1929.

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WESTERN AUSTRALIA.

ANNUAL PROGRESS REPORT

OF THE

GEOLOGICAL SURVEY

FOR THE

YEAR 1928.

PERTH:
BY AUTHORITY: JOHN LEE, ACTING GOVERNMENT PRINTER.

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TABLE OF CONTENTS.

Annual Progress Report of the Geological Survey for the Year 1928.

I have the honour to submit for the information of the Hon. the Minister for Mines my report on the work carried out by the officers of the Geological Survey for the year 1928.

STAFF.

There has been no alteration in the personnel of the professional officers, which comprises one Field Geologist, one assistant Field Geologist, a half time Petrologist and his assistant.

Mr. Glover, clerk-in-charge, having passed his final examinations in Accountancy, was transferred to the Crown Law Department.

His position was filled by Miss F. Armstrong, B.Sc. The benefit and economy effected by the clerk-in-charge possessing a scientific training in Geology has been amply evidenced in the production of a card catalogue of the Geological literature of the State, for author, subject, and locality, the collecting of the necessary and relevant data for reports, preparing maps for reports, editing and the ability to reply to much of the technical correspondence and every day enquiries.

FIELD WORK.

On the fifth January, in company with the Secretary for Mines, I attended a conference in Hobart, the main purposes of the meeting being to discuss Geophysical methods of prospecting and particularly to decide which were the best fields for active experimental work. We returned to Perth on January 27th.

At the latter end of February I visited Eradu to lay out fresh bore sites and make a survey setting out the relative elevations of the coal seams already cut in the first series of bores.

Continuing from Eradu I went to the Braeside Mineral Belt and fixed ten bore sites in positions to test the main lines of lead lodes at depths of from 250-400 feet.

Leaving Perth on May 8th in company with the Secretary for Mines I attended a second Geophysical Conference in Melbourne. I also attended the Geological Conference held at Adelaide a few days later. Minutes of these two meetings have been supplied by the Secretaries of the Conferences. I returned to Perth on June 3rd.

From June 3rd to August 24th my duties kept me in Perth attending to accumulated correspondence and preparing the Annual Report, etc. During the last days of August a trip was taken to the Fitzgerald River to sample the brown coal seam which had been partly developed.

On September 13th a second visit was paid to Braeside in connection with the boring there, and having completed that inspection I joined Dr. Woolnough at Port Hedland and travelled to the Freney Kimberley Oil Well at Poole Range to discuss the situation brought about by striking oil when boring in a wet hole.

Most of the month of November was occupied in sampling the alunite deposits at Lake Chandler, in company with Mr Bowley of the Government Analyst's Branch. These deposits were thoroughly sampled and my report is now waiting on the results of the analyses. A short break occurred in the work when I accompanied Mr. Broughton Edge to Ajana to inspect the lead deposits with the object of ascertaining their suitability or otherwise for geophysical investigations.

Early in December a short inspection was made of the Proprietary Coal Mine to ascertain whether a certain section of collapsed roof had left the surface unsafe for railway traffic. The final trip for the year was with R. Lockhart Jack while investigating the water question for the northern area set aside for the 3,500 Farm Scheme.

In addition to the foregoing, at the request of the Engineer-in-Chief, inspections were made of the Boya Quarry, Byford Brick Works, Canning No. 1 and No. 2 and Wongong reservoir sites. The text of those reports, which were not made for purely departmental purposes, is attached hereto.

F. R. Feldtmann and K. J. Finucane, B.Sc., Field Geologists.

Practically the whole of the time of these officers was spent in doing field work at Kalgoorlie for Dr. Stillwell, who was collecting data for a special report on the "Golden Mile."

Dr. C. O. G. Larcombe, Petrologist.

The greater part of the petrological work consisted of the examination of bore cores from Coolgardie, Mararoa G.M. Cue, Ajana, Big Bell Mine, Harbour Lights Gold Mine, Leonora, Sandstone, and Greenbushes. Some determinations were made of rocks collected in the Kimberley District by the Government Geologist and of various rock specimens submitted by the public generally.

T. BLATCHFORD, B.A.,
Government Geologist.

THE GEOLOGY OF THE TWO AREAS SET ASIDE FOR THE DEVELOPMENT OF THE 3,500 FARMS, PARTICULARLY WITH REGARD TO A WATER-BEARING ASPECT.

T. Blatchford, B.A., Government Geologist.

Geology.—Portions only of the area under discussion have been geologically surveyed in detail, the boundaries of the various rock formations being set out on the plans in Bulletin 71.

Broadly speaking, most of the two areas lies on a slightly elevated tableland consisting essentially of granites which have been intruded by narrow belts of more basic rock, which in turn have been intruded by later granites. Remnants of very old sediments undoubtedly of Pre-Cambrian age, also occur but are of no great importance to the question involved,

Apparently the whole of the area remained above sea level between Pre-Cambrian and Miocene times. During the latter period a submergence took place, for undoubted remnants of Miocene beds can be found as far north as Kojonup and Widgiemooltha. How much further the ocean may have crept in is not definitely known, but it is highly probable that the submergence extended much further north than the localities named.

Following Miocene times the whole area gradually rose and no doubt the depressions were left filled with sea water which on evaporation deposited considerable quantities of salts. The extreme salinity of the underground waters in the "dry" lake channels is probably largely due to this residual salt. Most of the salt in the underground waters, however, is in my opinion derived from the southern winds which are most persistent during the summer months. Right along the south coast the rusting of ironwork is most pronounced and is without doubt due to the salt in the air. Furthermore, all the rivers which flow south are more or less intensely salt. It would be difficult to imagine that the salt in these streams was derived from the residuals of the Miocene sea, seeing that most of the Miocene beds have been completly removed from the catchments, and the underlying rocks, though they may store water, are most unsuitable for water circulation. It should also be noted that the ratios of the various salts in the underground waters is very close to those of average sea water.

Summing up the geological evidence as far as it may be applied to underground water supplies, the main factors appear to be the low rainfall, absorption by vegetation and intense evaporation during the summer months. The area is essentially a granite tableland covered with shallow superficial deposits. In the depressions, particularly the "dry" lake areas, the underground waters are intensely charged with salt, the salt being possibly partly derived from the Miocene sea waters, but mostly from cyclic salts.

Cyclic salts from the southern winds are being constantly deposited, though no doubt this gradually falls off as we proceed north.

Under these conditions it is hardly to be expected hat the area would contain extensive fresh surface or underground water supplies, and such do not occur. There are no permanent surface water supplies, either salt or fresh. The records of underground waters in the greenstones and Pre-Cambrian strata show the supply at times to be appreciable, but the water is invariably salt. Instances such as at Westonia show that salt water is to be expected in abundance in any extensive depression in the granite where there is no circulation of the water. In the instance quoted one mine alone pumped 60,000 gallons per hour for several years.

There are, however, limited supplies of fresh underground water, and such have been found almost invariably in the drainages from the higher portions of the granite, particularly where there has been a concentration of circulating water into a channel. Experience shows also that as the distance from the granite catchment becomes greater the salinity of such water increases.

Fresh water has been found in isolated instances along the coastal area, rising to the surface or in shallow wells. Such occurrences can be traced to local and very limited catchments where there is a free drainage. There is, however, a possibility of obtaining limited supplies by closer study of similar condtions.

As a whole, however, the fresh water supplies must be looked for in the surface deposits which have been charged with rain waters flowing from granite and to a much lesser degree, greenstone catchments.

BORING FOR COAL AT ERADU.

T. Blatchford, B.A., Government Geologist.

The Bores.—For convenience sake the boring at Eradu may be best divided into at least two sections: (a) those west of the Greenough River, (b) those lying to the east of the river.

Western Section.—Two calyx bores, Nos. 1 and 2, are in this section. In No. 1 bore the top coal seam was struck at a depth of 170 feet: in the second the same seam was struck at a level 43 feet higher. The rock cores agree more or less in these two bores and I have no doubt that the same strata has been met with in both. Fourteen chains north of the railway bridge and on the western bank an outcrop of rock is exposed which is very similar to the core from 90 feet in the No. 2 Bore. Taking this spot and the 90 feet level in the bore, the levels agree, so that if the two strata are the same, the strike must be somewhere in the direction of north west and south east. As far as I could ascertain (and the readings are in no way to be considered accurate) the dip of the outcrop on the river bank varies from west to south west, which is confirmatory as to the north west strike. It is therefore reasonable for the present to assume that the strata on the western side of the Greenough dips to the south-west and strikes north-west and south-east.

Eastern Section.—There are three calyx bores and four hand bores in this section. The plan of reduced levels shows that the top seam in No. 4 calyx and Nos. 1, 3 and 4 hand bores was struck at practically the same level while in the second calyx bore it was met at a depth of 10 feet greater. There was no trace of coal reported in either No. 2 hand bore or No. 3 calyx, which has now reached a depth of 785 feet. I can notice a slight similarity between the cores of No. 4 calyx and those of Nos. 1 and 2 calyx, but none between those of No. 3 calyx and either of the first three. No. 3 bore has been a disappointment and the absence of coal is apparently due to faulting. This bore has also been very troublesome to the drillers from 300 feet down to the present (785 feet). Practically no core has been obtained from the last 500 feet, and the enormous heap of sand testifies to the amount of pumping which has been necessary to set in the casing. The last two days the bore has been in shale and progress may improve from now on, but it is doubtful whether the casing will not be seized again by the loose sand coming from the sides.

On the plan showing the positions of the bores a spot has been marked some 3½ miles up the river from the railway, where there is a distinct outcrop of shales, and scattered pices of coal were also found. The shales are overlain by three distinct beds of conglomerates embedded in a coarse gritty sandstone. The shale beds were too much covered up with talus to permit an accurate observation to be taken for strike and dip, though it is evident the dip is to the westward, probably south-westward. If the dip of these beds continues to the south-westward and the angle continues the same or increases, none of the present bores has gone deep enough to reach them unless there is unknown faulting.

— PLAN SHEWING BORE SITES —

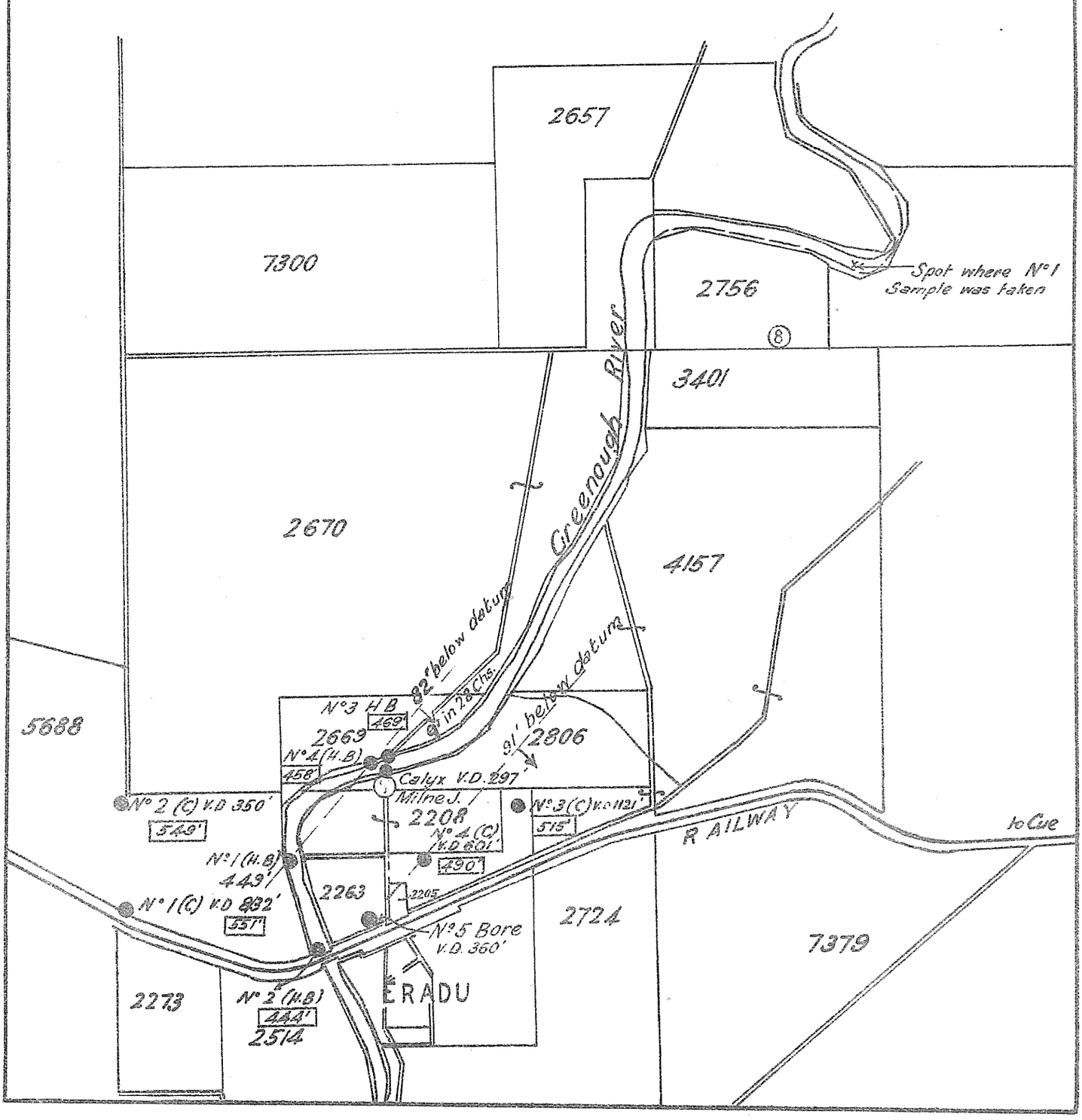
— AT —

— ERADU —

— Scale:- 40 Chains = 1 Inch —

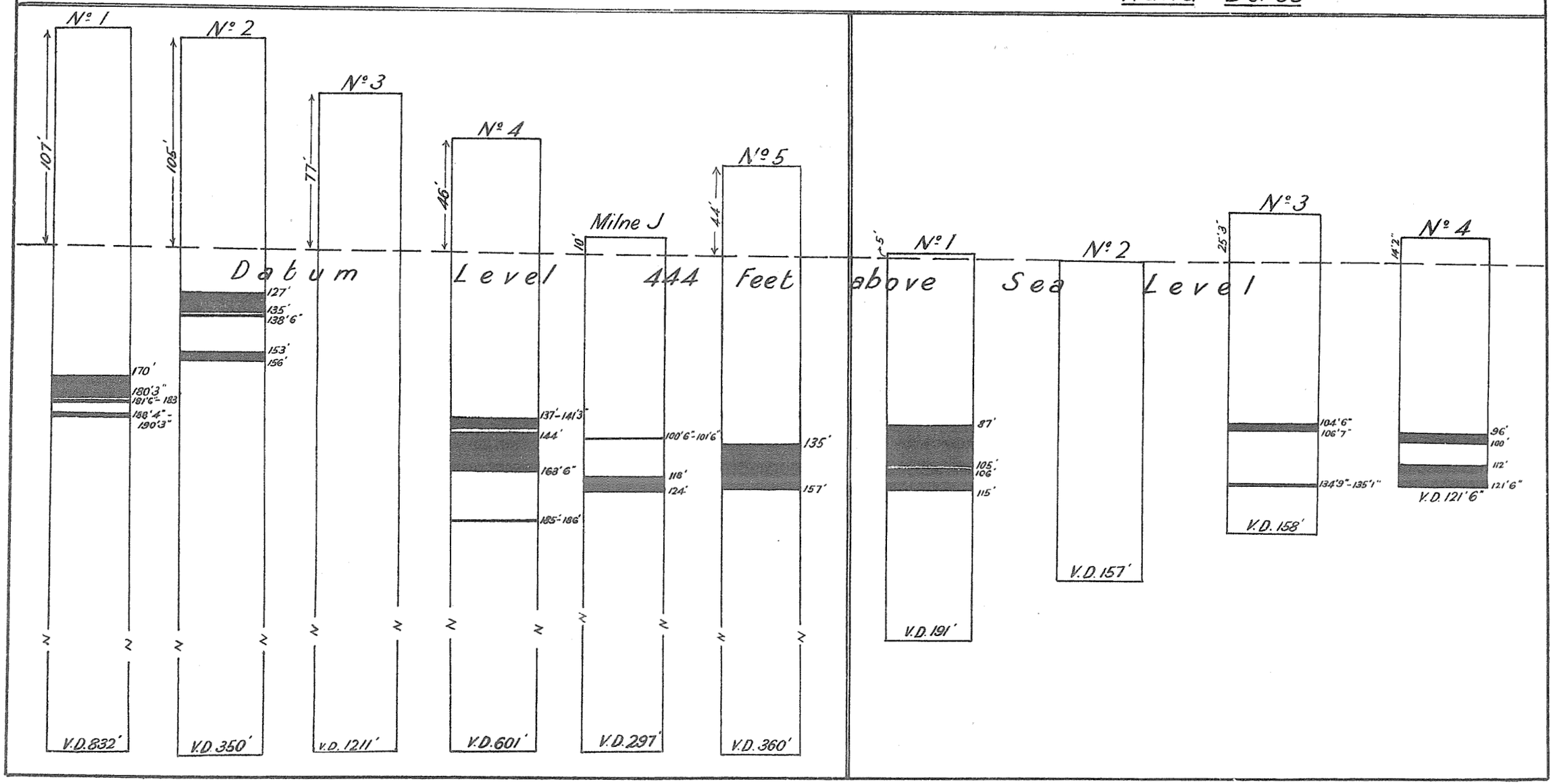
— LEGEND —

⑥ Bore Sites Suggested
[528'] Height above Sea Level
(C) Calyx
(H.B) Hand Bore
(V.D) Vertical Depth



Plan Shewing Surface Level of Bores at Eradu & Thickness & Relative Depths of Main Coal Seams

— Vertical Scale :- 60 Feet = 1 Inch —



With regard to the No. 2 section it appears to me, on the evidence we now possess, that there is a strong probability of the strata being more or less horizontal in this area, but that faulting has occurred somewhere in the vicinity of No. 1 hand bore and also between Nos. 3 and 4 calyx bores.

To test the coal seams further the following boring should be undertaken:—

(a). In the western section the dip and strike should be definitely decided by a bore placed say 20 chains on the river side of No. 1 calyx bore, near the railway line, and on a surface level of 523 feet. Coal should be struck here at between 150 and 200 feet. If successful a second bore much farther out on the dip should be put down to test the value of the seams at depth. The picking of the second site had best be deferred until the third bore is completed.

(b). In the eastern section the position is not so clear. I would like much to see one bore put down near the old calyx bore to test the seams more accurately, for there is too great a discrepancy in the logs of this and Nos. 3 and 4 hand bores to be satisfactory. As No. 2 hand bore failed to reveal coal, a calyx bore, say to 200 feet deep, should be put down somewhere between the Eradu siding and railway bridge to prove definitely what the dip and strike is and whether the coal seams continue in this direction.

As No. 3 bore is at present going through a strata not previously met with, this bore had best be continued, for if once abandoned it will surely fall in. In this case much will depend on whether drilling can be continued.

(c). Before removing the plant a hole should certainly be placed to go through the shales and coal seams on Block 2756.

Since writing the foregoing No. 5 bore has struck the main coal seam at 135 feet or 91 feet below datum level.

This is the same depth at which the seam was cut in No. 4 bore and so defines the strike as N.E. S.W. Coal was struck in No. 1 and No. 4 hand bores at 82 feet below datum and in No. 3 hand bore at 79 feet. The strike defined by these hand bores is so close to that by the calyx bores 3 and 4 that it can reasonably be assumed to be accurate.

The coal seams therefore, on the east side of the river strike N.E. S.W. and dip at the rate of 9 feet in 28 chains.

BORING FOR MINERAL OIL AT POOLE RANGE (FRENEY KIMBERLEY OIL CO.).

T. Blatchford, B.A., Government Geologist.

In company with Dr. W. G. Woolnough, Geological Adviser to the Commonwealth Government, I visited the oil bore at Poole Range.

What has taken place is briefly as follows:—

After exploring the strata to 1,000 feet with a pilot hole a 10-inch bore was carried down to 1,683 feet and all the top waters were cased off at this point by cementing.

On resuming the boring with an 8-inch hole, after a short distance heavy water came in again and eventually rose to a level of 127 ft. from the surface. Whether this water was due to the cement failing, or whether it was a fresh-water horizon which was struck, is not certain. Boring was continued in a wet hole through varying strata to a depth of 2,085 feet, when an oil was noticed coating the cable and floating on the water. This oil "show" continued to a depth of 2,115 feet and then diminished; a recurrence, however, was noticed between depths of 2,117 and 2,131 feet, when boring was definitely suspended.

When the oil was first struck it was noticed that the water had fallen a depth of 15 feet in the bore, but it is not certain as to the exact time when this occurred. The water level gradually rose to the original level, viz. 127 feet.

When we arrived the 8-inch casing with the packer had been lowered into the hole, the packer being set in the casing at a depth of 2,025 feet. The bottom of the casing which was resting on the bottom had been perforated to allow water to flow in.

All attempts to lower the water by bailing or swabbing had failed. At all bailings while we were present the water raised contained undoubted "shows" of mineral oil.

An attempt was made by Dr. Woolnough to ascertain whether the packer was holding or not by pouring a concentrated brine solution down between the 10-inch and 8-inch casings and testing the water from the bottom of the 8-inch casing for salinity. Unfortunately the test failed. At present it is not possible to state where all the water in the bore is coming from, though it is certain that there is at least one flow above the oil sands struck at 2,085 feet.

There appears to be no doubt that genuine oil sands have been struck, but it would not be reasonable to suppose that any appreciable quantity of oil would flow into the bore with a head of water equivalent to some 800 lbs. to the square inch acting against it.

The oil, which has shown, more than probably represents a portion only of what was liberated during the actual drilling.

As it is apparent that every effort should be made to try and test out these undoubted oil sands in a dry hole, and as the apparatus required was not on the spot and the rainy season about to start, it was unanimously decided on the spot to mud up the bore to the bottom of the 10-inch casing and so stop water circulation and at the same time ensure the safety of the hole.

This will give time to obtain up-to-date expert advice and purchase of the necessary plant which may be decided on.

FITZGERALD BROWN COAL DEPOSITS.

T. Blatchford, B.A., Government Geologist.

A further visit was made to the Fitzgerald Coal Deposits to sample the seam cut in a new shaft. The coal seam was struck in this shaft at a depth of 10 feet from the surface and 9ft. 6in. of coal was exposed, with a further 3 feet of carbonaceous shale immediately underlying. Samples were taken as follows:—

From Shaft.

1. Carbonaceous shale or clay underlying coal seam over 3 feet.
2. Coal—0-2′ bottom section.

3. Coal—2-4′
4. Coal—4-6′
5. Coal—6-8′
6. Coal—8-9′ 6″ top section.

   Two samples were also taken from the opening on the north side of the shaft from which the bulk parcel is being broken.
7. Top section over 2′ 9″; bottom section over 2′ 9″. These two samples should indicate the value of the bulk sample.
8. Another sample of coal was taken from a bore put down on an outcrop, about one mile downstream from the shaft. The seam proved to be about 8 feet thick at this spot. Only one sample was taken here.

A second bore was started some 300 yards up the Susetta River, but failed to reach the coal seam. This was due to the fact that a bed of wet sand or friable sandstone was cut and there was no suitable casing sent with the boring tools.

I found numerous blocks of coal in the river bed about 1½ miles upsteam from the shaft, and have no doubt that the coal seam extends in that direction for a considerable distance.

If the reported results of the two old bores be accepted, there seems to be little doubt that there is an extensive deposit of brown coal, more or less proved, with possibilities of a far greater area lying to the east of the river.

The following were the results of the analyses:—

Wheeler's Shaft.

Laboratory No.	2869	2870	2871	2872	2873	2874
Mark	Clay 0ft. to 3ft. from bottom	0ft. to 2ft. bottom section	2ft. to 4ft.	4ft. to 6ft.	6ft. to 8ft.	8ft. to 8ft. 6in. top section
Proximate Analysis.						
	%	%	%	%	%	%
Moisture	15·10	33·08	42·32	42·24	42·45	37·64
Volatile matter (including combined water)	11·67	24·82	26·81	30·13	27·67	32·39
Fixed carbon	6·41	14 24	14·47	17·50	17·32	18·17
Ash	66·82	27·86	16·40	10·13	12·56	11·80
	100·00	100·00	100·00	100·00	100·00	100·00

DRIVE FROM NEAR BOTTOM OF SHAFT IN CENTRE OF DEPOSIT.

Laboratory No.	2875/28	2876/28
Mark	Top section over 2ft. 9in.	Bottom Section over 2ft. 9in.
Proximate Analysis—	%	%
Moisture	42·93	43 40
Volatile matter (including combined water)	28·26	23·45
Fixed carbon	16·39	14·63
Ash	12·42	18·52
	100·00	100·00
Destructive distillation yielded—		
Crude heavy oil (gallons per ton)	11·3	10·6
Residue	31·4	36·1
Proximate Analysis of Residue—		
Volatile matter	3·77	4·70
Fixed carbon	58·85	47·42
Ash	37·38	47·88
	100·00	100·00
On artificially dried coal—		
Crude heavy oil (gallons per ton)	20·3	18·8

BORE ON OUTCROP ONE MILE DOWN THE RIVER FROM WHEELER'S SHAFT, OPPOSITE OLD CAMP.

Laboratory No.—2877/28.

Proximate Analysis—	%
Moisture	15·73
Volatile matter (including combined water)	7·67
Fixed Carbon	3·60
Ash	73·00
	100·00

A parcel of 30 tons has been sent to England to be tested by the Dvorkovitz Hydrogenation Process. The results of these experiments are not yet to hand, and it will largely depend upon them whether the coal deposits can be put to economic use.

PETROLOGICAL WORK.

C. O. G. Larcombe, D.Sc.

The following petrological work has been carried out in this Department during the year 1928:—

a. Petrological examination of cores from the bores at Coolgardie.

b. Petrological examination of cores from the boring done on the Mararoa Gold Mine (Reedy's), Cue.

c. Petrological examination of cores from the bores put down at Ajana to test the lead deposits.

d. Petrological examination of cores from the bores on the Big Bell Mine, Cue.

e. Petrological examination of cores put down at the Harbour Lights Mine, Leonora.

f. Petrological examination of cores from the last of the boring at Sandstone.

g. Petrological examination of cores from the boring for tin at Greenbushes.

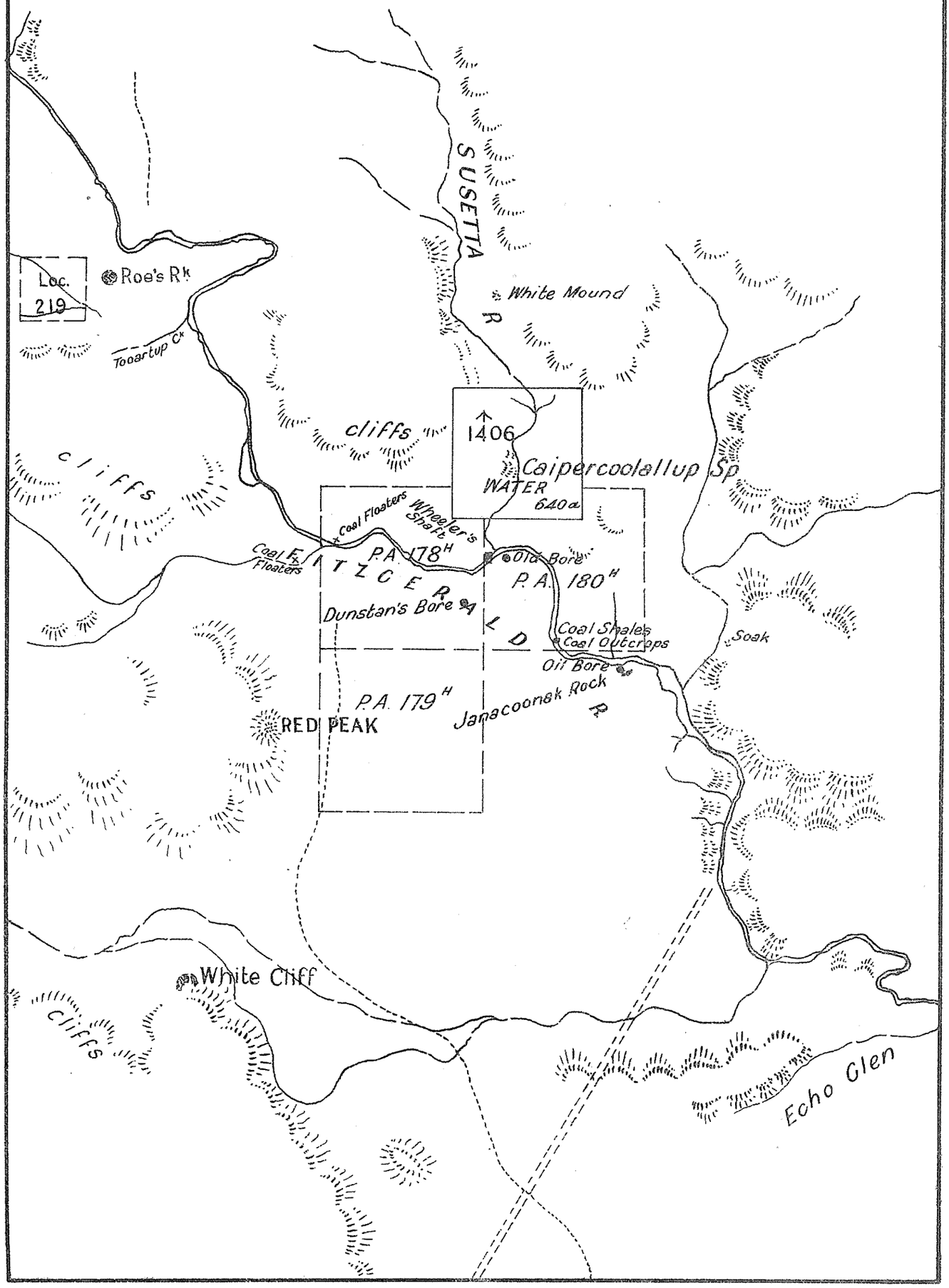
h. Petrological examination of rocks from the Kimberley Area.

i. Petrological examinations for the Department and the general public.

Plan Shewing Bore Sites at FITZGERALD RIVER

80 0 80 160

— Scale of Chains —



a.—BORING AT COOLGARDIE.

(Tindal's G.M.)

The No. 3 and No. 4 Bores—Final Report.

Boring was commenced at Coolgardie at the beginning of 1927. It was completed in August, 1928. Four bores were put down. The Nos. 1 and 2 bores were reported on and details—together with a plan showing bore sites, Plate X—in the Annual Report for 1927.

No. 3 Bore.

1. This was started 100 feet north of No. 2 Bore and drilled to a depth of 393ft. 4in., where a hole 17 feet across was encountered. Its angle of depression was 45° and direction westerly.

2. The record of rock formations met with is as follows:—

Depth in feet.		Nature of Rock.
0ft.	to 67ft. 11in.	No core.
67ft. 11in.	to 107ft. ...	Dense solid greenstone.
107ft.	to 157ft. 8in.	Biotite-quartz rock.
157ft. 8in.	to 357ft. ...	More or less massive greenstone—in part schisted.
357ft.	to 391ft. 3in.	Powerful actinolite schist, really "channel" rock.
391ft. 3in.	to 393ft. 4in.	Lode. White aplite, impregnated with iron pyrites.

3. *Assays.*—The only dyke met with in this bore was the pale pyritic aplite at 391ft. 3in. This rock consisted of pale aplite impregnated with fine-grained iron pyrites and traversed by quartz veinlets up to 3-10th inch wide. The dyke continued to 393ft. 4in. where the bore entered a hole and was stopped. The assay result of core between 391ft. 3in. and 393ft. 4in. was:—

Gold: 12dwt. 20gr. per ton.

From 107ft. to 157ft. 8in. is a weathered fine-grained clayey quartz-biotite rock not met with in the other bores. Only 2ft. 3in. of core was obtained from this rock, and in view of its different physical and mineralogical nature it was assayed, but no gold was obtained.

No. 4 Bore.

1. The No. 4 Bore was put down fifty feet north of No. 3 Bore.

2. The total depth reached along the inclination was 670 feet, *i.e.*, a vertical depth of 580 feet. The angle of depression was 60 degees and direction due west.

3. The zone of oxidation ended at 110 feet.

4. The dykes met with are as follow:—

1. 187ft. 6in. to 202ft. 2in. Somewhat weathered and with some intercalated schist from 196ft. 6in. to 199ft. 8in.
2. 577ft. 8in. to 581ft.... Dark dyke with a trace of pyrrhotite.
3. 610ft. to 660ft. ... Fresh pyrrhotitic aplite with occasional veinlets of pyrrhotite.
4. 664ft. 6in. to 670ft.... Pyrrhotitic aplite—end of bore. (This may be part of No. 3 dyke.)

No. 1 and No. 2 dykes contained no gold at all. The No. 4 dyke gave 2dwt. 17gr. of gold per ton from 666ft. 6in. to 668ft. 6in.; the remaining part of the dyke contained no gold.

The No. 3 dyke contained remarkably consistent values from 610ft. to 658ft. The assay results are as follow:—

Depth.		Gold per ton.		
		ozs.	dwts.	grs.
610ft.	to 612ft. 9in. ...	...	1	12
612ft. 9in.	to 615ft.	...	1	7
615ft.	to 618ft.	...	12	20
618ft.	to 620ft. ...	1	...	...
620ft.	to 622ft. 4in. ...	...	8	1
622ft. 4in	to 625ft.	...	4	3
625ft.	to 628ft.	...	2	9
628ft.	to 631ft.	...	7	6
631ft.	to 634ft.	...	5	16
634ft.	to 637ft.	...	3	6
637ft.	to 640ft.	...	...	10
640ft.	to 643ft.	...	6	16
643ft.	to 646ft.	...	1	23
646ft.	to 649ft.	...	4	14
649ft.	to 652ft.	...	6	23
652ft.	to 655ft.	...	2	18
655ft.	to 658ft.	...	2	18
658ft.	to 660ft.	...	*nil*	...

5. The rock formations passed through are as follow:—

Depth in feet.		Nature of rock passed through.
0ft.	to 110ft. ...	Zone of oxidation; weathered greenstone.
110ft.	to 169ft. ...	Dense actinolitic greenstone.
169ft.	to 187ft. 6in.	Schisted greenstone.
187ft. 6in.	to 196ft. 6in.	Dyke rock—somewhat weathered
196ft. 6in.	to 199ft. 8in.	Greenstone schist
199ft. 8in.	to 202ft. 2in.	Dyke rock—somewhat weathered.
202ft. 2in.	to 577ft. 8in.	Greenstone schist.
577ft. 8in.	to 581ft. ...	Dark dyke with a very little pyrrhotite.
581ft.	to 610ft. ...	Powerfully altered and schisted greenstone with some biotite.
610ft.	to 660ft. ...	White pyrrhotitic aplite with veinlets, and, in places small segregations of pyrrhotite.
660ft.	to 664ft 6in.	Greenstone schist.
664ft. 6in.	to 670ft. ...	White pyrrhotitic aplite.

The above table shows that (1) the main schist channel which carries the dykes commenced at 169 feet and continued throughout the bore. (2) The hanging wall country of the No. 3 dyke is very powerfully schisted, and this fact indicates that the "channel" is quite strong, as far north as boring has been carried out. (3) The small dykes in the No. 1 and most southerly bore do not continue this far north, and (4) the bore ended in dyke rock.

6. The petrographic investigations show the existence of a very large and auriferous dyke along the line of the No. 4 Bore, more or less continuous from 610 to 670 feet. The two distinct dykes met with in the No. 2 Bore are not so evident in the No. 4 Bore, and they may have converged, with change of strike, into the larger body.

7. *Petrology.*—It was only necessary to make a study of one section of the rich ore between 618 and 620 feet, where the assay return gave an ounce of gold to the ton. Under the microscope the ore at 619 feet was a medium grained holocrystalline aggregate consisting mainly of plagioclase felspar with small extinction angles near albite. Some untwinned areas are orthoclase. Much of the felspar has little shape, though some of it is well bounded, at least on two sides. The felspars are very slightly carbonated. The amount of interstitial quartz is comparatively small and allotriomorphic, and is not infrequently

segregated into mosaic-like areas. Biotite flakes are common. Patches of chlorite and calcite are frequent, the former evidently resulting from the alteration of some form of hornblende. Minute rods of apatite are scattered throughout the slide. The whole rock is impregnated with ragged and shapeless pieces of pyrrhotite.

b.—BORING AT MARAROA GOLD MINE, CUE.

(Reedy's Mararoa Leases.)

Final Report.

1. In accordance with the Government's programme, boring was commenced at this mine in April, 1928, and completed in September of the same year.

2. The object of the boring was to test at depth the lode formation worked in the upper levels by the Mararoa Company and tested to about 200 feet from the surface where a crosscut was put out from the bottom of the Prospecting Main Shaft.

3. Five bores were put down and marked 1 to 5. The location of these is shown on the attached plan, and the angle of depression of each bore, depth along inclination of bore, vertical depth of bottom of each borehole, position of lode channel along inclination of each bore, vertical depth of centre of lode channel, horizontal distance of centre of lode, and assay returns from each lode met with are set out in Table I. (page 9).

4. *Geology and Petrology.*—Only two rocks call for reference, viz.:—A, the Country rock; and B, the Lodestuff.

A.—*The Country Rock.*—This rock encloses the lode and is powerfully schisted. Its main constituent is a pale green hornblende which occurs in platy, prismatic, actinalitic and fibrous forms. Talc is often interlaminated with the hornblende, giving the rock a dark green and white banded appearance. In some places biotite is common, and the footwall of the No. 4 bore at 591 feet is a contorted actinolite-talc-biotite schist. In other places carbonates are strongly in evidence. The main constituent is, however, some form of hornblende.

The average type of country is a carbonated hornblende-talc-biotite schist, showing powerful foliation planes and in places distinct contortion—the result of enormous pressure effects.

B.—*The Lodestuff.*—(a) Mineralogical Constitution: The mineral constituents of the lodestuff are quarts, felspar (plagioclase), carbonates of lime and magnesia (calcite and dolomite), pale green hornblende, biotite, sulphide of iron (pyrites and possibly pyrrhotite).

Generally speaking the lodestuff is a dense dark grey fine-grained rock impregnated with abundant grains of iron pyrites, and sometimes with a brownish tinge due to the presence of microscopic flakes of biotite. Under the microscope the lodestuff presents the appearance of a mosaic of quartz, felspar and calcite. A feature characteristic of the ore is the presence of scattered plates, fibres and bundles of pale green hornblende. In some places biotite is common. Irregular shaped grains, patches, and sometimes crystals of iron pyrites are more or less uniformly scattered throughout the quartz-felspar-calcite mosaic.

(b) Origin : The lodestuff is a perfect metasomatic replacement of the enclosing country rock along a well marked line of weakness or trunk channel—now represented by the lode, where dynamic forces had full play, and at the same time afforded an opportunity for the auriferous, sulphidic, and carbonated alkaline solutions to carry on the processes of chemical alteration (metasomatism) whereby the country rock (hornblende-biotite-talc-schist) was converted or changed into lode material. The change from the country rock to lodestuff was thorough and complete, all that is left of the former being scattered plates of pale green hornblende in various forms. Only highly heated and deep seated solutions could affect such a change. The hornblende may be seen changing into carbonates (carbonation). The talc in some places is almost certainly derived from the hornblende, but in the lode the talc is further broken down into carbonates and quartz.

5. *Concluding Remarks.*—The petrological investigations into structure and mineralogical constitution indicate that the lode material penetrated by all five bores is the same. The country rock is similar throughout, and no foreign rock masses were encountered. The lack of values in the No. 5 bore may be due only to the natural selective deposition characteristic of lode formations, and probably varying conditions of temperature and width of channel had something to do with it. In any event the ore is of distinctly deep-seated origin, and when taken collectively the boring has fully justified itself.

MARAROA GOLD MINE.

Table I.—Showing Assay Results, etc. from the five Bores (1—5).

No. of bore-hole.	Angle of depression.	Depth along inclination of bore.	Vertical depth of bottom of hole (in feet).	Position of lode channel along inclination of bore (in feet).	Vertical depth of centre of lode channel (in feet.)	Horizontal distance of centre of lode.	Depth in feet.	Assay Results.
								Assay—
1	45°	418ft.	295ft.	367ft. to 379ft.	263·7	263·7	367ft. to 370ft.	Gold: 1 dwt. 10 gr. per ton.
							370ft. to 373ft.	Gold: 12 dwt. 3 gr. per ton.
							373ft. to 375ft.	Gold: 6 dwt. 3 gr. per ton.
							375ft. to 377ft.	Gold: 4 dwt. 12 gr. per ton.
							377ft. to 379ft.	Gold: 0 dwt. 3 gr. per ton.
2	60°	464ft.	402ft.	417ft. to 438ft.	370	214	417ft. to 419ft.	Gold: 8 dwt. 7 gr. per ton.
							419ft. to 422ft.	Gold: 12 dwt. 4 gr. per ton.
							422ft. to 425ft.	Gold: 13 dwt. 16 gr. per ton.
							425ft. to 428ft.	Gold: 11 dwt. 10 gr. per ton.
							428ft. to 431ft.	Gold: 4 dwt. 12 gr. per ton.
							431ft. to 434ft.	Gold: 10 dwt. 11 gr. per ton.
							434ft. to 436ft.	Gold: 4 dwt. 1 gr. per ton.
							436ft. to 438ft.	Gold: 3 dwt. 22 gr. per ton.
3	60°	603ft.	522ft.	450ft. 6in. to 484ft. 10in.	404	234	450ft. 6in. to 453ft. 6in.	Gold: 0 dwt. 10 gr. per ton.
							453ft. 6in. to 456ft. 6in.	Gold: 0 dwt. 5 gr. per ton.
							456ft. 6in. to 459ft. 6in.	Gold: 5 dwt. 9 gr. per ton.
							459ft. 6in. to 462ft. 6in.	Gold: 0 dwt. 17 gr. per ton.
							462ft. 6in. to 465ft. 6in.	Gold: 4 dwt. 9 gr. per ton.
							465ft. 6in. to 468ft. 6in.	Gold: 16 dwt. 18 gr. per ton.
							468ft. 6in. to 471ft. 6in.	Gold: 2 dwt. 4 gr. per ton.
							471ft. 6in. to 474ft. 6in.	Gold: Under 5 gr. per ton.
							474ft. 6in. to 477ft. 6in.	Gold: 3 dwt. 4 gr. per ton.
							477ft. 6in. to 479ft. 10in.	Gold: 1 dwt. 7 gr. per ton.
							479ft. 10in. to 482ft. 10in.	Gold: 0 dwt. 10 gr. per ton.
							482ft. 10in. to 484ft. 10in.	Gold: 6 dwt. 8 gr. per ton.
4	60°	642ft.	556ft.	573ft. 6in. to 589ft. 6in.	503	291	573ft. 6in. to 575ft. 6in.	Gold: 2 dwt. 4 gr. per ton.
							575ft. 6in. to 577ft. 6in.	Gold: 1 dwt. 7 gr. per ton.
							577ft. 6in. to 579ft. 6in.	Gold: 6 dwt. 16 gr. per ton.
							579ft. 6in. to 581ft. 6in.	Gold: 17 dwt. 5 gr. per ton.
							581ft. 6in. to 583ft. 6in.	Gold: 10 dwt. 21 gr. per ton.
							583ft. 6in. to 585ft. 6in.	Gold: 18 dwt. 0 gr. per ton.
							585ft. 6in. to 587ft. 6in.	Gold: 10 dwt. 4 gr. per ton.
							587ft. 6in. to 589ft. 6in.	Gold: 15 dwt. 1 gr. per ton.
5	60°	468ft.	405ft.	408ft. 7in. to 436ft. ...	366	211	The channel from 408ft. 7in. to 436ft. did not contain any gold; only one sample, 412ft. 9in. to 415ft. showing a trace.	

C. O. G. LARCOMBE,
Acting Petrologist.

c.—BORING AT AJANA.

Final Report.

Two bores were put down at the Surprise Lead Mine, viz., No. 1 and No. 2.

No. 1 Bore.—This bore was put down at an angle of depression of 55 degrees, in a direction North 86° East. Drilling was completed at 922 feet along the inclination of the bore.

The object was to cut the lode channel at a vertical depth of about 700 feet, but a careful examination of the core showed no lead ore, nor were there any special indications of a lode channel.

The main rock encountered in this bore was a garnetiferous granite containing pegmatitic and, in places, very siliceous zones. From 415 to 628 feet the bore passed through a dark green highly-altered basic to ultra-basic rock.

The order of succession of rock formations is briefly as follows:—

Depth in feet.			Nature of rock.
0ft.	to 8ft.	...	No core.
8ft.	to 22ft.	...	Somewhat weathered granite.
22ft.	to 311ft.	...	Garnetiferous granite.
311ft.	319ft. 6in.	...	Greenstone.
319ft. 6in.	to 333ft.	...	Very siliceous alaskitic rock.
333ft.	to 415ft.	...	Granite.
415ft.	to 628ft.	...	Highly altered basic to ultra-basic rock.
628ft.	922ft.	...	Garnetiferous granite, etc.

Petrology.—The garnetiferous granite or gneiss is apparently of great age, and probably the oldest rock in the State. At 761 feet the core was of unusual interest, the section showing cordierite altered to pinite, fibres of sillimanite, some green spinel, warm brown biotite, and curious bleached ash-coloured biotites full of sagenitic webs.

The main original basic rock was some form of quartz dolerite or gabbro now represented by carbonated fibrous amphibolites with leucoxene and other albitised forms. In places epidote-zoisite rocks with interstitial quartz and some pale fibrous hornblende were noted. Talcose rocks developed at other points.

No. 2 Bore.—This bore finished at a depth of 450 feet. Its inclination was 55 degrees.

There was not sufficient indication of an ore deposit of lead to warrant sending samples for analysis.

The rock formations passed through were as follows:—

Depth of bore.			Nature of rock.
0ft.	14ft.	...	Zone of oxidation (0ft. to 4ft. sand; 4ft. to 10ft.: clay; 10ft. to 14ft.: decomposed granitic rock).
14ft.	262ft. 9in.	...	Garnetiferous granite and gneiss with some pegmatite.
At 261ft. 6in.		...	Three inches of granitic core with a very little galena and iron pyrites.
262ft. 9in.	to 325ft.	...	Very basic altered dyke rock. Carbonated albitised and epidotised quartz-dolerite.
325ft.	to 450ft.	...	Garnetiferous granite and gneissic rock.

General Remarks.—Mr. Feldtmann (p. 16, G.S. W.A. Annual Report, 1920) points out that "the lode may contain no ore even where the shear zone is of moderate width, and shearing and brecciation are

fairly well marked." It is quite clear that these bores did not locate "ore," but in view of the intense alteration and great age of these rocks, one cannot say positively that no channel rock was met with in these bores.

d.—BORING AT BIG BELL GOLD MINE, CUE.

In all, five bores were completed in prospecting the Big Bell Lode. The second bore was abandoned at a depth of 165 feet, and No. 2 new bore started from near the same position.

The petrological determination and assays of bores 3, 4, and 5 are not yet to hand.

Report on No. 1 Bore.

1. This bore was started 75 feet north of the *centre of the main shaft and 100 feet from the eastern* wall of the lode. The direction of boring was westerly and the angle of depression 45 degrees.

2. The bore was completed at 300 feet 6 inches along its inclination, a vertical depth of 212 feet.

3. From 0-55 feet there was no core. From 55-107 feet consisted of black biotite schist. At 107 feet a remarkable granulated and for the most part pyritic quartz-muscovite schist was met with. This white schist, which forms the "formation" or lode in this mine, continued definitely to 201 feet, *i.e.*, 94 feet along the direction of inclination of the bore or 66 feet in horizontal width. Below 201 feet on the western side of the lode the rock gradually passes into dense dark siliceous biotite-actinolite rocks of no value.

The succession of rock formations met with is briefly as follows:—

0ft. to 55ft. ...	... No core.
55ft. to 107ft. ...	... Black biotite schist.
107ft. to 201ft. ...	... *Lode or "formation"* carrying values. Pyritic quartz-muscovite schist penetrated along its foliation planes by innumerable pegmatite, alaskite, and almost pure residual quartz veins containing pyrites.
201ft. to 237ft. ...	... Non-pyritic white sheared arkosic sandstone.
237ft. to 300ft. 6in.	... Dense dark aphanitic rock made up of varying proportions of more or less schisted biotite-hornblende-quartz rocks with some zoisite.

4. The "values" in this bore were essentially confined to the lustrous white quartz-muscovite schist that extended from 107-201 feet. Details of depth of core, amount of core received, nature of rock, and assay results are shown in Table 1.

TABLE I.—BIG BELL MINE, CUE.

Assay Values, No. 1 Bore—107ft. to 201 feet.

Depth in feet.	Core received.	Nature of Rock.	Assay Result (Gold per ton).
	ft. ins.		oz. dwts. grs.
107ft. to 114ft. 3in. ...	0 10	Pyritic quartz-muscovite schist with occasional pyritic glassy quartz veins	0 4 9
114ft. 3in. to 121ft. 4in. ...	0 10	Pyritic white schist with 1-inch veins of pegmatite ...	0 9 1
121ft. 4in. to 128ft.	1 2	Pyritic white schist	0 0 10
128ft. to 132ft. 4in. ...	1 0	Strongly pyritic white schist	0 0 5
132ft. 4in. to 136ft. 4in. ...	1 6	Pyritic white schist with 1½in. vein of glassy quartz and small pegmatitic veinlets up to 1in. wide	1 9 9
136ft. 4in. to 140ft. 4in. ...	2 0	White schist with alaskite veins	0 4 6
140ft. 4in. to 146ft. 7in. ...	2 6	Mainly white schist—pyritic	0 1 0
146ft. 7in. to 152ft.	2 1	Pyritic white schist	0 3 19
152ft. to 156ft.	1 3	White schist with a little alaskite	0 14 4
156ft. to 162ft. 8in. ...	2 0	Pyritic white schist	0 4 1
162ft. 8in. to 165ft.	2 0	do. do.	0 11 7
165ft. to 169ft. 6in. ...	1 10	do. do	0 1 2
169ft. 6in. to 172ft. 6in. ...	1 6	do. do.	0 3 22
172ft. 6in. to 175ft. 6in. ...	1 5	do. do.	0 3 11
175ft. 6in. to 178ft. 10in. ...	1 0	White schist broken by pegmatite veins	0 15 6
178ft. 10in. to 182ft. 10in. ...	1 4	Pyritic white schist	0 2 18
182ft. 10in. to 186ft. 10in. ...	1 6	do. do.	0 5 11
186ft. 10in. to 191ft. 7in. ...	1 0	Alaskite and strongly pyritic glassy quartz veins up to 1in. in white schist	0 7 10
191ft. 7in. to 196ft. 6in. ...	2 0	Glassy alaskite veins in white schist	0 4 9
196ft. 6in. to 201ft.	2 0	Poorer and faintly pyritic schist with some pegmatite ...	0 0 10

In addition to the foregoing, further assays were made in order to test (1) the black biotite schist on the eastern wall of the lode, and (2) the dense dark quartzitic-looking rock from the western wall.

Depth (in feet).	Core received.	Nature of the rock.	Assay result of averaged samples.
60ft. to 76ft. 10in. ...	8 feet ...	Biotite schist (eastern wall)	Gold: *Nil.*
76ft. 10in. to 107ft.	9 feet ...	Biotite schist (eastern wall)	Gold: 5 gr. per ton.
201ft. to 300ft. 6in ...	... ...	Dense dark quartzitic biotite-hornblende rock (western wall)	Gold: *Nil* (8 assays made).

These assays show that the biotite schist on the eastern side of the lode is not devoid of gold, but the dense dark quartzitic biotite-hornblende rock which forms the western wall carries no gold at all.

5. On account of the friable nature of the lode-stuff, its granular character, and extreme schistosity, *it did not core well.* It was therefore arranged that the "fines" should be collected in about 2ft. sections. Sixty (60) samples were taken in this way from between 100 and 237 feet. The assay made from an average of these 60 samples yielded:—

Gold: 4dwt. 3gr. per ton.

6. *The Auriferous Zone.*—The ore body or "formation" carrying the values may perhaps be best regarded as a huge low-grade type of lode formation. The rock which makes up this lode is remarkably typical in appearance, viz., a powerfully schisted and somewhat granulated quartz-muscovite schist with distinctive white pearly lustred faces parallel to the foliation planes.

This schist has a sugary to granular appearance, and is more or less impregnated with grains, particles, and small crystals of iron pyrites. A feature of this white schist is its intrusion—along its foliation planes—by pegmatitic, alaskite and glassy veins and veinlets of quartz, often pyritic, and ranging from as much as two inches thick to mere streaks and veinlets.

There would seem little doubt that the position and extent of the "values" are controlled by the disposition of material emanating from the acid magmas that supplied the pegmatites, alaskite and quartz, and at the same time carried the gold and sulphide of iron.

7. *Nature and Origin of the Lode Material.*—This remarkable white quartz-muscovite schist is made up microscopically of a more or less uniformly-grained mass of quartz particles, shapeless and in places sharp-edged, and presenting quite a mosaic appearance with some felspar. Thousands of perfectly straight rods of muscovite are arranged in a wonderfully parallel fashion throughout the quartz mosaic, and nothing seems to interfere with the parallel alignment of the muscovite rods. Grains of iron pyrites are scattered throughout this quartz-muscovite schist.

The extreme granulation, great proportion of quartz, remarkable development of muscovite, together with the microscopic pseudo-clastic appearance, suggest a sedimentary origin for this rock. A close petrographic study of the core from 220 feet indicates that the original rock was a fine-grained siliceous arkosic sandstone of uniform grain, with some white clay.

Metamorphism has produced small rods of hornblende, while some muscovite is present.

While this arkose sandstone was in the zone of flowage, or under great shearing stress during its later stages of metamorphism, acid auriferous and pyritic solutions were squeezed into and through this mass of quartz-muscovite schist, which formed a convenient and natural trunk channel for the passage of solutions. In this way countless pegmatitic, alaskitic and pyritic glassy quartz veins and veinlets—together with their associated gold—were introduced. After final solidification and settling the lode formation was developed, to be later revealed by erosion in its present form. The origin and mode of occurrence of this deposit is certainly of more than passing interest.

Report on No. 2 Bore.

1. This bore was started 130 feet south of the centre of the main shaft, and 100 feet from the east wall of the lode.

2. Its direction was westerly, and angle of depression 45 degrees.

3. The bore was stopped in lode formation at 165 feet on account of some trouble in drilling.

4. The following is a record of rock passed through:—

0ft. to 59ft. ... No core.
59ft. to 63ft. ... Biotite schist.
63ft. to 165ft. ... Lodestuff—pyritic quartz—muscovite schist with pegmatite, alaskite and quartz veins and veinlets.

5. The ore-body started at 63 feet and continued to 165 feet, *i.e.*, 102 feet along the direction of the bore or a horizontal distance of 72 feet. At 165 feet the bore was still in lodestuff.

6. The description of the lodestuff given in the report on No. 1 Bore applies also to this bore. Values were more or less consistent from 59 to 165 feet, as shown in detail on Table 1. An interesting feature is that the biotite schist on the eastern wall is auriferous.

7. For reasons similar to those given in the report on No. 1 Bore, 37 samples of "fines" were taken from 59 to 156ft. 10in. An average assay yielded:—

Gold—3dwt. 9gr. per ton.

BIG BELL MINE, CUE.—No. 2 Bore.

Depth in feet.	Core received.	Nature of rock.	Assay results. (per ton).
	ft. in.		oz. dwt. gr.
59ft. to 63ft.	0 9	Biotite schist	0 1 10
63ft. to 64ft.	0 5	White schist with some glassy quartz	0 2 14
64ft. to 68ft.	1 0	White schist with 1½in. of glassy quartz	0 0 21
68ft. to 71ft.	1 4	do. do. do. do.	*nil*
71ft. to 74ft.	0 7	White schist	0 1 2
74ft. to 77ft.	0 10	White schist with pyritic veins	0 4 1
77ft. to 79ft. 3in. ...	0 8	Strongly pyritic sandy schist, tourmalinised and with glassy quartz veins	0 9 19
79ft. 3in. to 83ft. 9in. ...	1 4	Pyritic schist with glassy veins	0 6 23
83ft. 9in. to 86ft.	0 10	Pyritic schist	0 0 21
86ft. to 88ft 6in. ...	0 9	Strongly pyritic schist with minute glassy quartz veinlets	0 19 17
88ft. 6in. to 90ft. 6in. ...	1 0	Pyritic schist	0 10 5
90ft. 6in. to 93ft.	1 0	Pyritic schist with quartz veinlets	0 4 23
93ft. to 95ft. 3in. ...	1 0	Pyritic schist with little pegmatite and some quartz veins	0 10 16
95ft. 3in. to 97ft. 9in. ...	1 1	Pyritic schist	0 0 5
97ft. 9in. to 100ft.	0 10	Pyritic schist with pyritic alaskite veinlets	0 2 7
100ft. to 102ft. 5in. ...	0 6	Pyritic schist	0 1 12
102ft. 5in. to 105ft.	1 0	do.	0 1 5
105ft. to 109ft. 5in. ...	1 0	Pyritic schist with quartz veinlets	0 2 14
109ft. 5in. to 111ft. 9in. ...	0 9	do. do. do.	0 9 22
111ft. 9in. to 114ft. 1in. ...	1 0	Pyritic schist	0 1 23
114ft. 1in. to 116ft. 4in. ...	1 0	Pyritic silicified schist with a 1in. quartz vein	0 3 22
116ft. 4in. to 121ft. 6in. ...	1 0	Strongly pyritic schist	0 11 11
121ft. 6in. to 124ft 9in. ...	0 11	Glassy quartz with some white schist	0 2 9
124ft. 9in. to 127ft. 9in. ...	1 0	Granular pyritic schist	0 0 5
127ft. 9in. to 130ft.	0 6	Pyritic schist, white	0 1 23
130ft. to 135ft. 6in. ...	0 3	Slightly pyritic white schist with tourmaline	0 2 14
135ft. 6in. to 137ft. 8in. ...	0 3	Tourmalinised pyritic white schist	0 1 12
137ft. 8in. to 139ft. 9in. ...	0 5	Slightly pyritic white schist with some glassy quartz	0 1 21
139ft. 9in. to 141ft. 10in. ...	1 0	Pyritic white schist with one quartz vein	0 0 21
141ft. 10in. to 144ft.	1 0	Pyritic schist with small quartz veinlets	0 0 21
144ft. to 146ft. 7in. ...	1 0	Pyritic schist	0 1 15
146ft. 7in. to 149ft.	0 5	Heavily pyritic schist with glassy quartz veins ...	0 0 21
149ft. to 151ft.	1 0	Pyritic schist	0 0 5
151ft. to 153ft. 3in. ...	1 0	do. do.	0 4 17
153ft. 3in. to 158ft.	0 4	Core mixed with sludge	0 4 12
159ft. to 165ft.	1 1	Pyritic white schist with glassy quartz veins	0 6 13

Report on No. 2 New Bore.

1. Owing to difficulties met with in drilling the No. 2 Bore, it was stopped in lodestuff at 165 feet, and the new No. 2 Bore started 2 feet east and 1 foot north of No. 2 Bore.

2. The bore was completed at 281 feet. Its direction was westerly and angle of depression 45 degrees.

3. The succession of rock formations cut by the bore is briefly as follows:—

Depth in feet.	Nature of rock.
0ft. to 48ft.	... White micaceous schist.
48ft. to 63ft.	... Biotite schist with some quartz veinlets.
63ft. to 212ft. 6in.	Lode or "formation" carrying values. Pyritic quartz-muscovite schist penetrated along its foliation planes by innumerable pegmatitic, alaskitic and pure glassy quartz veins and veinlets carrying iron pyrites.
212ft. 6in. to 217ft.	... Biotite schist with glassy quartz veins and garnets.
217ft. to 235ft.	... Pure white hardened and semi-schisted metamorphosed arkose.
235ft. to 281ft.	... Dark greenish dense hornblende-biotite quartzites and schists, in places garnetiferous.

From the above table of rock formations it will be seen that this bore started in white micaceous schist which continued to 48 feet. Biotite schist followed from 48 to 63 feet. The lode proper commenced at 63 feet and continued without a break to 212ft. 6in., *i.e.*, 149ft. 6in. along the direction of the bore, or a horizontal width of 106 feet. The western wall of the lode passes from biotite schist into a somewhat massive but semi-schisted white rock showing cleavage facets of muscovite. This rock is a metamorphosed arkose. It extends to 235 feet, *i.e.*, a thickness of 18 feet. This arkose gradually passes into remarkable hornblende-biotite-quartz schists and quartzites, also evidently of sedimentary origin, which continues from 235 feet to 281 feet—the end of the bore.

4. *Assay Results.*—(a) The "values" in this bore were essentially confined—as with the No. 1 and No. 2 Bores—to the lustrous white quartz-muscovite schist and its associated acid igneous veins of alaskite, quartz and pegmatite, the whole "formation" extending from 63ft. to 212ft. 6in. Details of depth of core, amount of core received, nature of lodestuff, and assay results are shown in Table I.

(b) In addition to the assays of the lode formation shown in Table I. other assays were made as follows:—

Depth in feet.	Core received.	Nature of rock.	Assay result.
0ft. to 11ft.	6in. ...	Mealy white micaceous schist ...	Gold: 10 gr. per ton.
11ft. to 48ft.	5in. ...	Similar to 0ft. to 11ft.	Gold: A trace.
48ft. to 63ft.	12in. ...	Biotite schist with 1½in. honey-coloured quartz veins	1 dwt. 12 gr. per ton.

It should be distinctly noted that these assays from 0ft. to 63ft. cannot be by any means regarded as representative, because only 23 inches of core were saved out of 63 feet. The assays were made in order to ascertain—

(1) if there was any gold in the white schist beyond the limits of the typical lode formation; and

(2) whether the biotite-schist was auriferous.

This is of interest because the presence of glassy quartz veins and "values" in the biotite schist indicate a probable contemporaneous origin of this rock with the lode formation.

(c) On account of the friable nature of the lodestuff, so-called "fines" were collected at intervals of about 2 feet—just as was done with the No. 1 and No. 2 bores. These were assayed with the following results:—

(1) An average of 28 samples taken from between 145ft. 7in. and 200ft. yielded—

Gold—4wt. 3gr. per ton.

(2) An average of five samples between 200ft. and 212ft. 5in. yielded—

Gold—1dwt. 0gr. per ton.

(3) An average of 11 samples between 212ft. 5in. and 236ft.—beyond the limits of the main schisted channel and not regarded as typical lodestuff, yielded—

Gold—10gr. per ton.

5. *The Lode Formation.*—This was made of the same material as was met with in the No. 1 and No. 2 Bores, viz., a somewhat granulated quartz-muscovite schist impregnated in places with iron pyrites and traversed along its foliation planes by small veins and veinlets of glassy quartz, pegmatite, and alaskite. A somewhat detailed description of the physical features, mineralogical constitution and nature and origin of this lode material was given in my report on the No. 1 Bore.

6. *Petrology.*—Petrological investigations have shown that the occurrence and origin of the ore deposit, as well as of the country rock at the Big Bell Mine, are of more than ordinary interest. Petrographically there is (1) the Lode Formation, and (2) the Country Rock—the latter being practically confined to the western side of the deposit.

1. *Lode Formation.*—The granulated pyritic quartz-muscovite schist, of which the lode is composed, has been generally described in the report on the No. 1 Bore. In origin it most probably represents an arkose, originally of the nature of a medium-grained siliceous sandstone made up of uniformly sized quartz grains and grains and plates of felspar, with some sporadic scales of muscovite. Under conditions of extreme metamorphism, accompanied by heat, compression, shearing and schisting, the original arkose was converted into its present form, viz., the quartz muscovite schist. It is probable that during the period of schisting the auriferous sulphidic siliceous solutions were squeezed through the schist, and in this way originated the multitude of veins and

veinlets of pegmatite, alaskite and quartz, which are responsible for the "values" and consequent development of the lode formation.

2. *The Country Rock.*—The country rock on the western wall of the lode formation.

In No. 1 Bore the lode formation passes by gradations into a solid white and semi-schisted rock which is a metamorphosed arkose. In the No. 2 Bore (New Bore) there is 19 feet of this rock, followed by dark green dense hornblende-biotite quartzites and schists. The whole of the country rock is also apparently of sedimentary origin, and whether it develops hornblende, biotite, zoisite or garnets depends on

(a) The chemical composition of the original sediment, and

(b) The temperature and pressure effects associated with recrystallization.

The conditions of sedimentation no doubt changed from time to time, and the amount of sand, felspar, clay, mud and so on repeatedly altered, producing at least three types of sediment. These types, together with their metamorphic products, were possibly as follow:—

Original Rock.	Metamorphic product.
I. Arkose—a porous mixture of quartz sand and felspar with a little muscovite.	The lode formation—a granular sugary quartz muscovite schist.
II. Ferruginous argillaceous sandstone or grit.	Mealy Biotite—quartz schist, *e.g.*, eastern wall of lode formation— 55ft. to 107ft. No. 1 Bore 59ft. to 63ft. No. 2 Bore 48ft. to 63ft. No. 2 New Bore.
III. Dense fine-grained argillaceous sandstones.	(*a*) Hornblende-zoisite quartz schist and quartzite. (*b*) Biotite-hornblende quartzites. (*c*) Hornblende-biotite quartz schist.

It would appear as if the lode formation developed in the white sandy arkose which lent itself to perfect schisting, and formed a channel or line of weakness eagerly sought by the siliceous solutions that made the pegmatite and associated quartz veins, for naturally these solutions would rise along the line of least resistance. The sediments in the western wall developed dense hard hornblende-biotite quartzites which offered resistance to and naturally diverted the main solutions into the channel represented in the lode formation.

BIG BELL MINE, CUE.

Assay Values from No. 2 New Bore—63ft. to 212ft. 6in.

Depth in feet.	Core received.	Nature of rock.	Assay Results (Gold per ton.
	ft in.		oz. dwt. gr.
63ft to 64ft.	0 10	Quartz muscovite schist with quartz veins	0 0 10
64ft to 67ft.	1 0	Quartz muscovite schist	trace
67ft. to 69ft.	1 3	A large 2in. quartz vein in white schist	*nil*
*69ft. to 74ft.	0 10	do. do. do.	*nil*
*74ft. to 82ft.	0 6	White schist with quartz veins	0 4 23
82ft. to 88ft. ...	2 1	Strongly pyritic white schist with several glassy quartz veins 2in. thick	0 6 0
88ft. to 90ft.	1 8	Pyritic white schist	Trace
90ft. to 92ft.	2 0	Pyritic white schist with small quartz and pegmatite veins	0 0 5
92ft. to 94ft. 7in. ...	2 0	Pyritic white schist with glassy quartz veinlets	*nil*
95ft. to 100ft.	2 6	do. do. do. do.	*nil*
100ft. to 100ft. 6in. ...	1 6	Pyritic white schist	0 2 21
100ft. 6in. to 103ft.	1 6	Pyritic schist, white	0 1 7
103ft. to 108ft	2 6	Pyritic white schist with quartz veins	0 1 7
*108ft. to 117ft. 7in. ...	1 2	do. do. do.	0 2 9
*117ft. 7in. to 126ft.	1 10	do. do. do.	0 1 10
*126ft. to 132ft. 6in. ...	0 5	do do. do.	0 1 7
*132ft. 6in. to 138ft. 6in. ...	1 0	Pyritic schist with many glassy quartz veins	0 5 6
*138ft. 6in. to 147ft.	1 0	Pyritic schist with pegmatite veins	0 3 11
*147ft. to 175ft. 10in. ...	2 0	do. do. do.	0 4 1
*175ft. 10in. to 179ft. 6in. ...	0 9	Slightly pyritic white schist	0 4 1
179ft. 6in. to 181ft. 8in. ...	1 10	Pyritic white schist	0 6 8
181ft. 8in. to 184ft.	1 2	Pyritic white schist	0 6 18
*184ft. to 186ft. 3in. ...	0 5	Pyritic white schist with pegmatite veinlets	0 1 7
*186ft. 3in. to 190ft.	1 0	Pyritic white schist	0 9 19
190ft. to 192ft.	1 0	While schist with very little pyrites	0 0 14
192ft. to 195ft.	2 0	do. do. do.	*nil*
195ft to 200ft.	3 0	Semi-schisted white rock	0 0 5
200ft to 206ft.	3 0	Non-pyritic white schist	*nil*
206ft to 208ft. 6in. ...	1 0	do. do. do.	*nil*
208ft. 6in. to 210ft.	1 0	Pyritic white schist	0 7 13
210ft. to 212ft. 6in. ...	1 6	Non-pyritic white schist	*nil*

Note.—White schist = Quartz muscovite schist. * The amount of core taken from these depths cannot be regarded as sufficient to give a reliable average assay return.

c.—BORING AT HARBOUR LIGHTS MINE, LEONORA.

Report on No. 1 Bore.

1. This bore was put down at an angle of 60 degrees.

2. It passed through a zone of oxidation from 0 to 160 feet.

3. From 160 to 253 feet the country was a strongly chloritised hornblende rock.

4. From 253 feet to the end of the bore—306 feet, the bore passed through a most powerful schist channel—really a siliceous carbonate schist. It consisted mainly of carbonate with quartz mosaics.

5. The whole of the rock from this schist channel (253-306 feet) was assayed. Seven samples contained no gold at all, and one sample from 273 feet, to 277 feet 8 inches assayed a trace (under 3 grains of gold per ton).

Report on No. 1 New Bore.

1. This bore was put down in a westerly direction at an angle of depression of 60 degrees. Along its inclination it reached 797 feet, *i.e.*, a vertical depth of 690 feet.

2. A highly altered and powerfully schisted carbonated belt of country came in at 253 feet and continued to at least 636 feet, *i.e.*, 383 feet. The whole of the rock between 253 and 317 feet, *i.e.*, 64 feet, was assayed, and then averages were taken from 317-450 and 524-636 feet.

A summary of the 30 assays made of core from 253 to 450 and 524 to 636 feet is as follows:—

From 253 to 311—Gold: nil.
311 to 317—Gold: 1 dwt. 23 gr. per ton.
317 to 343—Gold: nil.
343 to 350—Gold: trace.
350 to 398—Gold: nil.
398 to 416—Gold: trace.
416 to 450—Gold: nil.
524 to 636—Gold: nil.

In addition to the above core assays 22 samples of sludge from between 280 feet and 600 feet (each sample of sludge was taken in 10-feet sections) were averaged and assayed, with the following results:—

From 280 to 440 feet—Gold: 1 dwt. per ton.
440 to 600 feet—Gold: 14 grs. per ton.

3. *Geology and Petrology.*—This bore was started in rotten oxidised ground which continued to 164 feet. A green chloritic greenstone rock—probably from epidiorite—continued from 164 to 253 feet. At 253 feet a very distinctive and strongly schisted and foliated zone was encountered. This zone was characterised by its abundance of carbonates. The rock was made of alternating white and dark green bands, the former consisting mainly of a mass of granular carbonates with mosaics of quartz. The dark bands form well-marked foliation lines of chlorite and biotite. Grains of pyrites are occasionally met with.

This foliation zone of carbonated quartz-chlorite-biotite rock continued to maintain its distinctive mottled and banded character from 253 feet to 636 feet, and the greater part of this zone of 383 feet was sampled and assayed with negative results shown in paragraph (2).

From 636 feet to the bottom of the bore, 797 feet, the average type of the country was a fine-grained greenstone made up of a mass of minute actinolite needles throughout which small plates of biotite, clear patches of quartz and some small scales of chlorite were distributed. Very dense biotite-calcite schist riddled with veinlets of carbonate occurs at intervals, *e.g.*, at 680 feet.

The order of succession of rocks met with is briefly as follows:—

Depth in feet.	Nature of rock.
0ft. to 164ft. ...	Rotten oxidised rock.
164ft. to 253ft. ...	Chloritic greenstone—probably from epidiorite.
253ft. to 636ft. ...	Powerfully schisted and foliated zone of mottled, banded white and dark green calcite-quartz-chlorite-biotite schist.
636ft. to 797ft. ...	Fine grained actinolite-biotite rock alternating with bands of dense biotite schist with veinlets of white carbonates.

4. The bore indicates, as a result of petrological examination that at the Harbour Lights Mine there is a powerfully foliated and highly carbonated zone of banded calcite-quartz schist with some chlorite and biotite, extending from 253 to the vicinity of 636 feet, lying between a chloritic greenstone that was probably a medium-grained epidiorite and a fine-grained actinolite rock.

As the zone from 253—636 feet was so highly altered, carbonated and in places pyritic most of its was averaged and assayed.

The true lode stuff in this mine would only be a more highly pyritic form of the rock found in the foliated zone. Such a rock was only noted over 1 foot 4 inches from 544 feet 5 inches to 545 feet 9 inches. Here it was a strongly pyritic, siliceous carbonate schist, but it contained no gold.

From 636 to 797 feet the actinolite and biotite rocks are absolutely barren of any definite mineralisation or channels sufficiently altered to regard them as lode formations, and, consequently no assays were made.

Lodes could be developed in this country, especially in the highly foliated zone between 253 and 636 feet, but along the direction of this bore no payable lode was discovered.

f.—BORING AT SANDSTONE.

Final Report.

Six bores were put down at Sandstone. The first three bores (1, 2, and 3) were put down vertically to test at depth the Black Range Reef which had been worked in the Black Range Mine. The other three bores (4, 5, and 6) were put down to test at depth the Sandstone Reef which had been worked in the Oroya Black Range Mine.

Details of the first five bores were published in the Annual Report for 1927 (pages 149 and 150).

Report on No. 6 Bore.

This bore reached a total depth of 828 feet. It was put down vertically.

The following assays were made:—

About 19ft.	Quartz and ironstones. Gold: *nil.*
594ft. 4in. to 597ft. 7in.	Sheared rock on footwall of dolerite dyke. Gold: *nil.*
803ft. 6in. to 805ft. ...	A foot of white glassy quartz, 804ft. to 805ft.; the rest siliceous fractured fine-grained greenstone. Gold: *nil.*

Ore Deposits.

At 594ft. 4in. the footwall country came in beneath the black dolerite dyke. It was somewhat semi-schisted from 594ft. 4in. to 597ft. 7in., and then passed into a partially shattered and cracked zone not worth assaying.

Between 804 and 805 feet there was a foot of glassy white quartz in somewhat fractured dense greenstone.

It looks as if the No. 6 bore passed through country where the main shear zone had become broken up through lack of strength of earth forces at this point in the mine. Apart from the assays made there was no rock sufficiently sheared, silicified, or mineralised to warrant further assaying.

The rock formations passed through were as follows:—

0ft. to 150ft. ...	Zone of oxidation.
150ft. to 585ft. 8in.	Dense grey greenstone similar to that in the Nos. 4 and 5 bores
585ft. 8in. to 594ft. 4in.	Black dolerite dyke.
594ft. 4in. to 828ft. ...	Dense grey greenstone.

g.—BORING AT GREENBUSHES.

Final Report on First Eight Bores.

The object in boring at Greenbushes was to test the pegmatitic lodes at depth. Up to date (31-1-1929) eight bores have been completed.

Assay Results.

The number of the bore, its angle of depression, number of dykes cut, nature of lode and assay results are set out in Table 1. From this table it will be noted that the dykes cut in the bores contain a very low percentage of tin; in no bore was 1 per cent. recorded, the highest value being 0.91 per cent. in the Cornwall Lease.

The Cornwall Lease gave by far the best results, the amount of tinstone (cassiterite), though small, being consistently distributed through the dykes. Segregations of tinstone are likely to be met with in such an area. The large dyke on the "Dixie" Lease proved disappointing where cut by the bore—a trace being the highest assay. The extremely small dykes on the Lost and Found Mine were distinctly stanniferous.

Petrology.

The petrology of the area bored resolves itself into (1) Granitic and allied pegmatites with which the tin is associated, and (2) the Country into which the granitic rocks have intruded themselves, viz., reconstructed amphibolites and hornblende schists.

1. *Granitic Rocks.*—The dykes cut by the bores represent a variety of acidic rocks ranging from somewhat granular biotite granite, through normal pegmatites and albite-rich rocks to alaskite and glassy quartz veins. The rocks examined may be placed in five groups, viz.:—

A. Tourmalinised acid granites showing much quartz and white felspar. These white rocks, somewhat sugary in appearance and at other time grading into fine-grained biotite granite. Tourmaline in black prismatic forms and masses—blue-black under the microscope—is common, and at 270 feet in No. 2 bore irregular pieces of brown cassiterite were noted. These strongly tourmalinised granitic rocks were common in the bores on the Cornwall lease, and they were more or less consistently stanniferous.

B. Greisen, a pure quartz-white mica rock, was not abundant. It was met with in No. 1 bore on the Cornwall Lease, where it assayed 0.22 per cent. of tin dioxide.

C. Pegmatite. A normal form of pegmatite, *i.e.*, a coarse quartz-felspar-mica rock in big plates, was recorded from No. 4 bore on the Cornwall Lease, where it yielded 0.20 and 0.27 per cent. respectively of tin dioxide.

D. Alaskite, *i.e.*, an almost pure glassy quartz rock with a little felspar, or in places no felspar at all, was recorded from the Cornwall Lease, but its tin contents were very low, viz. 0.004 per cent.

E. White albite rock having the appearance of a white crystalline marble, but much harder. It is made of a holocrystalline aggregate of an albitic felspar with occasional lumps of quartz. It appeared to form the large dyke in the No. 5 bore on the "Dixie" M.L. 632. The tin contents of this albite rock are practically nil.

2. *Reconstructed Amphibolites and Hornblende Schists.*—These rocks constitute the country rock of the area into which the pegmatites and other acidic stanniferous dykes have forced their way. They are of some interest because they may easily be mistaken for hornblende gneisses, whereas they are products of extreme dynamic metamorphism and recrystallisation from basic rocks of the dolerite-gabbro type.

In the No. 1 Bore at 272 feet on the Cornwall Lease the rock is dark green and mottled owing to an admixture of dark ferro-magnesian mineral with white to glassy grains and cleavage facets. Under the microscope the mineral contents are: hornblende, biotite, plagioclase, quartz, magnetite, and apatite. In plain light the rock is seen to consist of water-clear material crowded with prisms, cross-sections, and irregular-shaped pieces of bright green hornblende, associated with a considerable amount of dark brown plates and cleavage flakes of biotite. Between the hornblende plates is a more or less granulated mass of plates and shapeless pieces of clear and well-twinned plagioclase with some quartz. Colourless rods of apatite are common in the water-clear material, and black grains and patches of magnetite are frequently seen. The rock is a reconstructed biotite amphibolite.

In No. 6 bore at 245 feet on the South Cornwall Lease is a similar rock, but without biotite and strongly schisted. It is a typical hornblende schist, almost identical with that figured by Harker (Petrology for Students, Fig. 91, p. 325), and stated to have been derived from the metamorphism of a dolerite.

Mr. Farquharson described (G.S.W.A. Bull. 59, pp. 172-175) what are evidently similar rocks under the heading of "Amphibolite and Hornblende Schists."

In the Lost and Found Mine the rocks are fine-grained hornblende schists. At 113 feet in the No. 8 bore the hand specimen is a dense dark green semi-schisted greenstone. Microscopically it is a mass of small prisms of green hornblende with minute interstitial grains of felspar and quartz. The whole rock is studded with clear grains of sphene and occasional colourless pieces of epidote.

In the No. 3 bore at 145 feet the rock is heavily biotised, and forms a biotite hornblende schist.

Concluding Remarks.

The petrological investigations show that the area covered by the first eight bores is made up of reconstructed amphibolites and hornblende schists of varying grain and frequently typical mottled appearance. Pegmatites, and other varieties of granitic rocks, often characterised by much tourmaline and in places some tinstone, have forced their way through these schists. It has been pointed out that the tourmalinised rocks, greisen and pegmatite showed the most consistent tin contents, whereas the white albite rock was almost barren of tin. It is important to note that where seen under the microscope the tinstone formed an accessory though primary constituent of the rock. Although where cut by the bores on the Cornwall Lease the tin contents cannot be regarded as payable, it is of interest to note the consistent tin contents in the dykes. Payable ore is simply a concentration of the cassiterite, and these dykes showing "consistent tin contents" are likely zones along which to look for segregations or patches of payable ore.

TABLE I.

BORING AT GREENBUSHES. ASSAY RESULTS ETC., OF BORING FROM THE FIRST 8 BORES.

No. of Bore.	Angle of depression.	Dykes cut (Depth in feet).	Nature of rock.	Assay result
			Cornwall Lease.	
1	45°	A. 56ft. to 56ft. 6in. ...	Pegmatite-glassy quartz, felspar and white mica ...	Tin dioxide (SnO_2) ... % 0·002
		B. 171ft. to 172ft. 4in. ...	Alaskite	Tin dioxide (SnO_2) ... 0·004
		C. 243ft. to 246ft.	Garnetiferous tourmalinised quartz-muscovite pegmatite	Tin dioxide (SnO_2) ... 0·22
2	45°	263ft. to 271ft. 3in. ...	Heavily tourmalinised quartz-felspar pegmatite	263ft. to 265ft. 6in. ... SnO_2 ... trace
				%
				265ft. 6in. to 268ft. ... SnO_2 ... 0·38
				268ft. to 270ft. 1in. ... SnO_2 ... 0·91
				270ft. 1in. to 271ft. 3in. ... SnO_2 ... 0·19
3	45°	(1) 105ft. to 113ft.	Medium-grained saccharoidal quartz-felspar rock with tourmaline	105ft. to 107ft. ... ... SnO_2 ... 0·16
				107ft. to 109ft. ... ... SnO_2 ... 0·12
				109ft. to 111ft. ... ... SnO_2 ... 0·83
				111ft. to 113ft. ... ... SnO_2 ... 0·17
		(2) 120ft. to 125ft.	Medium-grained tourmalinised saccharoidal quartz-felspar rock with white mica, and in places patches of pure white felspar (albites ?) rock	120ft. to 122ft. ... ... SnO_2 ... 0·09
				122ft. to 124ft. ... ... SnO_2 ... 0·16
				124ft. to 125ft. ... ... SnO_2 ... trace
		(3) 232ft. to 253ft. 6in. ...	Mainly white albite (?) rock with some quartz and a little tourmaline	252ft. to 253ft. 6in.... ... SnO_2 ... trace
4	45°	(1) 115ft. to 116ft.	Coarse greisen with some tourmaline	115ft. to 116ft. ... ... SnO_2 ... 0·13
		(2) 198ft. 3in. to 200ft. 1in.	Tourmalinised pegmatite with coarse white mica ...	198ft. 3in. to 200ft. 1in. ... SnO_2 ... 0·57
		(3) 212ft. to 215ft.	Tourmalinised greisen	212ft. to 214ft. 6in. ... SnO_2 ... 0·20
				214ft. 6in. to 215ft. ... SnO_2 ... trace
		(4) 256ft. to 258ft. 6in. ...	Tourmalinised quartz-felspar rock	256ft. to 258ft. 6in. ... SnO_2 ... trace
			Dixie M.L. 632.	
5	45°	(1) 153ft. to 153ft. 6in. ...	Tourmalinised white quartz-felspar rock	153ft. to 153ft. 6in. ... ... No tin.
		(2) 169ft. to 169ft. 4in. ...	Tourmalinised alaskite	169ft. to 169ft. 4in. ... ... Sn—a trace.
		(3) 220ft. to 223ft. 9in. ...	White aplitic rock	220ft. to 223ft. 9in. ... ... No tin.
		(4) 242ft. to 266ft.	Pegmatite	242ft. to 245ft. 6in. ... ... No tin.
				245ft. 6in. to 258ft. 4in. ... ... Sn—a trace.
				258ft. 4in. to 266ft. ... ... No tin.
		(5) 273ft. to 291ft. 2in. ...	Quartz-felspar rock	273ft. to 291ft. 2in. ... ... No tin.
		(6) 397ft. to 403ft.	Granular saccharoidal quartz rock	397ft. to 403ft. ... ... Sn—a trace.
			South Cornwall.	
6	45°	(1) 133ft. to 147ft.	Tourmalinised greisen with white to creamy coarse-grained quartz felspar rock	133ft to 147ft. ... ... No tin.
		(2) 199ft. to 200ft. ...	Tourmalinised quartz-felspar rock with garnet	199ft. to 200ft. ... ... Sn—a trace.
		(3) 231ft. to 235ft. 6in. ...	Tourmalinised medium-grained pegmatite with white mica	233ft. to 235ft. 6in. ... ... Sn—a trace.
				231ft. to 233ft. ... ... No tin.
			Lost and Found Mine.	%
7	45°	124ft. to 125ft. 6in.... ...	Tourmalinised medium-grained white quartz-felspar rock	124ft. to 125ft. 6in. ... SnO ... 0·90
8	70°	122ft. 2in. to 122ft. 6in. ...	Quartz-felspar rock with specks of tourmaline	122ft. 2in. to 122ft. 6in. SnO_2 ... 0·39

INDEX.

By Authority: JOHN LEE, Acting Government Printer, Perth.

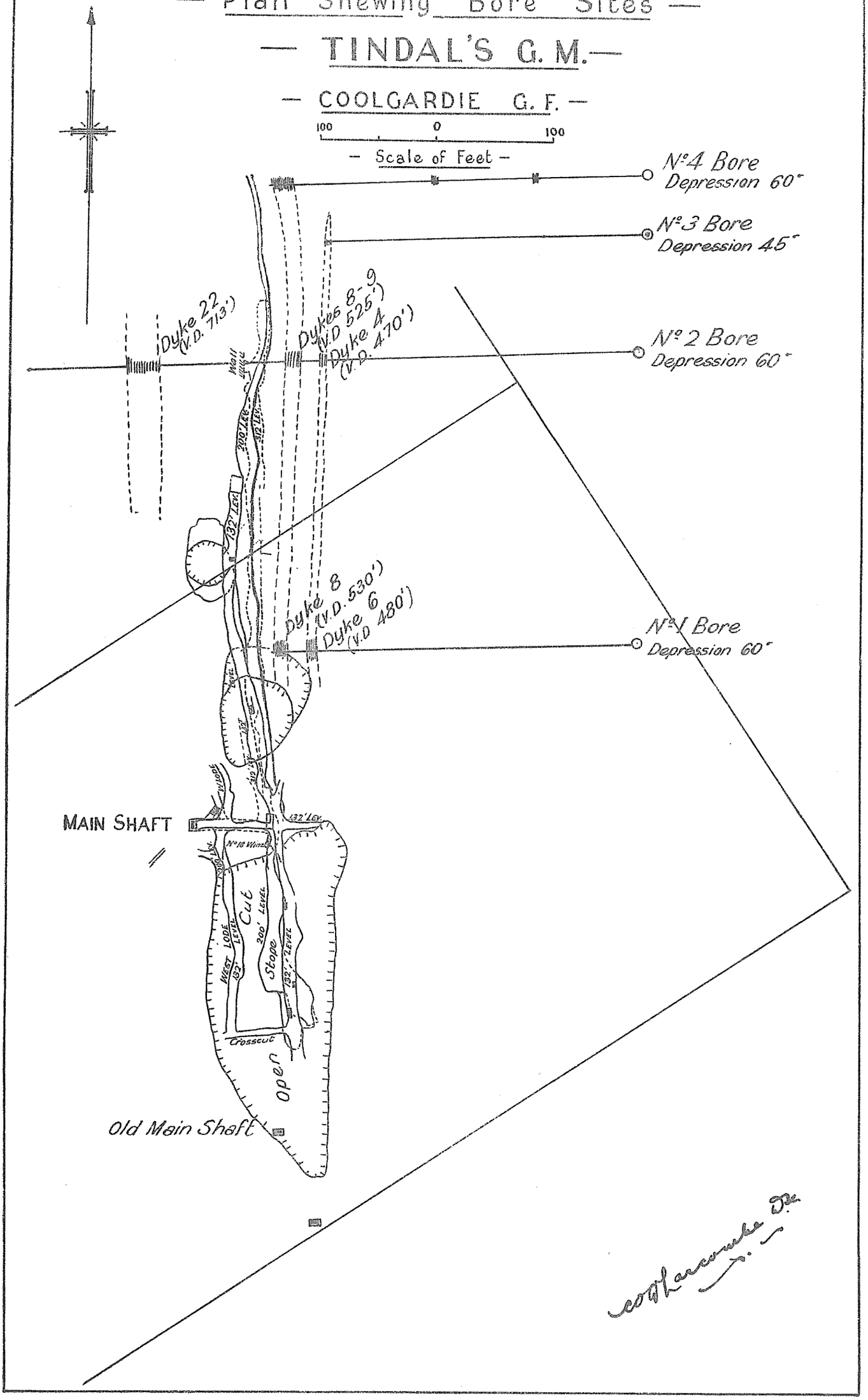
— Plan Shewing Bore Sites —

— TINDAL'S G. M. —

— COOLGARDIE G. F. —

100 0 100

— Scale of Feet —



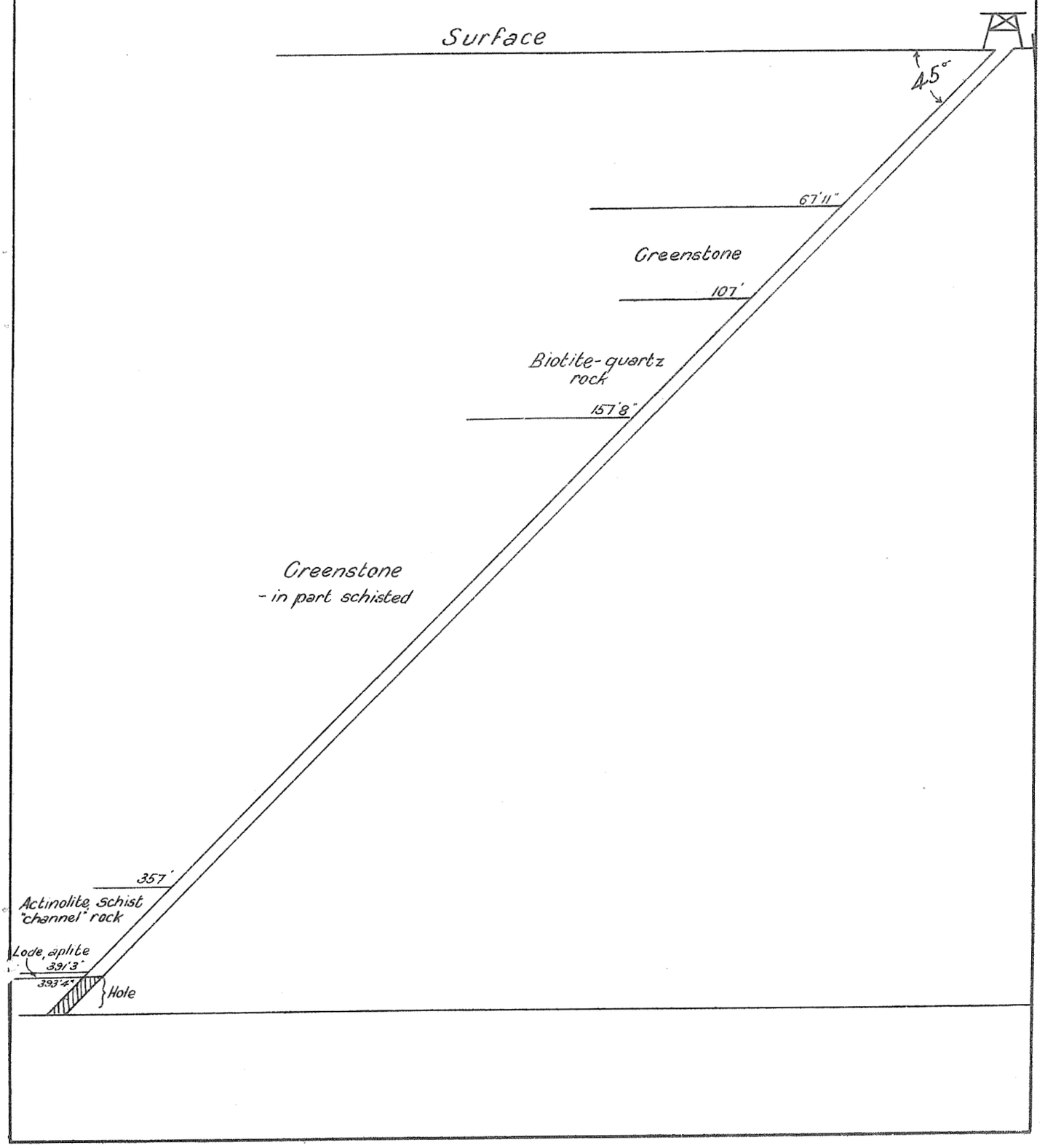
Section No 3 Bore

TINDAL'S

Coolgardie G. F.

40 0 40 80

— Scale of Feet —



Section Nº 4 Bore

TINDAL'S

Coolgardie G.F.

80 0 80 160

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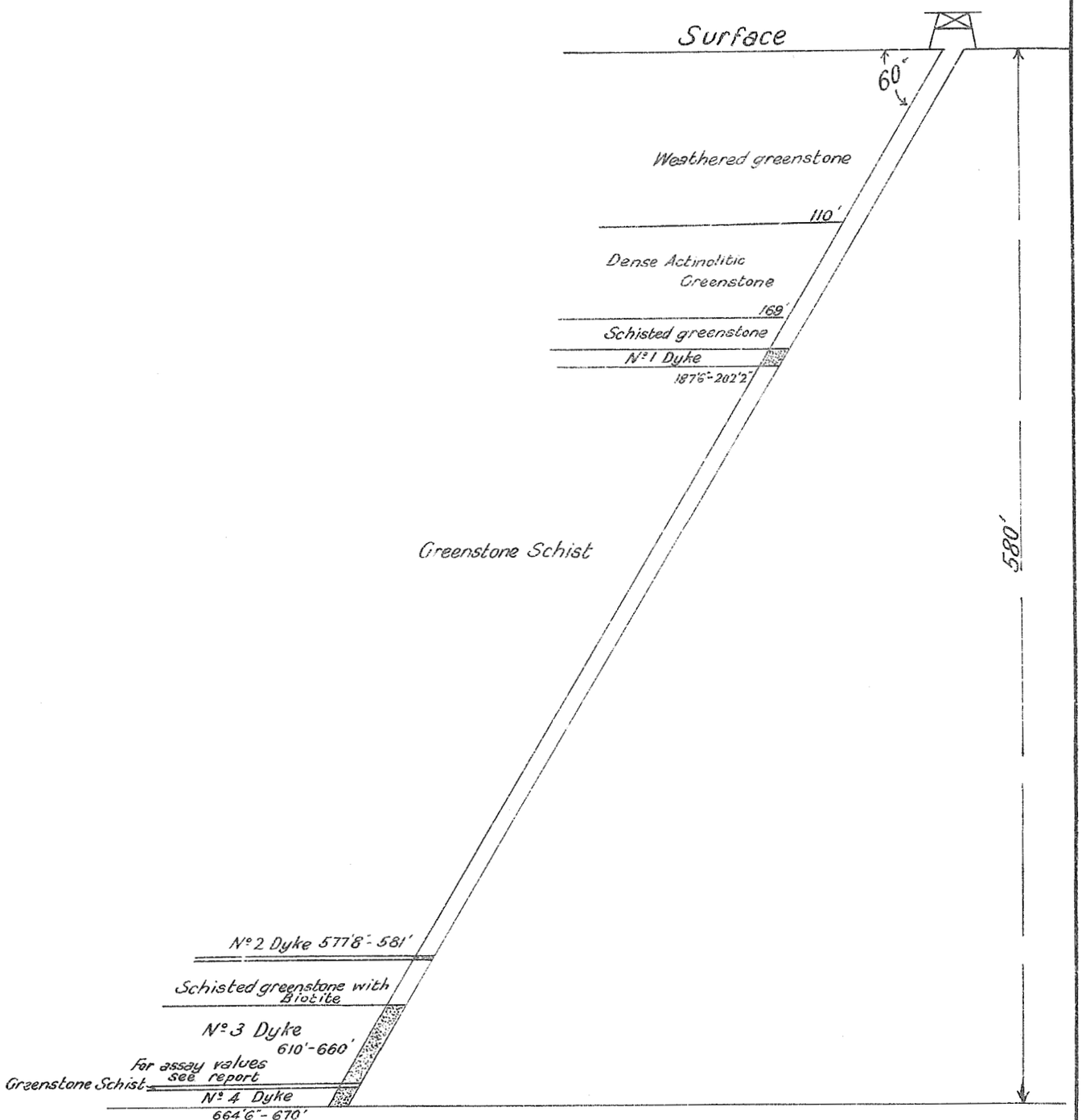
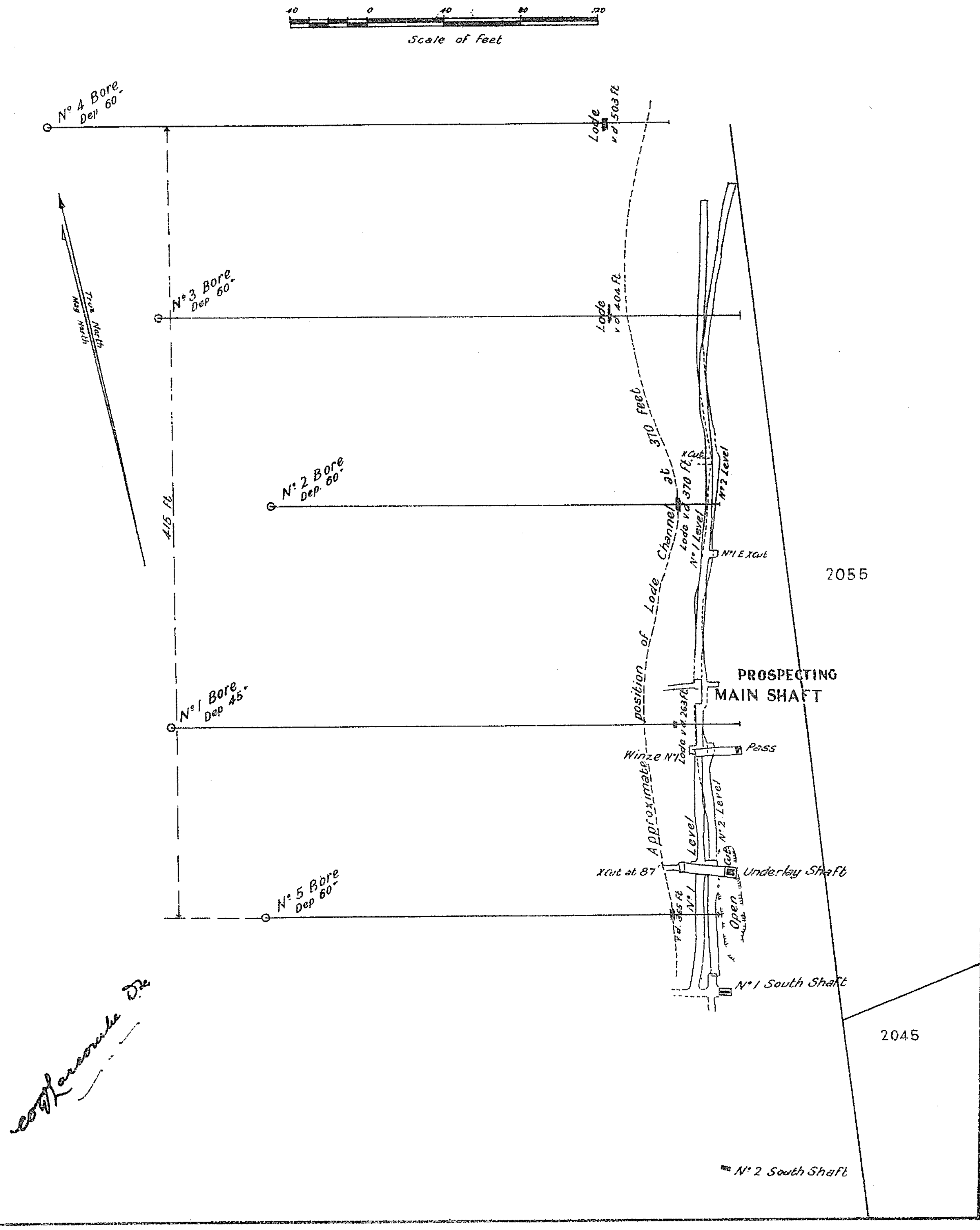


MARAROA GOLD MINING Cº N. L.

Plan Shewing Location of Diamond Drill Bores

Emu North Lease - Reedy's Find

MURCHISON G. F.



Section No 1 Bore

MARAROA G.M

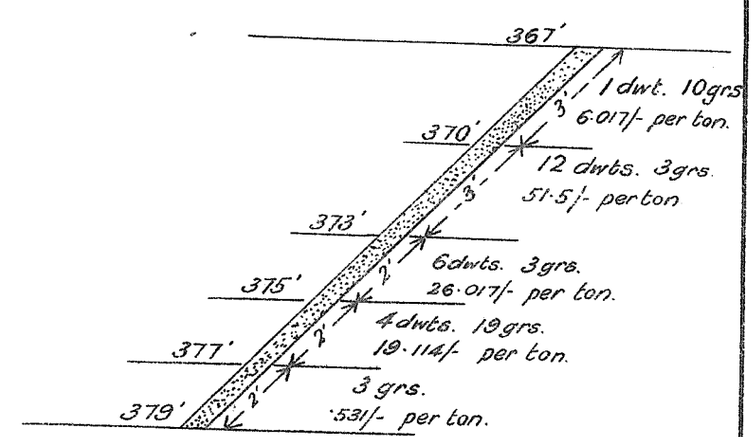
REEDY'S FIND

30 Miles N.E of Cue

— Scale of Feet —

Figures in brackets indicate the length of core recovered from corresponding section of boring.

Chart of assay results in lode material between 367' and 379'.



— Scale:- 4 Ft. = 1 In —

Section Nº 2 Bore

MARAROA G. M.

REEDY'S FIND

30 Miles N.E. of Cue

40 0 40 80

—Scale of Feet—

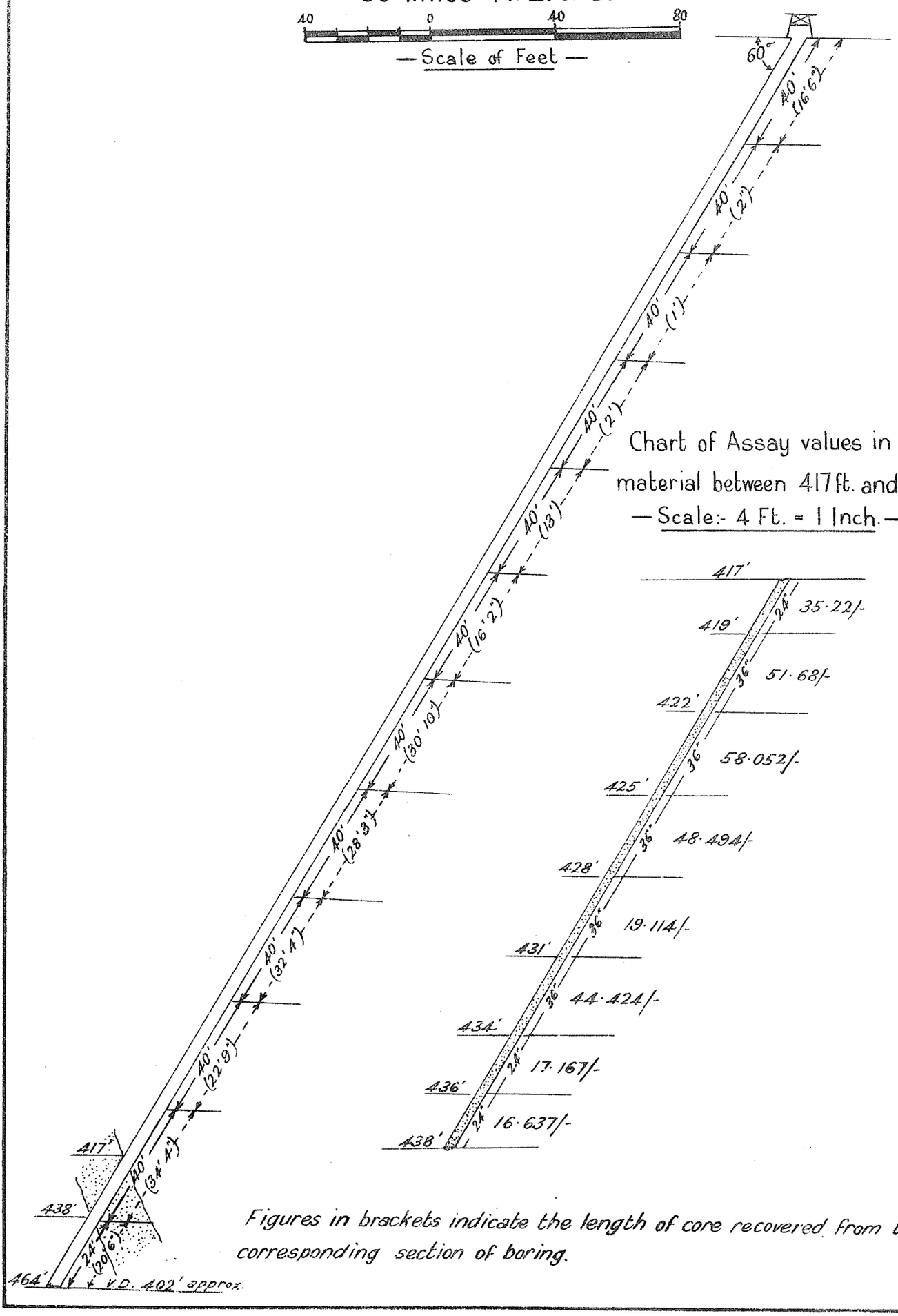


Chart of Assay values in lode material between 417 ft. and 438 ft.

—Scale:- 4 Ft. = 1 Inch.—

Figures in brackets indicate the length of core recovered from the corresponding section of boring.

Section No 3 Bore

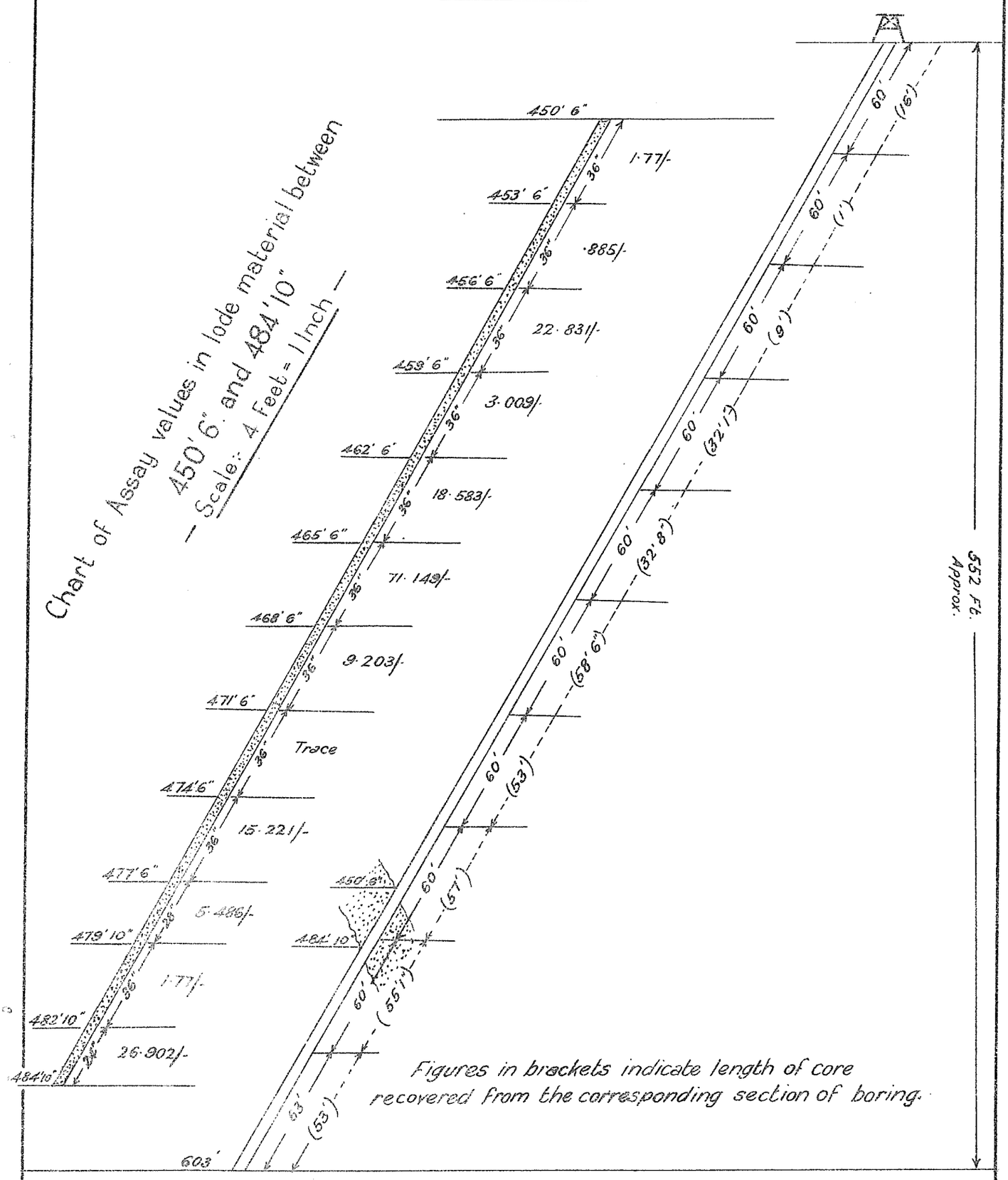
MARAROA G. M.

REEDY'S FIND

30 Miles N. E. of Cue

60 0 60 120

—Scale of Feet—



Section Nº 4 Bore

MARAROA G.M.

REEDY'S FIND

30 Miles N.E. of Cue

— Scale:- 64 Feet = 1 Inch —

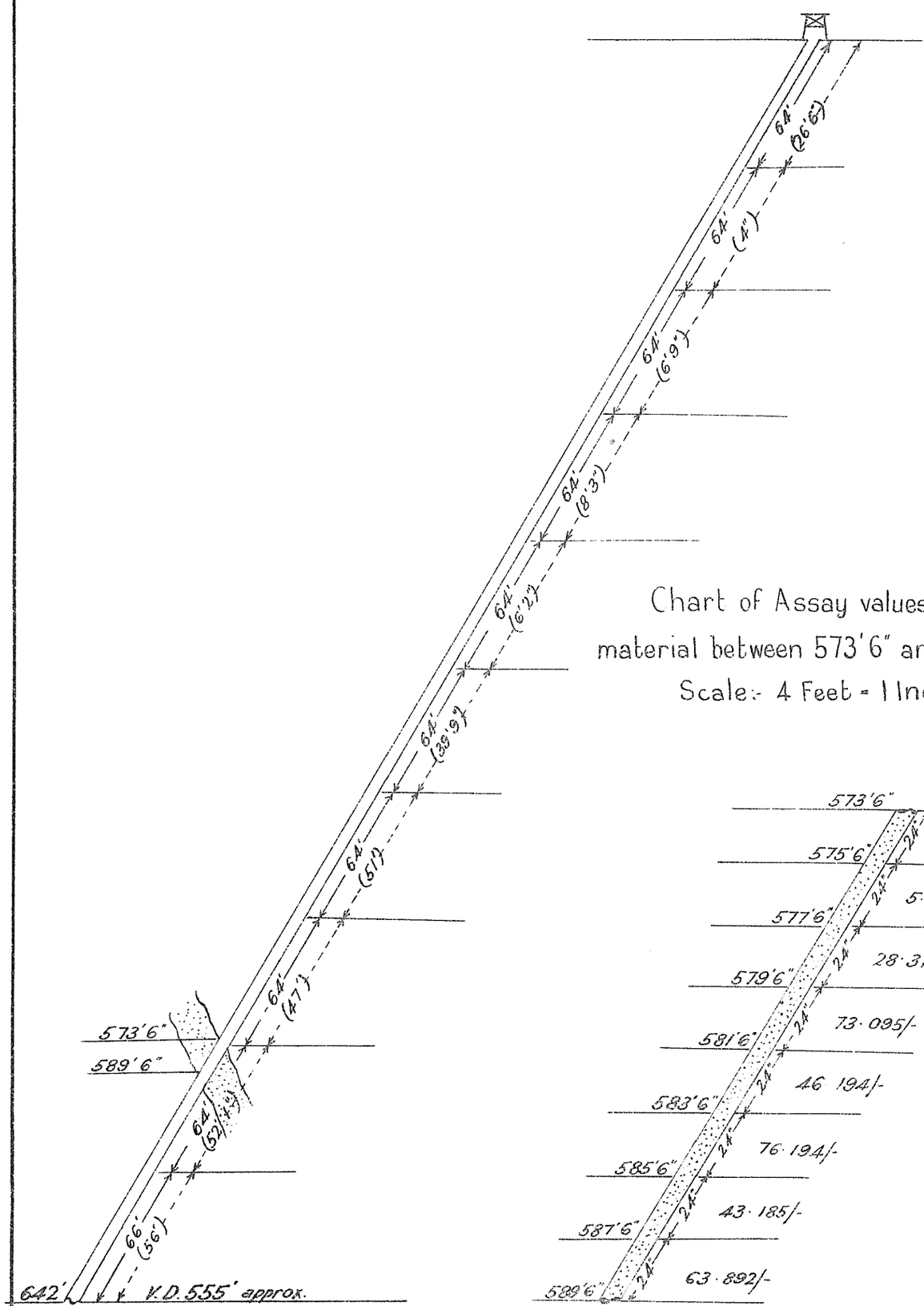


Chart of Assay values in lode material between 573'6" and 589' 6"
Scale:- 4 Feet = 1 Inch.

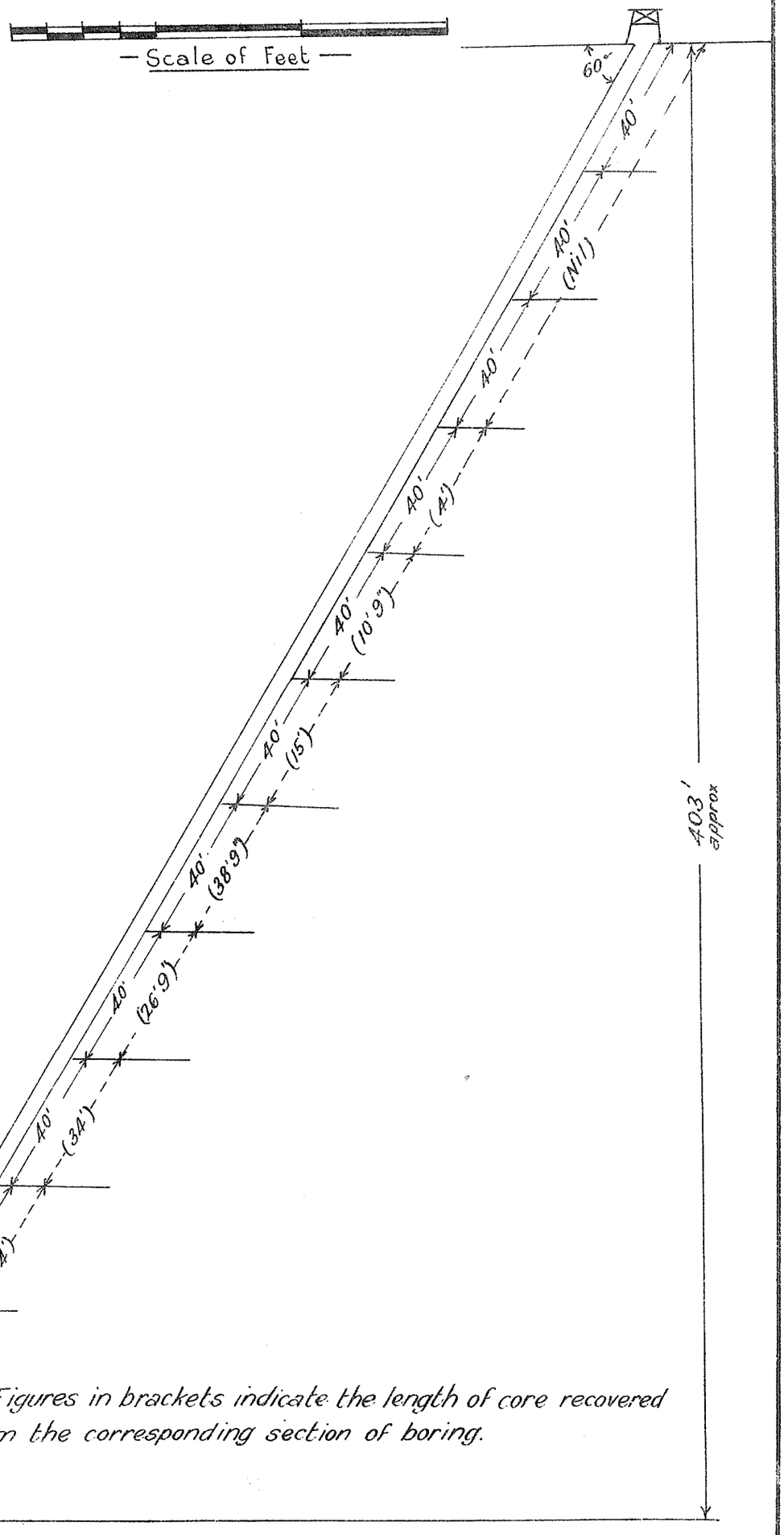
The figures in brackets indicate the length of core recovered from the corresponding section of boring.

Section N° 5 Bore

MARAROA G.M.

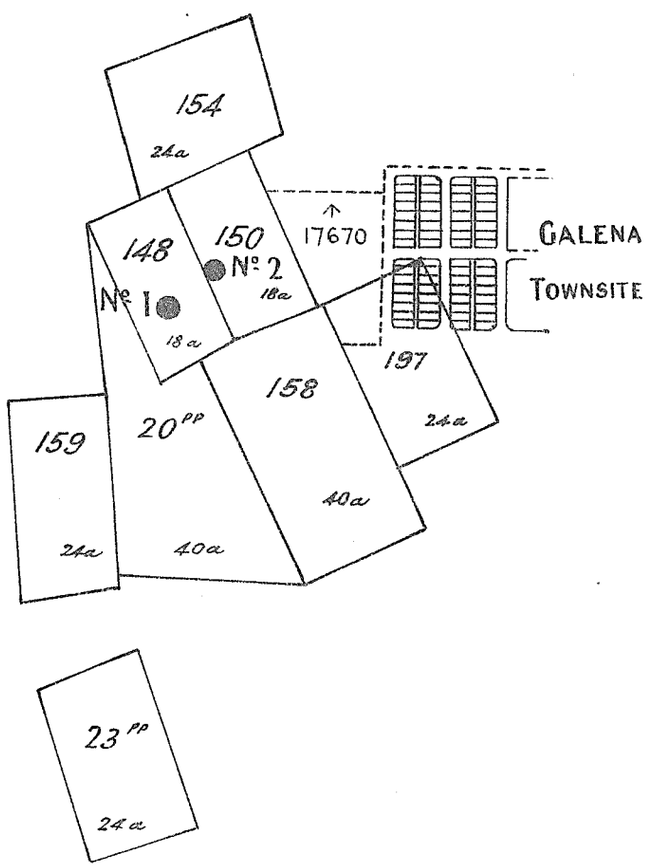
REEDY'S FIND

30 Miles N.E. of Cue



Figures in brackets indicate the length of core recovered from the corresponding section of boring.

Locality Plan
of Bores at
SURPRISE MINE
GALENA
— Scale:- 20 Chs. to an In. —

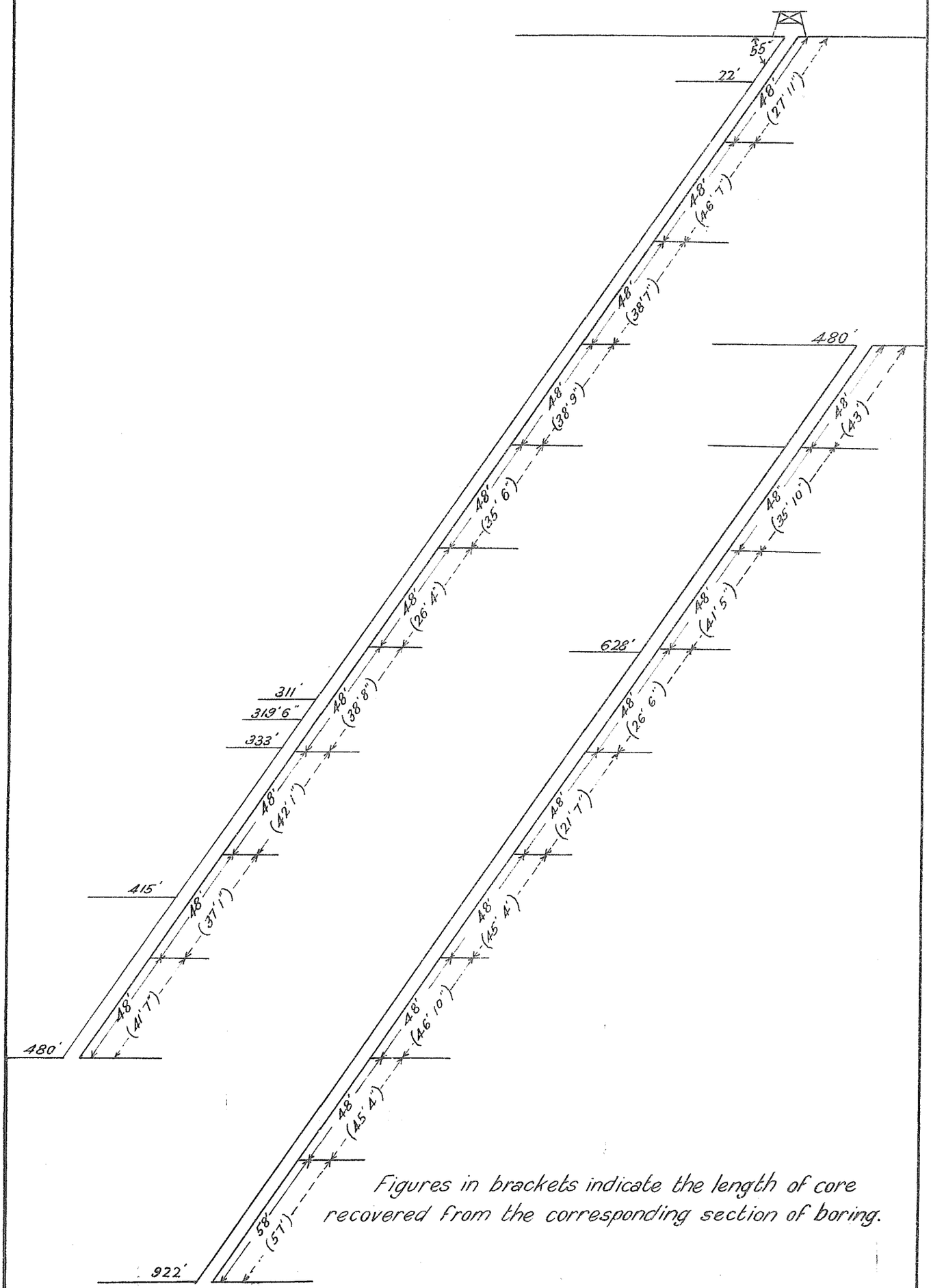


Section Nº 1 Bore

SURPRISE LEAD MINE

Galena, Northampton

– Scale:- 48 Ft. = 1 In. –



Figures in brackets indicate the length of core recovered from the corresponding section of boring.

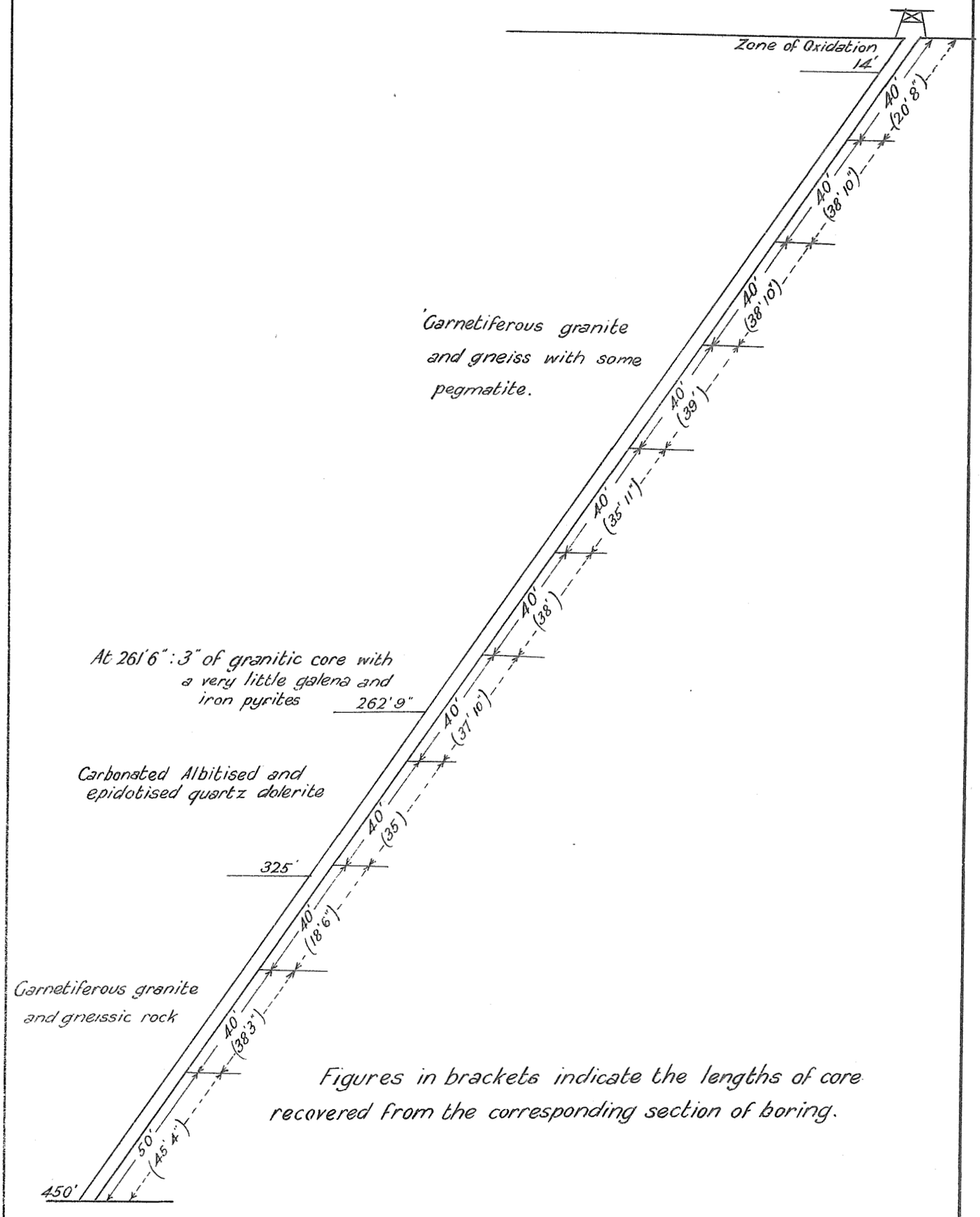
Section Nº 2 Bore

SURPRISE LEAD MINE

Galena, Northampton.

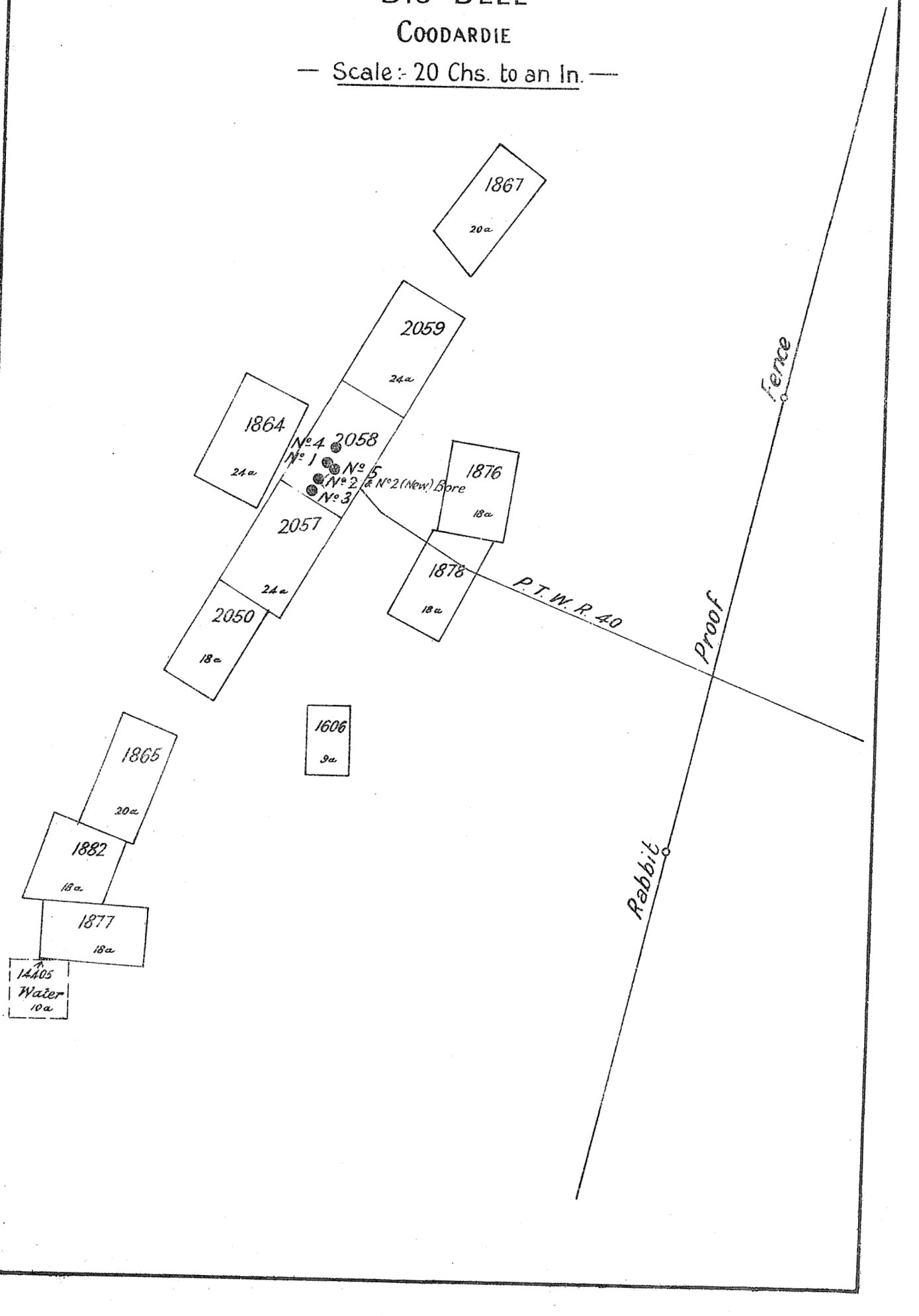
40 0 40 80

—Scale of Feet—



Figures in brackets indicate the lengths of core recovered from the corresponding section of boring.

Locality Plan
of Bores at
BIG BELL
COODARDIE
— Scale:- 20 Chs. to an In. —

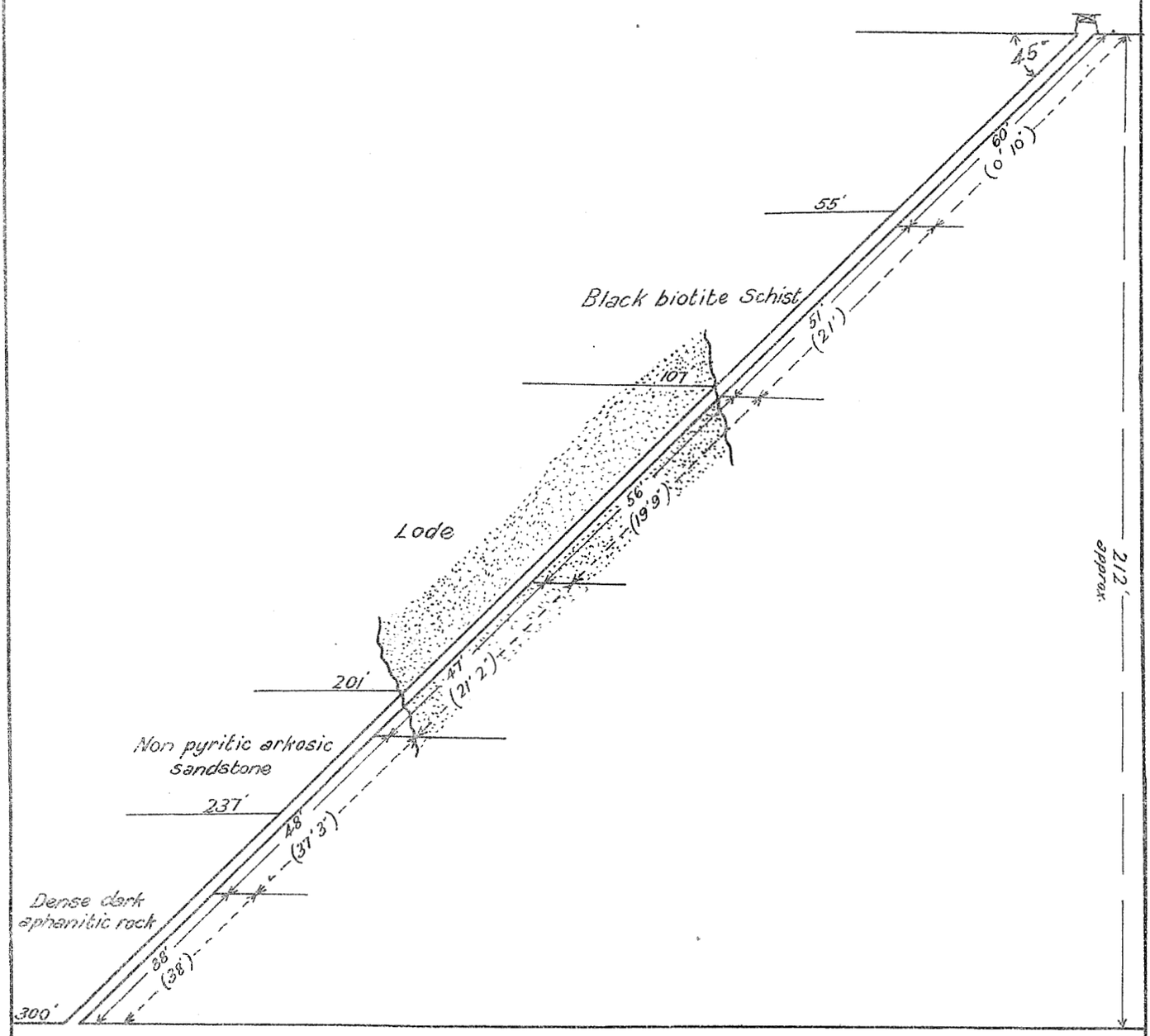


Section Nº 1 Bore

BIG BELL MINE

Cue

—Scale:- 32 Feet - 1 Inch—



Figures in brackets indicate the length of core recovered from the corresponding section of boring.

BIG BELL MINE

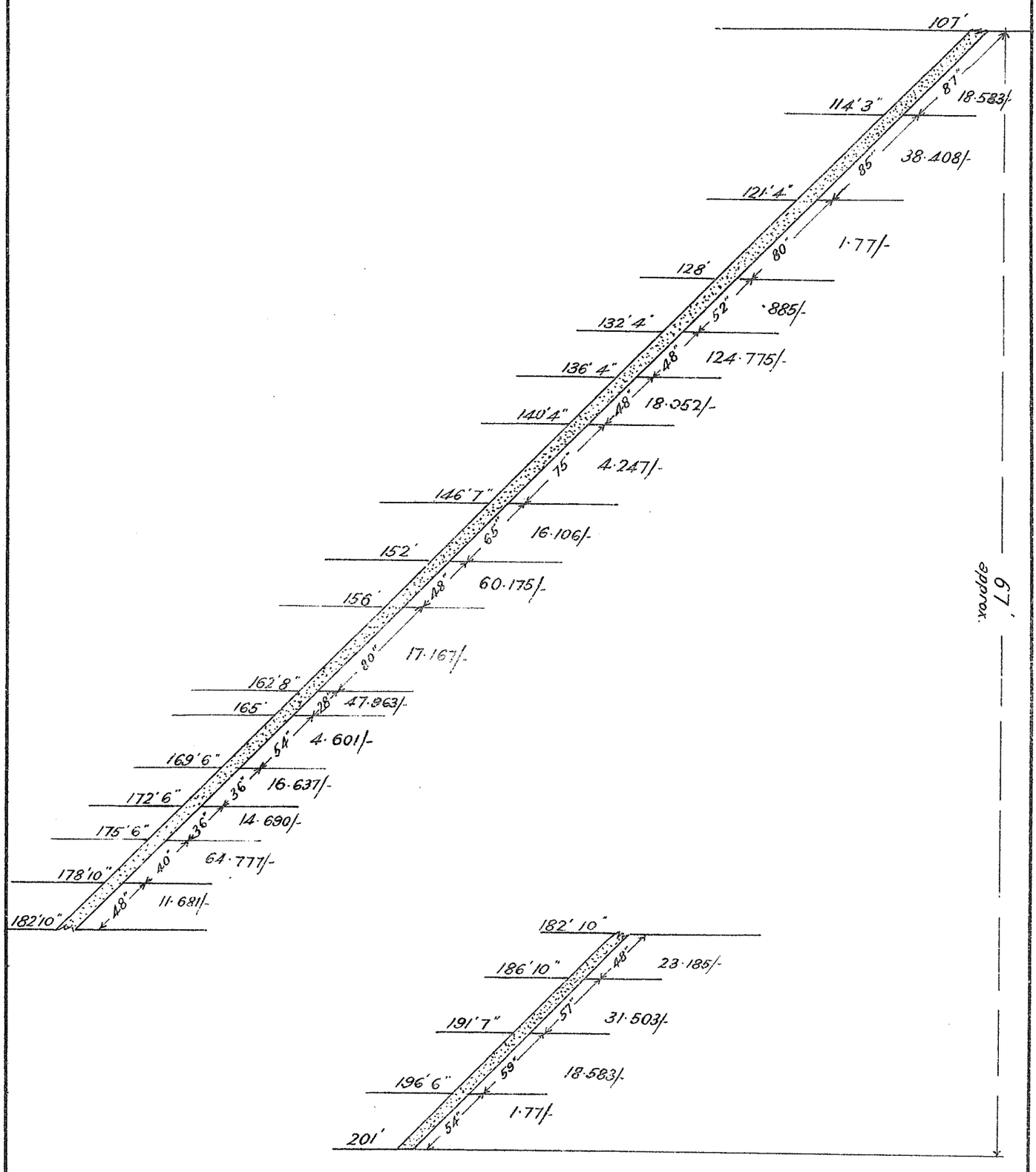
Cue

Section Nº 1 Bore

Chart of Assay values in lode material between 107 ft. and 201 ft.

8 0 8 16

— Scale of Feet —

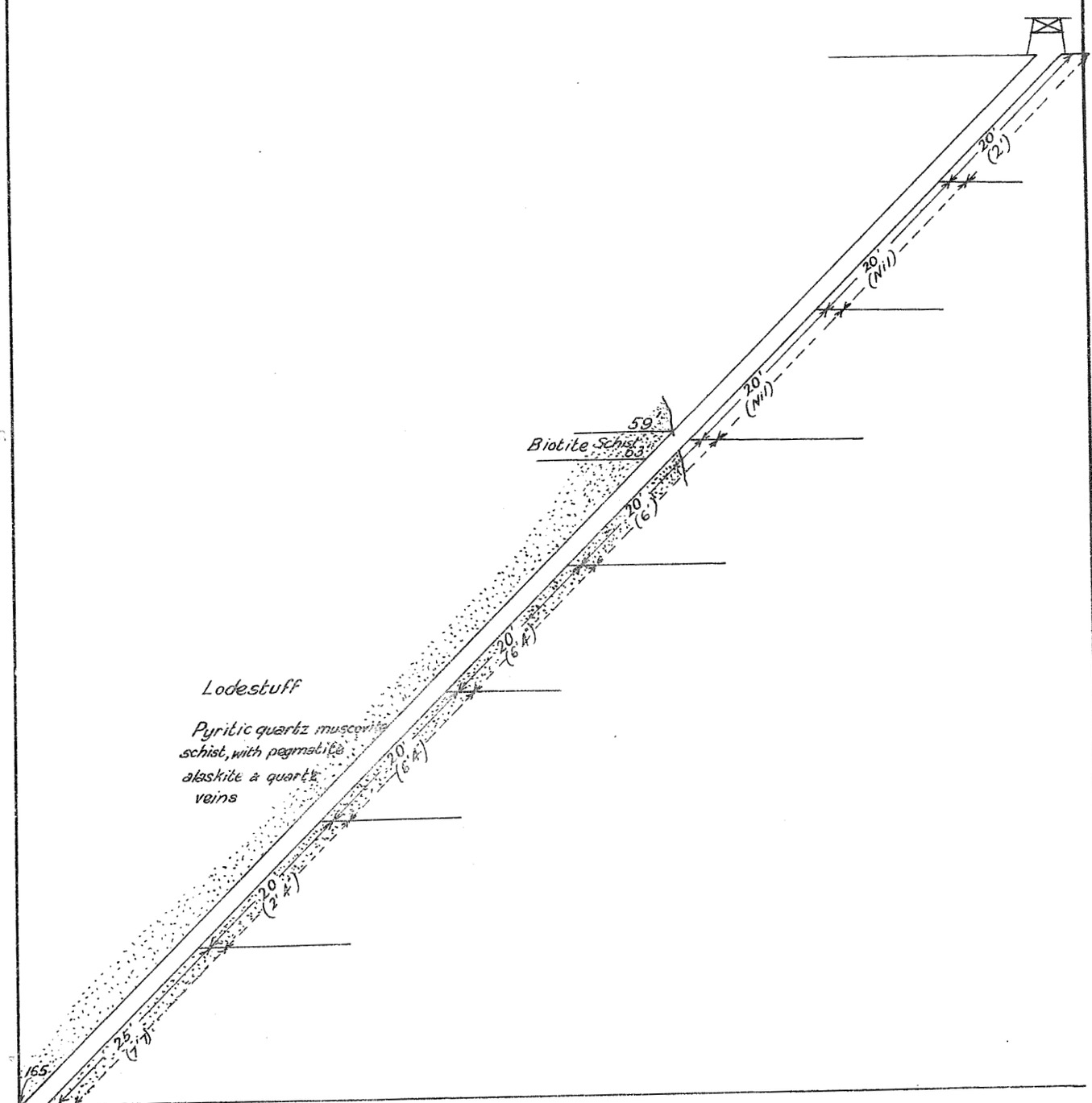


Section N° 2 Bore (Abandoned)

BIG BELL MINE

Cue

— Scale :- 16 Feet = 1 Inch —



Figures in brackets indicate the length of core recovered from the corresponding section of boring.

BIG BELL MINE

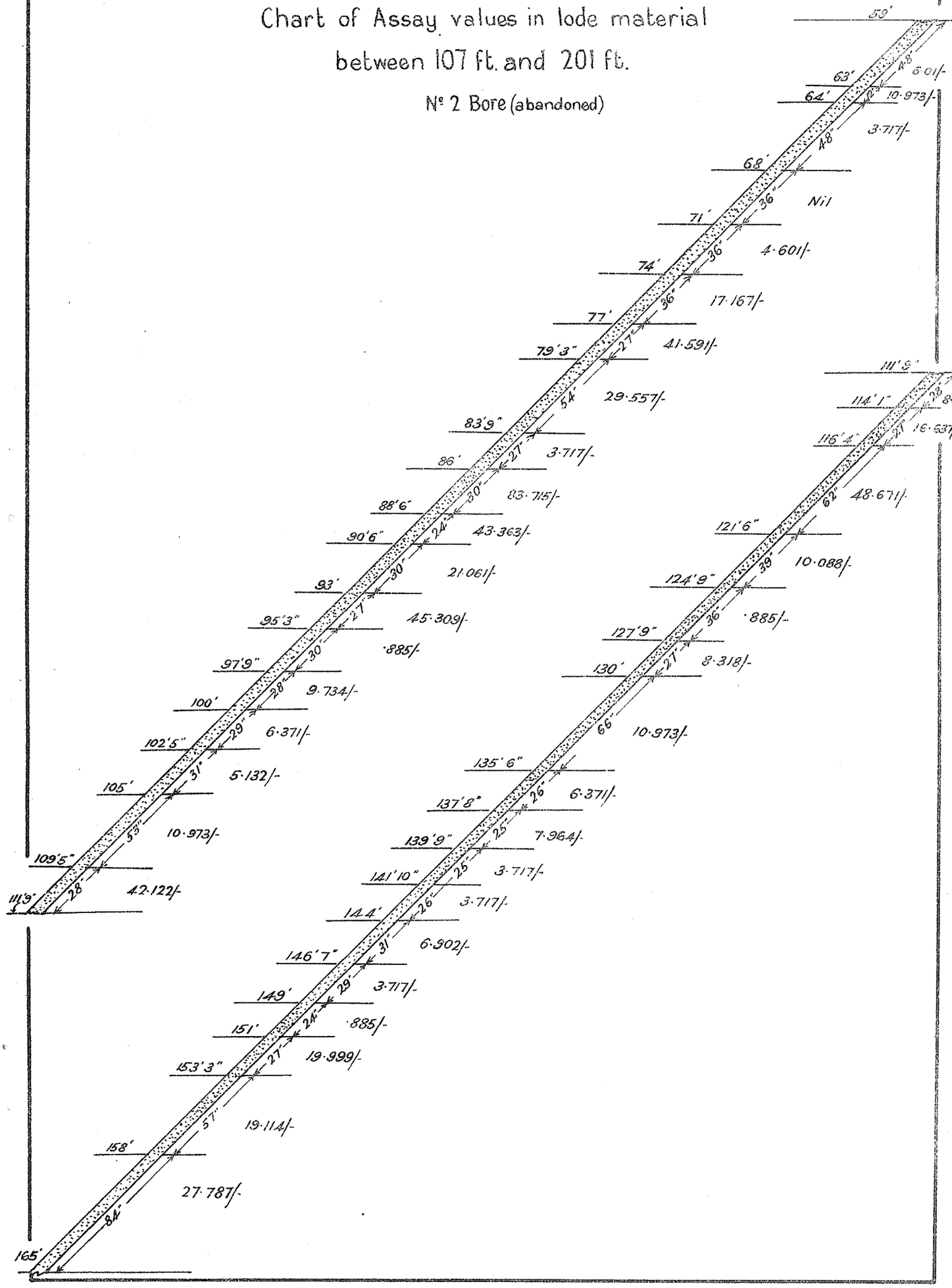
Cue

— Scale:- 5 Feet = 1 Inch —

Chart of Assay values in lode material

between 107 ft. and 201 ft.

Nº 2 Bore (abandoned)

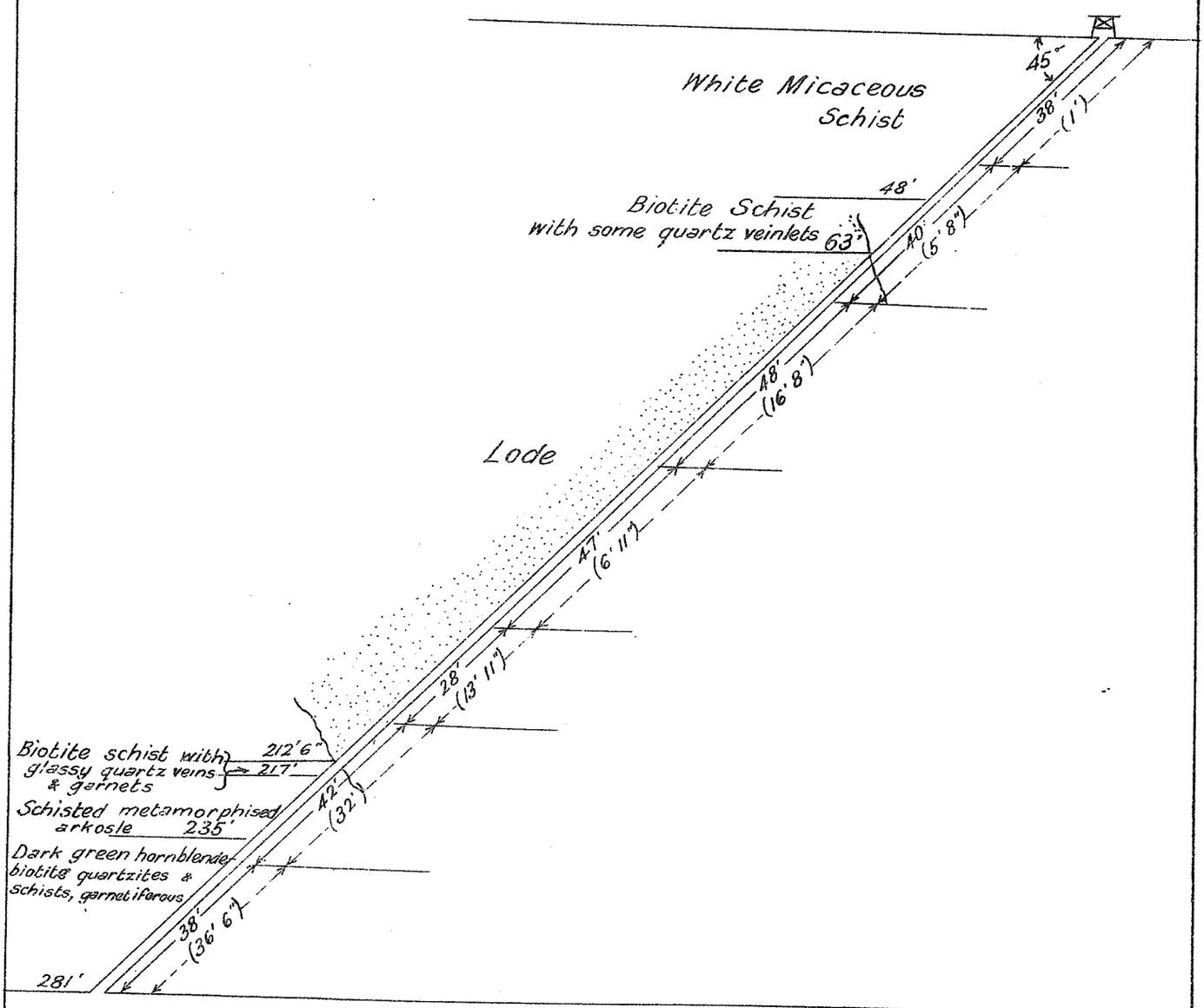


Section Nº 2 (New) Bore

BIG BELL MINE

Cue

—Scale:- 32 Feet = 1 Inch.—



Figures in brackets indicate the length of core recovered from the corresponding section of boring.

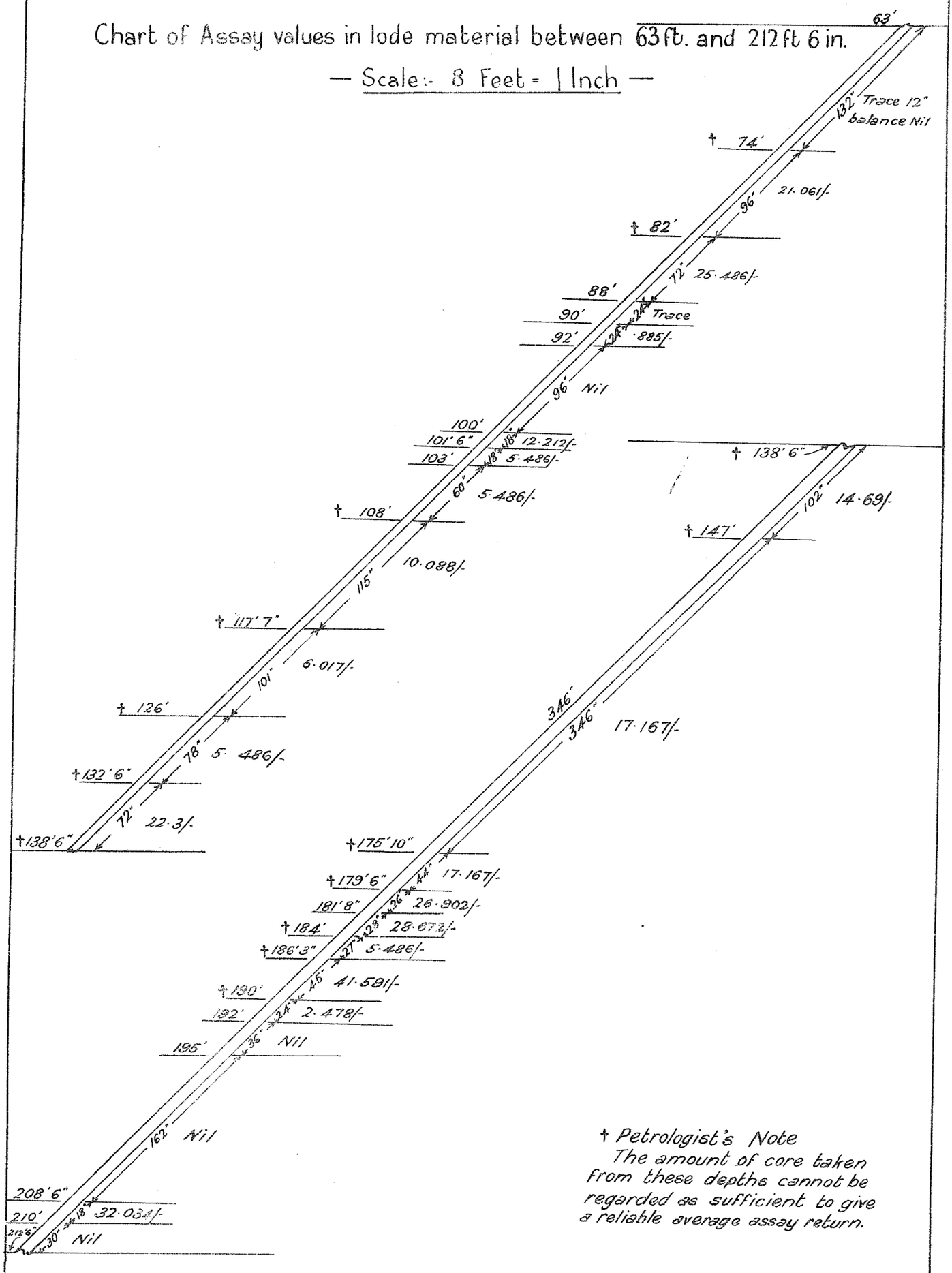
Section Nº 2 (New) Bore

BIG BELL MINE

Cue

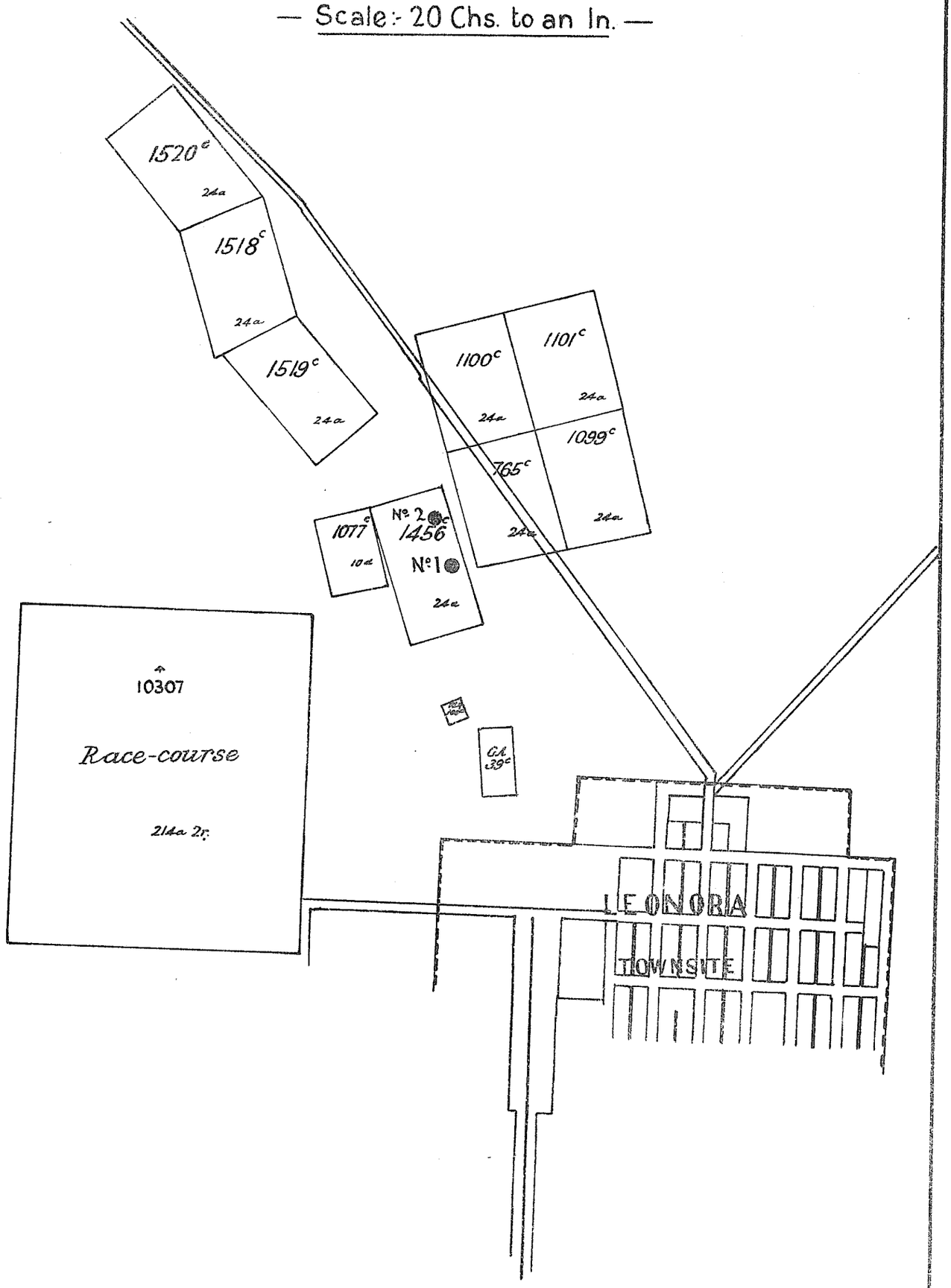
Chart of Assay values in lode material between 63 ft. and 212 ft 6 in.

— Scale:- 8 Feet = 1 Inch —



† Petrologist's Note
The amount of core taken from these depths cannot be regarded as sufficient to give a reliable average assay return.

Locality Plan
of Bores at
HARBOUR LIGHTS
LEONORA
— Scale:- 20 Chs. to an In. —



Section Nº 1 (New) Bore

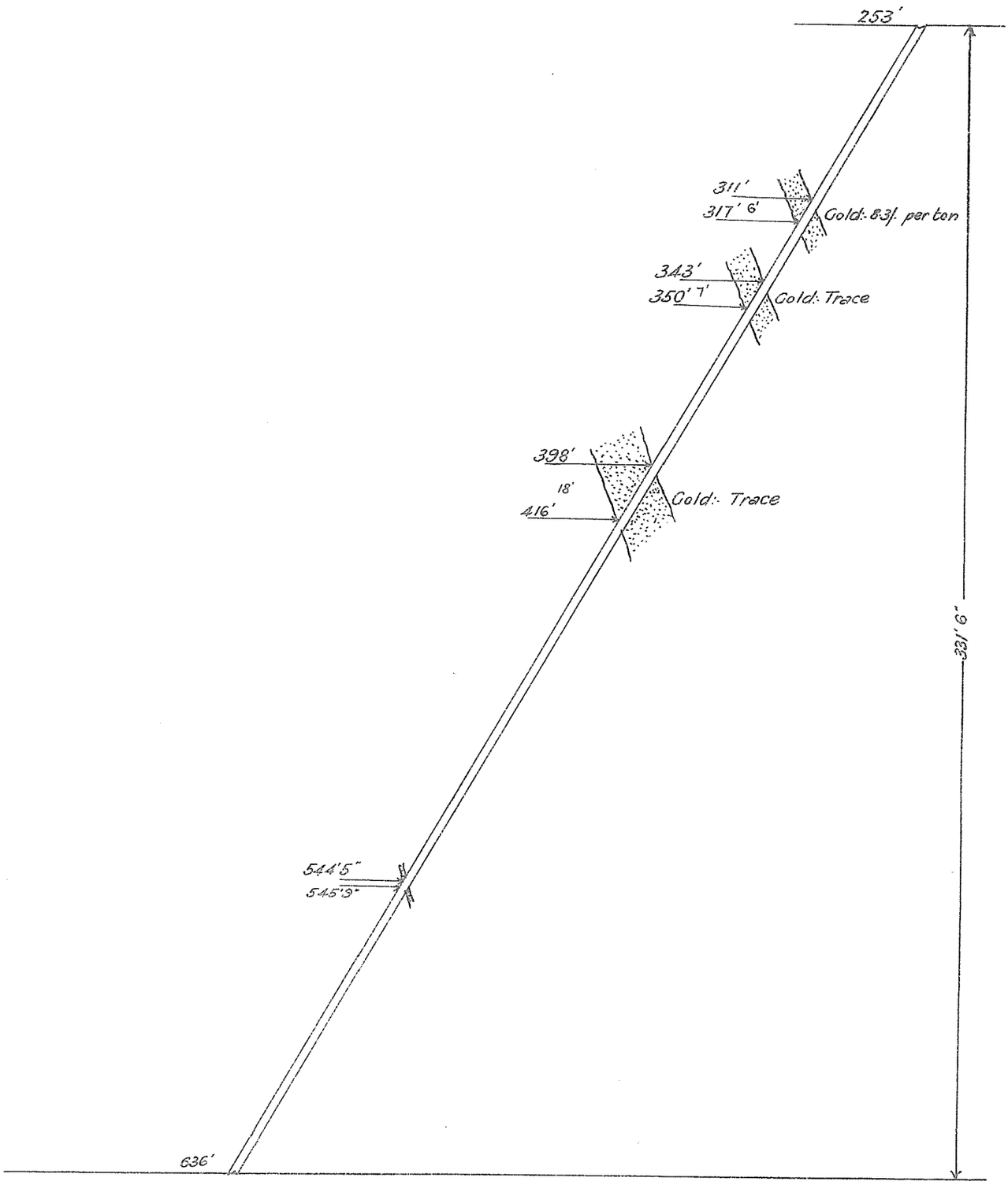
HARBOUR LIGHTS MINE

LEONORA

Assay chart of values in lode between 253 ft. and 636 ft.

40 0 40 80

— Scale of Feet —



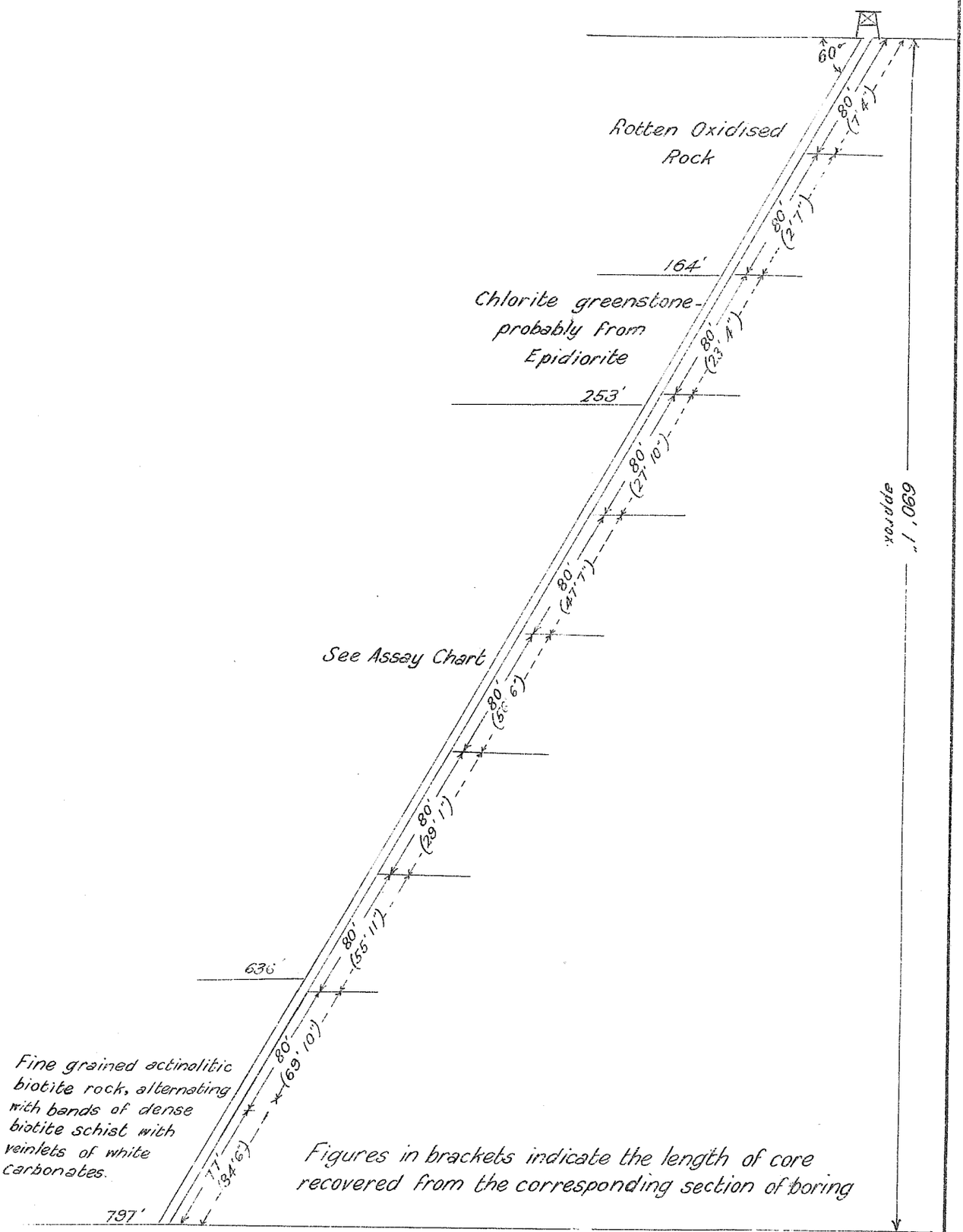
Section Nº 1 (New) Bore

HARBOUR LIGHTS MINE

LEONORA

80 0 80 160

—Scale of Feet—

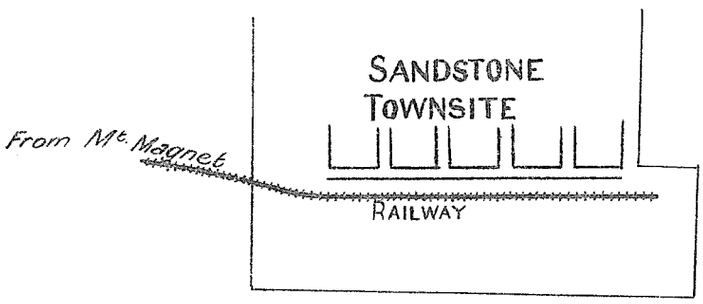


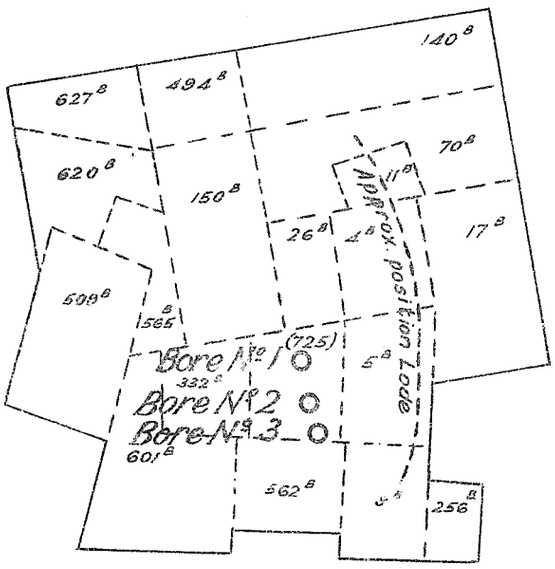
Figures in brackets indicate the length of core recovered from the corresponding section of boring

Locality Plan

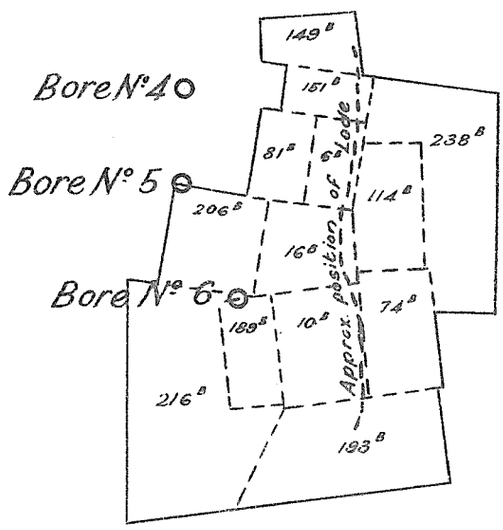
SHEWING POSITION OF BORES AT SANDSTONE

Scale:- 20 Chains = 1 Inch





Black Range & Black Range West
Gold Mining Cos. Leases

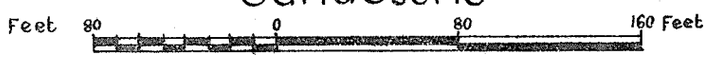


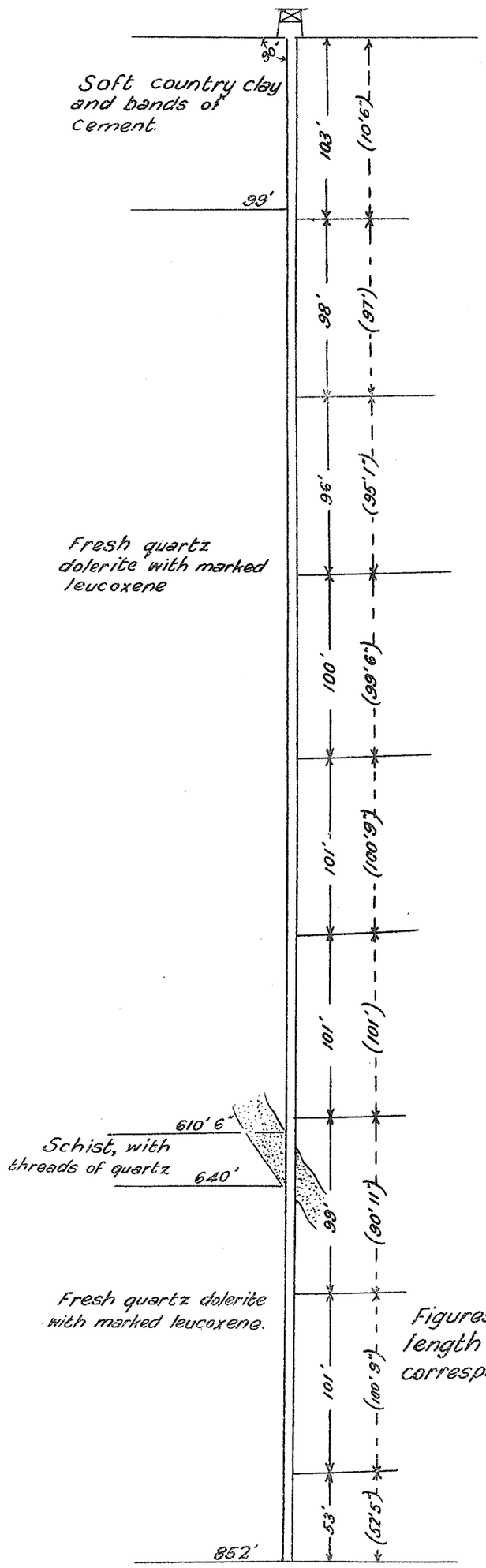
Oroya Black Range
Gold Mining Cos. Leases

Section Nº 1 Bore

BLACK RANGE G.M.

Sandstone





Figures in brackets indicate the length of core recovered from the corresponding section of boring.

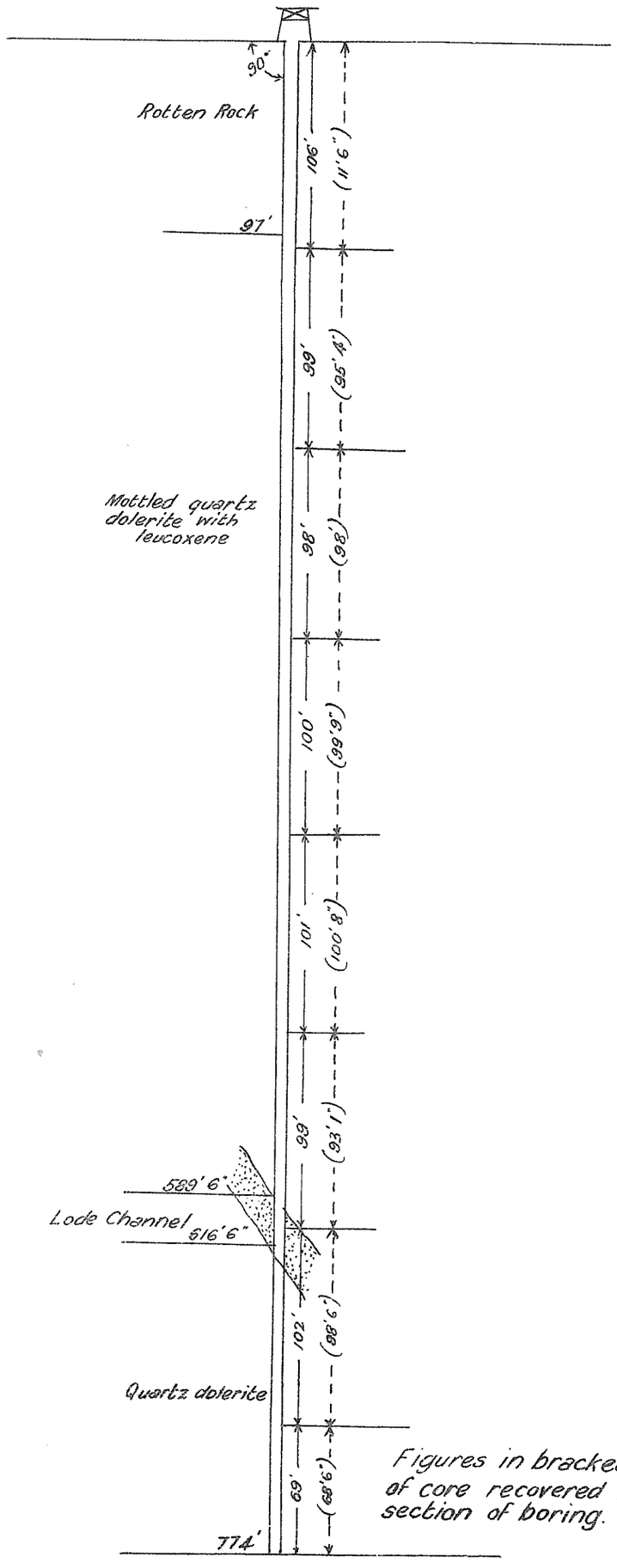
Section No 2 Bore

BLACK RANGE G.M.

Sandstone

80 0 80 160

— Scale of Feet —



Figures in brackets indicate the length of core recovered from the corresponding section of boring.

Section No 3 Bore

BLACK RANGE G. M.

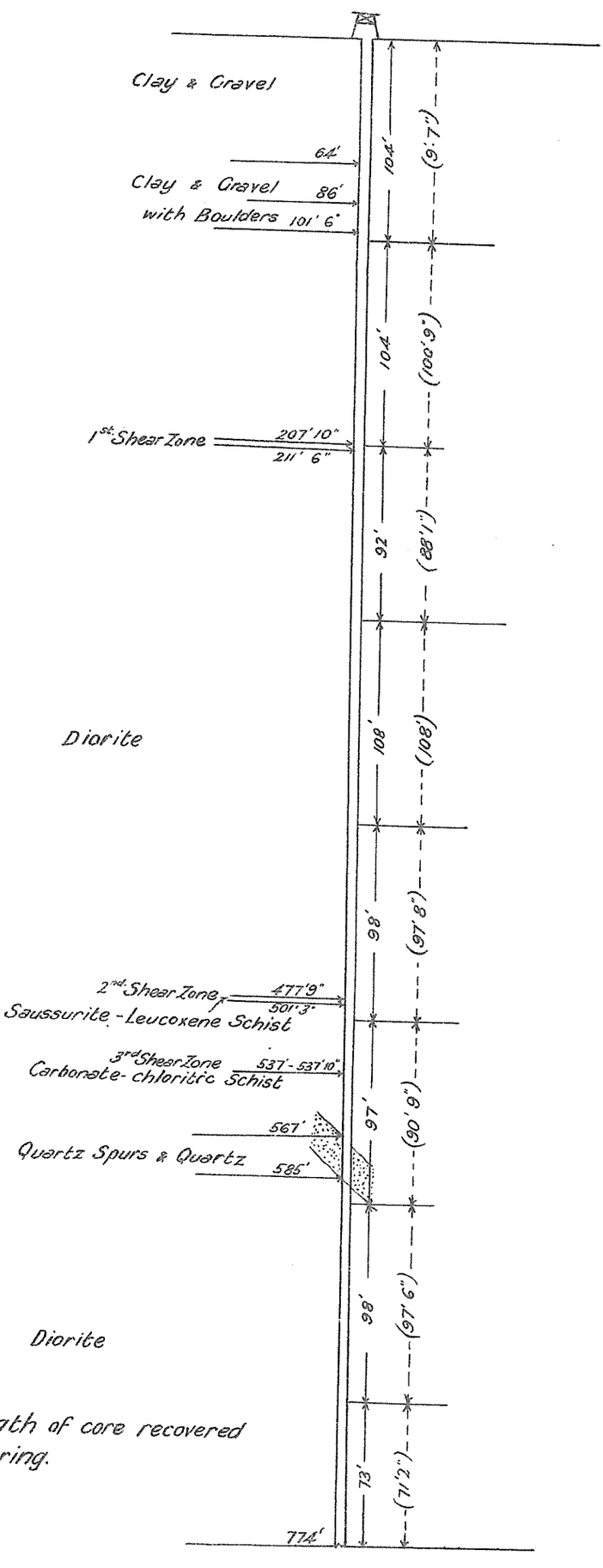
Sandstone

80 0 80 160

— Scale of Feet —

— Quartz —

207'6"	- 210'	Spurs
227'		1"
358'	- 368'	Threads
386'4"		1"
395'10"		3"
397'		1"
406'		3"
449'		2½"
453'		1½"
488'7"	- 489'2"	7"
568'9"	- 573'7"	Spurs
573'7"	- 579'7"	72"
595'10"		2"
730'		4"
759'		14"



Figures in brackets indicate the length of core recovered from the corresponding section of boring.

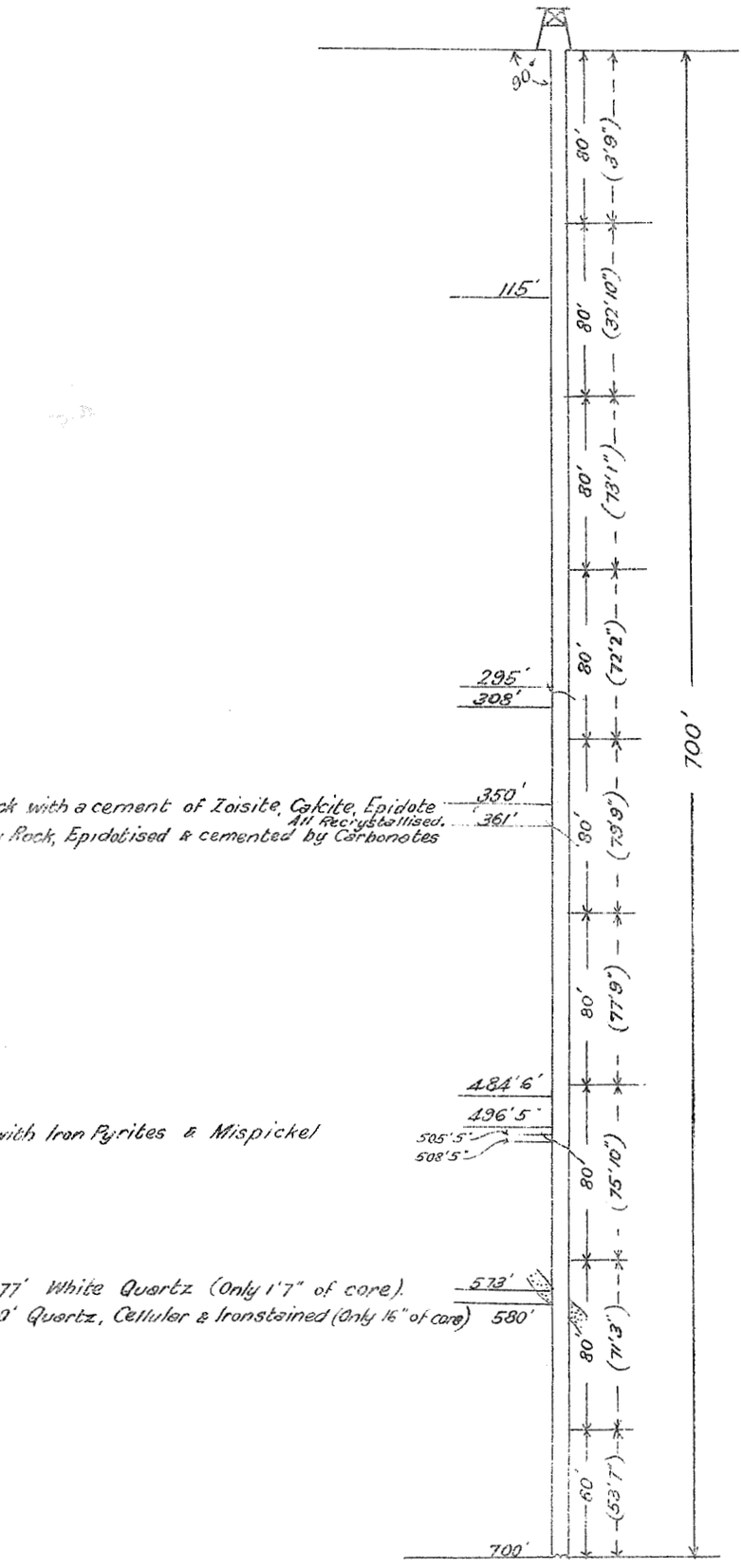
Section No 4 Bore

OROYA G. M.

Sandstone

80 0 80 160

—Scale of Feet—



Figures in brackets indicate the length of core recovered from the corresponding section of boring.

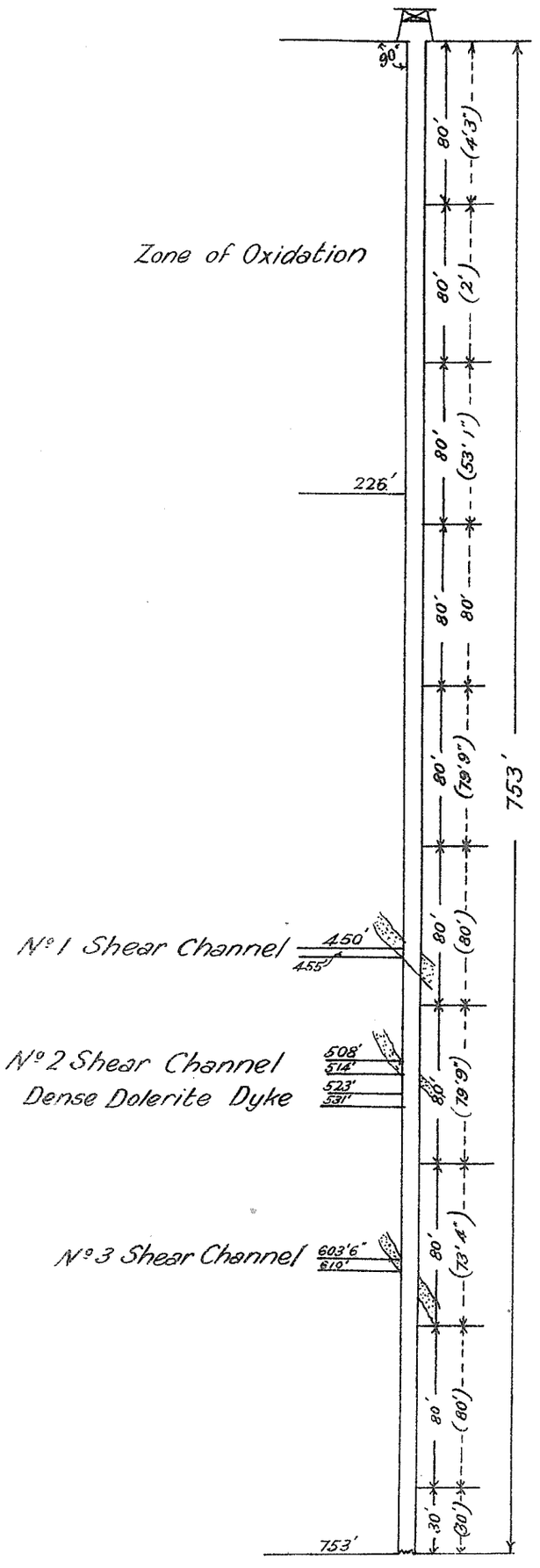
Section Nº 5 Bore

OROYA G. M.

Sandstone

80 0 80 160

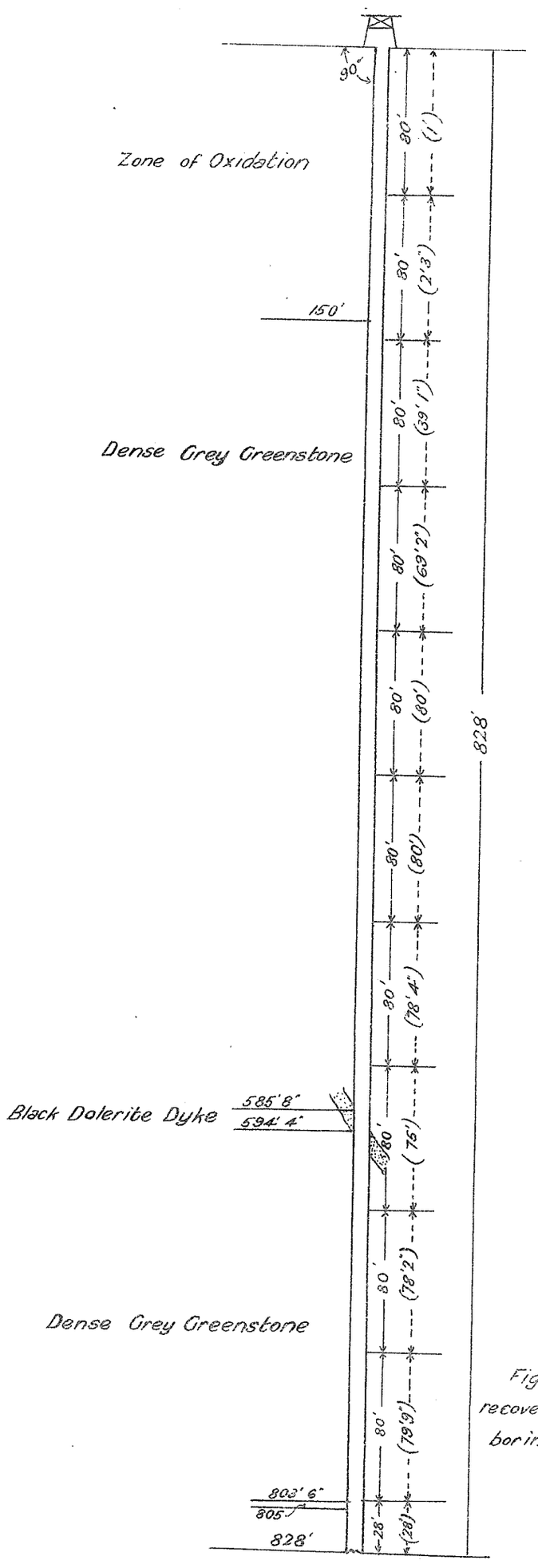
– Scale of Feet –



Figures in brackets indicate the length of core recovered from the corresponding section of boring.

Section No 6 Bore
OROYA G. M.
Sandstone

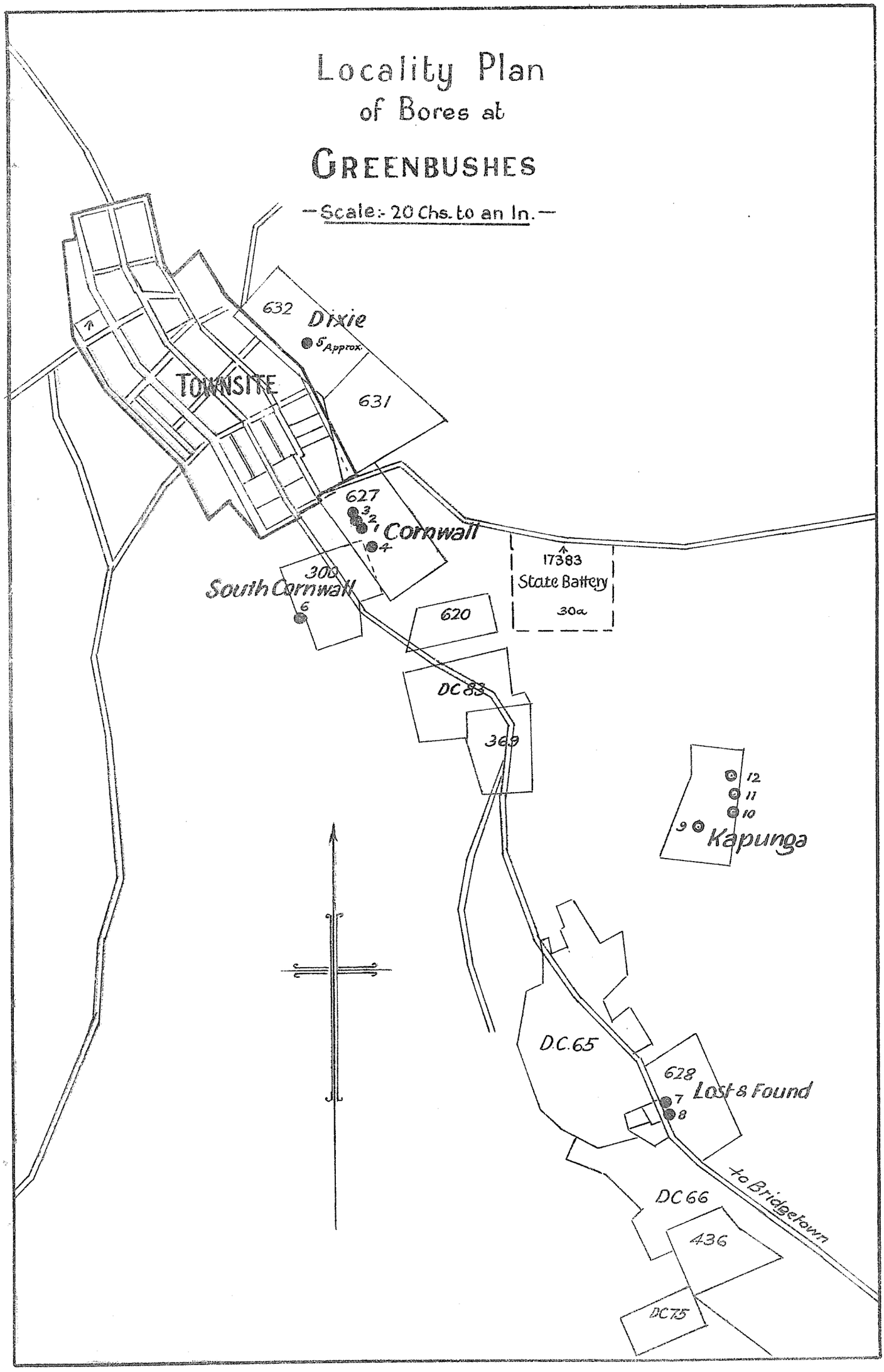
-Scale of Feet-



Figures in brackets indicate the length of core recovered from the corresponding section of boring.

Locality Plan
of Bores at
GREENBUSHES

—Scale:- 20 Chs. to an In.—



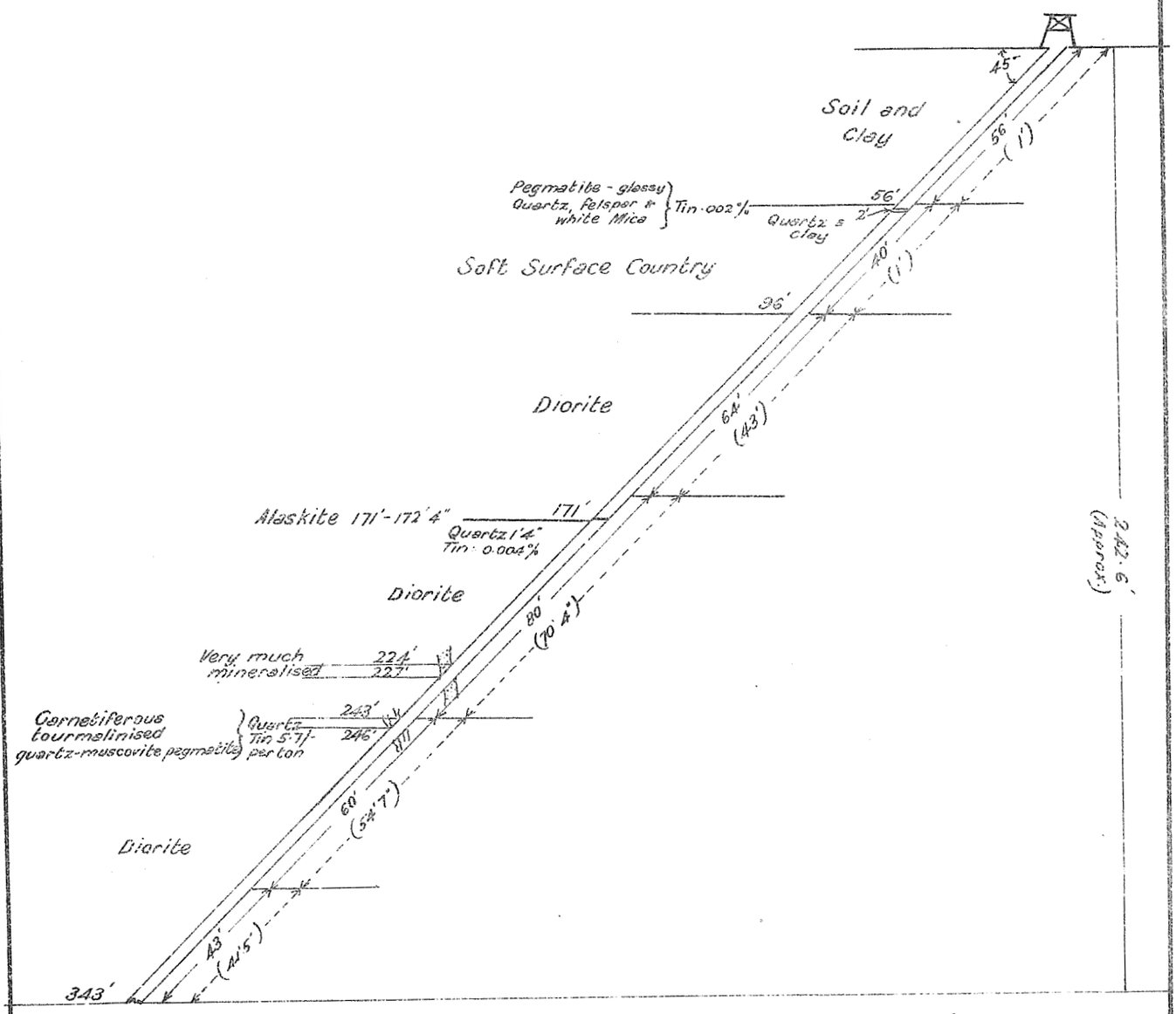
Section No 1 Bore

CORNWALL MINE

Greenbushes

40 0 40 80

Scale of Feet



Figures in brackets indicate the length of core recovered from the corresponding section of boring.

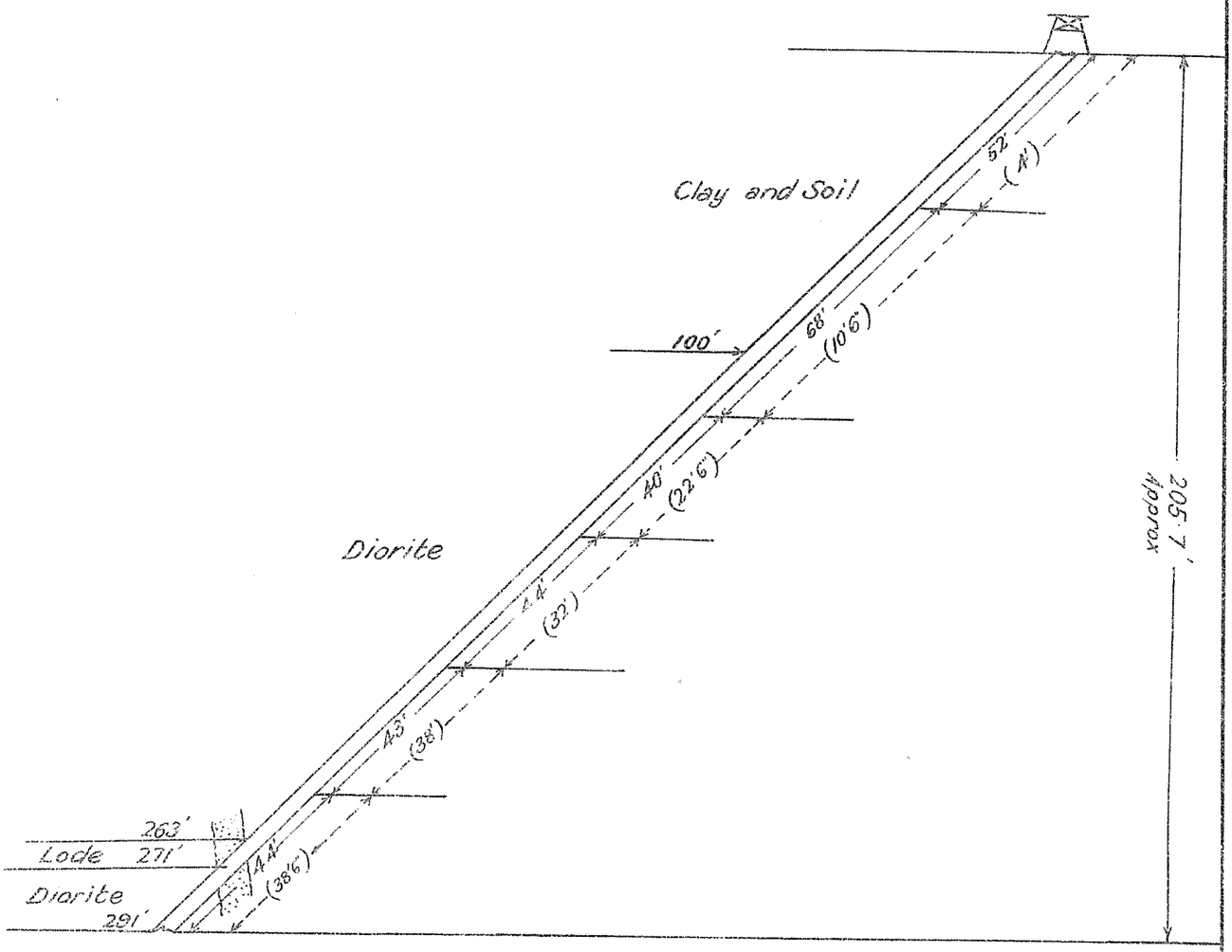
Section Nº 2 Bore

CORNWALL MINE

Greenbushes

40 0 40 80

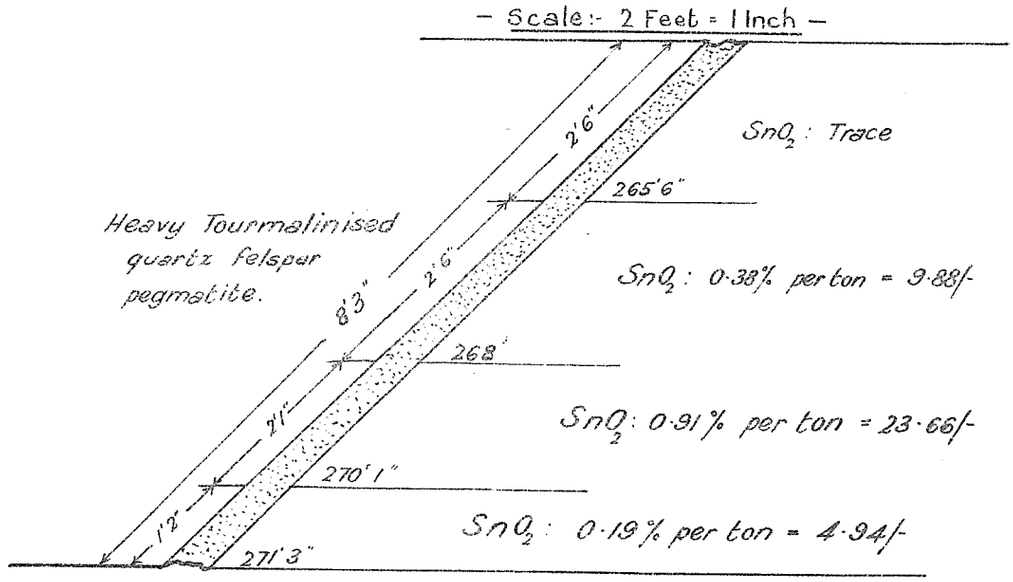
— Scale of Feet —



Figures in brackets indicate the length of core recovered from the corresponding section of boring.

Assay chart of values between 263 ft. & 271 ft. 3 in.

— Scale:- 2 Feet = 1 Inch —



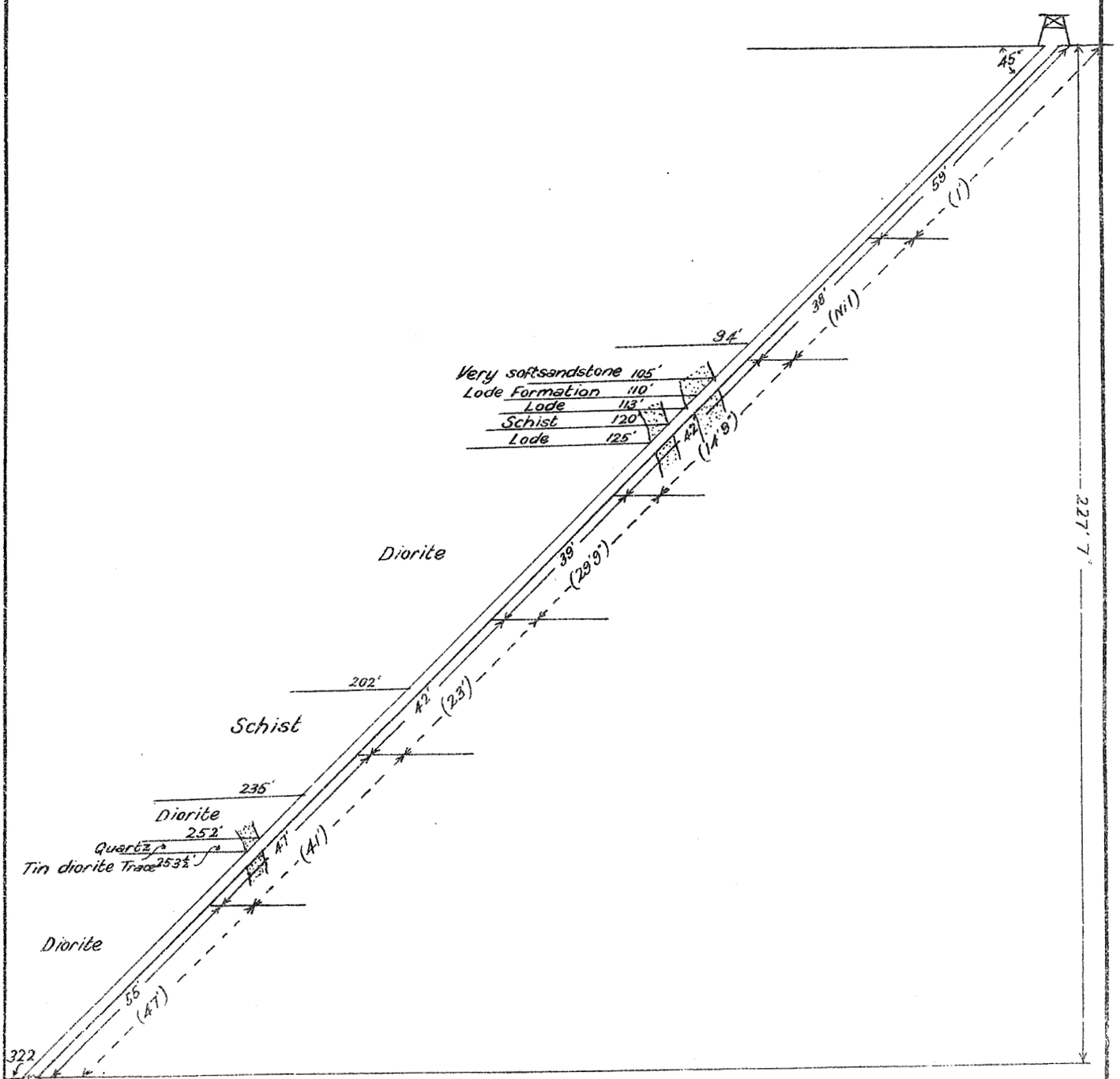
Tin at 26/- per unit.

Section Nº 3 Bore

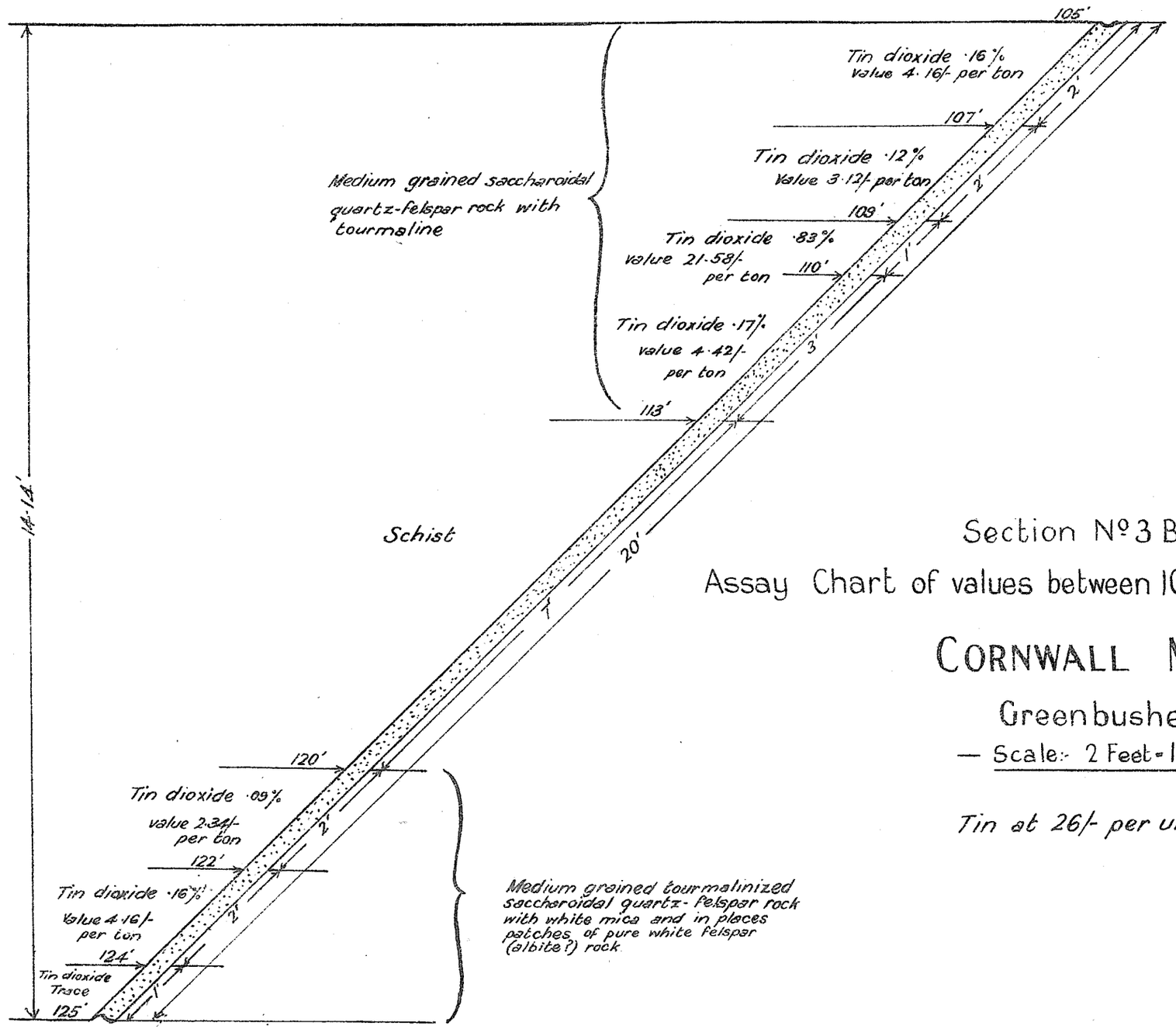
CORNWALL MINE

Greenbushes

— Scale:- 32 Feet - 1 Inch —



Figures in brackets indicate the length of core recovered from the corresponding section of boring.



Section Nº 3 Bore

Assay Chart of values between 105' & 113', & 120' & 125'

CORNWALL MINE

Greenbushes

— Scale:- 2 Feet-1 Inch —

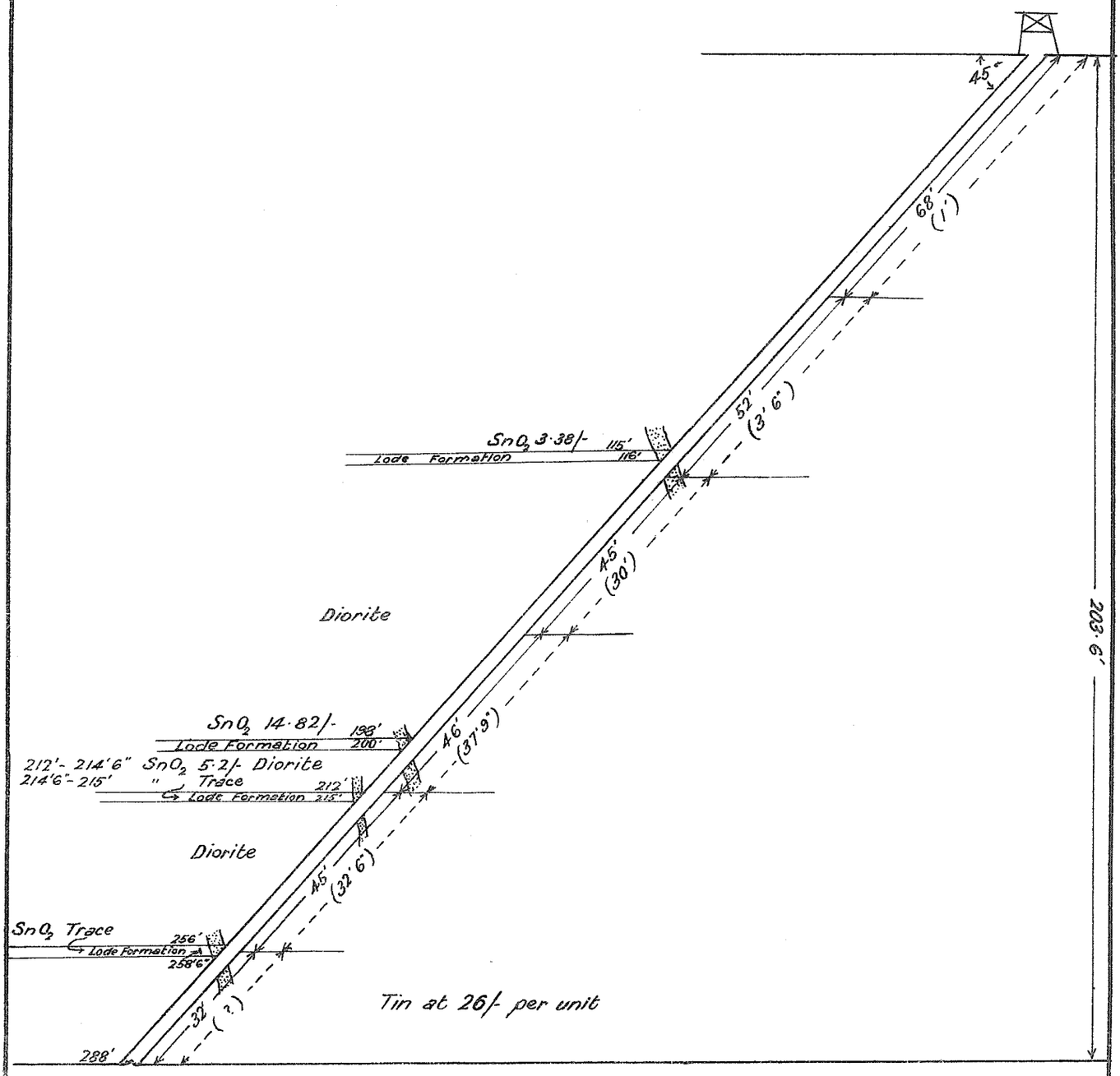
Tin at 26/- per unit.

Section № 4 Bore

CORNWALL MINE

Greenbushes

— Scale: 32 Feet = 1 Inch. —



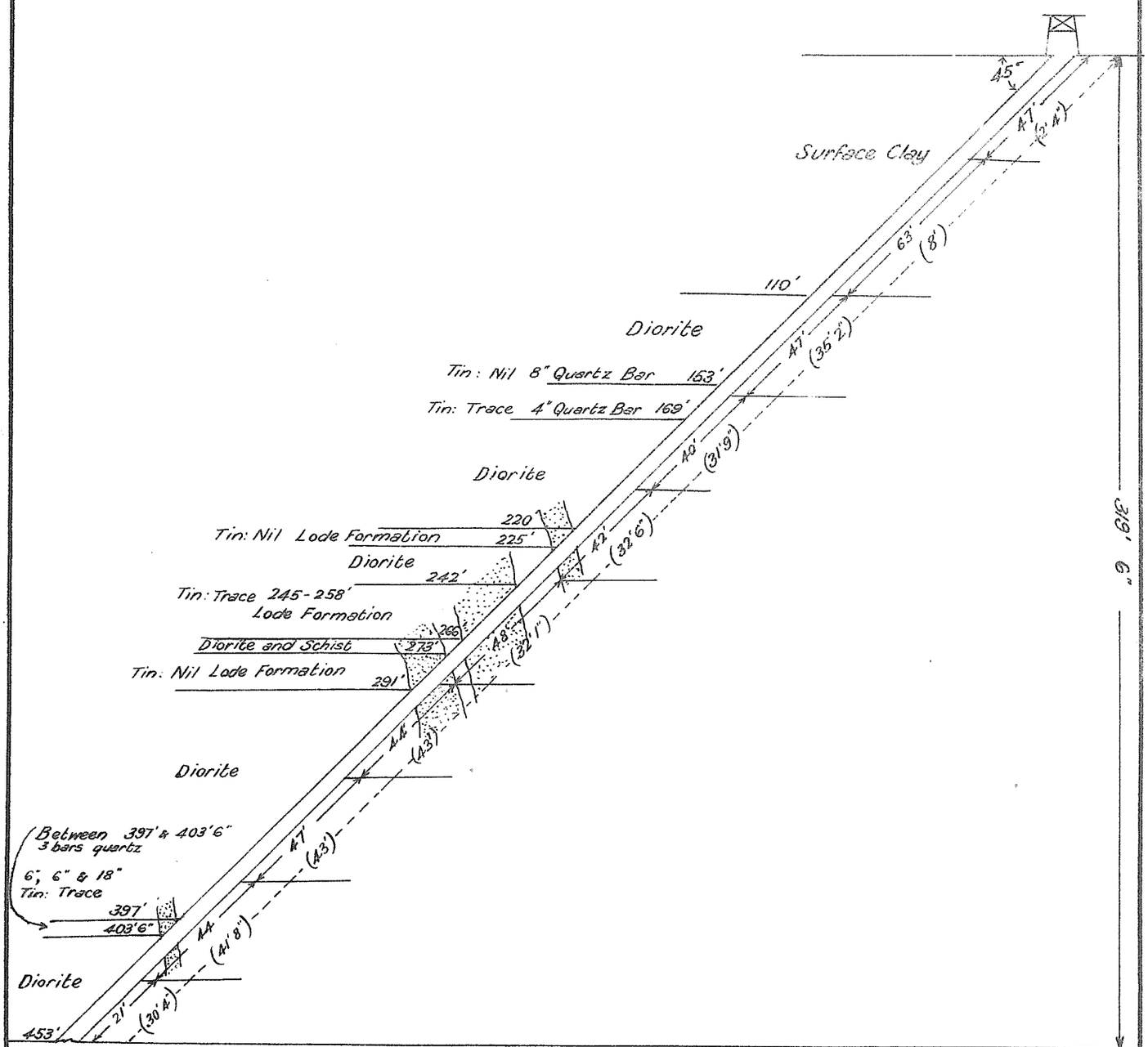
Figures in brackets indicate the length of core recovered from the corresponding section of boring.

Section N° 5 Bore

DIXIE LEASE

Greenbushes

Scale:- 48 Feet = 1 Inch



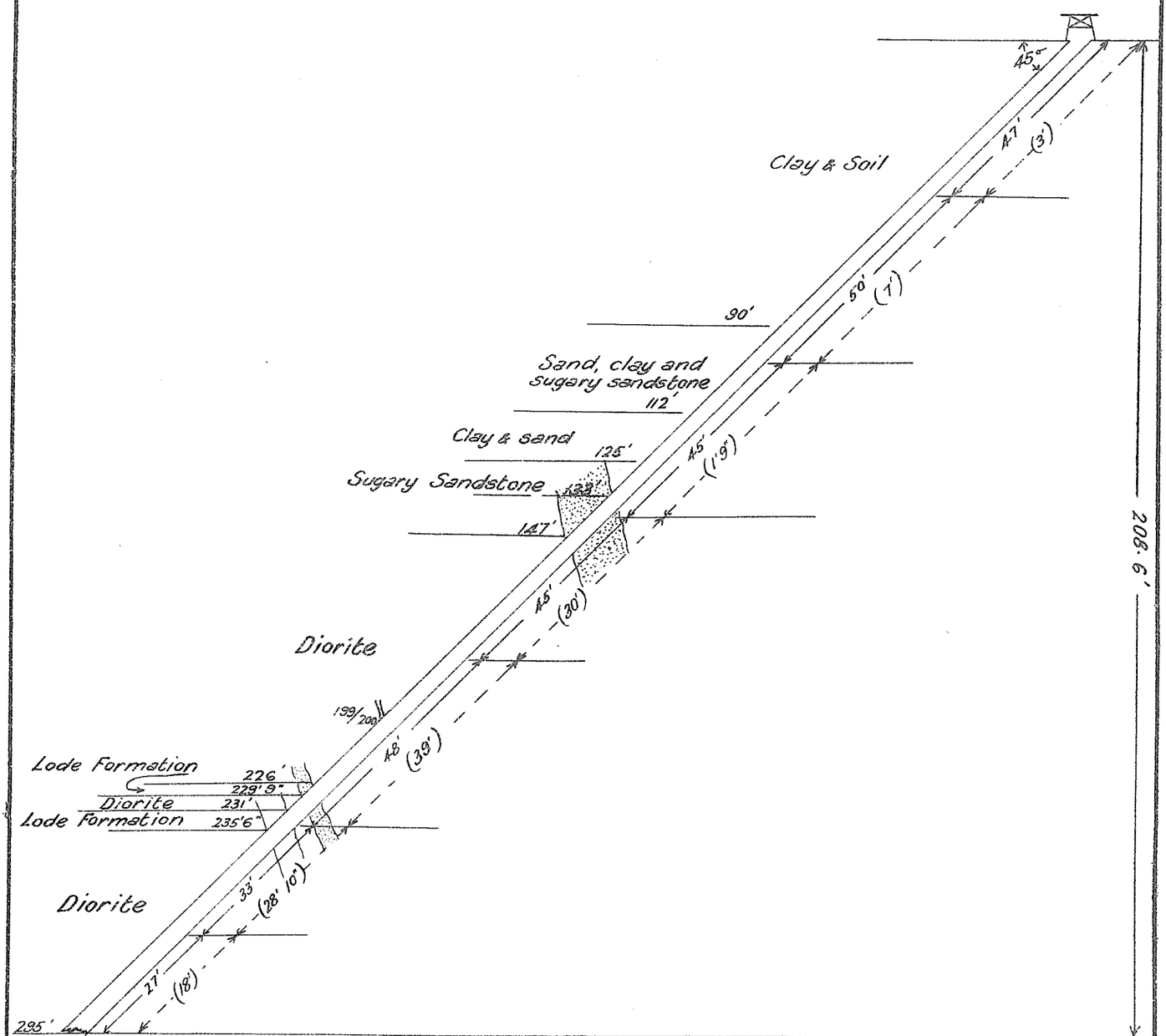
Figures in brackets indicate the length of core recovered from the corresponding section of boring.

Section Nº 6 Bore

SOUTH CORNWALL LEASE

Greenbushes

— Scale:- 32 Feet = 1 Inch —



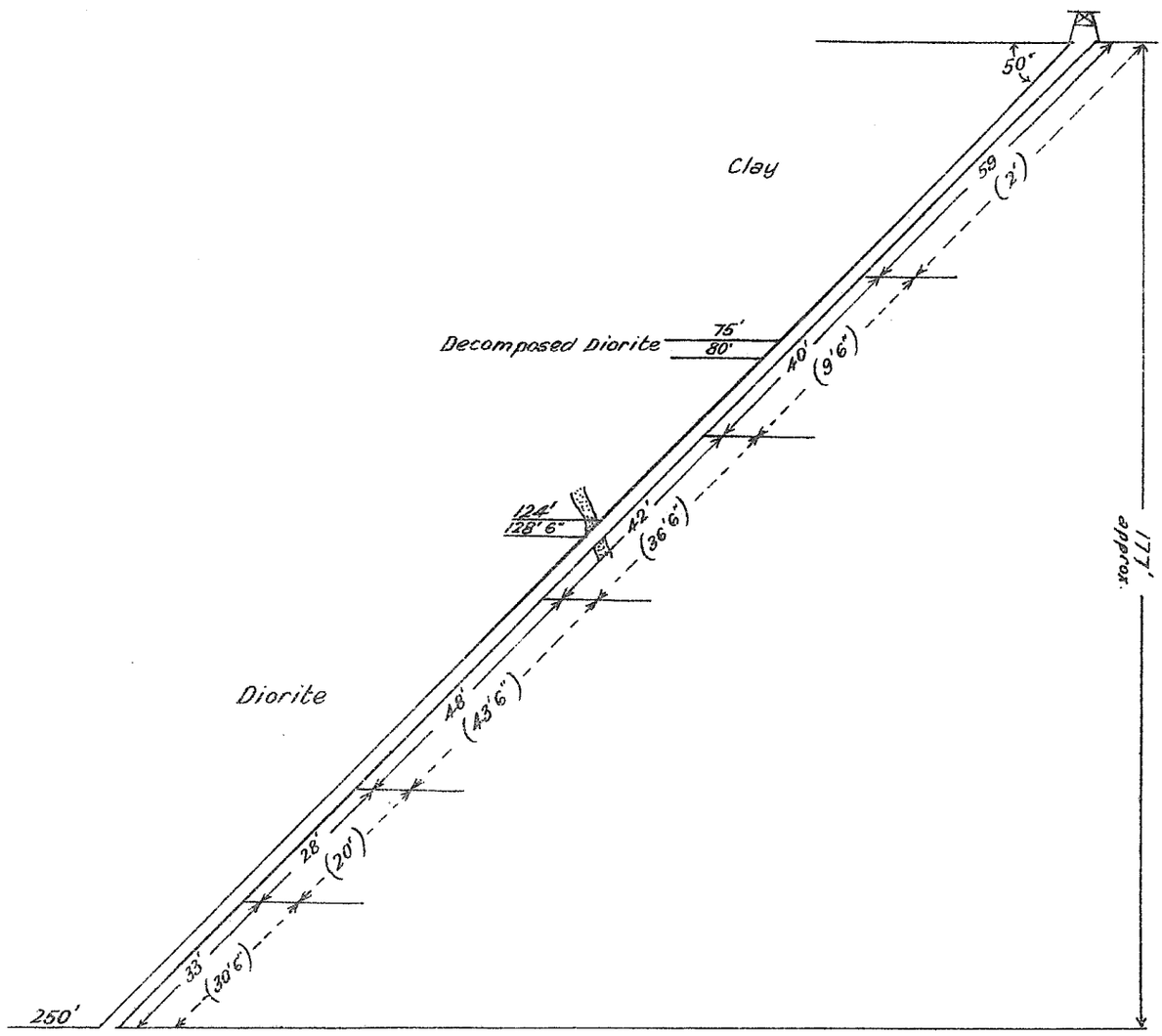
Figures in brackets indicate the length of core recovered from the corresponding section of boring.

Section Nº 7 Bore

LOST AND FOUND LEASE

Greenbushes

— Scale:- 32 Feet = 1 Inch —



The figures in brackets indicate the length of core recovered from the corresponding section of boring.

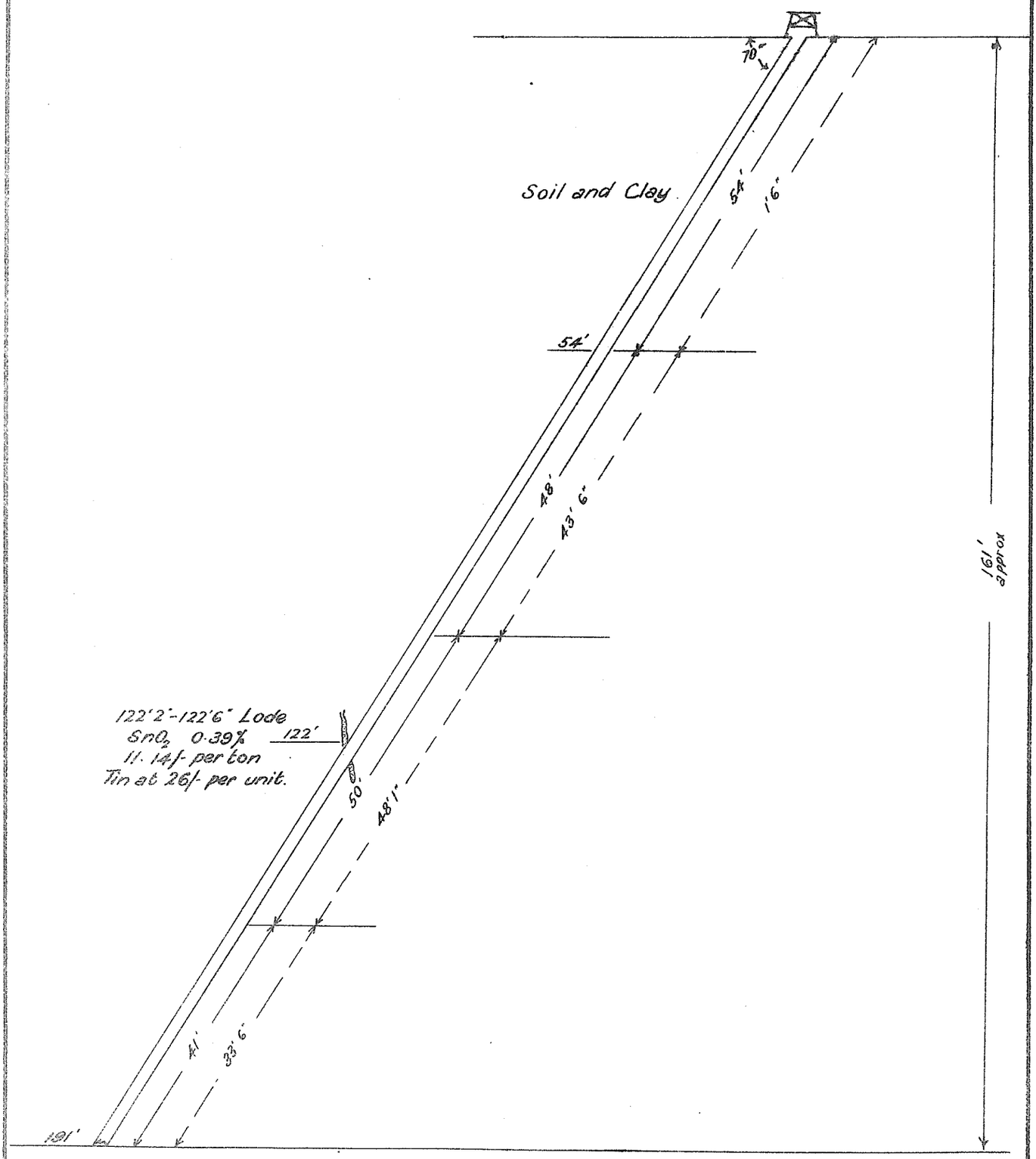
Section No 8 Bore

LOST AND FOUND LEASE

Greenbushes

20 0 20 40

— Scale of Feet —

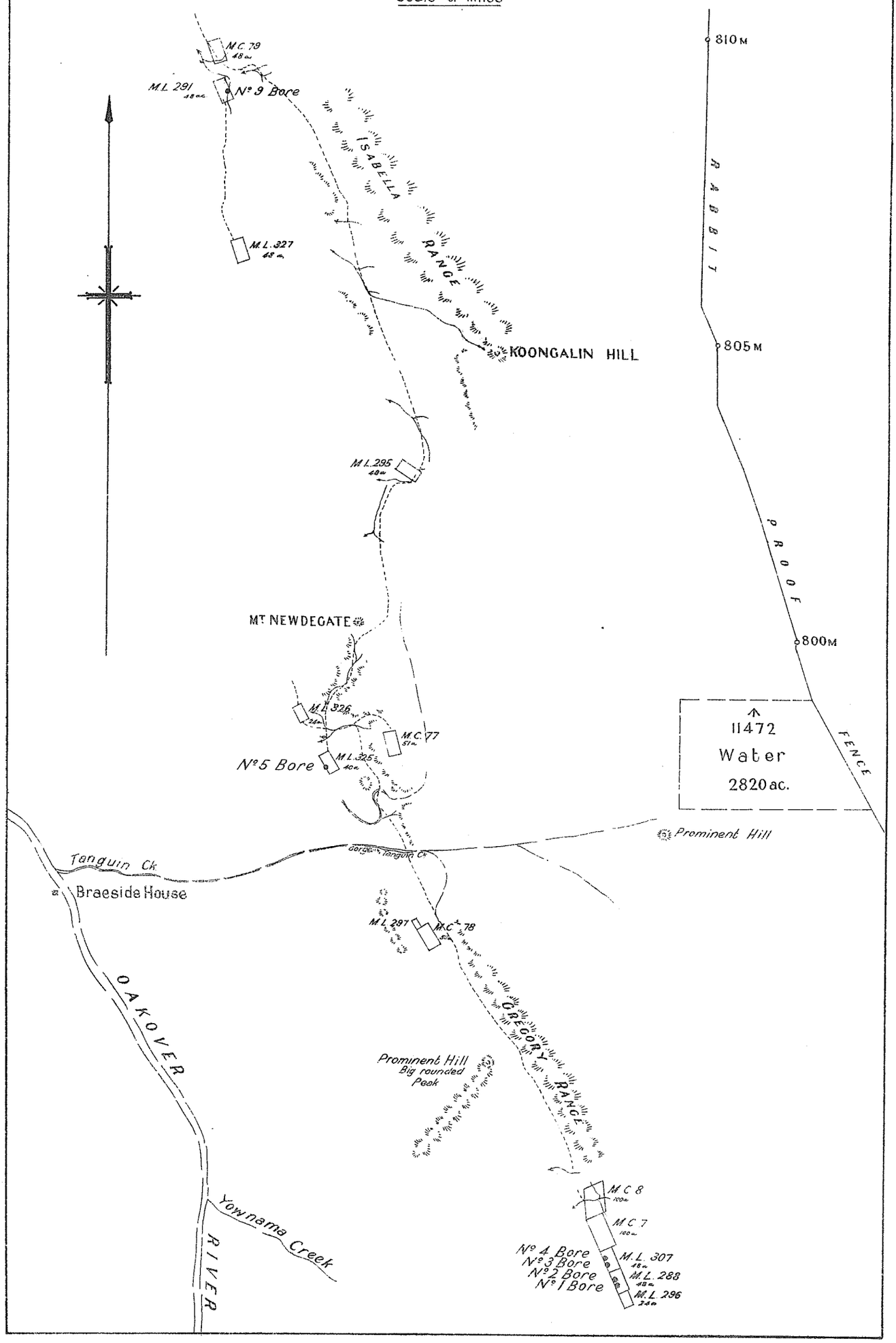


Figures in brackets indicate the length of core recovered from the corresponding section of boring.

Plan Shewing Bores at BRAESIDE

2 1 0 2 4

— Scale of Miles —



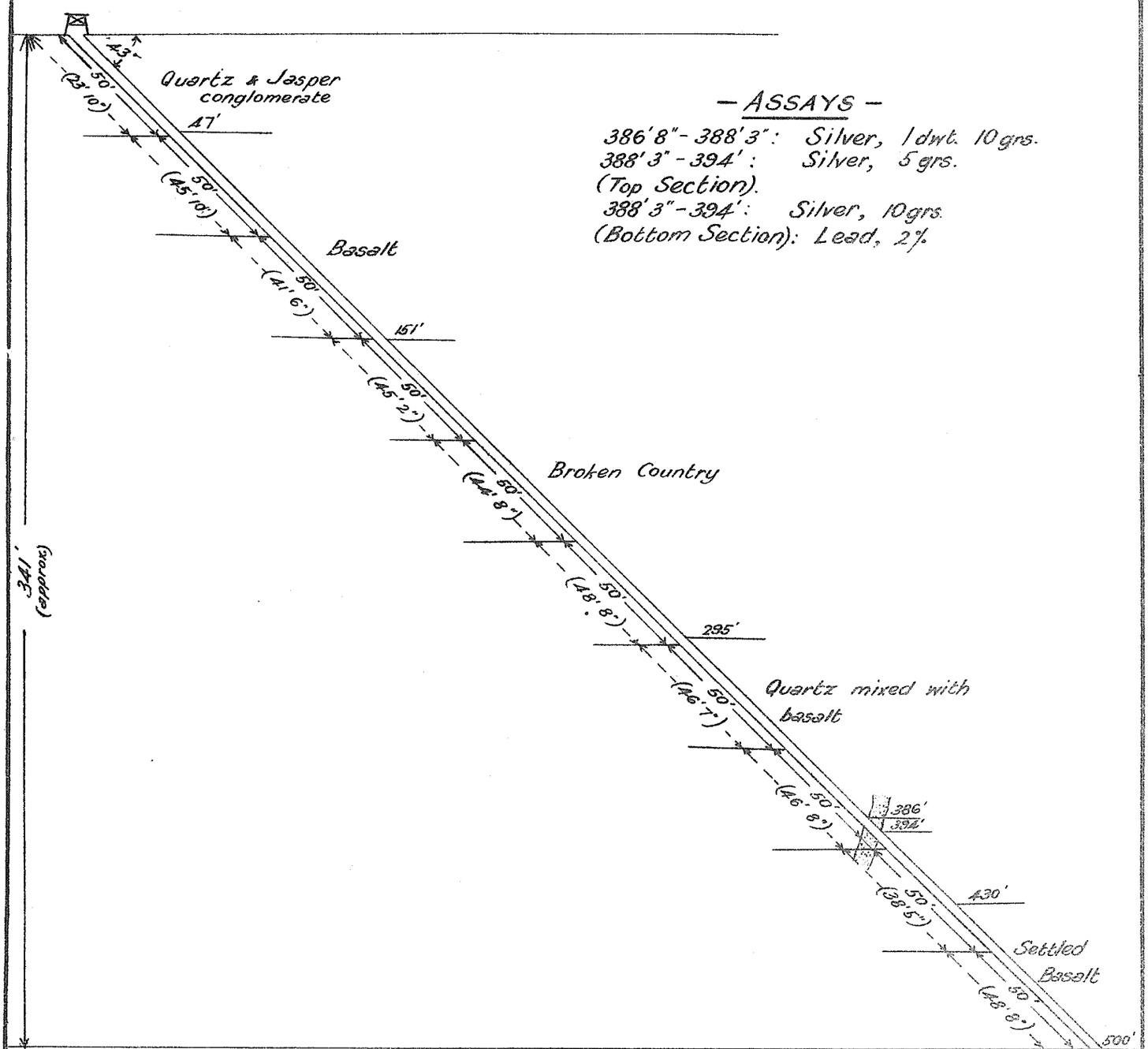
Section Nº 1 Bore

RAGGED HILL G.M.L.

Braeside

50 0 50 100

— Scale of Feet —



— ASSAYS —

386'8" - 388'3": Silver, 1 dwt. 10 grs.
388'3" - 394': Silver, 5 grs.
(Top Section).
388'3" - 394': Silver, 10 grs.
(Bottom Section): Lead, 2%.

Figures in brackets indicate the length of core recovered from the corresponding section of boring.

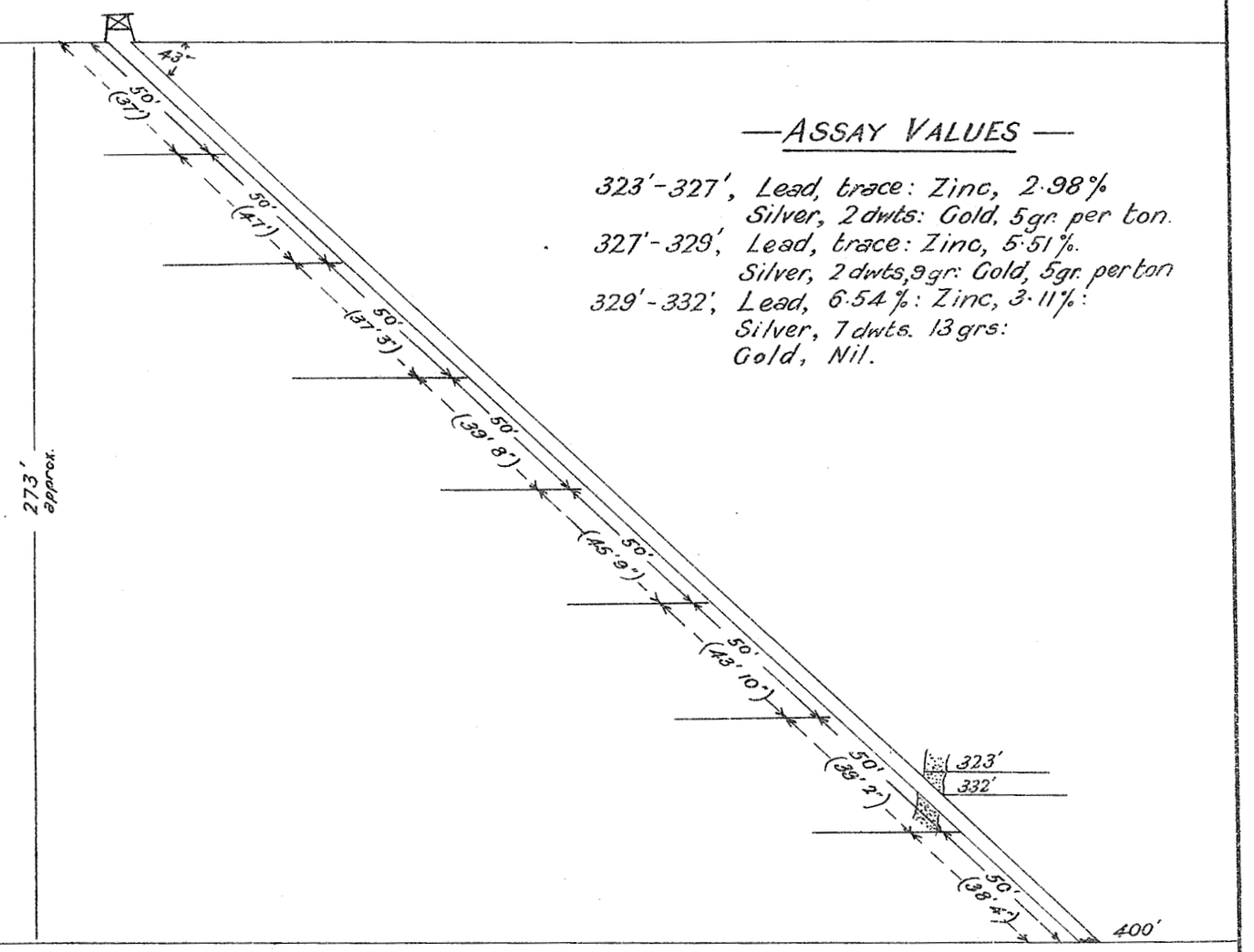
Section N°2 Bore

RAGGED HILL G.M.L

Braeside

50 0 50 100

— Scale of Feet —



—ASSAY VALUES —

323'-327', Lead, trace: Zinc, 2·98%
Silver, 2 dwts: Gold, 5gr. per ton.
327'-329', Lead, trace: Zinc, 5·51%.
Silver, 2 dwts, 9 gr: Gold, 5gr. per ton
329'-332', Lead, 6·54%: Zinc, 3·11%:
Silver, 7 dwts. 13 grs:
Gold, Nil.

Figures in brackets indicate the length of core recovered from the corresponding section of boring.

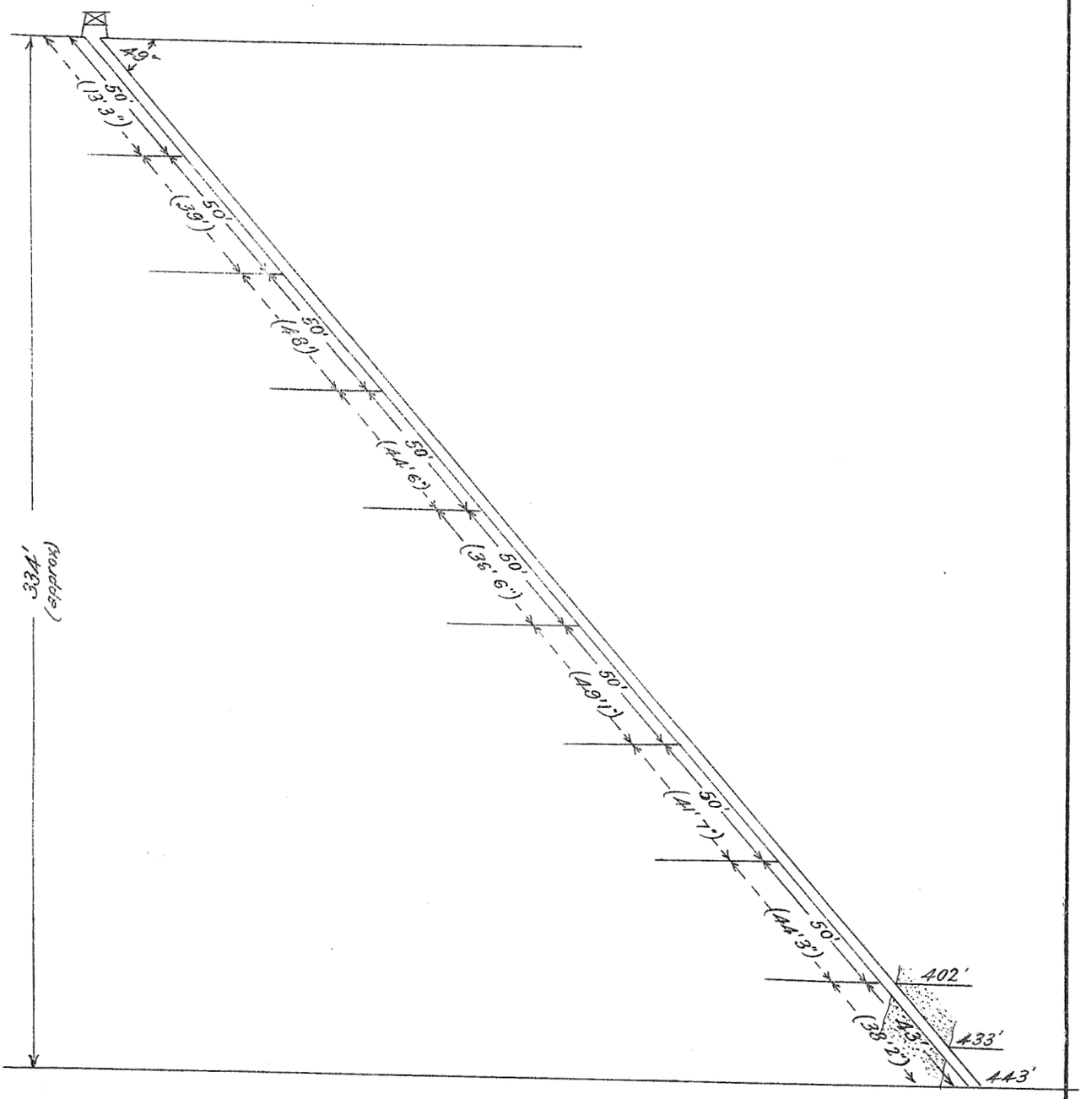
Section N° 3 Bore

RAGGED HILL G.M.L.

Braeside

50 0 50 100

— Scale of Feet —



Figures in brackets indicate the length of core recovered from the corresponding section of boring.

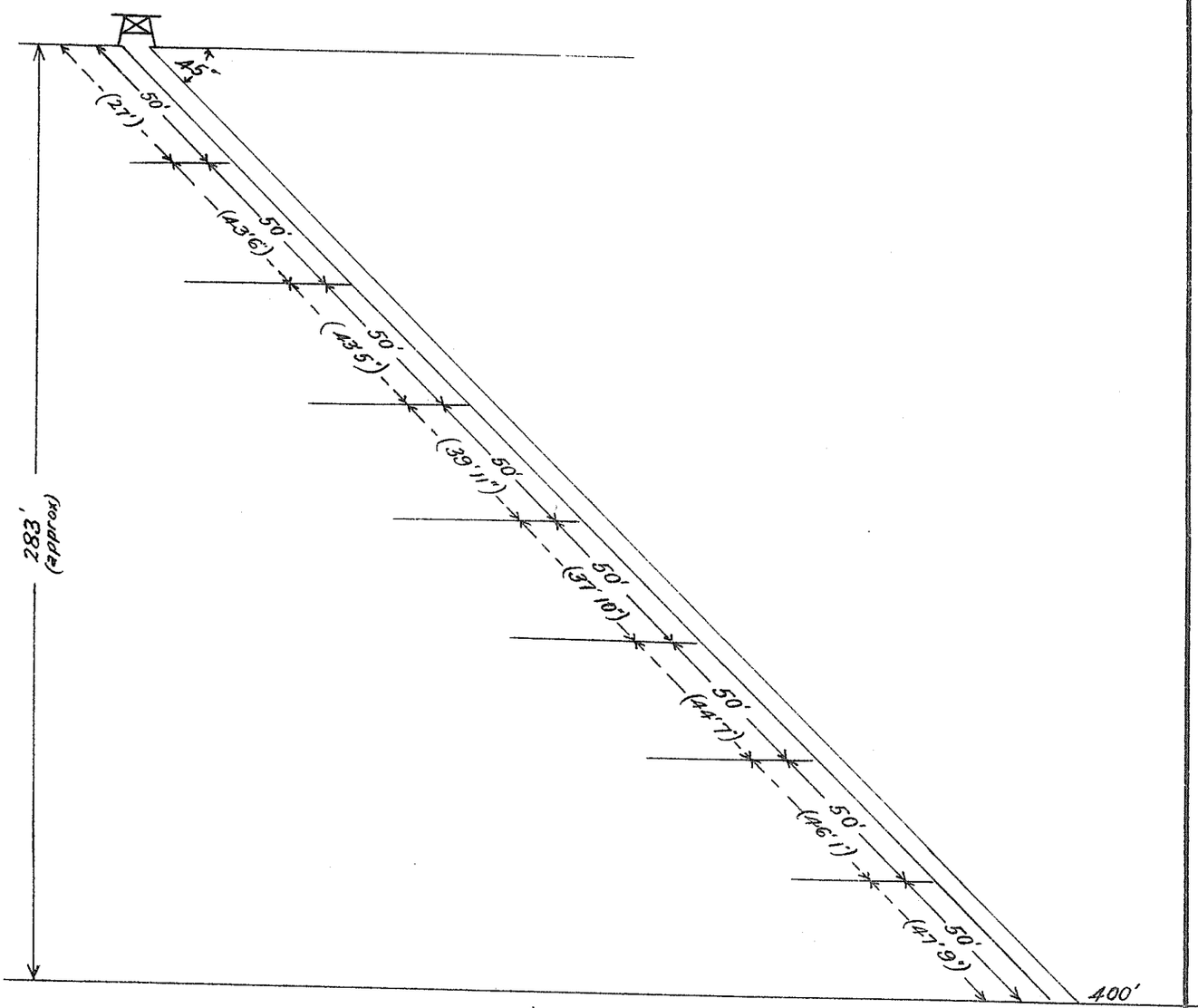
Section Nº 4 Bore

RAGGED HILL G.M.L.

Braeside

50 0 50 100

— Scale of Feet —



Figures in brackets indicate the length of core recovered from the corresponding section of boring.

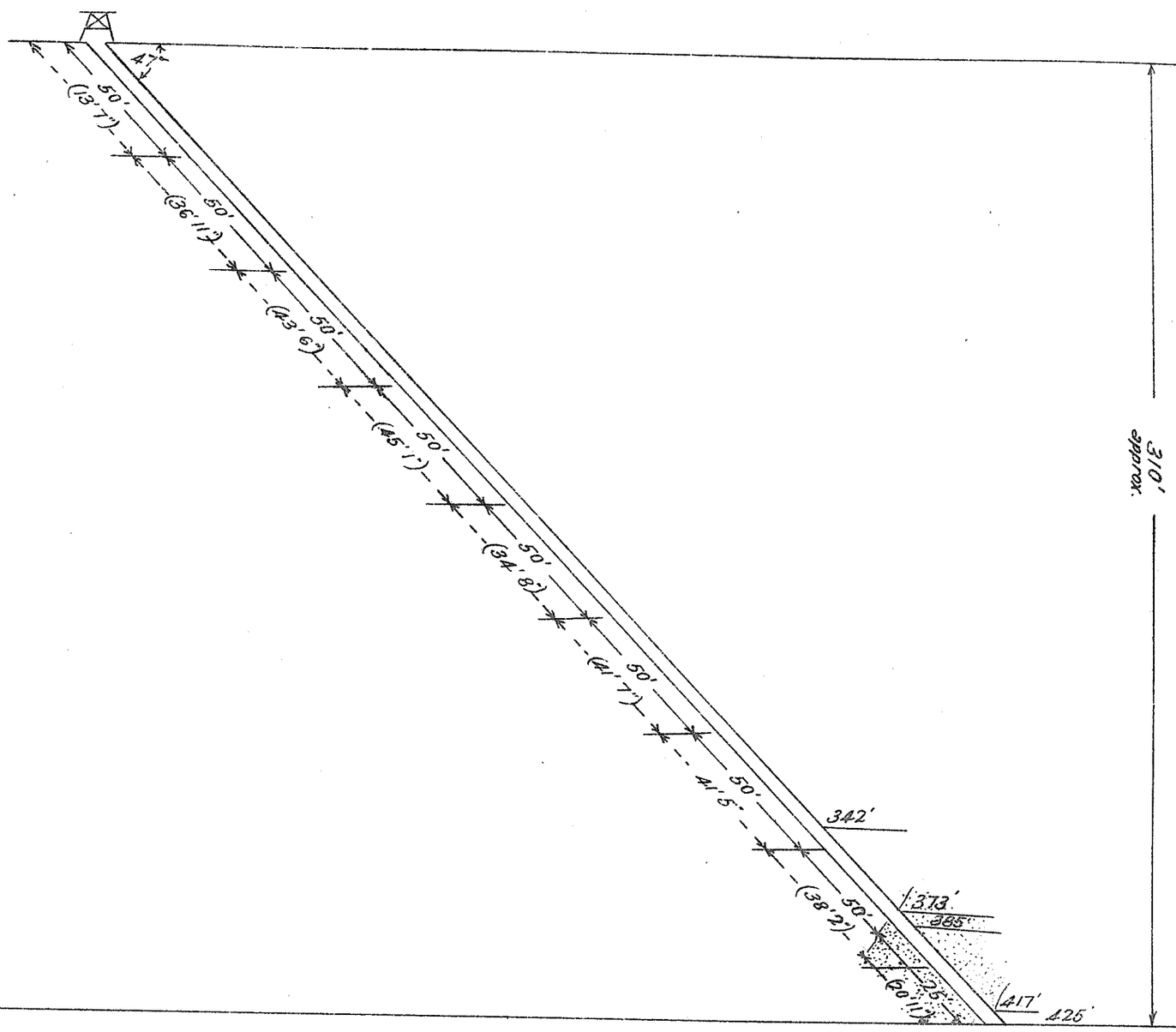
Section No 5 Bore

M. L. 325 (S. J. KENNEDY JR.)

Braeside

50 0 50 100

— Scale of Feet —



Figures in brackets indicate the length of core recovered from the corresponding section of boring.

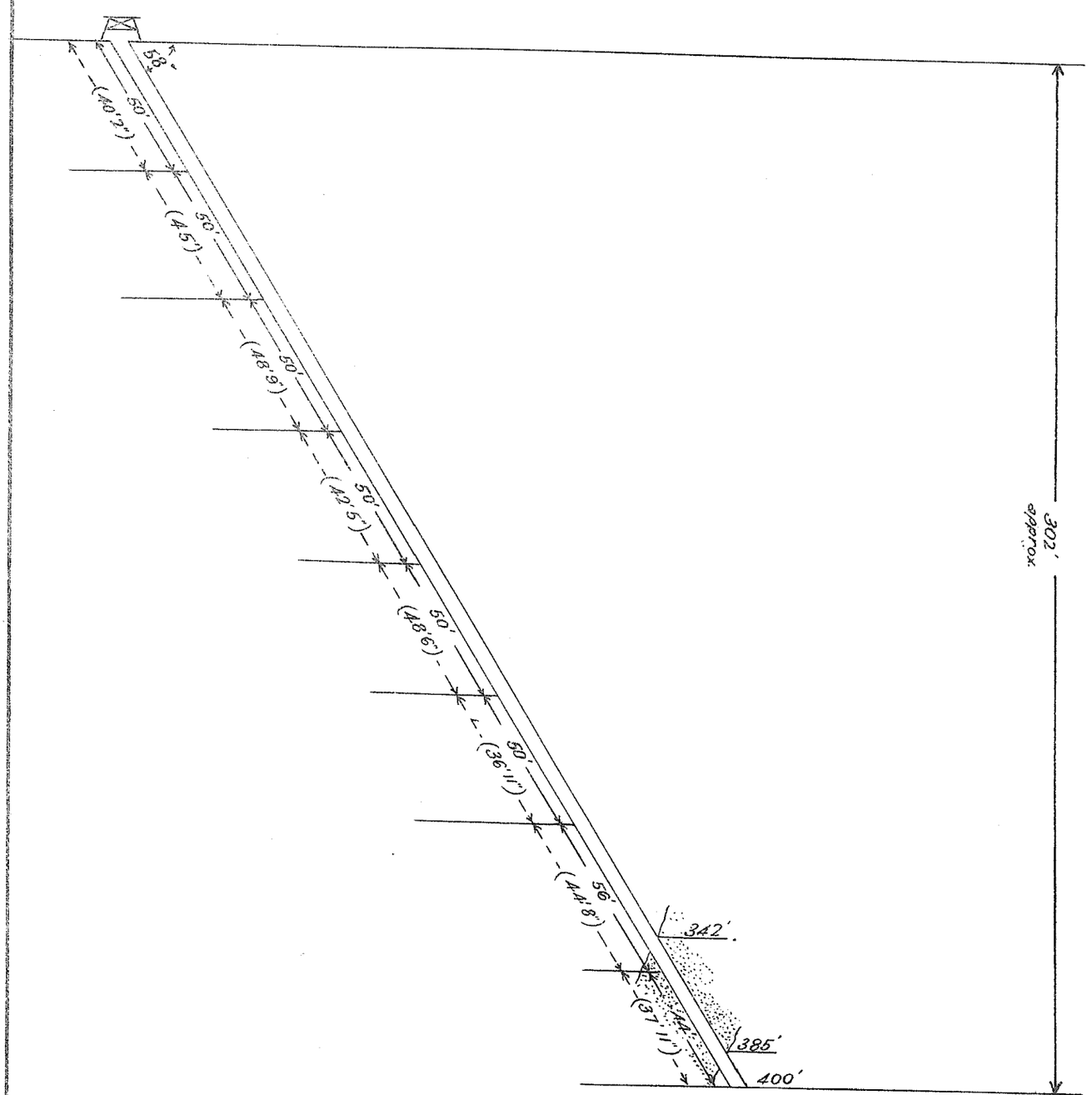
Section Nº 9 Bore (Nº 1 on this lease).

M.L. 291

Braeside

50 0 50 100

— Scale of Feet —



Figures in brackets indicate the length of core recovered from the corresponding section of boring.