500001

REG No. 1.

DRILLING PRACTICE
IN
TASMANIA by K. Burns

56-133

500E

500002 56-133 33

REGIONAL

003

DRILLING PRACTICE IN TASMANIA

by K. Burns
195?

INTRODUCTION

The only published references to drilling practice in Tasmania are the Annual Reports of the Director of Mines, and a report in the E. Z. Review for September 1956.

This report is concerned mainly with the geological aspects of drilling programmes, the methods of planning and administrating drilling, processing and storing core, and utilising the results. The ready co-operation of the many people interviewed has enabled this scope to be extended to cover other aspects, including costs and technical aspects of drill operation.

The report is intended as a private report to the University of Tasmania, and the help and co-operation of contributing organisations is acknowledged with a copy of the report.

ABSTRACT

The geology of an area affects the drilling mainly in the programming of drilling campaigns, but a strong control over actual drilling techniques arises in areas of acid ground water, and unstable or broken ground.

(1)

SUMMARY

The Hydro-Electric Commission and Mt. Lyell Mining and Railway Company let contracts for diamond drilling. The Electrolytic Zinc Company at Rosebery and the Mines Department maintain several diamond drills apiece, Mindrill equipment being favoured. Mt. Lyell uses Bucyrus-Eyrie churn drills for quarry work, and the Mines Department uses Goldfields percussion rigs for water boring.

The role of geologists varies markedly. At Rosebery geologists, exploring with drills, supervise closely all stages of mine development. At Mt. Lyell the orebody has been outlined by drilling, development proceeding at the direction of open-cut engineers, which has freed the geologists for long range exploration.

Diamond drill core costs up to £2 per foot and the cost of storage is about 2/- per foot, or 5%. In view of the rapid progress of geological knowledge, the cost of storage is infinitesimal compared with the potential usefulness of the core. This applies particularly to drilling by the H. E. C. and Mines Department who operate throughout the state and make limited use of the core. For example, numerous bores in the Mersey Coal Basin were put down at the turn of the century, and the core was discarded once the immediate purpose of locating coal or oil shale was accomplished. At the present time even one such core would be invaluable.

A well designed core shed carries 20 feet of AX core to the cubic foot of storage space and provides adequate working space. The capacity can be 1/3 of this in some sheds. The larger the shed the more space lost in passage-ways.

One of the biggest problems is staff. Organisations unsuccessful in assembling an efficient crew are forced by economic reasons to let contracts to private operators. The Mines Department is the only operator providing fixed salaries without bonuses for footage. These are provided by the Queensland and South Australian Mines Departments.

Drilling conditions vary widely, and depend strongly on the local geology. Unique problems are heavy sands at King Island, abrasive and heavy pyrite sludge and corrosive water at Mt. Lyell, drill hole deflection at Rosebery and Mt. Lyell, and loose dolerite scree in H. E. C. bores at Blackwood Creek.

The relationship between the local geology and the yield of water bores is investigated periodically by the Mines Department and published as Water Supply Papers. Sometimes mineral deposits are extensively investigated by drilling and the information published as Mineral Resources Bulletins, for instance bauxite and iron ore deposits. The bulk of drilling throughout the state is subsurface exploration preceding excavation - for foundations, mining, or tunnelling - and the information obtained is immediately utilised in planning these works.

ROSEBERY

Introduction

The drilling at Rosebery is under the direct control of the geological staff, who select the sites, attitude and length of holes. Some drilling is for blast holes, pilot holes for rises and holes for electric cables, but the bulk is used for outlining the orebody. The geologists carry great responsibility in the supervision of mine development.

The cores are exhaustively treated, the processing resulting in the production of detailed large scale mine plans.

Acknowledgments

The writer wishes to express his gratitude to the Superintendent, Mr. G. Hall, for permission to inspect the operations, to the Chief Geologist, Mr. V. M. Cottle, for his interest, co-operation and personal assistance, to Mr. H. Robinson, the diamond drill foreman for spending so much time explaining all the technicalities, and to Mr. J. Drewitt for explaining logging and development techniques.

Programming

Surface holes are numbered 62R, 63R, etc. and underground holes R959, R960, etc. Hercules bores use the letter H.

Some years ago, a series of holes was drilled along the strike at a horizontal interval of about 1,000'. The present programme is defining the size and attitude of the orebodies revealed. The first stage of this programme involves surface holes to intersect the lode at vertical intervals of 300' to 500'.

In underground exploration, particularly in drives from one ore lens to the next, pockets are out in the side of the drive every 100 feet, and horizontal holes are put out from these to the hanging wall black slate and footwall quartz schist, to ensure no orebodies are overlooked and to provide control for structural mapping. Experience shows the interval may safely be increased to 200', which will be the practice on 12 level.

It is cheaper in some instances to drive a long cross-out and put down a number of small holes (up to 200') than to drill long holes right from the top of Mt. Black, especially since roads have to be built to surface drill sites.

The drilling is under the control of the Chief Geologist who is responsible for the siting and direction of holes, hole surveying, and logging. Three or four mine surveyors are employed in levelling and stoping and these lay out the drill holes to the geologist's specifications, marking the collar with red paint underground, or with stout pegs on the surface.

Equipment Underground: 3XE500 Air Drives ? Drills

1XBBU Junior (Wells Bros. Underground Junior) (E100 air driven)

Surface: 1X Sullivan HD22, 1500AX, driven by a Hercules petrol engine (10 h.p. 30 bhp.)

1X Boyles Bros. surface machine. Nominally 1500 AX with an A-Ford petrol engine, converted to electric drive (30 h.p. variable speed) and now rating at 1500 EX.

1X XRB Mindrill 250 ft. ¾ bore 5 ft. rods (little used)

1X A2000 (mindrill) driven by a V8 industrial engine

1X B5000 driven by a Bedford S engine (36 h.p. develops 110 h.p. at 3,500 rpm.) This is a local modification of the Canadian BBS4 and was built during the war to Rosebery specifications.

All surface machines are skid mounted. Underground machines are operated on 8 ft. long miners legs. The B5000 uses a Cyclone scaffolding tower in 1½ inch steam pipe. Tripods of 3" or 4" pipe are used on the other surface machines. At the time of the visit the A1000 was using a 30' tower of Mills scaffolding (1½" inside diameter steam pipe) which allowed a 30 ft. pull. Tripods allow a maximum 20' pull unless 6" pipe is used. The site was rather steep and the lower leg of the tripod would have needed to be 50 ft. long so the scaffolding was preferable.

Drill rods are standard E, A and B Rods and are all 10 ft. with 5 ft. rods used for smaller holes underground. No 20 ft. rods are in use. Casing is used only for soft or weathered rocks and fault zones. As will be discussed later, the holes swing, but larger sizes less so. In order to hit the target, BX is sometimes used initially for about 1,000 ft., then AX size used. In some cases the hole has to be cased down to the changeover.

Three Mindrill pumps are used which supply 750 galls./min. at 400 lbs. per sq. in. or 1,200 galls. at 250 lbs. The capacity is altered by changing the cylinder liners. A Mindrill pump supplying 400 galls. at 400 lbs. is in use, also three Cameron and Sutherland pumps of the type used for orchard sprays. These supply 600 galls. at 300 lbs.

For deflection and fishing, standard tools and the usual improvisations are used. If wedging is intended, a larger hole is drilled down to the wedging points than is finally used, because trouble can arise using wedges in the same size hole.

Additional equipment includes a 3½ ton "Cletrac" tractor. This is a useful supplementary tractor, but would be much more useful if fitted with a blade as the bulldozers borrowed for site clearing leave an uneven site which could be conveniently levelled with the small machine.

Other vehicles are Willys Jeep and a Landrover.

In wintry conditions the B5000 may take up to 5 weeks to shift between sites. Once the machine is levelled at the site, a length of pipe is placed in the machine and lined up with the pegs, the inclination being determined with an Abney.

Continuous core is taken, The bits have orientated diamonds.

Staff:

The mechanical operations are supervised by the drilling foreman whose responsibility ends with the production of core. He directly supervises the six or seven drillers and their offsiders.

Drillers are trained on the job as offsiders. There is some turnover of single men, but generally there is little staff trouble, most drillers being married and settled at Rosebery. The fact that Rosebery finds it economic to maintain its own drilling crew is evidence that staff difficulties have been surmounted. The crew was assembled by obtaining a first class driller as foreman, and a good driller to operate underneath him. The mine spared no expense in obtaining an adequate initial combination. The driller is then paid an extra allowance to train his offsider properly. The offsider then takes over a second drill, and the senior driller then trains a new offsider. There is nothing to indicate this method has not been most successful.

There are now six operating crews. The wages are paid on footage, the scale increasing every 250 ft. The drill runner and helper are on different scales although at Mt. Isa the two are paid the same rate. The total wages are computed as follows:

Footage X Rate per foot ADD 10%of footage (drillers only)

Add wages (idle time) ADD basic rate (applicable to all miners.)

The rates vary according to length of pulls, depth of hole and size of hole.

The petrol engines are maintained and supervised by mechanics. Fitting and turning is done in the general workshop except in the field where the foreman has his own store for equipment and materials.

Surveying

The hole surveying is done by a geologist with the assistance of the driller. Surveying equipment is lowered on rods as the broken nature of the holes leads to trouble with cable lowered instruments. Holes are surveyed every hundred feet. The inclination is obtained with hydrofluoric acid bottles. The acid is the usual strength, acid: water 50 : 50. Once in position, the bottle is left about half an hour for the etch to take effect. The etched tube has the forward end filed before the surveying to ensure the proper orientation of the tube is known. The tube, labelled with the hole number and footage is then examined in the Cottell designed light box for measuring the vertical angle.

~~As illustrated Fig.~~) The etched tube is rotated in the light beam until the etched ellipse appears to be in a staright line. The observer is then looking down the plane of the ellipse. A piece of paper is then pinned over the tube and the shadow of the line traced upon it with a line to indicate the orientation of the tube. The angle can be read off. This is done in each of the four ways possible (rotating the tube 180° about both a long vertical and a transverse axis). All four readings must correspond within 1° before being accepted.

Once the measured angle is obtained, correction is made for capillarity on the basis of an experimentally derived curve ~~(Sketched in Fig.)~~. The capillarity correction depends upon the acid mixture used, and is quite large. Thus an etched angle of 40° is actually 33°.

The drill hole deflection is measured with a Radiolite. The instrument used is one modified by Cottle and Boyle from an American instrument. In essentials it consists of a luminous compass needle mounted on gymbols recording its attitudes upon a piece of film. The luminous reference marks were originally a dot and two opposed triangles aligned in the direction of the hole. In practice the two triangles were indistinguishable on the film, so the reference marks were changed to three dots on one side with the control one opposed to a single dot on the other side. The instrument is placed with the three dots facing down the hole. The arrangement was also changed so that the reference marks and compass marks are on the same side of the film. This prevents errors due to the film being turned over. The film is developed on the spot in a portable dark room, and stuck to a piece of paper with the hole number and footage marked on it. The instrument itself has also been altered from a square shape to a round one which is more satisfactory.

The instrument is lowered on brass rods usually with about 15ft to 20ft of brass rod interposing between the instrument and the end of the steel rods. Fifteen feet is regarded as a minimum.

Magnetic bodies may affect the compass, but usually this is obvious. The orebody itself is not magnetic. The brass rods are necessary as the steel rods are highly susceptible, even polarized, sometimes coming out of the hole coated with iron filings.

Hole Deflection

The most important practical feature of Rosebery drilling is the prediction of the hole deflection. All drill hole surveying is in reference to the mine grid, elongated about 20° east of north, and parallel to the line of the lode. Holes are preferably routed in a vertical plane running east-west (grid), but a few are put down with a north-south component, for example some holes from the end of 12 level. The resulting hole is a corkscrew shape, but the Chief Geologist reports that all these hit the target.

At Rosebery the drills swing perpendicular to the grain of the country, i.e. tend to become perpendicular to the strongest plane in the rock, which usually is the cleavage which is approximately parallel to the bedding. The swing is generally small in the massive pyroclastics with only weak cleavage, but is very large in the cleaved rocks e.g. black slates. Since the cleavage dips east (grid) at roughly 60° and the tendency is to swing round to cleavage, then the actual direction is parallel to cleavage, i.e. a hole drilled parallel to cleavage will be liable to swing either way. Once started in one direction it will be unable to return. In practice, the critical angle is not 60° as expected but 75°E. A hole put down at 76° will swing west, a hole at 74° will swing east. This technique has been exploited extensively for deep drilling. This behaviour was predicted from underground holes, and 42R was the first surface hole experimenting with the technique. Since that time much work has been done to put the technique on a scientific basis. Drill holes deflection curves have been prepared for all holes drilled in geographical divisions. The curves are weighted, or averaged, in order to predict drill behaviour and are the main guide in drilling holes.

The writer suggests that the holes describe a type of conic section to the critical angle (75°E grid) and the normal to cleavage (or 30° W grid). This is not strictly true as the transition from massive pyroclastic to black slate invariably results in an increase in curvature. In addition there is a suggestion that holes would, if continued, deflect past the cleavage normal. However, for present purposes, it is a sufficient approximation. Such a conic section with a pair of asymptotes intersecting at a high angle, is, of course, a hyperbola, and it is fairly apparent that the important controlling factor is the position of the intersection of the asymptotes i.e. the "origin". Each origin will be on a line perpendicular to the cleavage through the target and on a line at 75°E grid from the drill hole site.

The behaviour of the drills is such that the depth of the origin below the collar is determined almost entirely by two factors, the initial angle of depression and the size of the hole. Thus the deepest origin and hence the deepest ore intersection, is obtained by drulls started at about 80° E grid and BX size. The extra depth so obtained is sufficient to compensate for the altitude increase in the collar - the land rises steeply to the east of the mine. Thus the A1000 rig operating at present is drilling a BX hole in order to get as much depth and as little deflection as possible in the massive pyroclastics, and once at the required depth will change to the AX size.

In order to obtain higher intersections, wedging techniques are being introduced. Thus hole 57R was drilled in BX size down to the ore, then the first 600 ft. was cased and an AX hole wedged out (5 wedges) from the 600 ft. level. An intermediate section was thus possible with 600 ft. of drilling saved. This technique is still in the initial stages but should be capable of effecting great swings in very deep holes.

It would seem, although constant behaviour of the holes is the great factor in hole routing, that inevitably very deep intersections will be obtained only by drilling NX, drilling from underground, or wedging once the hole starts to deflect. This is because no hole can be put down shallower than - 75°E grid which means the depth at which the hole is nearly normal to the cleavage is really only a matter of the height of the collar or size of the hole, and thereafter very little vertical footage is gained. This is a problem, however, that may never arise.

<u>Assay</u>

All core is split with a maul and arranged in mineralised zones which are easily recognisable. It is necessary to adjust the assays using an empirically derived relation between the core recovery and assay percentage to be utilised.

The relation is such that at Rosebery the ore recovery is better than gangue recovery in mineralised zones. This is not something predictable so the curve must be empirically constructed.

Core Storage

The drilling foreman's responsibility finishes with the production of core. Thereafter the geological section takes over. Core is stored on the site in large, earth-bottomed boxes with a hinged lid. The boxes are deep, each layer of core being covered with Sisalkraft and another layer of core being placed on top.

A geologist visits the rig every week and logs and skeletonises the core taking samples of its massive pyroclastics. The remainder of the pyroclastic core is stored permanently on the site. Once into the host rock all the core is removed to indoor storage.

'Current core' is stored temporarily in No. 1 shed. Then the core is logged; every cleavage, bed, lithological change and vein being logged. Then the core is split for assay in mineralised zones. Once this is finished, the core is temporarily retained there until no longer required. (Perhaps until all surface drills into that particular ore lens have been completed.) In the same way all acid bottles and radiolite film are stored temporarily until the completion of that particular exploration phase.

The core is then transferred into permanent storage in No. 2 shed. All Hercules core is permanently stored in No. 2 shed.

The core is transported to the shed in wooden boxes with bolt on lids. Hinged lids were found unsatisfactory. Each box is 3ft long containing 10 trays for EX and 6 trays for BX and AX. The trays are 3ft long, rectangular in section, made of bent tin, and fit snugly next to each other in the box.

012 The tray bolts are placed between the middle trays. For storage the core is transferred to lidless trays 5ft long 1ft wide divided in plan into four quadrants by 1 inch wooden partitions in a cross shape. The rows of core are separated by tapered wooden slats the ends of which fit into slots in the partitions and box. The boxes are made with the same outside dimensions regardless of core size. This greatly simplifies storage. The storage boxes have tin bottoms and wooden sides.

In No. 1 store the trays are stored parallel to the wall, supported on wooden scaffolding by angle iron lugs at each end. The angle iron is 1 inch size which appears to be rather small. Seven trays are supported on each pair of angle irons. The boxes sometimes sag markedly and are then supported by wedges. The method is not at all satisfactory.

The No. 2 shed scaffolding is 2 inch cyclone piping. The room is 20 ft. by 20 ft. by 12 ft. with a concrete floor. The scaffolding is bolted to form rectangles 2 ft high, the height of 10 trays and the width of 2 trays, thus 20 trays are supported in each section. The trays are stored end on to the wall which means that five feet out from each wall is occupied by the trays leaving a 10 ft. by 20ft. working space between. The total capacity is about 160,000 ft. of EX i.e. 96,000 ft. of AX core, or 20 ft. AX cubic feet. At the worst to obtain one tray will require shifting no more than 9 others. This storage system is excellent being sturdy and neat and allowing operators plenty of room. There is ample room for a table in the centre of the floor and no trays have to be carried farther than a few feet from the rack.

All spaces in the trays have footage stamped onto copper strips nailed to wooden blocks.

<u>Utilisation</u>

<u>Logs and Plans</u>

All logs are entered on standard sheets which are typed and filed. Three types of sheet are used. On type 1 is recorded all survey data including collar location and hole surveys and all assay data. If there is insufficient room for this another type 1 sheet is used.

Type 2 is used as a continuation sheet and contains room for assay data and lithology. Type 3 is an alternative continuation sheet and contains room for lithological data only.

On type 1 there is also room to indicate the object of the hole and the results. The plans on which the hole is plotted are also indicated.

In the lithological log the dip of all planar elements with respect to the core is noted against the footage. The symbols JT (joints) b (bedding) c (cleavage) f (flow structure) b (banding) are used to indicate the type of element.

For plotting purposes each hole is calculated by latitudes and departures and the behaviour on a horizontal projection determined from radiolite data. Then the r.l. at each point is computed using the acid bottle dips. The position of the bore intersection with each of the standard mine intersections is computed and plotted on the appropriate plans with lithological and assay data. In this way the current mine plans are kept up to date.

Ore Reserves

Three ore reserves are recognised at Rosebery. These are O.R.S. - ore ready for stoping; O.P.D. - ore partly developed; and P.O. - prospective ore which includes pillars. Stoping methods are outlined in the E. Z. Review, for September 1956. Cut and fill stoping method is used. The old technique was the fill stope but new flat back stopes and slot and pillar stopes are being introduced.

For reserve calculations O.R.S. is ore defined by two levels and a rise and is computed from the ground between the rises. O. P. D. is ore defined by two levels and P. O. is ore defined by one level and drilling or by drilling alone. Thus drill results are relied upon only for the lowest class of reserves. The area of the ore body on each level is computed then the average multiplied by the height between each pair of levels to determine the volume of O.R.S. or O.P.D. 10 cub. ft. of ore is approximately one ton.

Utilisation

The drilling programme is at present engaged in assessing ore discovered in an exploratory drilling programme some years ago when holes were put down at regular intervals into the lode. As yet the overall structure of the district is not known definitely, nor is the source of the ore so this was the only practical method of exploring in depth. The ore bodies are lenticular in plan and section, so mineralised zones discovered in the original drilling have to be proved by routing drills to intersect the host rocks at intervals of about 100 ft. above and below the known ore, and at similar intervals horizontally. In this way a reliable approximation to the size, shape, and quality of the ore body is obtained and initial mining plans can be formulated. The most recent work has indicated the presence of large minor folds in the host rock on the western limb of the major syncline. The relation of these structures to the ore body may answer many vital questions on ore control and origin.

Costing

(a) Diamond Loss

Diamond returns are handled by the drilling foreman, but the final responsibility lies with the Senior Geologist. The diamond loss is estimated beforehand - for EX at .05 carats per foot. It is the foreman's job to keep a history of each bit, including salvage returns, and determine actual diamond loss. This is used to adjust the estimated loss occassionally so that an operating loss close to fact is used for accounting.

The Senior Geologist charges this diamond loss against each job at say, 503 - per carat. Since the cost of diamonds is subject to variation a figure is selected and used for some years. If the figure is wrong, a surplus or deficit becomes apparent and then the cost per carat is reviewed.

(b) Drilling Costs

Costs are the best criteria of efficiency in any enterprise. Surface holes are costed individually, and underground holes are divided between Rosebery and Hercules, Since the division of costs between the two mines depends on many individuals allocating their time between the two places, the division is not wholly accurate so only the combined records are quoted here.

1955/1956	Rosebery & Hercules	
Transport and preparation		
(Wages, stores, timber etc.)	2024	
Operating expenses		
(Wages, stores, petrol etc.)	5073	
Core Storage		
(Time, boxes etc.)	872	i.e. 1/6 per ft.
Power	139	
Diamond Loss	1897	
Maintenance	512	

This gives a total of £10,517 for a footage of 12,225 ft.

It will be seen that the costs are phenomenally low. This is due to the fact that power charges for air operated drills are not included, nor are charges for fitting which is carried out by the general workshops. For six operating crews the operating expenses are low. The cost of bulldozers for drill transport, site preparation and roadmaking is not included being borne by the mining Department.

More attention is given to cost per foot, rather than cost per shift or cost per footage shift as this is the only figure useful in predicting the cost of exploration programmes. As a sample, however, the following costs were graciously made available.

Hole	Location	Footage	Machine Shift	Footage/Shift
R952	Underground	185	6	3
R953	Underground	130	4	32
60R	Surface BX (3000 ft.deep)	86	7	12
63R	Surface BX (at surface)	253	7	36

As other specific examples: EX drilling underground (air machines, one electric) works out at 16/- per foot; and B7R (surface AX down to 1,400 ft.) cost 31.7/- per foot and 60R (surface BX down to 1,800 ft.) cost 40.6/- per foot.

It is thus apparent that the low overall costs are due to cheap underground drilling, and that surface drilling costs could be expected to be about £2 per foot for BX and £1.10. 0 for AX. The scale is so arranged that the wages per shift are comparable at all depths, even slightly higher at great depth and with reduced footage, it means that the cost at depth is perhaps three times that obtaining at the surface.

The major factor in the low cost structure is considered locally to be the mine policy of paying high wages for competent employees, the increased efficiency more than recouping the wages. Indications from observations elsewhere indicate that this is the only policy making for efficient operation.

<u>Summary</u>

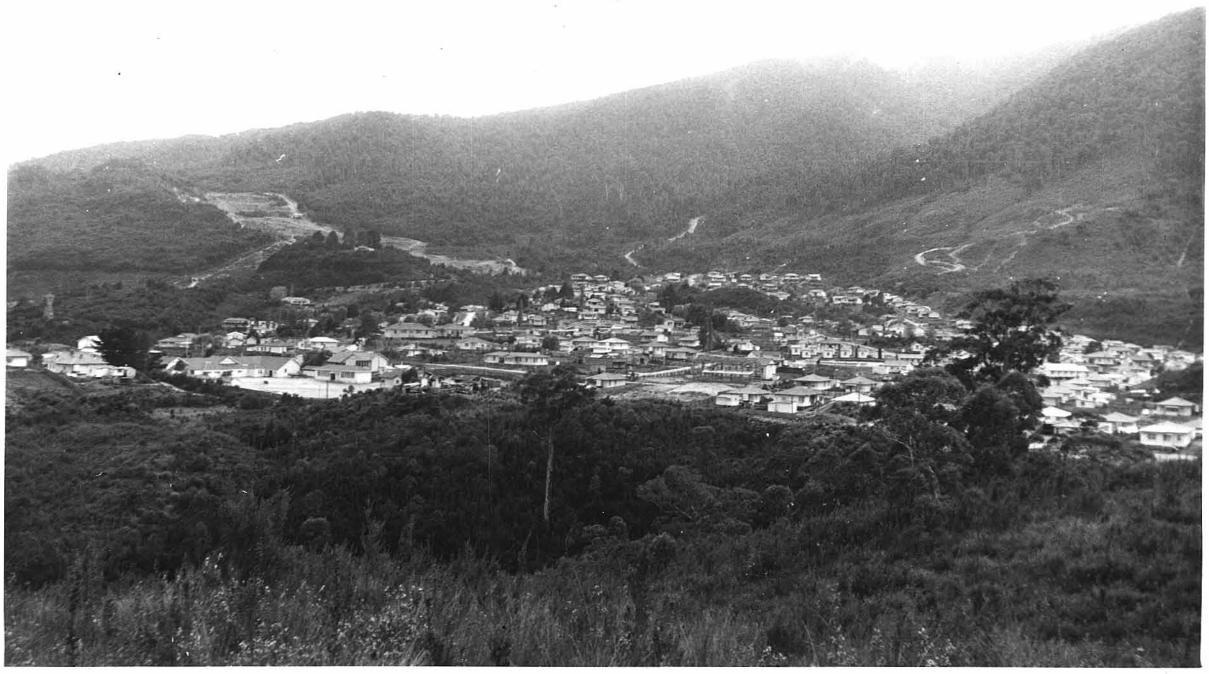
The overall Rosebery situation is thus one of a geological section in direct control of the location and assessment of ore lenses. Its exploration possibility may be said to end with the presentation of plans to the mining section showing the location and grade of ore. To this end it instigates exploratory drilling from the surface and bottom levels underground. The mapped programme goes to the drilling foreman who is responsible for maintenance and operation of all drills, and who has finished his job when he turns the core over to the geologists. The geologists then log and store core and use the results to plan mine development.

The geological responsibility does not rest at prospective ore but also involves working in conjunction with the mining department, mapping all drives and outlining ore and structure with short holes from mine openings, and finally finishes with ore ready for stoping.

With respect to the major drilling problem, namely staff turnover and inefficiency and waste, these problems have been satisfactorily settled at Rosebery. The first by the care taken to assemble a skilled crew. This crew assembly takes many years and represents skilled personnel management. An exactly comparable situation exists in the building trade.

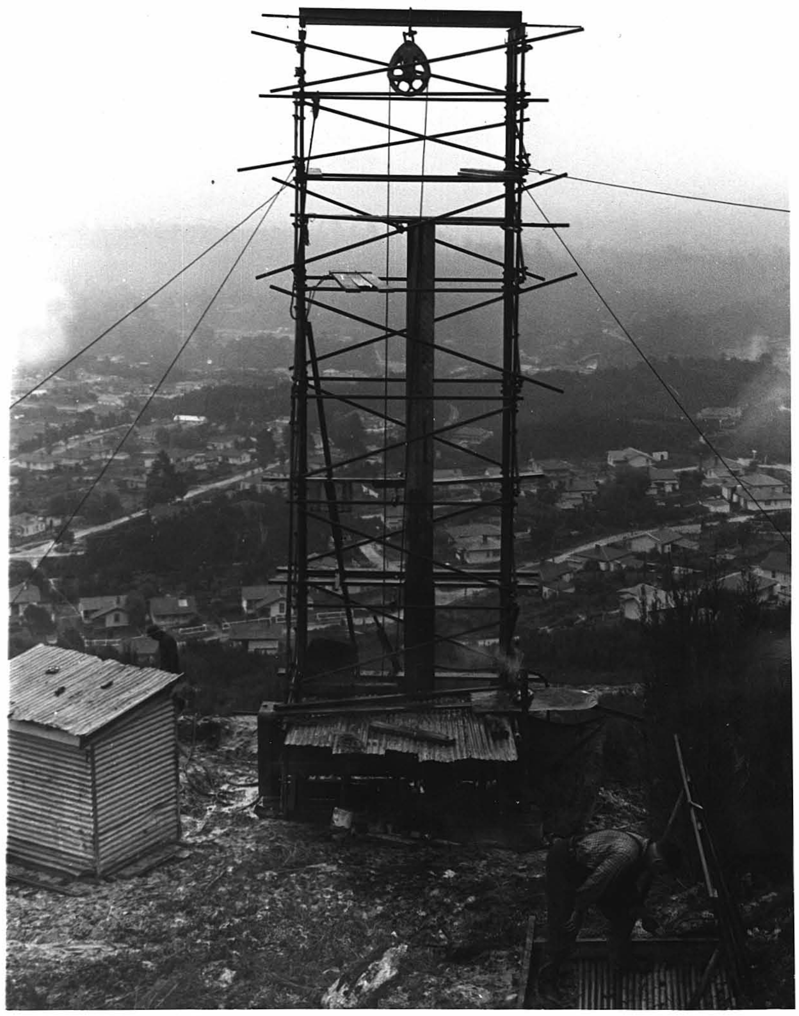
The Company's policy of paying high wages for efficient personnel appears to be the solution to the second. Unless staff problems can be settled in this way the only economic alternative appears to be to employ private firms on contract - firms that have taken just these measures to ensure efficiency.

With respect to core storage, core costing up to £2 per foot can be stored efficiently for approximately 1/6 per foot.



ROSEBERY, FROM THE SOUTH

The mine is on the left, Mt. Black on
he right. The tracks are to drill sites.
t

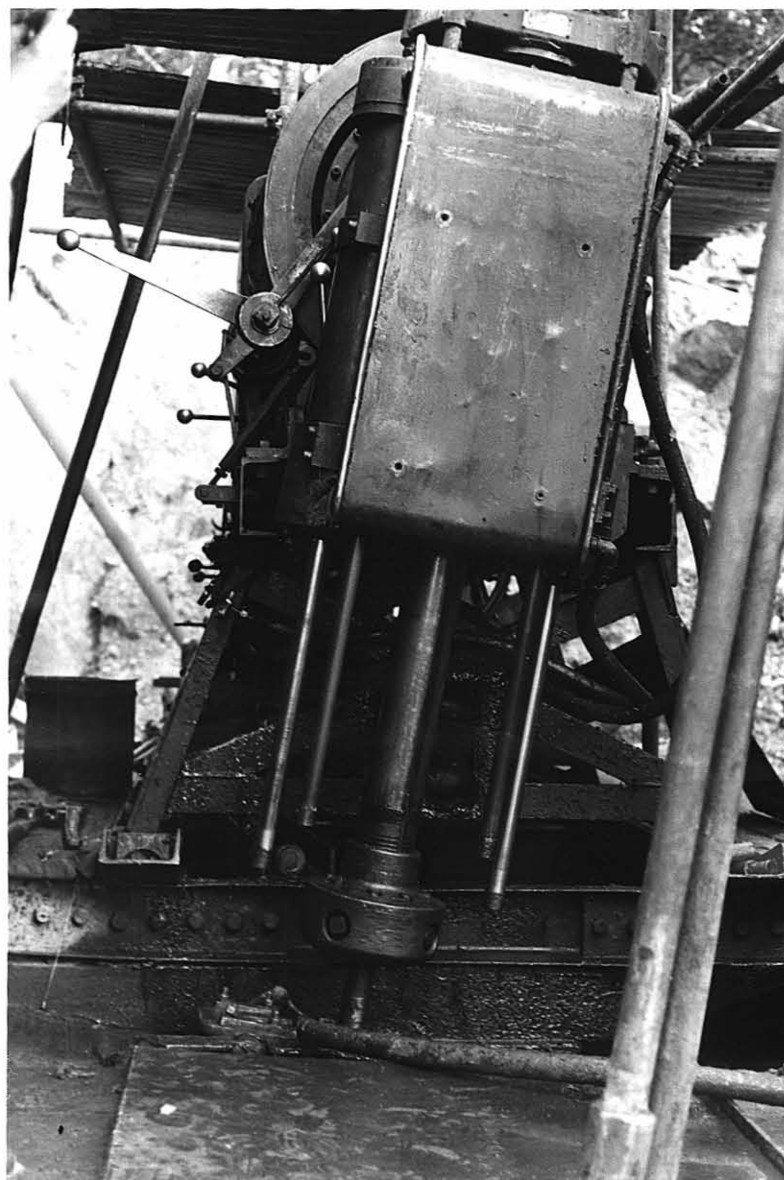


<u>A1000 RIG, ROSEBARY</u>

The derrick is cyclone scaffolding. Core box in the foreground.

B1000 RIG, MT. BLACK

The derrick is cyclone scaffolding.



P1000 DRILL, MT.BLACK

The drill is inclined near the critical angle for a deep intersection with the lode.

CORE STORAGE, MT.BLACK

Core from the Massive Pyroclastics is permanently stored on the site. A skeleton, and all core from the host rocks is stored centrally.

MT. LYELL

Introduction

Exploration at Mt. Lyell is done with rotary drills operated by contractors. The geological staff are responsible for the programme.

Blast holes for the open cut are put down with churn drills operating under the supervision of the Mining Department, specifically the Open Cut Engineer.

Acknowledgments

The writer is greatly indebted to Mr. Hudspeth of the Mt. Lyell Mining and Railway Company for opportunity to inspect the operations at short notice. Thanks are due to Messrs M. Wade and M. Solomon for supplying details concerning geological aspects; to Mr. K. Russell of Associated Diamond Drillers for explaining the peculiar problems of the Mt. Lyell field in exploration drilling. Dick Moffat, the Open Cut Engineer, and Mr. R. Turner, the Assistant Drilling Foreman at West Lyell, gave valuable help with quarry practice and churn drilling.

Exploration Methods

The orebody at West Lyell was proved some years ago by about 90 holes, guaranteeing reserves for at least 20 years production. The geological staff, relieved of immediate ore finding problems, is concentrating on solving the problems of structure and ore localisation. The present exploration programme is designed to test new country in favourable structural zones. The mineralisation is such that large tonnages must be available to justify development.

The drilling on company leases is at the rate of 6,000 feet per annum but is increasing to 15 to 20 thousand feet per annum. The tempo of exploration is dependent on the price of copper which governs the amount of money available. The percentage of returns expended in exploration is as high as for any company in Australia.

Drilling Arrangements

All exploration drilling is let under contract to Associated Diamond Drillers. Staff trouble is the reason for the changeover, the mine finding great difficulty in assembling a good crew. The contractor commenced about the beginning of the year. The Lyell Company is responsible for shifting drills and locating collars and assumes responsibility over the core. Mt. Lyell provides workshop facilities and charges the contractors accordingly.

Surveying

All hole surveying is done by geologists with a tropari compass. This records dip and inclination simultaneously, halving the time to survey a hole. This type of instrument is mounted on gimbols, and a watch mechanism is wound up. After a specified time the mechanism locks the compass and clinometer in position. The compass is lowered on rods, not on a cable, as holes are too broken to allow it. The orebody has generally no effect on the compass although some haematite-chalcopyrite veins carry a little magnetite which causes deviations. Generally these are obvious. Ten foot of brass or aluminium rod is interposed between the compass and the steel rods. Five foot is considered adequate however.

Deflection

Schistosity varies about 30°. It strikes between N 300°E and N 330°E and dips between 85° and 60° to the SW. The holes drilled seem to wander all over the place, the deflection curves showing wide variation. Holes drilled NE i.e. near normal to the schistosity and normal to the strike seem to deflect to the north (NNE) and flatten out. One hole put down at 65° i.e. at 50° to the schistosity, deflected to 25° i.e. normal to the schistosity in 2,000 ft. The flattening is in accord with Rosebery experience but the deflection northwards is not explained on the hypothesis that holes will tend to normal schistosity. Lyell experience points to holes tending to parallel schistosity.

<u>Coring</u>

Hole sizes are NX, BX, and AX. AX is the preferred drilling size. No EX is used unless absolutely necessary since it leaves no margin for trouble and provides an inadequate sample.

Coring is continuous. All core obtained is split and half sent for assay since the mineralisation is often not obvious. A copper content variation between 0.5% and 0.7% is important. A member of the geological staff collects the core daily.

Core is transported in deep wooden boxes with leather hinged lids. The boxes are 2'6" long. At the core shed the core is split, half sent for assy, half retained for storage. The core is stored at the moment on the top floor of the cable shed at the smelters but will soon be shifted to new quarters at West Lyell. The storage trays have wooden sides with a wooden or masonite bottom. The boxes are 5ft long and 10 inches wide. The separators are of steel, tin or wood, butt-ended onto the ends of the tray. The racks are made of 4" x 2" studs fixed flat against the walls. Each tray is supported near its ends by 1" wooden dowels fixed into the studs perpendicular to the wall. The trays are separated vertically by 3". The trays are aligned along each wall, six along the wall and 24 up. An island in the centre of the floor has the trays aligned transversely with 25 trays the length of the room. Thus a room 12ft by 12ft by 32 ft will store 28,000 ft of AX core i.e. 7ft per cubic ft.

<u>Logging and Utilisation</u>

Core is logged in a big hand written log book including survey, lithological and assay data. No printed forms are used.

Ore reserves are not graded. The amount is based solely on drilling. At West Lyell the ore body is defined by 90 holes which is low density. Holes are spaced at about 200 ft. intervals and went down 800-1,000 ft.

Hole results are transferred to plans and utilised immediately and the direction of the programme depends on the results at any stage.

Sludge from churn drill holes is assayed.

Associated Diamond Drillers

Equipment

The contracting firm operates Mindrill equipment, N, A, B and E sizes (the latter hired from Mt. Lyell). 8" x 8" oregon post tripod legs are used with a telescopic back leg of steam pipe - a 6" pipe sliding over a 4" pipe with holes for a pin every 6" to provide for adjustment. The tripod stands 38 ft high giving 20 ft pulls up to 1,000 ft. For holes much greater than 2,000 ft. 30 ft. pulls are used.

Drills include an A 3,000, powered by a 32 h.p. Mercury V8 petrol engine, and an A 2,000 with a Perkins P6 73 h.p. diesel (develops 190 bhp.). Other drills, including a compound E 1,000, are available. Mindrill pumps are used. Both machines are skid mounted, drill, tripod, and workmen's shelter as well. To shift a drill merely requires a bulldozer to pull the lot. A loaded Euclid is preferred for shifting as it gives a smoother pull. A mine crane is used to stand the legs.

The skid on one side is 32 ft long but the other is shorter. The two front legs are bolted to the ends of the long skid. The skid is made of I section steel fabricated to the foreman's design, suitably braced, and is 15ft wide. This supports the whole unit. The whole unit is very mobile, and means that the only requirement for drilling is a level site.

Pumps used are two 700/1200 Mindrill pumps powered by Enfield six cylinder diesels. The contractor employs eight men and a foreman to two drills. Although there is a reservoir on West Lyell, there are still shortages in summer.

Problems

The Mt. Lyell has several characteristic problems.

Pyrite: Below 1500 to 1600 ft. the drills are sometimes held up for days by a heavy accumulation in the hole. Casing has to be used in every hole to try and control the condition. The country is loose and broken and the casing has to be jarred into the hole. The minimum amount of casing used by the contractor is 30 ft.

If left over the weekend, the pyrite settles in the bottom of the hole. The pyrite is hard and abrades tools rapidly. In 500 ft. of drilling on hole 101 one new 20 ft. barrel and three new 10 ft. barrels were worn out by pyrite abrasion. A reamer with a Tungsten carbide coating on the outside (Mindrill type) is the only one available capable of resisting this abrasion.

Bits used are without waterways. If waterways are present, the water sweeps a current of pyrite through, rapidly abrading the setting metal.

Attempts to cement the hole were not very successful. A special hardening cement (Fondu) which sets overnight was used. It sets satisfactorily but breaks away when drilled. This is due to the talcose schists which are greasy and will not bind the cement.

With usual water circulation, the pyrite is carried some distance up the hole, and stays there, falling to the bottom as soon as the pump stops. The only effective control devised by the contractor has been to case the hole with A casing. An E string is let down inside the hole through a watertight gland capping the A casing. Water is pumped down the annular space between the casing and drill string and up into the E string. The pyrite is then pulled up with the drill string.

One way of dealing with loose holes is to rake the sides and force the loose rock to the bottom. Then when the hole is reasonably clean a chop bit is used. The rods are raised and lifted and rotated by an operator with stillsons. This method is most particularly effective in very hard ground.

After 800-900 ft. the ground gets bad with rotten schist and quartzite. The ground is very bad near the schist conglomerate contact.

The casing has to be jarred in and hammered out. It cannot be hand jarred as the pyrite packs too tightly about the casing. A 300 lb. machine driven hammer is used to lift the casing. A sudden loosening of the casing requires an instantaneous stop to prevent it going through the roof.

Pug has to be taken slowly in low gear as rushing causes jamming.

Corrosion

The mine water is very corrosive. In the first hole drilled by the contractors brand new casing, painted with the usual D.A.F. (dark anti-friction grease) was corroded right through in three weeks. Only fragments of casing were recovered. Now the casing is painted with acid resisting bituminous paint. A heavy coating of graphite grease is put on the casing when it goes into the hole. Wedging is not attempted any more as on previous attempts the wedges dissolved in the hole and left only fragments.

King Island

The contractor was able to recall similar problems arising out of drilling through sand at King Island. Two E1000 rigs were used at the King Island Scheelite mine. Casing had to be driven through up to 150 ft of beach sand. In very bad country the hole was initially BX but immediately reduced to E. If E size was used through A casing, sand would jam between the casing and rods.

Casing had to be jarred out of the hole. A new technique, very successful, is to fill the hole with mud before running casing. This makes casing easy to withdraw.

Churn Drilling

Equipment

Churn drilling at Lyell is the responsibility of the open cut engineer with a foreman and two assistant foremen in direct charge of operations.

7 x 29T Bucyrus-Eyrie machines are used mounted on trucks with 20 h.p. electric motor. The mast is non-telescopic and can be laid down for tunnelling. The mast is 30ft high. They drill a 9" hole (8" is needed for charging) to an average depth of 53 ft. the height of the quarry face. The drills work at 54 strokes a minute and the average drilling rate is about 45 ft. a 7½ hour shift. Two men are employed to each drill, both classed as drillers.

Other vehicles include a radio-controlled truck operated by the foreman. The rugged A.W.A. system saves many hours in ordering material for the drills and summoning personnel. There are about 8 or 9 mobile water tankers with tricycle undercarriage each holding several hundred gallons. These are towed. Serving these are two automatic water tanks, diesel driven, which carry 2000 - 3000 gallons, and are employed part of the time supplying the mobile water tanks.

Drilling Tools

The bit is the regular chisel bit with opposed watercourses. This is 7" diameter and 7 ft. long. This is screwed into a sinker bar 18 ft. long and 6½" diameter. A swivel mandril is screwed onto the top of the sinker bar. The mandrill is concave downwards, the cable being led in through the collar at the top and frayed out to. fill the cone. Molten zinc is then used to fill up the hole. The total length is about 29ft. The machine is designed to use a tool weighing 2,700 lbs. but the weight has been increased to 3,000 lbs. to increase the drilling speed.

Pains are taken to ensure a flush fit of the sinker bar and bit. The bit is protected during transport by a special cap to protect the thread.

The cable used is 6 x 19, ¾" diameter, left hand twist. It thus untwists against the thread of the drilling tool.

Bit sharpening is carried out on a Bucyrus-Eyrie machine. Most of the wear is on the shoulders. The bit is heated red hot in a furnace and fastened in a guide. Shaped tools on the machine deliver a series of hammer blows to reshape the softened bit, one striking end on to reform the water channels, and one flattening the shoulders as the bit is rotated. Bits are rejected when worn down to 18" water channel. Reshaping is done at the first signs of wear to avoid delays due to lost tools. Most of the wear is on the cable at the tool collar.

No casing is used. A short collaring pipe is set up over the hole about six feet long. This sinks as the drilling proceeds. A large collaring pipe is used for loose rock. This is not left in the hole but removed well before priming..

The rock varies from hard to wet to very soft. A cushion of pyrite or rock will often fill the bottom of the hole.. This is cleared by putting mud into the hole to increase the density of the water and hold the armour of pyrite in suspension. Dart balers are used as it is found that clack valve balers are more difficult to separate particularly to open when full of pyrite sludge.

The hole is baled about every two feet.

A big trouble is deflection of the hole by cross faults called "heads". Schistosity generally dips about 70° in the cut. The hole is drilled to about 6ft. below the level of the cut with an extra two feet for sludge.

The holes are often deflected by schistosity or heads which jar the tools. In such cases the deflected hole is filled with scrap iron which generally deflects the tool back to a vertical course. About 1% of the footage is lost due to deflection. Altogether 5% of footage is abandoned due to holes lost in firing, incomplete firing, hard toe, stuck tools and sumps for sludge. Bits irretrievably lost and recovered later after blasting are not of much use.

The fishing tool is a long instrument with jars. This is lowered over the end of the drilling tool over which it is designed to clamp tight. The cable is then adjusted so that on the downstroke the movement is taken up on the jars but pulls tight on the upstroke. This jerks the tool out of the hole. Before the advent of shock absorbing towers all churn drilling tools had jars.

The drills are shifted frequently owing to shortage, They can be moved under their own power with mast up, or towed by a tractor, or carried on a transported with the mast lowered. Quarry tractors and tornadozers which service the whole cut clean off the bench before drilling.

Quarry Methods

The quarry is worked more easily with faces parallel to the schistosity and the cut is being re-aligned for that reason. When the schistosity runs into the bench, each blast weakens the rock for some distance behind which makes the next round of drilling more difficult.

Holes are spaced along the bench at 18ft intervals, slightly closer if working across the schistosity. They are drilled so that the burden is 20ft which is the distance from the bottom of the hole to the toe of the face. Toe hole drilling is only done to control persistent irregularities of the toe.

The holes are loaded with 50lb. plugs of Nobel Quarigel of 8" diameter. The hole is first baled out, then measured, and deepened or filled in as necessary.

032 A primer plug with cordtex fuse (detonating fuse) is inserted and the depth of the plug measured. The rest of the charge is lowered on a self detaching hook - a hook with an eccentric swivel which swings clear when the load is released. If the charge gets stuck it is cut up with a chisel on a stick and forced down the hole. In such cases another primer would be inserted. The hole is then tamped with smelting slag which is ideal for the purpose being heavy, granular and free running. The holes are then connected together in sequence with a millisecond delay between holes.

The power factor is 3.1 tons per lb.

Misfires are surveyed and tabulated. With Cordtex relays a miss means that the rest of the holes do not fire. With electric firing each hole is fired separately and a miss does not stop the run. Misfires are marked with a red plug and avoided on the next round.

Staff

This consists of two foremen, one per shift, who are in charge of all operations of the open cut. Two assistant foremen supervise the seven drills on each shift.

The drillers are paid on a footage basis. They receive an industrial allowance of 30/- per shift, a prosperity bonus of about 7/- per shift and a footage rate averaging 4/-. Wages rates are paid for down time.

There is no staff trouble and no turnover difficulties.

033

500035 66

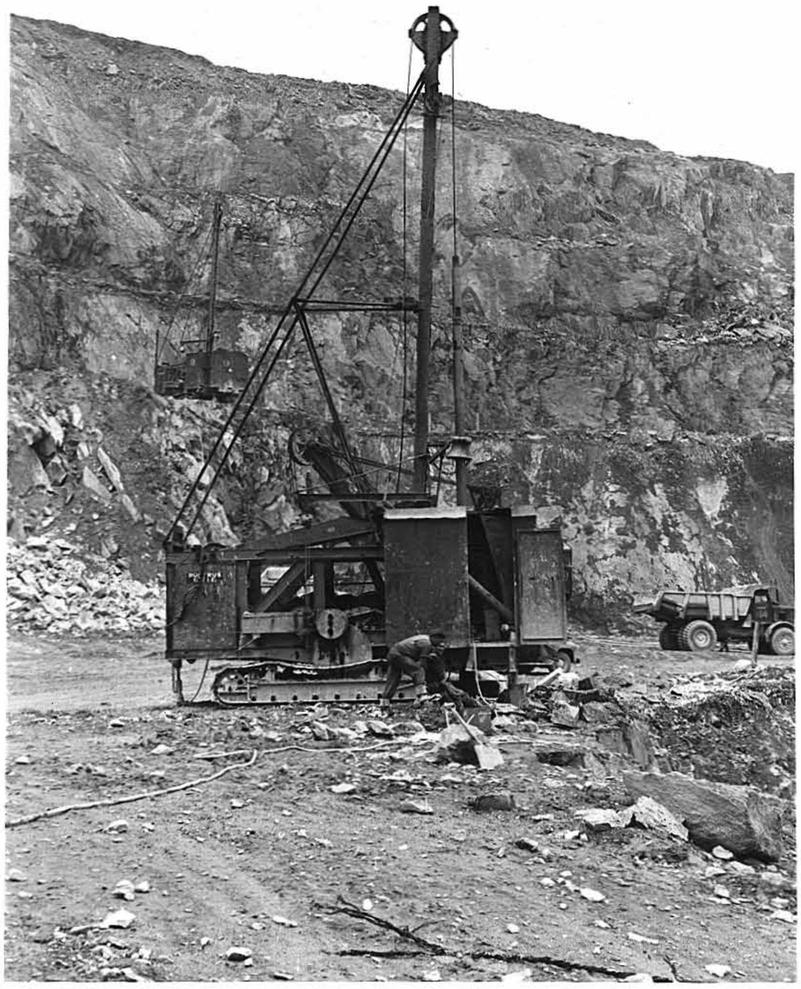
MACHINE RESHAPING BITS

Workshops, West Lyell.

CHURN DRILL:

On the West Lyell Open Cut.

With maintenance truck.



CHURN DRILL :

On the West Lyell Open Cut.

Mines Department

The Mines Department operates drills under contract to farmers for water, harbour and municipal authorities for foundations, and mining companies for exploration. Some work is done for the Commonwealth in exploration of mineral resources in areas reserved under the Mining Act. Such areas include the Rio Tinto and Blythe iron deposits. Details of assignments and expenditure are published in the Annual Report of the Director of Mines, pages 19 or 20.

Organisation

Most drilling is done as part of a geological investigation, so that a geologist always locates the sites, and supervises the treatment and storage of core. The driller's responsibility ends with the consignment of core to Hobart.

The drills are operated by two men who have a caravan and truck, thus forming a mobile, self contained unit. The Superintendent visits the drills regularly, supervising progress, delivering materials and removing core, in addition to supervising the ordering and storing of equipment and parts, and recording of bore logs.

Equipment

The diamond drills include a Goldfields No. 6 (capacity 350 feet of BX), with screw feed, driven by a Ford 10 petrol engine. The pump is an Ajax-McPherson pump, driven by a 2 h.p. hopper cooled English-Lister petrol engine.

A Mindrill E1000 rig is in operation, powered by an 18 h.p. twin opposed, aircooled Enfield diesel. This uses a D4D Mono pump, powered by a 3 h.p. air cooled petrol-paraffin Petters engine.

The Goldfields drill is skid mounted, but the E1000 is mounted on a chassis with sprung wheels and pneumatic rubber tyres. This provides manoeuverability, but only in open country. The open chassis is a disadvantage in that dust is admitted. For drilling, the wheels and springs are removed, and the unit bedded on logs, as a sprung drilling platform plays havor with bits.

The derricks are tripods of fixed lengths of steam pipe allowing 30 foot pull.

Other drills held in reserve include an E100 with screw feed, a steam powered Sullivan C (AX 1500) with water hydraulic feed, a Junior Straitline (AX equipment), and a Mitchel air drill which has non-standard fittings.

Three G33 percussion rigs are in use, powered by BDC, 10 h.p. Southern Cross cold starting diesels with CAV solid fuel injection. The masts are of Oregon pine.

Two hand boring plants are in use, mainly for tin boring and foundations. This equipment is usually hired out, and operated by the hirer.

Additional equipment includes a caravan to each rig. Each caravan has two bunks, a kerosene stove and inbuilt cupboards. A 30 cwt. truck is used with each rig. The Superintendent has a motor vehicle.

Methods

Efforts are made to extract core all the time. Casing is used only for caving ground (as at Zeehan) and to assist water circulation in broken holes. Generally it is possible to draw fresh water direct from a creek, so that water return is not needed as in a recirculating system. The collars are usually cased in percussion and hand bores. In cementing, waterglass is admixed to facilitate setting. To prevent dilution, the cement is wrapped in a paper parcel which is tamped into place.

Workshop facilities are lacking, and repairs are executed by the drillers or referred to private engineers.

The time lost transferring drills between sites is variable. The percussion rigs are very mobile and are generally in action within a shift of completing the previous hole. The diamond drills take longer as they have to be dismantled. Time losses due to weather are variable depending on the climatic zone.

Diamond loss is not calculated until salvage returns are available.

Drillers are trained on the job under the supervision of the Superintendent. Two men operate on each drill shift. Drillers are paid a daily rate, and overtime is discouraged, in accord with Government policy.

Holes are not usually surveyed, the core is transported in wooden boxes by the Drilling Superintendent or by geologists and is stored on the Domain in Hobart.

Water Boring

Of a total Departmental expenditure in the last ten years of £24,165/9/7. £11,507/-/- or almost half has been spent on water boring. Considering that three percussion rigs are in continuous operation and working at a much lower cost than diamond drills, it is apparent that the bulk of the boring is done for water.

Detailed investigation of bore records is done in the production of Water Supply papers, so this is not repeated here. Some aspects of water boring not usually considered in such papers will, however, be discussed here.

A tabulated summary of all water bores is given below. It will be noted that 32% by number, or 21% by footage of dry holes is recorded. (A hole is considered "dry" if it makes less than sixty gallons per hour.)

TABLE

UNDERGROUND WATER 1946 - 1956

LOCALITY	NUMBER Wet	Dry or abandoned	Total	FOOTAGE Wet	Dry	Total
Andover	10	1	11	1165	27	1192
Antill Ponds	1	-	1	55	-	55
Baden	5	-	5	355	-	355
Bagdad	1	1	2	90	63	158
Black River	-	2	2	-	65	65
Bothwell	6	1	7	619	209	828
Britton's Swamp	4	3	7	432	330	762
Broadmeadows	12	3	15	585	49	634
Campbell Town	1	-	1	75	-	75
Chudleigh	3	6	9	221	220	441
Christmas Hills	5	-	5	395	-	395
Colebrook	7	4	11	1085	290	1375
Cressy	3	4	7	286	535	819
Forest	3	2	3	150	42	192
Gretna	1	-	1	78	-	78
Hagley	1	3	4	110	210	320
Hamilton	3	4	7	260	612	872
Jericho	15	5	20	1582	131	1713
Kempton	5	1	6	490	200	690
Lamont	3	4	7	291	240	531
Lileah	3	2	5	128	65	193
Longford	7	4	11	551	185	736
Mangalore	1	2	3	38	42	80
Melton Mowbray	7	11	18	2192	706	2898
Montagu	6	3	9	319	94	413
Mount Seymour	1	1	2	99	155	234
Mowbray Swamp	3	3	6	118	106	224
Oatlands	7	-	7	677	-	677
Old Beach	3	-	3	620	-	620
Parattah	9	2	11	825	195	1020
Rhyndaston	-	1	1	-	205	205

LOCALITY	NUMBER Wet	Dry or abandoned	Total	FOOTAGE Wet	Dry	Total
Ron	2	-	2	335	-	335
Scotchtown	4	4	8	181	51	232
Smithton	9	7	16	441	228	669
South Forest	3	-	3	225	-	225
Stanley	1	1	2	148	70	248
Stonor	12	-	12	1000	-	1000
Tiberias	1	-	1	80	-	80
Tunbridge	-	1	1	-	30	30
Tunnack	3	-	3	253	-	253
Whiteford	1	-	1	23	-	23
Whitemore	1	-	1	33	-	33
Wiltshire	1	-	1	75	-	75
Woodbury	11	-	11	1045	18	1063
Woodsdale	3	-	3	345	-	345
Tom Plains	26	8	34	2902	643	3545
Northern District	15	17	32			2349
Far Northwest	56	27	83			4326
Derwent Valley	7	4	11			1570
Midlands	137	44	181			18763
TOTAL	214	93 (32%)	307	21214	5794 (21%)	27008

Figure 1 is a summary of the boring done at York Plains. This is fairly representative of the Midlands area. The bores are arranged in order of the depth. Except for holes in dolerite, abandoned at shallow depths, the bulk of the drilling was in Triassic sandstone and shale. The blank top indicates surface material, the very deep weathered zone in one bore being due to a fault. The yield is inappreciable below 100 feet which is a general feature in Tasmania, most water being obtained from shallow holes. Water in dolerite is usually restricted to fault zones.

Comparison with Fig. 2, which shows the corresponding drilling times, computed from a calendar and the commencement and finishing times, indicates an average of two days elapses from the time drilling ceases at one hole to the time of commencement at the next. The solid curve is the performance to be expected providing no delays occur. Thus without delays, a 200 foot hole takes 12 days, and an 100 foot hole 4 days. Delays average 2½ days per hole. This would include time for sharpening bits and repairing equipment, and all types of delays not accounted in drawing the curve. Some delays are beyond the control of the driller, such as the delay due to replacement of broken equipment which has to be obtained from Melbourne. The period of such a delay is spent on maintenance work, and it is noticeable that after a long delay performance is improved for a while, giving an asymmetrical sawtooth pattern. The dotted curve shows the average performance of the rig. The conclusions given here are not based upon this figure alone but on similar figures prepared for all districts.

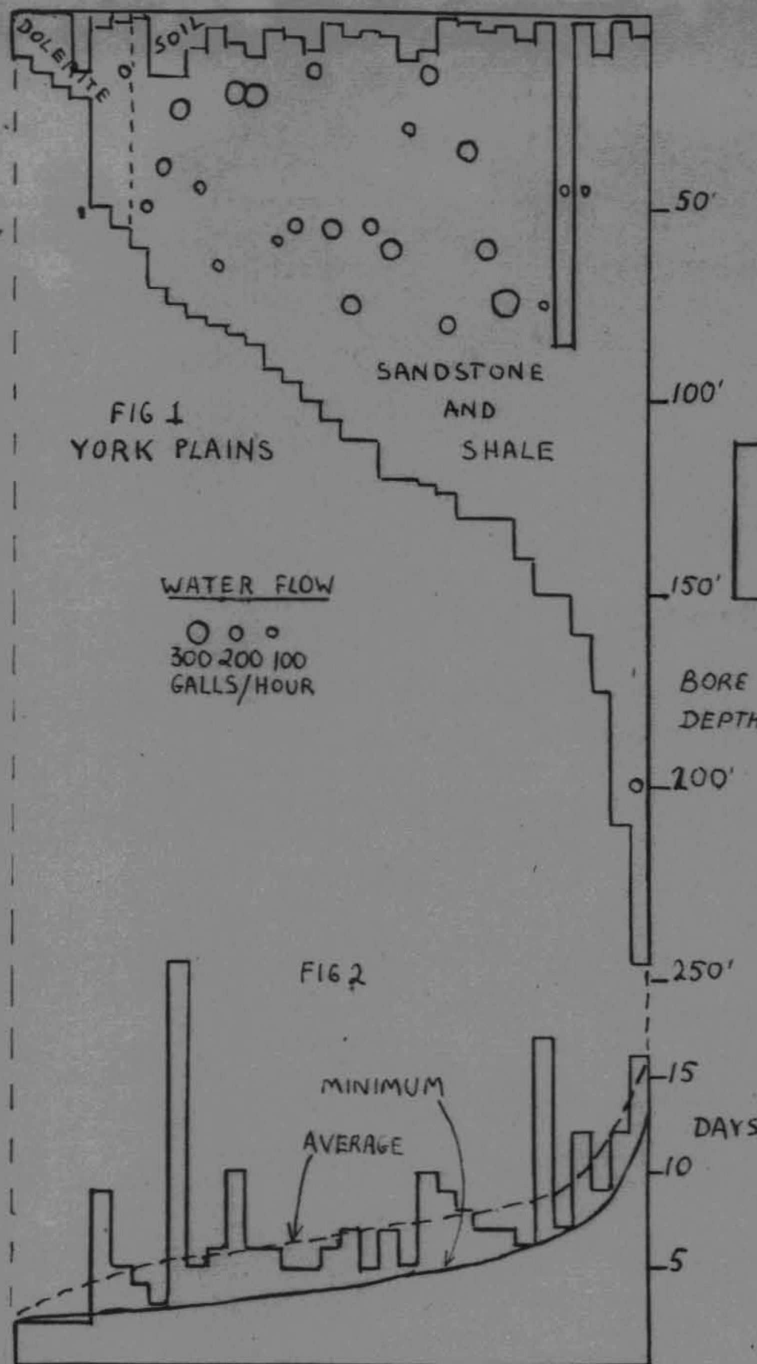
Fig. 3 is a histogram showing the relationship between the yield of holes and the frequency this yield occurs. Two maxima occur, a 22% maximum for dry holes, and a 47% maximum for holes yielding near 300 gallons per hour. The shape of this histogram is very characteristic and is repeated in similar figures constructed for nearly all of the other districts in Tasmania. Fig. 4 gives the combined pattern for bores in the far North-West. The occurrence of peaks every hundred gallons/hour indicates the drillers tend to refer flow measurements to the hundred gallons. Smoothing in threes removes this irregularity.

In the midlands, there is a secondary maximum at 200 gallons/hour, which is well marked on similar histograms for the whole of Tasmania.

The method of assessing yield is to bale with a four gallon baler. The maximum rate of baling is about 300 gallons per hour so that all figures given higher than this are a matter of guess work. The effect of this is to transfer a maximum at any value higher than 300 gallons back to three hundred gallons per hour. Also it produces an asymmetry in that the tail of the curve is foreshortened. This foreshortening is very large in fig. 3, but negligible in fig. 4, so the maximum in fig. 4 is near the 300 gall/hour peak on the curve.

Factors controlling yield are hole diameter, thickness and permeability of the aquifer, and hydraulic head. If geological factors are properly evaluated, true measurements of the yield would enable the importance of bore diameter to be assessed. Conceivably a significant increase in yield could result from boring larger holes.

Fig. 5 shows the relationship between depth of bore and bore yield for the Midlands (Triassic sandstone and shale) and fig. 6 is the corresponding relation for the far north-west (dolomite overlain by superficial sediments). The 200 galls/hour maximum is for holes between 20 and 100 feet deep, showing there is little point in taking bores below 100 feet. The random scatter in the midlands is modified by appearance of a blank portion of the field in fig. 6. In this area the water is obtained from permeable lenses in the superficial deposits, or from the fractured rock at the surface of the docomite, and is only found in depth in fault zones in the dolomite. There is thus a lack of low yield bores at depth, which may be the cause of the blank field.



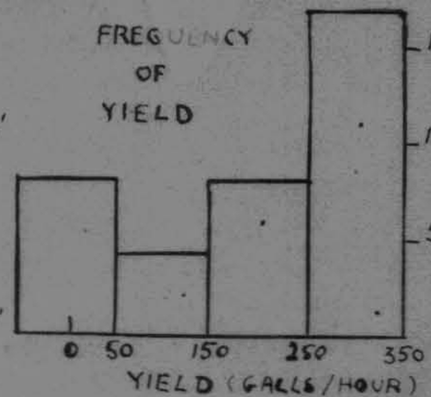


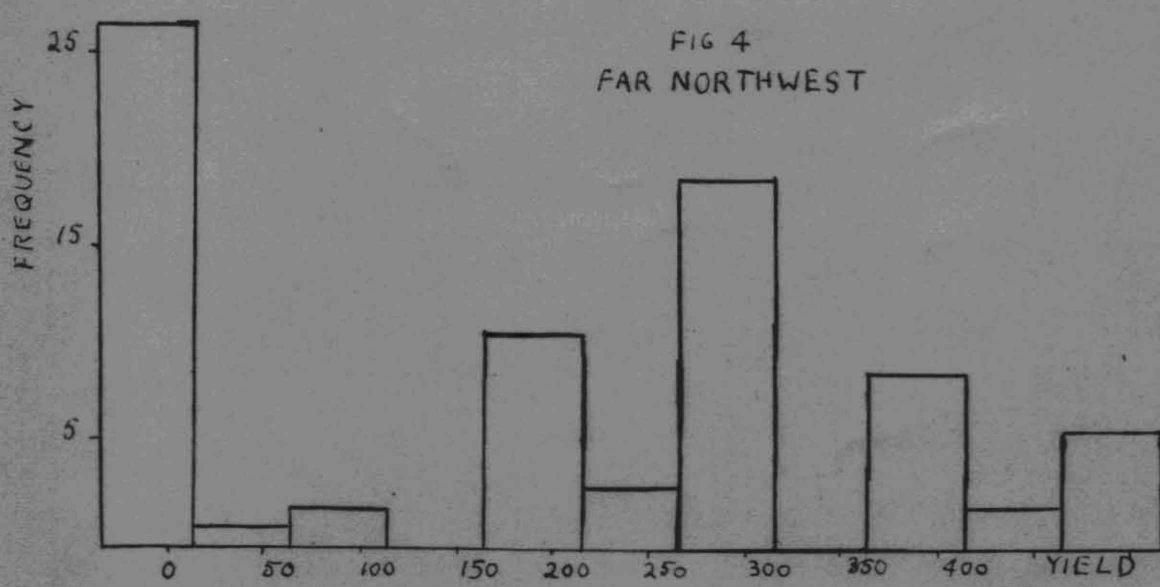
FIG 3

FIG 1: Summary of wells drilled at York Plains, arranged in size order

FIG 2: Corresponding drilling time. Peaks represent delays

FIG 3: Frequency v. Yield Histogram York Plains Area

FIG 4: Frequency v. Yield Histogram, Far Northwest Areas.



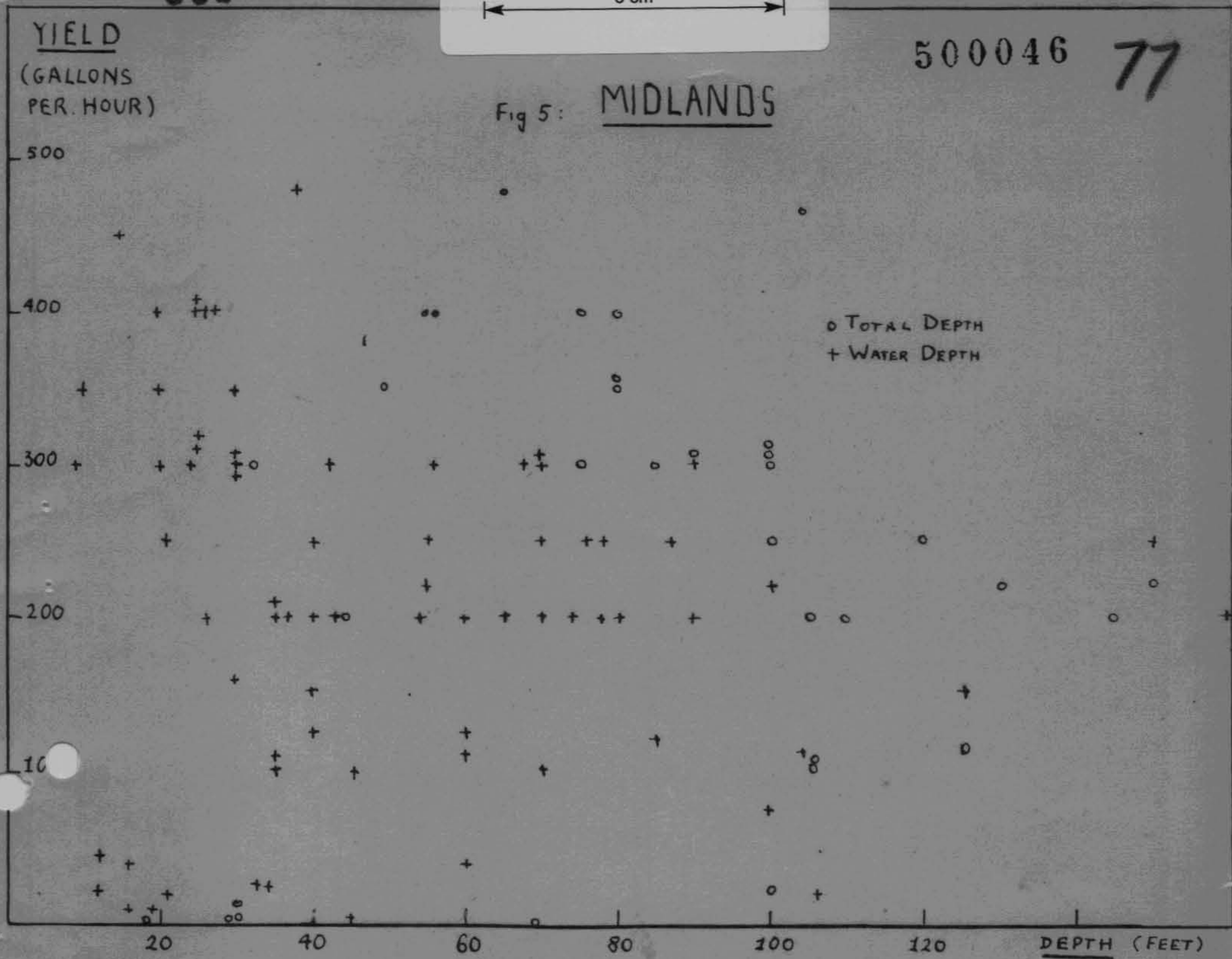


Fig 5: MIDLANDS

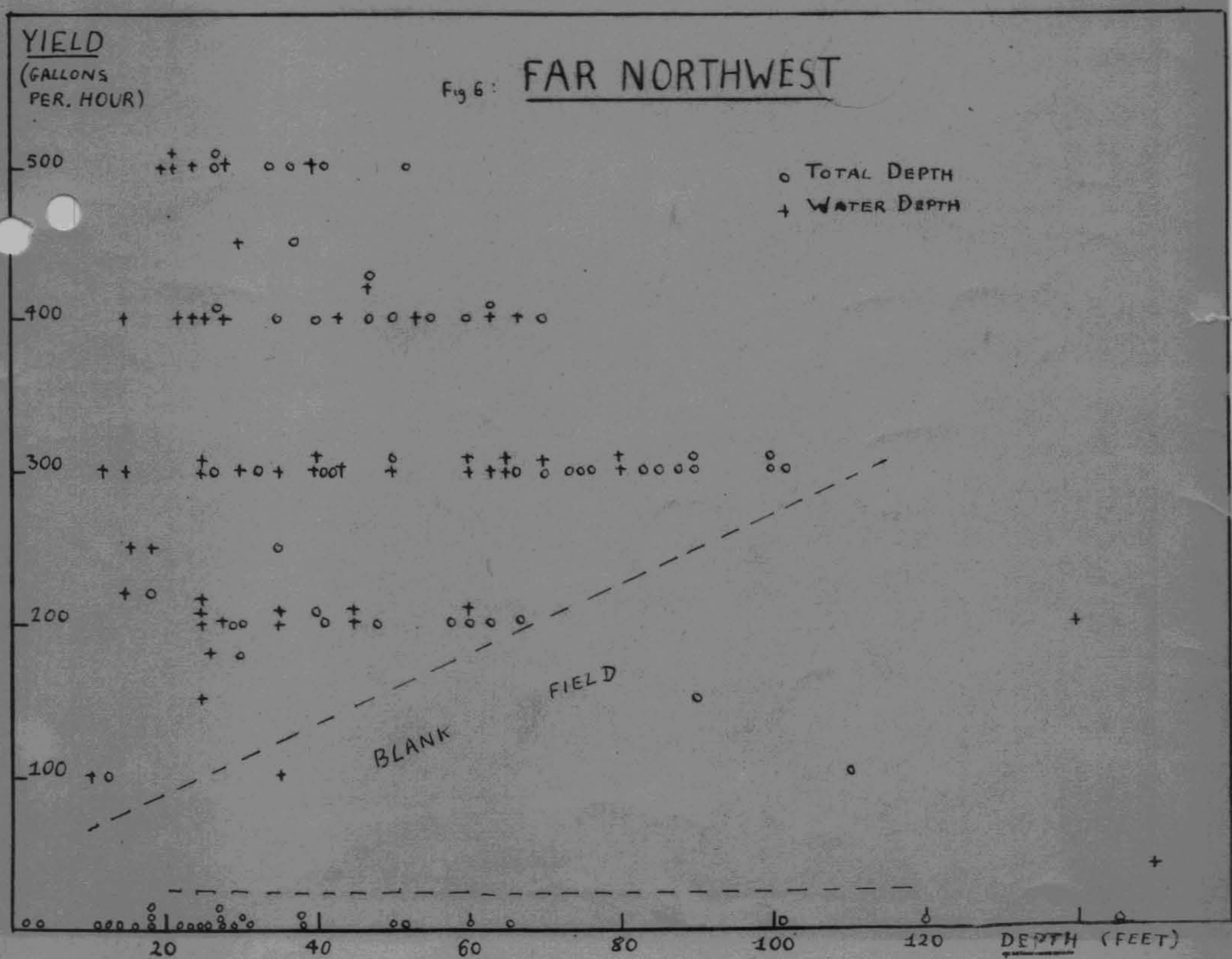


Fig 6: FAR NORTHWEST

HAND BORING:

The auger has been wound down several feet and the drill string is being lifted with dogs. The casing sinks with the lifting.

HAND BORING:

Removing sample from auger.

HAND BORING:

View showing construction of staging and method of attaching to casing.

Hand Boring.

In addition to percussion and diamond drills the Mines Department maintains several hand boring plants. These are used by Departmental Officers and hirers for sampling beach sands and deep leads, and for foundation exploration. The photographs were taken during boring to sample Tertiary clays in a reservoir site.

The plants bore a three inch diameter hole to over 50 feet, depending on the rock. Clays are easy to bore, sands and gravels difficult. A platform is attached to the casing, and the auger wound down by rotating the platform, with operators on the platform putting weight on the rods. After a few feet the rods are lifted to free the auger, at which time the casing sinks. The process is repeated until a full load of clay is upon the auger, which is then lifted out and cleaned.

Hiring rates are low and the equipment is very useful for shallow holes in soft rock.

HYDRO-ELECTRIC COMMISSION

Introduction

The Hydro-Electric Commission does many thousands of feet of drilling annually exploring dam foundations and tunnel routes. Geologists are responsible for locating the holes and logging the core, the results being incorporated into geological reports utilised in the planning of schemes.

Drilling Operations

The installations at Blackwood Creek were visited in 1955. At the time the contractors were drilling NX and BX along the proposed tunnel routes for the Great Lake North scheme. The Commission has most of the drilling done by contract.

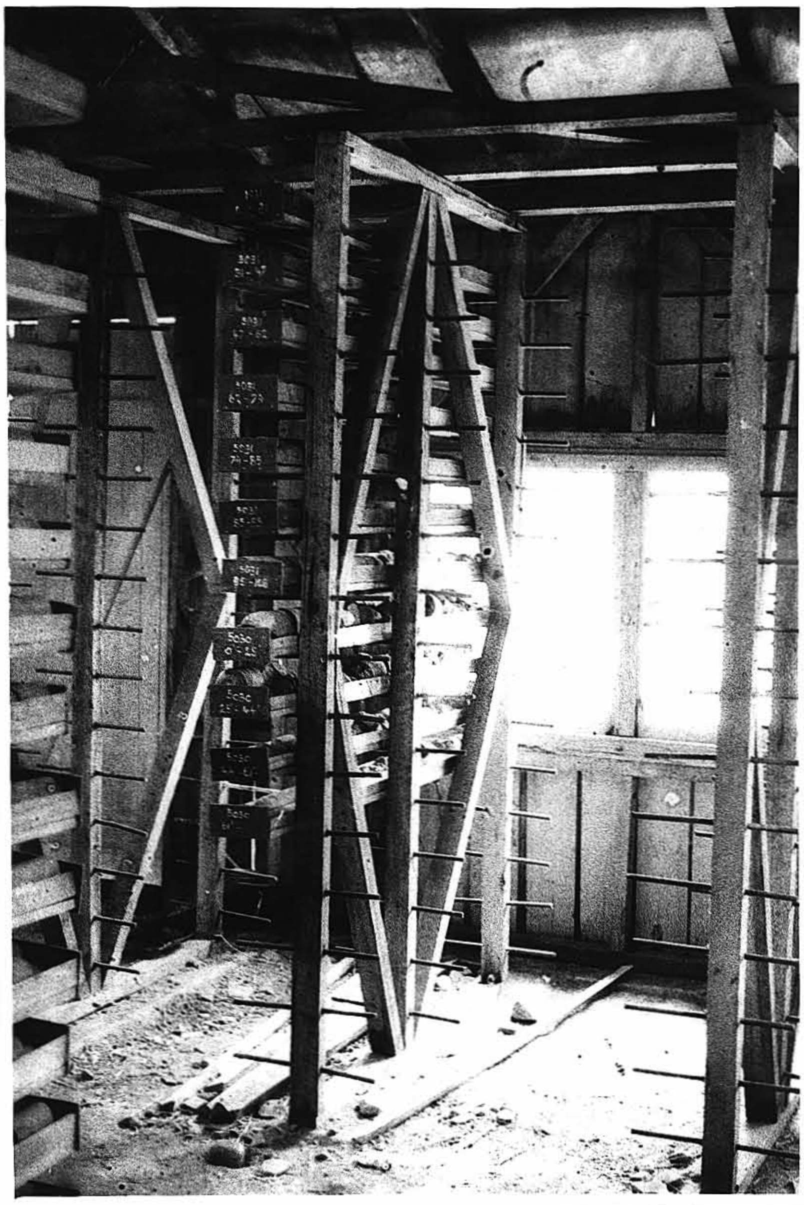
The contractors, Goldfields Pty. Ltd., had built a small village at the foot of the Tiers, with separate sleeping accommodation for the men and a central mess-room. Jeep tracks were built across the scree to all drill sites.

The major drilling problem is the rotation of boulders of the scree under the bit. It is necessary to cement the hole to hold the boulder firm and then drill through it. With scree several hundred feet thick progress is often very slow.

The core is stored in a self-contained hut at the foot of the Tiers, and is so designed that any core is accessible without shifting other core. Since the orientation of the core is important, particularly in dolerite which may be later used for measurement of the magnetic moment, each piece is marked with an arrow which points down the hole.

The core shed has a small office with sleeping accommodation at one end. The core is stored in a separate room, 24' x 36' with racks along each long wall and an island rack in the centre. There are 12 racks in the length of the room, with 2' gaps between for access. Each rack supports 15 5' core trays up to 7' above the floor on reinforcing steel rod projecting 6" from the timber.

The rod is spaced at 5" centres vertically. The total capacity is 5,400 feet of NX core in 6,000 cubic feet of storage space, or about 1'/cu.ft. The low efficiency of this shed is due to the large number of passageways required to make each piece of core separately accessible. The core trays are 6" wide, 5' long, with sides and core spacers of 2", 1" or 1/2" moulding strip/



CORE SHED.BLACKWOOD CREEK

The core size is NX.