINE STAFF ORGANISATION CHART



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Confidential

THE A.B.A. STORY

Volume 2

Statistical and Financial

C 4426

SECTION I

GENERAL STATISTICS

Payroll tax paid - £151,600

Production in recent years:

	Year	Tons	Valued at £s.
	1959	16,416	1,540,000
	1960	14,474	1,404,000
	1961	15,777	1,531,000
	1962	17,301	1,627,000
Est.	1963	~~13,000~~ [illegible]	1,196,000

Grade of asbestos mined:

1959	3.6"
1960	3.4"
1961	2.9"
1962	2.7"
1963	2.7"

Tonnages exported:

	Tons	Valued at £s.
1959	11,832	1,150,000
1960	9,631	930,940
1961	8,248	801,400
1962	9,937	929,270
1963	~~3,600~~ [illegible]	~~323,750~~

Freight rates Wittenoom to Fremantle - per ton - £13.12.0.

Distribution Markets

Short tons asbestos fibre

Year	Australia	Europe	Asia	America	Total
1948	783	10	-	50	843
1949	748	-	-	200	948
1950	758	90	-	274	1,122
1951	707	258	20	292	1,277
1952	1,593	820	2	272	2,687
1953	628	290	-	2,043	2,961
1954	200	264	-	1,522	1,986
1955	387	4,069	-	3,542	7,998
1956	363	3,643	60	3,801	7,867
1957	1,014	3,635	929	6,720	12,298
1958	3,207	2,411	1,300	5,991	12,909
1959	4,650	1,547	1,254	9,031	16,482
1960	5,252	3,555	2,252	3,824	14,883
1961	7,464	1,809	3,483	2,956	15,712
1962	6,233	747	2,768	6,422	16,170
[illegible]	[illegible]	525	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible] 332	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

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Annual Development:

		Feet
1948)) 1949)	Old method (development and stoping combined).	-
		-
1950		2,730
1951		6,722
1952		9,346
1953		3,366
1954		2,918
1955		2,209
1956		2,076
1957		3,772
1958		4,741
1959		5,495
1960		4,304
1961		4,366
1962		5,373

Ore Reserves: Large areas remain to be tested, but it is estimated that the ore reserve contains not less than 3,000,000 tons of recoverable fibre.

Production:

	Tons ore mined
1948	13,000
1949	18,000
1950	21,000
1951	42,536
1952	98,972
1953	133,269
1954	128,181
1955	90,987
1956	125,487
1957	182,923
1958	214,405
1959	281,434
1960	258,064
1961	296,107
1962	349,551

	Short tons asbestos fibre
1948	850.16
1949	1107.26
1950	1155.59
1951	1566.86
1952	3290.73
1953	4253.97
1954	4248.92
1955	4845.67
1956	8160.34
1957	12222.19
1958	13313
1959	16416

Wages and salaries paid together with payroll tax commitments and labour expense overhead percentages

Overhead includes holiday pay, travelling time, sick pay, air fares, workers' compensation insurance, cost of messing and accommodation, advertising and recruiting of labour, welfare, bus service, medical services etc.

Year	Wages & salaries paid	Payroll tax	Costs overheads labour exp.	Overhead percentage on wages paid
	£	£	£	£
1948	75,802	1,598	16,078	28.81
1949	156,658	3,163	28,900	23.75
1950	191,394	4,244	27,474	17.91
1951	299,156	5,143	38,011	14.96
1952	362,038	8,689	46,747	16.41
1953	350,217	8,568	47,154	14.38
1954	345,612	8,528	48,158	16.61
1955	276,837	6,834	46,728	19.45
1956	360,952	8,824	54,120	17.71
1957	501,909	12,214	74,175	17.16
1958	549,408	13,246	62,349	13.10
1959	623,473	15,083	71,451	13.19
1960	637,563	15,309	79,939	14.36
1961	750,461	18,124	91,646	13.87
1962	867,928	20,911	109,330	14.26

Freights paid:

Year	Inwards cargoes	Outward fibre cargoes	Total
	£	£	£
1950	56,423	3,835	60,258
1951	60,077	5,676	65,753
1952	56,118	16,321	72,439
1953	47,810	27,782	75,592
1954	48,462	25,532	71,994
1955	48,854	25,723	71,577
1956	59,691	43,175	102,866
1957	90,026	64,908	154,934
1958	107,191	95,880	203,071
1959	93,578	93,816	187,394
1960	85,240	87,799	173,039
1961	117,845	101,017	218,862
1962	112,156	109,138	221,294

Milling:

Summary of the milling account

Period	Cost per ton		Total milling costs
	Ore treated	Fibre bagged	
Half-year to December, 1961	30.59/-	£23.17	£235,204
Half-year to June, 1962	36.84/-	£28.85	£226,336
Half-year to December, 1962	37.50/-	£29.26	£276,672

Fibre Produced:

Half-year to December, 1961	10,150 tons	392 tons per week
Half-year to June, 1962	*7,845 tons*	*300 tons per week*
Half-year to December, 1962	9,456 tons	360 tons per week

Cost of wear steel:

The following is a breakdown of costs for the major wear parts in the crushing section and the treatment section.

Fibreisers for the six month period ending December, 1962. All parts are of manganese steel.

Crushing section:

	£
Kue Ken jaws	500
4½' Symons bowl liners	608
4½' Symons mantle liners	432
4' Symons bowl liners	1,440
4' Symons mantle liners	1,344
3' Symons bowl liners	1,980
3' Symons mantle liners	1,980
	£8,284

Treatment section:

	£
Hazemag fibreiser beaters	5,440
Hazemag fibreiser other wear parts	2,856
Kubit mill fibreiser beaters	4,800
Kubit mill fibreiser other wear parts	4,314
	£17,410

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Total crusher and fibreiser parts - Manganese steel wear parts only.

= £25,694

A comparison of crusher and fibreiser costs from the above shows that:-

(a) The cost of fibreising equipment wear parts is double that of crusher wear parts.

Major cost items include:

Labour - operating	£5.4 per ton fibre bagged
Labour - maintenance	£3.3 per ton fibre bagged
Stores - maintenance	£6.0 per ton fibre bagged
Power	£5.25 per ton fibre bagged

SECTION II

MINING MONTHLY CONTROL REPORT

4 weeks ended 4/6/63

THIS PERIOD					HALF YEAR TO-DATE (24 WEEKS)			
BGT.	ACTUAL				BGT.	ACTUAL		
£ / sq. yd.	£ / sq. yd.	Ex-pense	Vari-ance	DIRECT EXPS.	£ / sq. yd.	£ / sq. yd.	Ex-pense	Vari-ance
3.167	3.185	19399	- 108	Labour	3.167	3.234	116685	-2406
.507	.521	3171	- 83	Labour exes.	.507	.525	18943	- 649
.463	.192	1168	plus 1652	Stores OPTG.	.463	.272	9814	+6893
.407	.422	2572	- 93	Steel	.407	.451	16277	-1591
.878	.595	3622	-1726	Explosives	.878	.775	27973	+3709
.971	.971	5912	- 2	Repairs & Mtce.	.971	.937	33800	+1237
.548	.572	3491	- 153	Power	.548	.548	19777	- 3
.463	.448	2728	- 92	Compressed air	.46	.457	16484	+ 223
7.404	6.906	42063	-3035		7.404	7.199	259753	-7413
				Less				
-	-	-	-	Mine develop.	-	-	-	-
7.404		42063	-3035	Increase	7.404		259753	+7413
.775	.636	3870	- 530	- develop. susp.	.775	.480	17297	-9603
6.629	6.270	38193	-2505		6.629	6.719	42456	-2190
				INDIRECT EXES.				
.007	.013	80	- 40	Labour	.007	.012	43	- 193
.403	.370	2256	-	Salaries	.403	.391	14093	-
.071	.067	406	- 5	Labour & sales exs.	.071	.071	2563	- 66
.117	.111	677	-	Motor vehicles	.117	.113	4062	-
.203	.672	4090	-	Depreciation	.703	.680	4540	-
7.930	7.503	45702	-2460	Total cost mining	7.930	7.986	38152	-2449
				STOCK ADJUSTMENT				
		21907		Opening ore stock			16894	
		67609					305046	
		21164	- 743	Closing ore stock			21164	+4273
		46445	+1727	Total cost ore milled			283882	+1821
			6091	Square yards lifted	36.084			
			101.5	% Budget	103.17			

This budget is based on 1500 sq. yds. per week, 250 tons fibre per week and 145 ft. development per week.

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COSTS - MINING ACCOUNT

H.Y.E. 31-12-62.

LAST HALF YEAR		
55,923	Sq. Yds. ore lifted	64403
175,849	Tons rock mined	203911
161,863	Tons ore broken	187688
152,464	Tons ore to mill	181879
7,844.78	Tons fibre bagged (after deducting bag weight adjustment)	9456.33
.1403	Tons fibre bagged per sq. yd. lifted	.1468
4.847	% Fibre to ore broken	5.038
4.461	% Fibre to rock broken	4.637
44.380	Cost per ton rock mined	45.703

LAST HALF YEAR		COST PER TON ORE BROKEN LAST H.Y. SHILLINGS	THIS H.Y.	£. s. d.
184,799	Labour operating	22.83	21.27	199,634. 0. 0.
15,664	Labour maintenance	1.94	1.71	16,031. 0. 0.
32,636	Labour expenses	4.03	3.38	31,674. 17. 3.
31,116	Stores operating	3.84	3.35	31,465. 0. 0.
25,014	Stores maintenance	3.09	2.90	27,208. 2. 4.
45,507	Explosives	5.62	5.37	50,408. 0. 0.
19,537	Mining steel	2.42	2.64	24,743. 0. 0.
12,645	Power	1.56	1.72	16,178. 0. 0.
23,047	Compressed air	2.85	3.27	30,687. 0. 0.
3,333	Working expenses motor vehicles	.41	.49	4,581. 0. 0.
21,675	Salaries & travelling expenses	2.68	1.88	17,665. 9. 0.
-	Engineering department	-	.57	5,368. 0. 0.
414,973		51.27	48.55	455,643. 8. 7
-	Provision for replacement			25,232. 0. 0.
414,973				480,875. 8. 7.
800	Add value of ore at start - Bins 600 tons @ £2			1,200. 0. 0.
3,394	U/G 12793 tons @ £1.4			17,910. 0. 0.
419,167				499,985. 8. 7.
	Less value of ore at end -			
1,200	Bins 800 tons @ £2			1,600. 0. 0.
17,910	U/G 10924 tons @ £1.4			15,293. 0. 0.
400,057		49.43	51.48	483,092. 8. 7.
9,851	Less transferred to account No. 11			17,123. 17. 0.
£390,206	To cost of production account	48.21	49.65	£465,968. 11. 7.

Note: 7000 tons of broken ore lost in mine cave-in and now written out of U/G stocks.

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WITTENOOM GORGE,
8th February, 1963.

ACCOUNT NO. 5

DETAILS MINING COSTS

H.Y.E. 31-12-62

	Cost per ton ore broken (shillings)		Fibre bagged (pounds)				
	Last H.Y.	This H.Y.	Last H.Y.	This H.Y.	Labour	Stores	Total
OPERATING -							
Breaking (S)		7.09		7.03	64,572	£1,949	£66,521
Breaking (D)		2.18		2.16	18,483	1,992	20,475
Shovelling mechanical		.09		.09	593	232	825
Shovelling scraper		7.72		7.66	63,046	9,385	72,431
Locomotives		1.83		1.91	16,826	314	17,140
Explosives		5.53		5.49	1,477	50,408	51,885
Mining steel		2.64		2.62	-	24,743	24,743
U/G Conveyor		1.32		1.31	11,550	792	12,342
Platelaying		.43		.43	3,648	387	4,035
Pipefitting		.56		.55	3,726	1,520	5,246
Ventilation		.54		.53	1,973	3,065	5,038
Electrical		.02		.02	131	44	175
Chute construction feeders		.41		.41	3,382	504	3,886
Surveying & sampling		.32		.32	2,819	217	3,036
Health and safety		.34		.33	25	3,138	3,163
Electric cap lamps		.12		.12	744	398	1,142
Drill sharpening		.35		.35	1,815	1,516	3,331
Storekeeping		.10		.10	909	4	913
Mine water supply		.01		.01	-	92	92
Rock drills & tools		.21		.21	-	1,952	1,952
Indirect overhead office		.22		.22	2,062	9	2,071
Ore trucks		.00		.00	-	30	30
Salvage		.04		.05	410	32	442
Technical school & language classes		.01		.01	111	-	111
Timbering main adit		.08		.08	267	529	796
Timbering levels		.47		.47	1,065	3,364	4,429
TOTAL OPERATING	34.71	32.63	35.81	32.38	199,634	106,616	306,250
MAINTENANCE							
Breaking - development		.01		.01	-	134	134
Breaking - stoping		.02		.03	68	217	285
Shovelling mechanical		.11		.11	382	692	1,074
Shovelling scraper		.98		.97	3,104	6,085	9,189
Locomotives		.68		.67	2,296	4,039	6,335
U/G Conveyor		.47		.47	2,361	2,042	4,403
Platelaying		.04		.04	420	-	420
Pipefitting		.08		.08	158	637	795
Ventilation		.10		.10	430	511	941
Electrical		.46		.45	2,030	2,248	4,278
Chute construction feeders		.23		.23	906	1,234	2,140
Surveying & sampling		.00		.00	-	34	34
Electric cap lamps		.26		.26	1,071	1,387	2,458
Drill sharpening		.00		.00	14	10	24
Mine water supply		.06		.06	149	379	528
Rock drills & tools		.88		.88	2,091	6,174	8,265
Mine buildings		.14		.14	49	1,294	1,343
Ore trucks U/G		.06		.06	376	70	546
Health & safety		.01		.01	26	21	47
TOTAL MAINTENANCE	5.03	4.61	5.19	4.57	16,031	27,208	43,239
Total operating	34.71	32.63	35.81	32.38	199,634	106,616	306,250
Total maintenance	5.03	4.61	5.19	4.57	16,031	27,208	43,239
SUB TOTAL	39.74	37.24	41.00	36.95	215,665	133,824	349,489
Engineering dept.	-	.57	-	.57			5,368
Power	1.56	1.72	1.61	1.71			16,178
Compressed air	2.85	3.27	2.94	3.25			30,687
Motor vehicles	.41	.49	.43	.48			4,581
Labour expense	4.03	3.38	4.16	3.35			31,675
Salaries expense	-	.28	-	.28			2,673
Salaries & trav. exp.	2.68	1.60	2.76	1.59			14,992
Provision for replacement	-	2.69	-	2.67			25,232
TOTAL MINING COST	[illegible] 27	51.24	52.90	50.85	To A/C No. 4		£480,875

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MINE DEVELOPMENT SUSPENSE

ACCOUNT No. 11
H.Y.E. 31-12-62

		RATE	MINE DEVELOPMENT	MINE DEVELOPMENT SUSPENSE Sq. Yds Ore.	Rate per Sq. yd.		MINING ACCOUNT NO. 4
DEVELOPMENT COLONIAL GORGE							
CAPITAL							
No. 1 adit heading	87 feet	15. 0. 0.	1,305. 0. 0.				
No. 1 adit stripping	102 feet	10. 0. 0.	1,020. 0. 0.				
Adit rises	143 feet	11. 0. 0.	1,573. 0. 0.				
Drives to service rises	41 feet	12.10. 0.	512.10. 0.				
Stripping bins etc.	3009 cu. ft.	3. 0.	451. 7. 0.				
Timbering main adit			835. 0. 0.				
SUSPENSE							
Drives, crosscuts & turnouts	2129 feet	12.10. 0.				26,612.10. 0.	
Rises	489 feet	11. 0. 0.				5,379. 0. 0.	
Miscellaneous stripping	8198 cu. ft.	3. 0.				1,229.14. 0.	
Timbering levels		-				4,584. 0. 0.	
TRANSFERRED TO MINE DEVELOPMENT ACCOUNT NO. 10			£5,696.17. 0.				
Total developed				103,400	.366	37,805. 4. 0.	43,502. 1. 0.
Less developed now written off				64,403	.410	26,378. 4. 0.	26,378. 4. 0.
Increase mine development suspense account				38,997		11,427. 0. 0.	
Balance brought forward				459,417	.147	67,739. 3. 3.	
				498,414	.150	79,166. 3. 3.	
Less zones lost in mine cave-in				121,000			
Uneconomical zones written off				-			
				377,414	.198	79,166. 3. 3.	
TRANSFERRED FROM MINING A/C TO NO. 4							£17,123.17. 0.

WITTENOOM GORGE,
8th February, 1963.

C 4435

SECTION III

MILLING MONTHLY CONTROL REPORT

4 weeks ended 4/6/63

THIS PERIOD					HALF YEAR TO-DATE (24 WEEKS)			
BUDGET	ACTUAL				BUDGET	ACTUAL		
Shgs. Ton ore milled	Shgs. Ton ore milled	Ex-pense	Vari-ance	DIRECT EXPS.	Shgs. Ton ore milled	Shgs. Ton ore milled	Ex-pense	Vari-ance
6.30	6.73	4971	- 320	Labour	6.30	7.69	31153	-5619
1.17	1.30	956	- 92	Labour exes.	1.17	1.40	5691	- 949
.98	1.43	1057	- 334	Operating stores	.98	.90	3678	+ 293
.15	.14	102	+ 8	Lubricants	.15	.15	596	+ 11
7.30	7.95	5869	- 481	Power	7.30	8.42	34109	-4524
11.91	8.95	6606	+2185	Repairs & Mtce.	11.91	11.05	44766	+3503
3.30	4.06	2999	- 563	Sacks	3.30	3.68	14920	-1546
1.49	1.51	1112	- 12	Tailings disposal	1.49	1.50	6088	- 49
32.60	32.07	23672	+ 391	Total direct exes.	32.60	34.79	141001	-8880
				INDIRECT EXPS.				
1.48	1.48	1095	-	Salaries	1.48	1.63	6556	-
.26	0.26	192	-	Salaries exes.	.26	.28	1148	-
.92	0.92	677	-	Motor vehicles	.92	1.00	4062	-
7.42	7.43	5488	-	Depreciation	7.42	8.12	32928	-
10.08	10.09	7452	-	Total indirectexes.	10.08	11.03	44694	-
42.68	42.16	31124	+ 391	Total milling cost	42.68	45.82	185695	-8880

Tons	Rate £	Expense	Variance		Tons	Rate £	Expense	Variance
14763	2.11	31124	-	Cost ore milled	81057	2.29	185695	-
13610				Tailings to dumps - ore	74407			
152.05				fibre	916.30			
1000.95	31.09	31124	+1427	Fibre bagged	5733.70	32.39	185695	+3517
9.35				Bag weight variation	36.54			
				Nett fibre	5697.16			

BUDGET	ACTUAL	PERCENTAGE		BUDGET	ACTUAL	PERCENTAGE
2.7	2.62	97.0	Assay	2.7	2.7	100.0
87	86.8	99.8	Mill recovery	87	86.2	99.1
15252	14763	96.8	Tons milled	88472	91057	91.6
1000	1000.95	100.1	Fibre produced	5800	5733.70	98.8
150	152.05	101.4	Loss of fibre	867	916.30	105.7
3348	3260	97.4	Rock discarded	19428	18623	95.8

MILLING ACCOUNT

ACCOUNT NO. 6
H.Y.E. 31.12.62.

LAST HALF YEAR			THIS HALF YEAR
152,264	Tons ore from bins		181,882
29,390	Less rock discarded		34,325
122,874	Tons ore treated		147,557
300 tons fibre 7,844.78	Tons fibre bagged (after deducting bag weight adjustment)	304 tons fibre	9,456 33
weekly average 6.384	Yield fibre bagged to ore treated	per weekly average	6.407
5.152	Yield fibre bagged to ore from bins		5.199

		COST PER TON				
		ORE TREATED		FIBRE BAGGED		
		LAST H.Y.	THIS H.Y.	LAST H.Y.	THIS H.Y.	
LAST HALF YEAR		SHILLINGS		POUNDS		
46,360	Labour operating	7.55	6.23	5.91	4.86	45,991. 0. 0.
* 26,055	Labour maintenance	4.24	1.68	3.32	1.31	12,371. 0. 0.
11,790	Labour expenses	1.92	1.16	1.50	.90	8,535. 0. 0.
6,433	Stores operating	1.04	1.02	.82	.80	7,558. 0. 0.
* 46,002	Stores maintenance	7.48	7.86	5.87	6.13	57,973. 1. 5.
1,337	Lubricants	.22	.15	.17	.12	1,148. 0. 0.
18,667	Sacks	3.04	2.89	2.38	2.26	21,339. 0. 0.
46,363	Power	7.54	5.86	5.91	4.57	43,246. 0. 0.
740	Compressed air	.12	-	.10	-	- - -
3,333	Motor vehicles	.55	.62	.42	.48	4,581. 0. 0.
10,304	Salaries & travelling expenses	1.68	1.17	1.31	.91	8,611. 10. 10.
8,952	Tailings disposal contract	1.46	1.50	1.14	1.17	11,030. 16. 7.
Eng. Dept. charges - included in charges above	Engineering Department	-	2.60	-	2.03	19,156. 0. 0.
£ 226,336		36.84	32.74	28.85	25.54	241,540. 8. 10.
-	Provision for replacement	-	4.76	-	3.72	35,132. 0. 0.
£ 226,336	COST OF MILLING - TO COST PRODUCTION A/c	36.84	37.50	28.85	29.26	£... 276,672. 8. 10.

WITTENOOM GORGE
8th February, 1963.

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DETAILS MILLING COSTS

ACCOUNT NO. 7
H. Y. E. 31. 12. 62.

	COST PER TON						
	ORE TREATED (SHILLINGS		FIBRE BAGGED (POUNDS)		LABOUR	STORES	TOTAL
	LAST H.Y.	THIS H.Y.	LAST H.Y.	THIS H.Y.			
Primary picking		1.53		1.19	10,501	788	11,289
Supervision		.18		.14	1,271	41	1,312
Secondary crushing		1.10		.86	5,899	2,196	8,095
Treatment		1.00		.78	6,009	1,384	7,393
Waste disposal		.00		.00	22	-	22
Greasing		.25		.20	694	1,148	1,842
Cleaning		.67		.52	4,823	120	4,943
Sampling		.40		.31	2,799	158	2,957
Bagging		.96		.75	6,366	702	7,068
Retreatment		-		-	-	-	-
Dust collecting		.28		.22	1,933	119	2,052
Storage & loading		.41		.32	2,985	47	3,032
Health & safety		.26		.20	42	1,886	1,928
1st Grade fibre		.04		.03	282	12	294
Mill buildings		.08		.06	482	89	571
Tailings treatment		.26		.20	1,883	-	1,883
Electric plant lighting		.00		.00	-	16	16
Sacks		2.89		2.26	-	21,339	21,339
TOTAL OPERATING	11.85	10.31	9.28	8.04	45,991	30,045	76,036
Picking		.02		.02	78	73	151
Primary crushing		.62		.48	597	3,969	4,566
Secondary crushing		2.06		1.61	2,849	12,336	15,185
Treatment		5.31		4.14	5,719	33,462	39,181
Waste disposal		.01		.01	4	71	75
Greasing		.01		.01	84	-	84
Cleaning		.05		.04	316	60	376
Sampling		.00		.00	6	28	34
Bagging		.25		.20	309	1.562	1,871
Retreatment		.00		.00	-	28	28
Dust collecting		.55		.43	1,579	2,478	4,057
Storage & loading		.01		.00	22	8	30
Health & safety		.01		.01	-	60	60
1st Grade Fibre		.02		.01	-	132	132
Mill buildings		.11		.09	411	434	845
Tailings treatment		.15		.12	216	885	1,101
Electric plant lighting		.34		.27	170	2,348	2,518
Mill water supply		.01		.00	11	39	50
TOTAL MAINTENANCE	11.72	9.53	9.19	7.44	12,371	57,973	70,344
SUB TOTAL	23.57	19.84	18.47	15.48	58,362	88,018	146,380
Tailings disposal	1.46	1.50	1.14	1.17			11,031
Engineering dept.	-	2.60	-	2.03			19,156
Power	7.54	5.86	5.91	4.57			43,246
Motor vehicles	.55	.62	.42	.48			4,581
Labour expenses	1.92	1.16	1.50	.90			8,535
Compressed air	.12	-	.10	-			-
Salaries & Sals.Exp.	1.68	1.16	1.31	.91			8,611
Depreciation	-	4.76	-	3.72			35,132
TOTAL MILLING COSTS	36.84	37.50	28.85	29.26			£276,672

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AUSTRALIAN BLUE ASBESTOS PTY. LTD.

ENGINEERING MONTHLY CONTROL REPORT

4 weeks ended 4/6/63

THIS PERIOD				HALF YEAR TO-DATE (24 weeks)		
BUDGET	ACTUAL EXPENSE	VARIANCE	WORKSHOP	BUDGET	ACTUAL EXPENSE	VARIANCE
2524	2644	- 120	Labour	15144	16200	- 1056
398	510	- 112	Labour exes.	2388	2738	- 350
76	151	- 75	Stores	456	735	- 279
320	773	- 453	Repairs & mtce	1920	2202	- 282
144	130	+ 14	Power	864	895	- 31
3462	4208	- 746	Total workshop exes.	20772	22770	- 1998
			ELECTRICAL			
1040	864	- 176	Labour	6240	5631	+ 609
162	146	+ 16	Labour exes.	972	892	+ 80
8	1	- 7	Stores	48	5	- 43
62	111	- 49	Repairs & mtce.	372	321	- 51
1272	1122	+ 150	Total elect. exes.	7632	6849	+ 783
			INDIRECT EXES.			
80	6	+ 74	Labour	480	67	+ 413
520	520	-	Salaries	3120	3120	-
104	92	+ 12	Labour & sals. exes.	624	558	- 66
62	62	-	Motor vehicles	372	372	-
42	42	-	Depreciation	252	252	-
808	722	+ 86	Total indirect exes.	4848	4269	- 479
5542	6052	- 510	Total engin. exes.	33252	33988	- 736
5542	5264	- 278	Recovery of charges	33252	31697	- 1555
			Under (-) or Over			
	- 788	- 788	(+) Recovery		-2291	- 2291
	- 594	- 594	Allocation to prod.		-1712	- 1712

AUSTRALIAN BLUE ASBESTOS PTY. LTD.

ENGINEERING DEPARTMENT

ACCOUNT No 14
H. Y. E. 31. 12.62.

LAST H. Y.			H. Y. E. 31. 12. 62
	WORKSHOP		
-	Labour - operating		£19,860. 0. 0.
-	Labour expense		2,902. 0. 0.
-	Power		1,056. 0. 0.
-	Stores - operating		928. 0. 0.
-	Stores maintenance		1,694. 0. 0.
		SUB TOTAL	£26,440. 0. 0.
	ELECTRICAL		
-	Labour - operating		£ 7,602. 0. 0.
-	Labour expense		1,114. 0. 0.
-	Stores - operating		70. 0. 0.
-	Stores maintenance		286. 0. 0.
		SUB TOTAL	£ 9,072 0. 0.
-	Salaries		£ 4,359. 13. 3.
-	Salaries expense		777. 0. 0.
-	Depreciation		267. 0. 0.
		SUB TOTAL	£ 5,403. 13. 3.
	TOTAL COST ENGINEERING DEPARTMENT		£40,915. 13. 3.
	ALLOCATION		
	Mining		£ 5,368. 0. 0.
	Milling		19,156. 0. 0.
	W.E.M.V.		59. 0. 0.
	Town		1,782. 0. 0.
	Recoverables		2,309. 0. 0.
	Power House - power		1,72.. 0. 0.
	- air		1,180. 0. 0.
	Capital		7,736. 0. 0.
	Warehouse		39. 0. 0.
	Sackmaking		169. 0. 0.
	Settlement		675. 0. 0.
	Mine admin. G.C.		610. 13. 3.
	Management		111. 0. 0.
			£40,915. 13. 3.

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WITTENOOM GORGE.
8th February, 1963.

POWER HOUSE MONTHLY CONTROL REPORT

4 weeks ended 4. 4. 63.

THIS PERIOD					HALF YEAR TO-DATE (24 weeks)			
BUDGET	ACTUAL				BUDGET	ACTUAL		
£ per 100 KWH	£ per 100 KWH	Ex- penses	Var- iance	DIRECT EXES.	£ per 100 KWH	£ per 100 KWH	Ex- penses	Var- iance
1531	.0991	679	- 370	Labour operating	.1531	.1103	4387	+ 1705
0379	.0267	183	+ 77	Labour expense	.0379	.0263	1046	+ 462
1940	1893	1297	- 32	Repairs & mtce.	1940	.1955	7780	- 61
.8770	.8035	5505	- 504	Fuel & lubs.	.8770	.7818	31106	- 3788
1.2620	1.1186	7664	- 983	Total direct	1.2620	1.1139	44319	- 5894
				INDIRECT EXES.				
.0289	.0265	182	-	Salaries	.0289	.0274	1092	-
.0051	.0047	32	-	Salaries exes.	.0051	.0048	192	-
.0059	.0054	37	-	Motor vehicles	.0059	.0056	222	-
.2879	.2638	1907	-	Depreciation	.2879	.2725	10842	-
.3278	.3004	2058	-	Total indirects	.3278	.3103	12348	-
1.5898	1.4190	9722	- 983	Total power cost	1.5898	1.4242	56667	+ 5894
1.5898	1.5898	10892	- 187	Recovery of chrgs.	1.5898	1.5898	63254	+ 693
-	-	1170	- 1170	Under (-) or over (+) recovery	-	-	- 6587	+ 6587
-	-	1084	- 1034	Alloc. to prod.	-	-	- 5711	+ 5711
		752550		KWH PRODUCED	4390210			
		685139		KWH DISTRIBUTED	3978776			
£/1000 Cu. ft.	£/1000 Cu. ft.			COMPRESSED AIR	£/1000 Cu. ft.	£/1000 Cu. ft.		
		75	- 35	Labour			473	+ 172
		46	-	Salaries			276	-
		56	- 8	Labour & sals exes.			451	- 173
		766	- 214	Repairs & mtce.			4095	- 891
		1056	- 213	Fuel & lubs.			6815	- 551
		9	-	Motor vehicles			54	-
		720	-	Depreciation			4320	-
		2728	+ 26	Total Comp. Air			16484	- 341
		2728	- 26	Recovery of chrgs.			16484	+ 341
		-	-	Under (-) or over (+) recovery			-	-

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AUSTRALIAN BLUE ASBESTOS PTY. LTD.

POWER HOUSE ACCOUNT

ACCOUNT NO. 15
H. Y. E. 31. 12. 62

LAST HALF YEAR		COST PER TON FIBRE Last H. Y.	This H. Y.	
	TOTAL			
£ 4,783	Labour operating	.61	.60	£ 5,694. 0. 0.
6,438	Labour maintenance power house	.82	.58	5,456. 0. 0.
1,678	Labour maintenance reticulation	.21	.08	759. 0. 0.
-	Engineering department - maintenance	-	31	2,901. 0. 0.
2,100	Labour expenses	.27	.18	1,740. 0. 0.
1,834	Salaries & sals. expenses	.24	.18	1,738. 0. 0.
8,625	Stores maintenance power house	1.10	.55	5,163. 0. 0.
2,828	Stores maintenance reticulation	.36	.53	4,998. 0. 0.
45,507	Fuel & lubricants	5.80	5.54	52,413. 0. 0.
300	Motor vehicles	.04	.03	300. 0. 0.
15,470	Depreciation	1.97	1.72	16,269. 0. 0.
£89,563		11.42	10.30	£97,431. 0. 0.
	COMPRESSED AIR			
£ 1,917	Labour operating	.24	.06	570. 0. 0.
1,987	Labour maintenance power house	.25	.19	1,831. 0. 0.
185	Labour maintenance reticulation	.02	.08	751. 0. 0.
-	Engineering dept. maintenance	-	.12	1,180. 0. 0.
665	Labour expenses	.09	.06	544. 0. 0.
367	Salaries	.05	.04	348. 0. 0.
701	Store maintenance power house	.09	.21	2,015. 0. 0.
30	Store maintenance reticulation	.00	.42	3,983. 0. 0.
4,538	Fuel & lubricants	.58	.78	7,325. 0. 0.
60	Motor vehicles	.01	.01	60. 0. 0.
3,769	Depreciation	.48	.48	4,568. 0. 0.
£14,219		1.81	2.45	£23,175. 0. 0.
	ELECTRIC POWER			
£ 2,866	Labour operating	.37	.54	5,124. 0. 0.
4,451	Labour maintenance power house	.57	.37	3,625. 0. 0.
1,493	Labour maintenance reticulation	.19	.00	8. 0. 0.
-	Engineering dept. maintenance	-	.18	1,721. 0. 0.
1,435	Labour expenses	.18	.13	1,196. 0. 0.
1,467	Salaries	.19	.15	1,390. 0. 0.
7,924	Stores maintenance power house	1.01	.33	3,148. 0. 0.
2,798	Stores maintenance reticulation	.36	.11	1,015. 0. 0.

C 4442

AUSTRALIAN BLUE ASBESTOS PTY. LTD.

POWER HOUSE ACCOUNT

ACCOUNT NO. 15
H. Y. E. 31. 12. 62

LAST HALF YEAR		COST PER TON FIBRE Last H. Y.	This H. Y.	
	TOTAL			
£ 4, 783	Labour operating	. 61	. 60	£ 5, 694. 0. 0.
6, 438	Labour maintenance power house	. 82	. 58	5, 456. 0. 0.
1, 678	Labour maintenance reticulation	. 21	. 08	759. 0. 0.
-	Engineering department - maintenance	-	. 31	2, 901. 0. 0.
2, 100	Labour expenses	27	. 18	1, 740. 0. 0.
1, 834	Salaries & sals. expenses	. 24	. 18	1, 738. 0. 0.
8, 625	Stores maintenance power house	1. 10	. 55	5, 163. 0. 0.
2, 828	Stores maintenance reticulation	. 36	. 53	4, 998. 0. 0.
45, 507	Fuel & lubricants	5. 80	5. 54	52, 413. 0. 0.
300	Motor vehicles	. 04	. 03	300. 0. 0.
15, 470	Depreciation	1. 97	1. 72	16, 269. 0. 0.
£89, 563		11. 42	10. 30	£97, 431. 0. 0.
	COMPRESSED AIR			
£ 1, 917	Labour operating	. 24	. 06	570. 0. 0.
1, 987	Labour maintenance power house	. 25	. 19	1, 831. 0. 0.
185	Labour maintenance reticulation	. 02	. 08	751. 0. 0.
-	Engineering dept. maintenance	-	. 12	1, 180. 0. 0.
665	Labour expenses	. 09	. 06	544. 0. 0.
367	Salaries	. 05	. 04	348. 0. 0.
701	Store maintenance power house	. 09	. 21	2, 015. 0. 0.
30	Store maintenance reticulation	. 00	. 42	3, 983. 0. 0.
4, 538	Fuel & lubricants	. 58	. 78	7, 325. 0. 0.
60	Motor vehicles	. 01	. 01	60. 0. 0.
3, 769	Depreciation	. 48	. 48	4, 568. 0. 0.
£14, 219		1. 81	2. 45	£23, 175. 0. 0.
	ELECTRIC POWER			
£ 2, 866	Labour operating	. 37	. 54	5, 124. 0. 0.
4, 451	Labour maintenance power house	. 57	. 37	3, 625. 0. 0.
1, 493	Labour maintenance reticulation	. 19	. 00	8. 0. 0.
-	Engineering dept. maintenance	-	. 18	1, 721. 0. 0.
1, 435	Labour expenses	. 18	. 13	1, 196. 0. 0.
1, 467	Salaries	. 19	. 15	1, 390. 0. 0.
7, 924	Stores maintenance power house	1. 01	. 33	3, 148. 0. 0.
2, 798	Stores maintenance reticulation	. 36	. 11	1, 015. 0. 0.

ELECTRIC POWER (Cont'd)

ACCOUNT NO. 15 Cont'd

£40,969	Fuel & lubricants	5.22	4.77	£45,088. 0. 0.
240	Motor vehicles	.03	.03	240. 0. 0.
11,701	Depreciation	1.49	1.24	11,701. 0. 0.
£75,344		9.61	7.85	£74,256. 0. 0.

POWER	LAST H. Y.	THIS H. Y.
Kilowatt hours produced	61545440	6631560
Cost per kilowatt produced (not including reticulation)	2.833	2.650
Cost per kilowatt produced (pence)	2.942	2.687
Cost per kilowatt distributed (pence)	3.185	2.942

ALLOCATION ELECTRICITY

Mine - power	1319591	£16,178. 0. 0.
- compressed air	612690	7,512. 0. 0.
Mill	3535464	43,246. 0. 0.
Settlement	77223	947. 0. 0.
Town distribution	433096	5,310. 0. 0.
Power house usage	574842	- - -
Sackmaking	572	7. 0. 0.
Engineering	78082	1,056. 0. 0.
	£6,631,560	£74,256. 0. 0.

ALLOCATION COMPRESSED AIR

Mine (compressed air)	£23,175. 0. 0.
Total charged out	£97,431. 0. 0.

KILOWATT HOURS DISTRIBUTED

LAST H. Y.	THIS H. Y.
5,676,600	6,056,718

C 4444

WITTENOOM GORGE,
8th February, 1963

AUSTRALIAN BLUE ASBESTOS PTY. LTD.

MONTHLY OPERATION REPORTS

	Four - weeks Period Ended		
	7/5/'63	4/6/'63	TARGETS
Fibre produced - tons	859	1,001	1,000
Mill recovery - %	87	87	87
Sq. yds. broken	5,716	6,091	6,000
Assay - inches	3	3	3
Tons fibre per miner shift total	2	2	1
Tons fibre per sq. yd. milled	0.149	0.164	0.178
T100 mesh test grade 3F	31	33	28
C 14 mesh test grade 3F	64	62	68
Estimated profit & loss - £s.	12,819	2,308	L. 3,373
Cost per ton F.O.B. - £s.	107	97	97
Sq. yds. per miner shift total	9	9	7
Sq. yds. per scraper stopes.	13	12	10
Trainee miner shifts	25	10	25
Total miner shifts	615	654	840
Ore from mine pocket	15,438	17,523	18,580
% Waste picked	18		18
Grade milled	7	7	7
Tons milled (less waste)	11,837	14,269	15,240
% Operating - primary crushing	63	68	65
% Operating - secondary crushing	93	95	93
% Operating - treatment	78	85	95
Tons fibre per shift	19	21	21
K.W.h. per ton ore treated	26	24	22
K.W.h. generated	680,230	752,550	700,000
Gallons fuel per K.W.h.	625	625	62
Men at start	326	326	340
Men engaged	44	34	-
Men left	44	27	-
Men at end	326	333	340
Steel used	299	401	358
Footage drilled - total feet	79,309	82,634	74,560
Development advances - feet	179	363	450
Rising - feet	101	140	-
Stripping - cubic feet	1,470	2,543	-
Average steel footage per use	265	206	230
Explosives - stoping lbs. per sq. yd.	3.33	3.18	3.60
Average stope height - inches	39	40	40

COMPARATIVE FIGURES - MINING & MILLING

	1958		1959		1960		1961		1962	
	JUNE	DEC.	JUNE	DEC.	JUNE	DEC.	JUNE	DEC.	JUNE	DEC.
Sq. yds. lifted	31.766	36.889	39.672	48 028	33.636	45.632	35.934	60.692	55,923	64.403
Tons rock mined	112.380	131.946	144.163	171.429	124.450	158.562	126.706	196.883	175.849	203.911
Tons ore broken	98.795	115.610	128.131	153.303	114.450	143.614	115.393	180.714	161.863	187.688
Tons ore to mill	94 [illegible]2	138.632	124,485	151.722	116.765	145.515	112.759	183.069	152,464	181.879
Tons rock discarded	10.115	16.170	18,223	21.070	15.670	22.160	19.380	29.080	29,390	34,325
Tons ore treated	84.272	102.339	106.985	130.902	101.465	123,105	93.629	153.789	122,874	147.557
Tons fibre bagged	6.179	7.134	7.395	9.021	6.998	7,474	5.627	10.150	7,845	9.456
Yields:										
Tons fibre per sq. yd. lifted	.1945	.1934	.1864	.1878	.1964	.1638	.1566	.1672	.1403	.1468
% Fibre to rock mined	5.498	5.407	5.130	5.263	5.263	4.714	4.441	5.155	4.461	4.637
ore broken	6.254	6.171	5.771	5.885	6.279	5.204	4.876	5.617	4.847	5.038
ore from bins	6.546	6.020	5.906	5.936	5.974	5.145	4.979	5.550	5.152	5.199
ore treated	7.332	6.972	6.912	6.892	6.897	6.071	6.010	6.600	6.384	6.407
% Ore broken per ton rock mined	88.0	87.6	88.7	98.5	92.0	90.6	91.0	91.8	92.0	92.0
% Rock discarded per ton ore to Mill	10.7	13.6	14.4	13.8	13.4	15.2	16.7	15.9	19.3	18.8
Cost of mining per ton rock mined. Shillings	37.962	35.396	35.274	34.150	40.620	39.534	48.507	43.662	44.380	45.703
MINING (Shills./ton ore broken)										
Labour - operating	17.91	18.45	18.03	18.34	20.11	20.16	22.25	21.77	22.83	21.27
maintenance	1.10	1.15	.91	.80	1.08	1.11	1.64	1.82	1.94	1.71
expenses	2.65	2.19	2.59	2.39	3.29	2.83	4.13	3.10	4.03	3.38
Stores - operating	3.00	2.24	2.90	2.45	2.20	2.03	4.68	4.31	3.84	3.35
maintenance	2.37	1.86	2.84	2.47	3.12	2.19	4.23	2.36	3.09	2.90
Explosives	5.87	5.34	5.19	5.12	5.33	5.40	5.42	5.83	5.62	5.37
Mining steel	2.35	2.64	2.79	2.59	2.76	3.47	3.96	3.02	2.42	2.64
Power	2.05	1.53	1.17	1.23	1.71	1.69	2.18	2.03	1.56	1.72
Compressed Air	2.15	2.32	2.59	1.89	2.65	2.54	3.43	2.17	2.85	3.27
Working expenses - motor vehicles	.47	.20	.25	.27	.42	.38	.60	.23	.41	.49
Salaries and travelling expenses	2.21	1.85	1.84	1.60	2.42	2.03	2.83	1.86	2.68	1.88
Cartage contract	3.34	1.71	.07							
Engineering department										.57
	45.47	41.48	41.17	39.15	45.09	43.83	55.35	48.50	51.27	48.55
Stock change	+ 1.23	+ .21	- .98	- .30	- 1.09	- .38	- .85	- .35	- 1.28	+ 1.82
Transferred to suspense	- 3.98	- 3.96	- 3.64	-3.20	- 3.09	-2.70	-4.16	-3.79	- 4.23	- 4.78
Development suspense written off	+ 2.53	+ 2.36	+ 2.39	+2.37	+ 2.29	+2.35	+2.39	+2.66	+ 2.94	+ 2.90
TOTAL MINING COST	45.25	40.09	40.90	38.62	43.20	43.10	54.43	47.02	51.26	48.49
MILLING. (Shills/ton ore treated)										
Labour - operating	8.85	9 31	8.03	5.95	7.52	8.23	9.03	7.16	7.55	6 23
maintenance	4.28	4.67	3.56	3.82	3.68	4.09	4.57	3.08	4.24	1.68
expense	1.82	1.56	1.58	1.23	1.74	1.81	2.35	1.35	1.92	1.16
Stores - operating	.16	.52	1.01	.92	1.15	.95	.89	.64	1.04	1.02
maintenance	7.45	6.57	6.34	7.21	4.68	5.53	6.27	4.76	7.48	7.86
Lubricants	.36	.31	.13	.09	24	.20	.20	17	.22	.15
Sacks	4.54	4.07	3.92	3.85	3.24	3.71	3.62	4.42	3.04	2.89
Power	9.06	9.44	7.25	5.31	6.27	6.78	8.13	5.96	7.54	5.86
Compressed air	.84	65	.77	.25	.32	.33	.47	.29	12	-
Motor vehicles	.33	.24	.31	.34	.48	.46	.74	.27	.55	.62
Salaries and travelling expenses	1.60	1 48	1.35	1.03	1.46	1.07	1.91	1.18	1.68	1.17
Tailings disposal contract	2.28	1 76	1.25	1.26	1.24	1.30	1.41	1.31	1.46	1.50
Insurance recoupment	40 (cr).	09 (cr)					.82 (cr)			
Engineering department										2.60
TOTAL MILLING COST	41.17	40.49	35.50	31.26	32.02	34.46	38.77	30.59	36.84	32.74
TOTAL COST PER TON OF FIBRE - £										
Mining	34.52	32.73	34.38	32.44	36.13	41.96	54.61	42.35	49.74	49.27
Milling	28.08	29.04	25.68	22.68	23.22	28.38	32.26	23.17	28.85	29.26
Depreciation	7.33	6.54	6.13	6.06	8.10	7.70	10.43	5.98	8.00	5.86
Other costs (including stock charge)	5.29	3.09	8.71	6.96	9.55	7.82	.42	~~24.04~~	6.97	2.96
Selling expenses	14.53	11.86	9.06	8.48	9.22	10.40	10.41	10.74	9.84	11.20
TOTAL COST	89.15	83.26	83.96	76.62	86.22	96.26	108.29	~~106.26~~	103.40	98.55
Sales	98.83	98.42	97.29	96.44	96.81	97.11	97.16	97.25	93.45	93.49
PROFIT OR LOSS	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.85	[illegible]	[illegible]	[illegible]	[illegible]

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COMPARATIVE FIGURES - SALES AND MINE DEVELOPMENT

		1958		1959		1960		1961		1962	
		JUNE	DEC.	JUNE	DEC.	JUNE	DEC.	JUNE	DEC.	JUNE	DEC.
FIBRE SALES -	£'s.	645.724	628.589	766.493	836.114	726.757	713,502	573.636	928.113	676.052	838.631
GRADE -	SHORT TONS										
1		41	49	10	51	21	5	25	27	1	19
2				1		1	5				1
3		6,493	6.338	7.367	8.619	5.570	5.355	5,070	6.369	5,643	5.235
3A						1,890	1,910	277	513	346	
3B								489	2,097	1,113	
3F											10
4						16	70	43	37	132	11
U.S.											3.595
Fibreised							2				
		6.534	6.387	7.378	8,670	7.507	7,347	5.904	9,544	7,235	8.971
MINE DEVELOPMENT											
Actual cost to-date		244.822	252.703	257.597	259,829	262.905	266,218	300,528	326.662	356,036	391,704
Written down value		137.294	135.995	131.708	124.280	117,612	111,066	135.393	150,257	167,382	189,710
Suspense account		47,465	48.860	51.495	55.517	57.156	57,887	65,027	66,261	67,739	79.166

...PORATED 6th APRIL, 1943. COMMENCED PRODUCTION JUNE, 1944.

AUSTRALIAN BLUE ASBESTOS PTY. LTD.

YEARS ENDED JUNE

	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952
...s capital										
Deferred			20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000
Ordinary			180,000	180,000	380,000	380,000	980,000	980,000	980,000	980,000
...pital	20,000		150,000	180,000	300,000	400,000	550,000	600,000	600,000	600,000
...apital		76,000	135,000	180,000	270,000	380,000	540,000	600,000	600,000	600,000
...ld by outside shareholders										
...above - deferred	9,800	9,800	9,800	9,800	9,800	9,800	-	-	-	-
ordinary					-	50,000	50,000	50,000	50,000	50,000
...by C. S. R. Co. Ltd										
deferred	10,200	10,200	10,200	10,200	10,200	10,200	16,325	16,325	16,325	16,325
ordinary		56,000	115,000		250,000	310,000	470,000	530,000	530,000	530,000
Declared - %										
- £										
...P. & L. Appropriation Account		*3,888	*18,928	*46,466	*69,520	*135,203	*218,162	*30,113	*467,825	*542,473
...t to paid up capital %										
...T ASSETS										
			1,811	2,308	4,983	10,879	16,766	20,815	13,915	28,671
debtors and prepayments			1,203	2,423	18,186	15,288	23,135	42,659	72,174	68,602
stores			7,714	17,409	20,658	35,984	60,496	87,159	127,721	218,903
fibre and ore	No accounts or Balance Sheets for this Period	5,359	12,090	6,269	4,242	11,327	25,090	40,697	39,073	87,715
					48,069	73,478	125,487	190,760	252,883	403,891
...ENT LIABILITIES										
Trade Crs.			1,986	2,459	7,836	13,517	13,599	7,640	10,256	22,251
... Co. Ltd. and subsidiaries			12,326	16,668	6,294	30,430	64,051	98,789	144,919	177,598
...RKING CAPITAL					33,939	29,531	47,837	84,331	97,608	204,042
...SETS										
leases			-	-	-	-	-	-	-	-
...gs - mine & settlement			28,592	30,034	43,704	54,004	56,370	74,419	126,129	110,297
...op					101	18,096	46,953	73,381	90,821	101,880
...Etc.			37,453		54,550	67,883	72,251	86,885	101,195	156,542
			2,139	2,189	3,497	4,273	4,867	5,111	5,850	6,600
...development			39,705	57,100	77,850	93,254	124,803	141,938	158,921	179,155
...LE ASSETS										
...inary expenses)			7,317	7,382	7,382	7,832	7,832	7,832	7,832	7,832
...ill, Etc.)										
...TAL EMPLOYED					221,023	274,427	363,463	473,447	496,906	765,898
bad debts										590
provision for replacement			7,842	13,302	20,543	29,630	41,625	58,560	81,053	108,281
fibre contract loss									23,778	
long service leave										
...raft and/or C. S. R. loan (a)					58,988	182,518	200,431	393,213	633,340	222,901
...FIT OR LOSS - fibre		10,308(L)			*20,117	*58,841	*67,566	*65,134	*145,507	*115,364
other		663(L)	197(L)	446(P)	*2,938	* 6,841	*15,392	*17,818	* 21,205	40,716
Govt. subsidy					-	-	-	-	-	-
TOTAL	-	*3,888	*1,504(L)	*27,537	*23,055	*65,682	*82,958	*62,952	*166,712	* 74,648
...capital employed				-	-	-	-	-	-	-
...TION - Short tons			357	427	660	937	1,085	986	1,095	2,594
...ake & sell £									290,401	473,039
£ Per Ton									260.90	199.10
- Short tons			132	610	717	842	1,009	969	1,113	2,376
£ per short ton				42.86					130.20	150.50
Total £		289	5,209	26,412	27,167	42,921	65,771	93,939	114,899	357,675
...ates %									-	-
...e of bonus £					16	61	100	135	150	170

YEARS ENDED JUNE (1953–1957) / YEARS ENDED DECEMBER (1957–1962)

	1953	1954	1955	1956	1957 (June)	1957 (Dec.)	1958	1959	1960	1961	1962
...s capital											
Deferred	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	-	-
Ordinary	1,980,000	1,980,000	2,980,000	2,980,000	2,980,000	2,980,000	2,980,000	2,980,000	2,980,000	3,000,000	3,000,000
...pital	1,600,000	1,950,000	2,200,000	2,200,000	2,200,000	2,200,000	2,200,000	2,200,000	2,200,000	2,200,000	2,200,000
...apital	1,510,167	1,825,000	2,050,000	2,050,000	2,050,000	2,050,000	2,050,000	2,050,000	2,050,000	2,050,000	2,050,000
...ld by outside shareholders											
...above - deferred	-	-		-	-		-	-			
ordinary	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000		-	
...by C. S. R. Co. Ltd											
deferred	16,325	16,325	16,325	16,325	16,325	16,325	16,325	16,325	16,325	-	-
ordinary	1,140,167	1,755,000	1,980,000	1,980,000	1,980,000	1,980,000	1,980,000	1,980,000	2,055,000	2,071,375	2,071,375
Declared - %									7%		
- £									182,100		
...P. & L. Appropriation Account	*515,240	*602,951	*775,698	*791,060	*662,618	*580,567	*376,115	*119,217	*215,527	*222,116	*339,088
...t to paid up capital %					6.9%	6.5%	7.8%	13.9%	4.2%	1.1%	
...T ASSETS											
	1,005	9,989	35,404	20,773	26,851	5,951	4,525	630	4,265	40,251	21,923
debtors and prepayments	33,228	21,229	31,660	117,345	131,373	35,131	18,817	31,696	282,218	108,712	65,211
stores	190,795	161,085	149,394	151,023	187,119	252,192	249,819	320,052	326,291	278,357	273,663
fibre and ore	248,567	456,913	449,918	175,925	161,856	164,586	189,574	161,571	145,003	121,130	243,445
	473,595	652,216	666,376	465,066	507,199	457,866	462,735	513,919	757,797	549,053	604,442
...ENT LIABILITIES											
Trade Crs.	24,211	24,536	6,117	10,363	12,616	17,677	37,378	45,341	190,926	137,766	38,825
... Co. Ltd. and subsidiaries	33,942	6,106	-	-	15,670	51,000	104	16,673	17,512	280	52,299
...RKING CAPITAL	415,442	621,574	659,959	151,703	478,913	389,189	425,253	151,935	549,327	411,007	513,318
...SETS											
leases	55,228	55,344	55,344	55,344	55,344	55,344	55,344	55,344	55,344	(b)20,690	(b)16,539
...gs - mine & settlement	111,518	114,455	121,526	127,322	129,754	134,756	143,241	157,091	164,628	168,922	192,112
...op	103,381	103,660	105,537	104,744	104,789	110,542	113,602	117,133	126,878	143,866	150,432
...Etc.	193,775	253,744	278,607	503,502	670,264	875,462	1,250,693	1,127,226	1,525,650	1,589,976	1,701,252
	8,820	12,437	13,357	13,670	16,180	19,353	23,815	31,806	33,867	34,317	34,325
...development	212,584	235,904	258,136	266,837	276,804	285,450	301,563	315,346	321,105	392,923	470,880
...LE ASSETS											
...inary expenses)	5,382	5,382	5,382	5,382	5,382	5,382	5,382	5,382	5,382	630	(c)160,681
...ill, Etc.)											
...TAL EMPLOYED	1,106,160	1,402,500	1,498,148	1,531,504	1,737,430	1,875,478	2,318,894	2,561,266	2,785,181	2,762,331	3,099,869
bad debts	216	189	190	190	190	190	190	190	190	1,354	800
provision for replacement	140,987	180,262	223,655	272,400	349,858	400,856	526,765	659,080	810,132	931,651	1,107,085
fibre contract loss			-	-	-	-	-	-	-		
long service leave									1,548	1,072	1,500
...raft and/or C. S. R. loan (a)	310,303	328,271	327,350	-	-	10,221	168,351	1,208	168,818	-	230,180
...FIT OR LOSS - fibre	*5,819	*62,894	*132,981	*73,214	102,411	115,005	154,945	272,010	85,741	25,789	*91,653
other	3,053	5,183	234	10,250	13,633	18,870	5,202	5,192	11	*2,609	*25,689
Govt. subsidy	-	-	-	47,576	12,424	-	-	-	-	-	
TOTAL	*2,767	*57,711	*172,747	*15,388	128,468	133,875	160,147	277,202	85,765	23,180	*117,312
...capital employed	-	-	-	-	7.4%	7.1%	6.9%	10.8%	3.1%	.8%	-
...TION - Short tons	3,856	4,437	4,010	6,158	10,665	12,222	13,314	16,417	14,472	15,777	17,301
...ake & sell £	444,065	416,653	581,539	876,148	969,547	1,025,076	1,114,166	1,323,559	1,354,174	1,478,568	1,606,336
£ Per Ton	161.70	168.00	157.96	108.23	88.87	85.89	85.83	79.67	91.18	95.88	99.05
- Short tons	2,697	2,480	3,627	8,095	10,909	12,297	12,920	16,548	14,854	15,448	16,205
£ per short ton	162.50	142.60	107.13	97.19	98.26	98.31	98.63	96.73	96.96	97.20	93.30
Total £	138,246	353,759	409,963	802,934	1,071,958	1,208,951	1,271,313	1,600,761	1,110,259	1,501,748	1,514,683
...ates %	-	-	-	-	12.0	11.1%	12.0%	17.3%	6.0%	1.9%	-
...e of bonus £	150	125	125	98	98	98	98	98	98	98	

(a) Includes plant and leases hired to A.B.A.

(b) Value of lease at written down value

(c) Includes Flood Restoration Expenditure £20,100.

* Asterisk denotes debit figures

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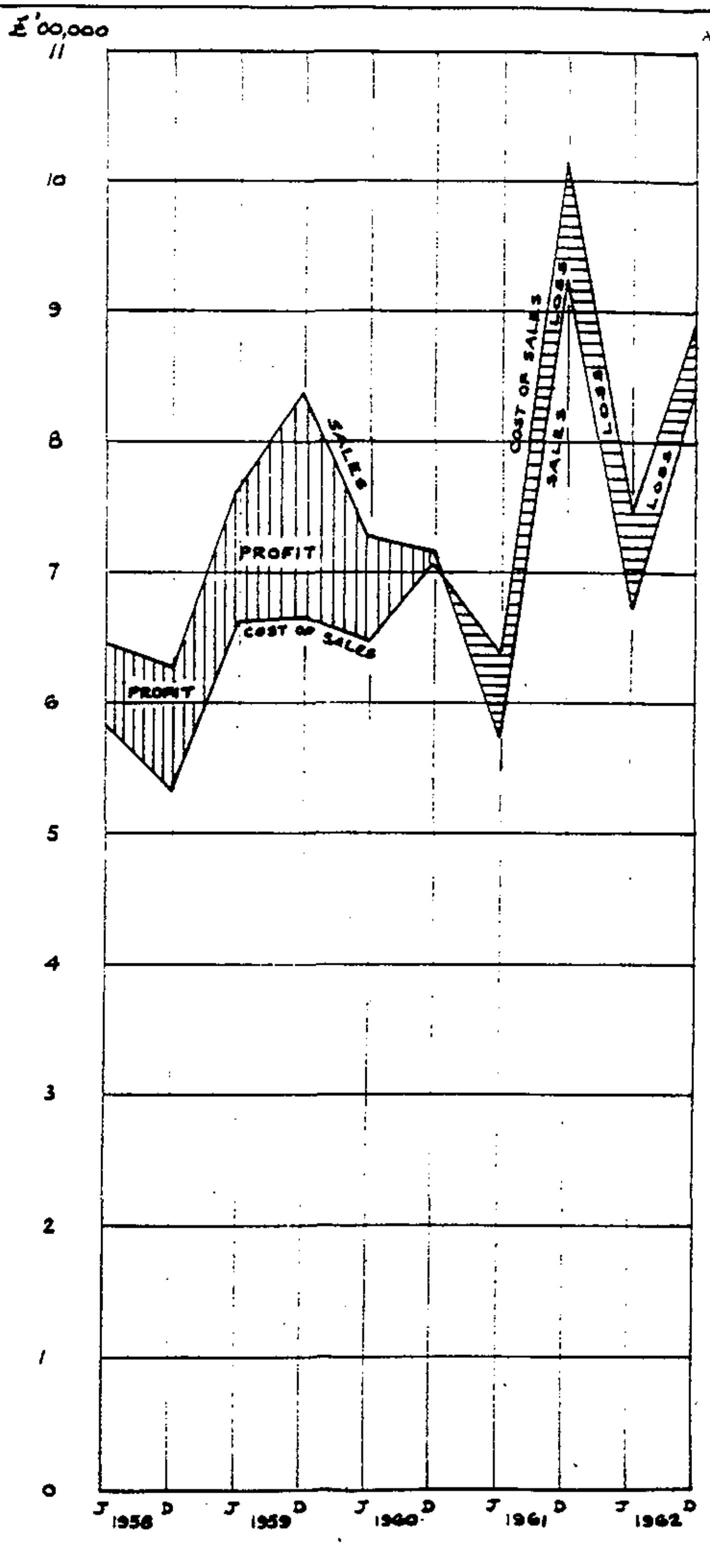
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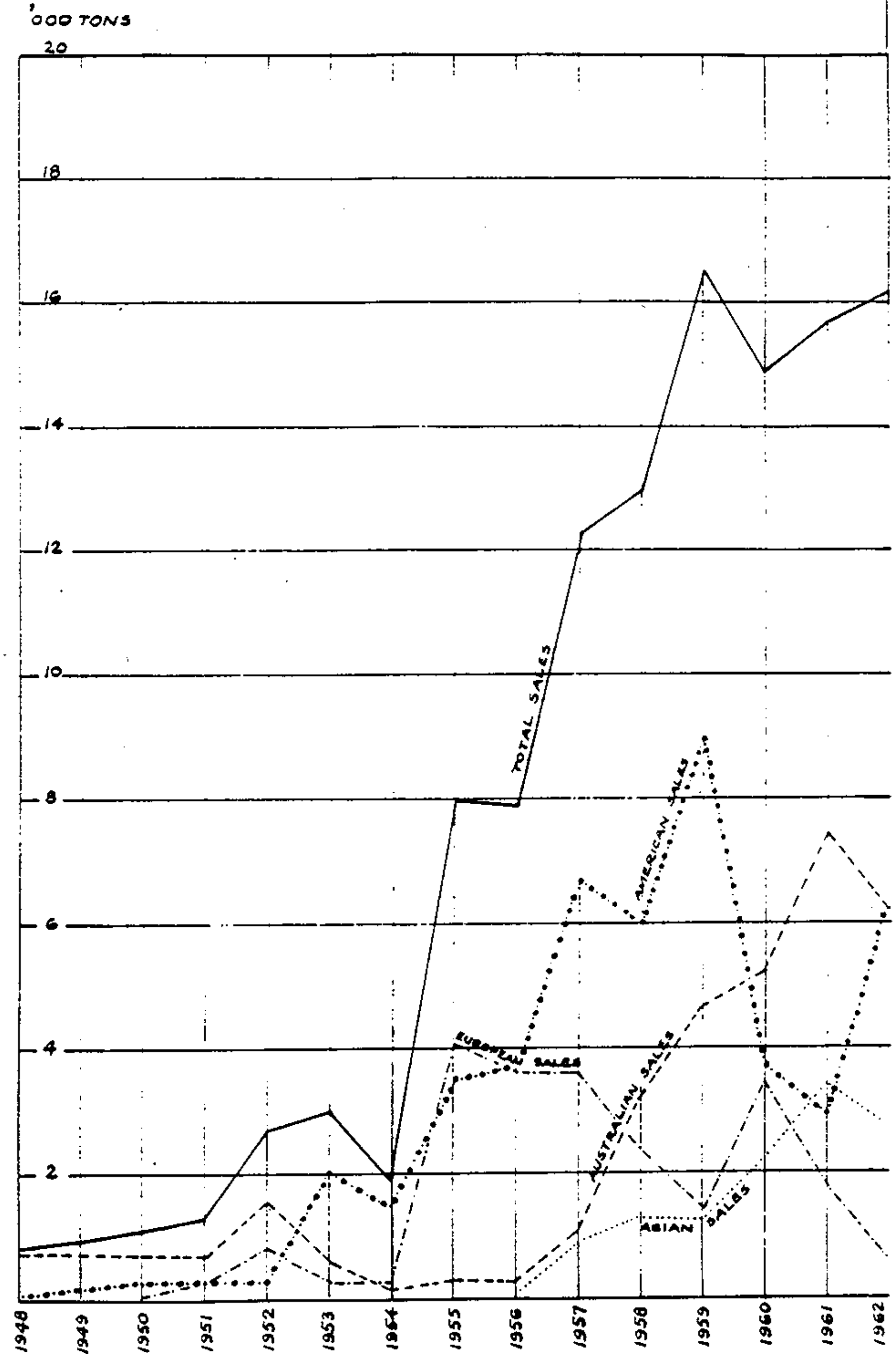
APPENDIX C



A.B.A. LTD.

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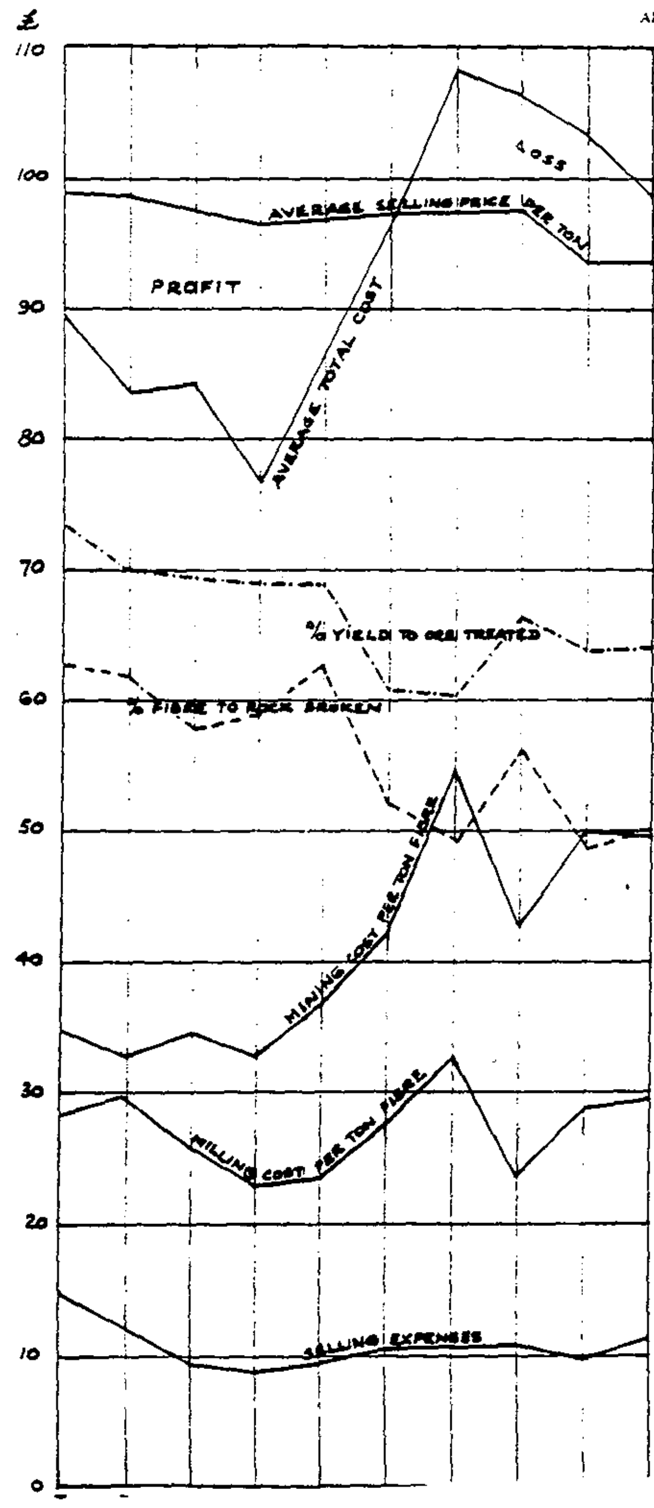
APPENDIX D



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