THE UNIVERSITY OF ADELAIDE
DEPARTMENT OF ECONOMIC GEOLOGY

Geology
of the
RAPID BAY AREA
South Australia.

by
B.J. Skinner.
1950

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CONTENTS

Page

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LOCATION AND PHYSIOGRAPHY

Rapid Bay, on Fleurieu Peninsular, is 65 miles south of Adelaide in the southern Mt. Lofty Ranges.

The district investigated is approximately 20 square miles in area. It is roughly bounded to the north by St. Vincent Gulf to the east by Second Valley, to the west by Yohoe Creek and to the south by the Second Valley-Delamere road.

The region has a semi-mature topography with the main streams, Parananacooka, Yattagolinga, No Where Else and Yohoe Creeks running N.N.W. from the highlands towards the sea.

The highest point in the area is Mt. Rapid, 910 ft., which rises up steeply 1½ miles south of the cliffs on Rapid Head, making a prominent landmark.

The coast line is precipitous, (Fig. 1A), with cliffs up to 400 ft. high, broken only by the small beaches at Second Valley, Rapid Bay and the mouth of Yohoe Creek.

The area lies in the 20-25 inch rainfall belt, and except for a few small patches on the southern slopes of Mt. Rapid and some of the hills south of Delamere, has been cleared for dairy and grazing uses. The remaining patches of native vegetation indicate sheok and small eucalypts habited the higher areas with tall white gums along the creeks. The trees on the exposed highlands are all bent towards the south-east, indicating the predominant wind is a northwesterly, off the sea.

Peculiar topographic markings are caused by small landslides which occur very commonly throughout the area. They are due to the removal of natural vegetation which binds the soil on the steep slopes. Once this stabilising influence has been removed, the soil, past its angle of repose, slips down the hill in small "glaciers". (Fig. 1B)

MAPPING METHOD

The area is photographed on 9" x 9" vertical airphotos, flown in May 1949, by the Adastra Co., on a scale of 1" = 1360'.

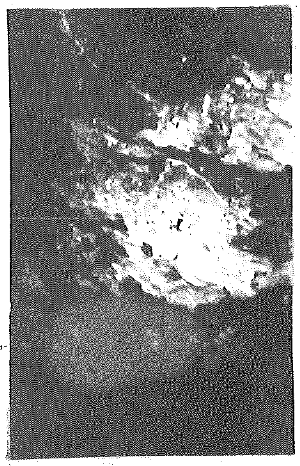
With these photos a slotted template map was prepared using Mt. Rapid, Cape Jervis Lighthouse, Bullaperinga Hill and Yankalilla Hill as the controlling trig points.

Field mapping was done directly on to the air photos or onto ethulon sheets covering the photos. All data were transferred from the photos to the fact map by tracing or resection.

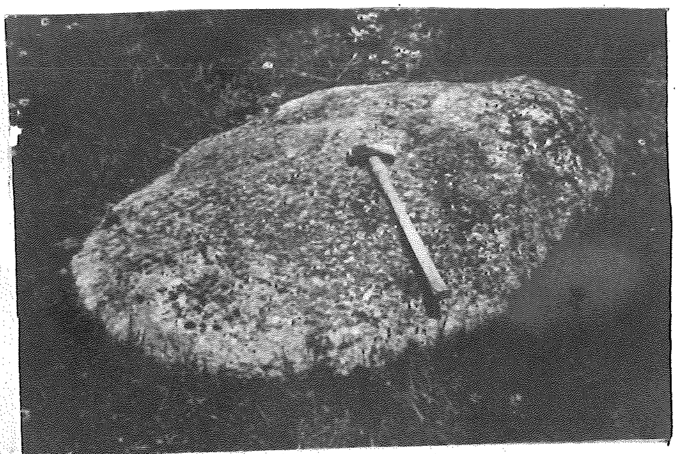
FIG.1

A. Coastline between Second Valley & Rapid Bay. Looking west.

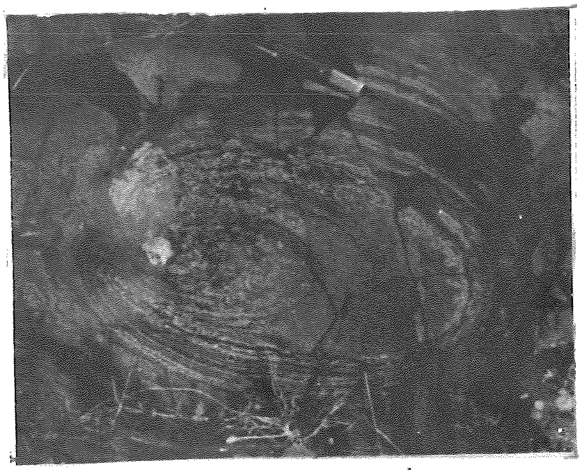
B. Landslide "glaciers"



C. Calcite incrustation in cave. Rapid Bay.



D. Granite Glacial erratic.



E. Concentric markings in joint plane of the subgreywackes.

STRATIGRAPHY

The sequence of sedimentation in the Rapid Bay area is typical of the closing or molasse stage of geosynclinal deposition.

The beds are characterised by extreme lensing and frequent facies changes, and in all cases show a predominant lack of felspars. This is probably due to slow erosion of the denuded land surface allowing the felspars to weather away leaving a concentration of quartz and clay-like minerals.

Due to the lensing of the sediments, it is impossible to ennunciate a satisfactory stratigraphic sequence. In view of this, the sediments are discussed as groups rather than particular bands, even though physically distinguishable bands exist within the groups.

I Slates

The oldest beds in the area are grey and black slates. The black slates lie below the grey slates, and though generally distinct in appearance, no serious attempt was made to fix the contact between them.

A. Black Slates

Outcropping continuously along the coast except near Yohoe Creek where they run out to sea, and in the vicinity of Second Valley, the black slates form the lowest stratigraphic horizon in the district.

The slates are fissile, very fine and even grained, black in colour and strongly cleaved in a direction parallel to the bedding. The ready cleavage of the slates causes them to break and fret easily, making treacherous surfaces on steep slopes.

Numerous caves have been developed in the black slates by wave action, all following small faults from 3 to 6 inches wide. The caves are frequently covered with a thin layer of white calcium carbonate (Fig. 10) probably deposited by carbonate waters moving down the faults. Local developments of pyrite and a glassy slickenside are present on some of the fault walls.

B. Grey Slates.

Immediately above and grading into the black slates, is a band of grey slates. These are light grey in colour, soft and micaceous, in places approaching a phyllite. The grey slates gradually become calcareous as they pass into the marbles above.

The slates have a well developed cleavage parallel to that of the black slates, and generally parallel to bedding. In many places, local contortions confined to the slates, were produced before the development of the cleavage, since the bedding cuts across the cleavage in these cases.

A well developed jointing striking about 240° and dipping steeply south, and another perpendicular to this, but vertical, tends to break many of the outcrops into a cube shape and produces flat surfaces in both the black and grey slates.

Interbedded with the marble lenses are numerous thin slates bands, very similar to the grey slates. These bands vary from 1/10 of an inch to many feet thick, but on the scale of the mapping could not be satisfactorily distinguished.

The contact between the slates and the subgreywackes to the east of the Rapid Bay marble lens is indistinct, due to a gradual change in composition.

II Marble.

At least six and possibly seven distinct lenses of marble were mapped. All contain small local bands of slates and quartzites which could not be correlated between exposures and are presumably lenses.

The marbles are dense, white and grey, banded rocks (Fig. 3A) with calcite crystals up to ¼th of an inch in diameter. Except where faulting has introduced iron, silica and magnesium, or where a thin slate band is intercalated, the marbles are very pure - 98.5% $CaCO_3$ in places.

Specific marble lenses have been called Formation I, Formation II, Formation III etc., to overcome any confusion which may arise in comparisons with C.T. Madigan's work.[x]

[x] C.T. Madigan - "The Geology of the Fleurieu Peninsula, Part I - The coast from Sellick's Hill to Victor Harbour". Trans. Roy. Soc. S.A. Vol. 49. 1925.

Formation I.

The largest lens of marble is that worked by the B.H.P. at Rapid Bay. This has a maximum thickness of 2,000 feet and a maximum length of 13,000 feet. It runs from the River Yattagolinga west towards Yohoe Creek, outcropping on the coast below and to the east of the quarry.

Several quite wide slate and subgreywacke bands occur in the marble, but could not be correlated between exposures.

The marble is a definite lens. The boundary was mapped almost to the termination, before it was obscured by lack of outcrop. No marble or even calcareous slates outcrop in Yohoe Creek until right up near Yohoe Station. The western boundary is largely coverd by alluvium in the Yattagolinga valley and has been interpolated from the few outcrops available.

Several crush zones due to strike faults of small magnitude have introduced copper, silver and lead minerals into the marble. These are discussed more fully under "Economic Geology".

Formation II.

Exposed in the township of Second Valley is a very prominent marble band. To the east the band is lost beneath the cover of glacial debris but to the west it is possible to trace it for some distance. The western boundary is uncertain, but the band is apparently terminated by lensing since argillaceous rocks outcrop continuously across the area where one would expect the marble. The marble definitely does not outcrop along the River Yattagolinga, where almost continuous rock exposure occurs.

C.T. Madigan joined the marbles of Formations II and III as a continuous band, but this is a definite fallacy. No evidence of faulting occurs, and it is most feasible to explain the termination of the marble by lensing, since other horizons are known to be definite lenses.

The marble is exactly the same in appearance to Formation I. No crush zones were noted in it, and no metallic minerals have ever been discovered in it. Numerous small quarries have been opened in the lens for building stone, and in many cases provide the only available outcropping evidence of the marble.

Formation III.

Running through the town of Delamere is a well developed marble horizon, again exactly similar to the marble of Formation I. The upper boundary of this marble is not known, but c n be placed within reasonably accurate limits.

Below the main horizon, and separated from it by approximately 350 ft. of sub-greywackes in another thin marble horizon. Both of these marbles are included under Formation 3 since they are so close stratigraphically and neither appears to lens out within the area mapped, but continue as persistent bands.

The marble of Formation 3 is probably the persistent band, mapped by Madigan, which continues as far as the south coast of Fleurieu Peninsula, and named by him the Delamere Marble.

Formation IV.

A few hundred yards south of Yohoe Station, a narrow marble horizon crosses Yohoe Creek. East of the creek exposures are lacking, until the horizon outcrops again on the eastern side of the large spur running south from Mt. Rapid. The horizon can be traced as far as the Rapid Bay road, but does not outcrop again. No marble appears along the River Yattagolinga corresponding to Formation 4, and it is probable that it lenses out rather abruptly as shown on the map.

The marble is similar in all respects to the other lenses, being a typical grey and white, coarsely crystalline rock. Quite prominent slatey beds occur above and below the marble proper, but the amount of calcite in these beds makes them impure marbles, and they have been mapped as such.

Formation V.

A large and persistent marble horizon occurs 600 ft. above Formation I, the same in all respects as Formation I, but with fewer slate intercalations.

The lens can be traced from Mt. Rapid to the Rapid Bay road with almost continuous exposure, then a break occurs due to the alluvium cover in the River Yattagolinga. Outcrops can then be followed eastwards almost to Second Valley before they are lost again beneath the cover of alluvium. The horizon gradually thins out towards the east.

Formation VI.

The most puzzling marble is that outcropping along the cliffs between Rapid Bay and Second Valley. The marble can be traced right into Rapid Bay itself and shows prominently on the cliffs on the eastern side of the bay.

The horizon is not similar to the other Formations in that it does not consist of a large body of marble, but of relatively narrow beds of grey slates, calcareous slates and marble. The lens is shown with a possible boundary on the map, since the limits are unknown.

On first appearance this Formation would appear to be a continuation of Formation I, but mapping did not indicate this, nor was any evidence found to suggest it could be the faulted continuation of Formation I. The formation is probably another lens, but with more argillaceous intercalcations than the other marbles. Marbles and calcareous slates outcropping near the Golden Ridge Mine, east of the Second Valley Jetty, possibly belong to this formation.

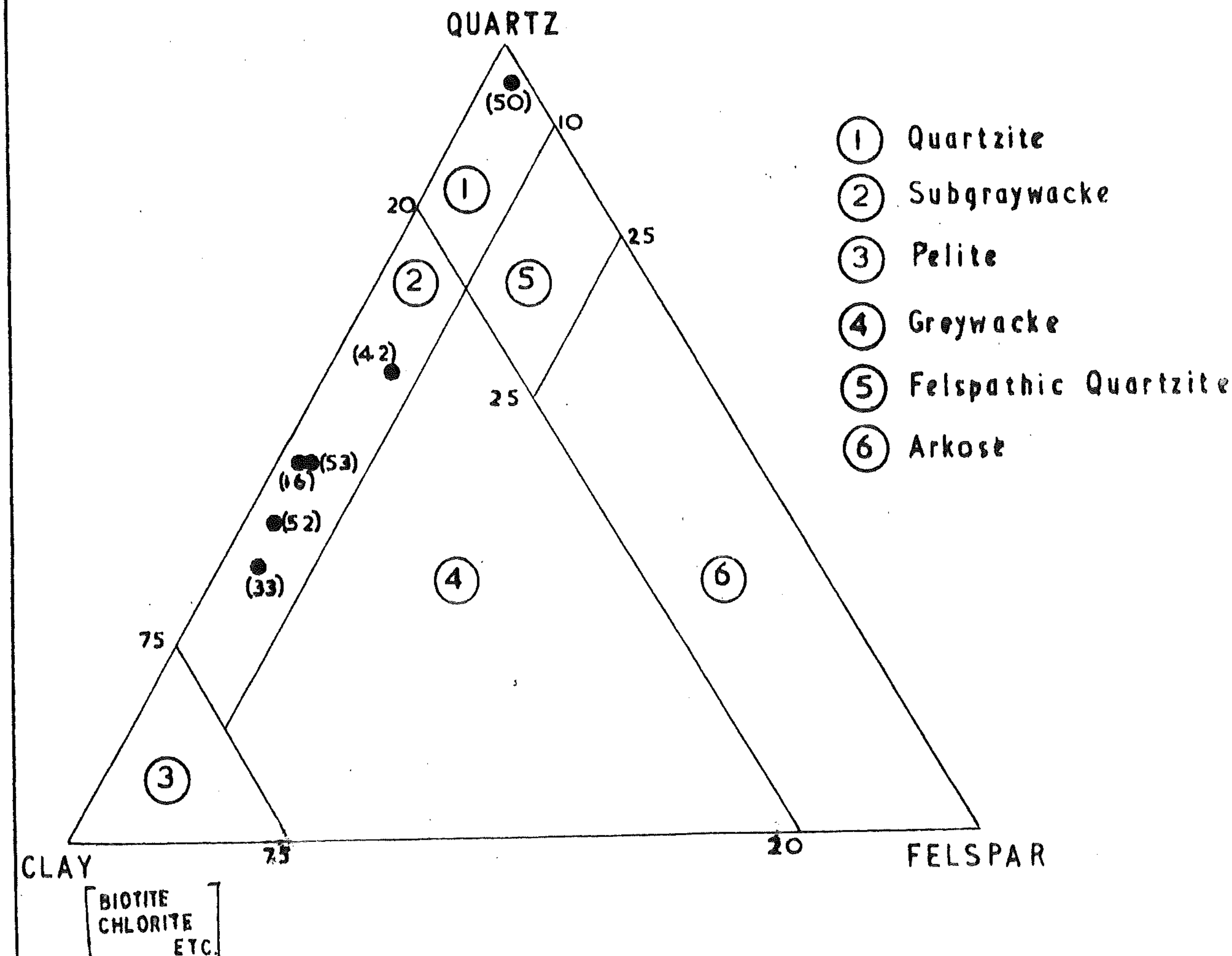
Conclusions.

The lens like nature of the marbles is a puzzling feature and deserves more accurate mapping on a larger scale. This would indicate more fully the exact nature of the facies changes near the terminations of the lenses, and possibly the true relation of Formation VI, which at present is not known.

The lenses are suggestive of coral reef formations, the reefs being restricted locally to favourable basins.

FIG. 2

Composition of Sediments RAPID BAY.



(Numbers in brackets refer to specimen numbers)

(adapted from F.J. Pettijohn)

Subgreywackes

The normal sediment of the area is a dense fine-grained, grey coloured rock, composed mainly of quartz grains in a ground mass of biotite, sericite, very subordinate chlorite and minute fragments of indeterminate minerals. In no instance was more than 8% of felspar recorded.

Many of the bands appear macroscopically to be fine grained slates, but microscopic examination reveals them to have the same composition as the other sediments, but a very much finer grain size. The variability in appearance is often confusing, since the rocks may appear to be slates, in some cases even coarse grained phyllites and quartzites, but on microscopic examination they all have nearly the same composition.

Using the classification of F.J. Pettijohn[x], the sediments, when plotted on a triangular composition diagram, are seen to be subgreywackes (Fig 2). The maximum grain size observed was ·34 mm.

The very fine sediments are too fine grained to be classified as true subgreywackes, and are best described as silty-subgreywack[es].

The thickness of the subgreywackes is unknown, but the base is probably the contact with the grey slates and with Formation I. Above Formation III a very uniform series of subgreywackes occurs, the upper limit of which is unknown.

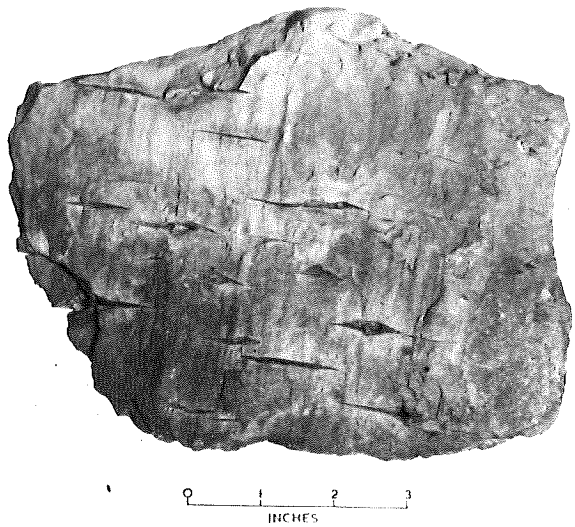
The subgreywackes are generally dark grey in colour, but may weather to a red colour on the surface. They are relatively hard rocks with well defined bedding planes. Some local bands, more quartzitic than others, show small scale cross bedding which indicates the beds are correctly orientated.

There is no pronounced cleavage, but a weakness plane parallel to the bedding often occurs. A predominant jointing striking at 240° and dipping steeply at 60 to 70° NNW produce flat surfaces and many outcrops.

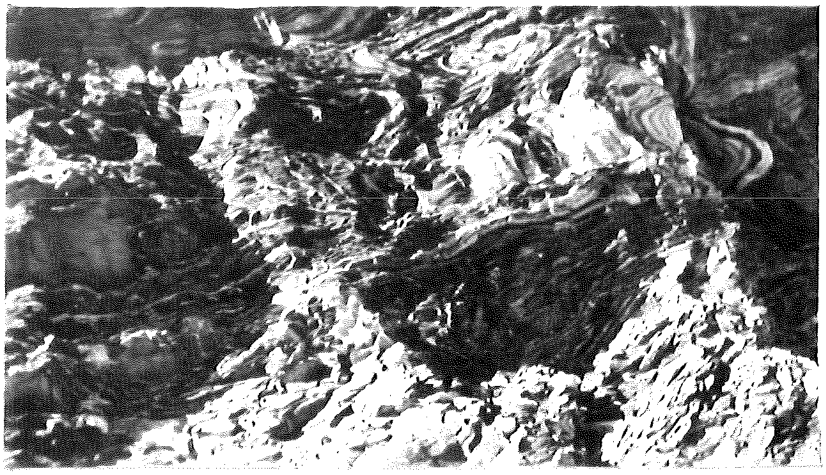
Developed in the plane of jointing is a system of peculiar concentric markings (Fig. 1E), which appear as "scars" or open c[racks] when viewed in a direction perpendicular to the plane of jointing (Fig. 3B). The markings vary from one or two inches to eighteen inches in diameter and are a series of concentric rings covered with small mica flakes, around a central nucleus of quartz and mica. The cause of the marking is unknown, but

FIG. 3.

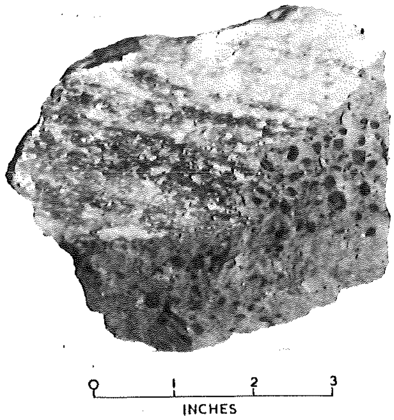
A. Banded Marble.
Rapid Bay Quarry.



B. Markings in Subgreywacke.
Perpendicular to plane of jointing.



C. Contortions due to faulting.
Headland at Second Valley.
Scale 1in. = 3ft.



D. Marble cemented by limonite.
Crush zone, Rapid Bay.

it is suggested they may be due to crystallisation in the joint planes. The force of crystallisation, as it proceeded away from the central nucleus, would be sufficient to cause openings in the rock.

The markings are developed with equal facility in all bands of the subgreywackes and show no preference for any particular one. Both fine and coarse grained bands are similarly affected.

Subgreywackes are typical sediments of the molasse stage of geosynclinal deposition[x], and according to Pettijohn have two marked characteristics.

(1) A scarcity of felspars; between 1 and 15%. Normal greywackes have 15 to 50% felspar.

(2) Association with limestone and lenses of orthoquartzites.

They are poorly sorted sediments since they are composed of relatively coarse quartz grains and a fine "clay" like groundmass. The depositional environment is one of relatively shallow water and fairly rapid currents which would not allow a sorting of the sediments.

<u>Ortho quartzites.</u>

Throughout the subgreywackes are thin lenses of very pure quartzites. They are dense and hard, white in colour with a blocky character. The quartzites are composed of 95% or more quartz with very subordinate felspar. When plotted on the triangular composition diagram they occur very high up in the quartzite range (Fig. 2).

Examined microscopically, the original rounded grains of quartz are seen to be surrounded by a rim of secondary quartz with the same optic orientation, acting as a cementing agent. They are typical orthoquartzites in that they are cemented entirely by secondary quartz, no metamorphic process being required.

x F.J. Pettijohn "Sedimentary Rocks". 1949.

The quartzites appear to be purely local, the longest one being traced for three quarters of a mile. The maximum width is 20 ft., but one zone of several small bands gives the appearance of being a much wider single band.

Immediately below the thin marble band of Formation III is a very resistant horizon of subgreywackes with numerous quartzite lenses. The subgreywackes of this zone are more quartzitic than general and hence more resistant to erosion. This quartzite zone (see map) forms a prominent ridge with well defined knick points in Yattagolinga and No Where Else Creeks.

The quartzites are probably due to a local "cleaning" of the subgreywackes, whereby the clay minerals are washed away leaving a very pure quartz sand. P.D. Krynine[x] in discussing the origin of orthoquartzites of this type states "they exist as clean sands in the midst of an otherwise porrly sorted suite of sands and muds". The sands were probably formed as offshore bars where the currents were strong enough to "clean" the subgreywackes.

Conclusions

The sequence found at Rapid Bay is a series of subgreywackes, marble lenses and orthoquartzites, the typical sediments of the closing stages of geosynclinal deposition.

The full picture in such a case as this can only be revealed with very exact and close attention to detail. Due to limited time it was found too impossible to pay as much attention to detail as is necessary and errors and inconsistencies must be present in the work.

The exact stratigraphic location of the beds is unknown, since no fossil evidence remains. It is considered the beds are most likely to be Lower Cambrian in age since.

(1) Cambrian archaeocyathinae limestones occur a short distance north of Rapid Bay, at Carrickalinga Head,

x Geol. Soc. Am. Bull. Vol. 52, 1941 pp 1915-1916 and again on Kangaroo Island to the south. Projecting along the strike, the Carrickalinga beds could be expected to outcrop along the coast to the south, since no apparent structural swing occurs. If this is so, the marble beds would represent altered Cambrian limestones.

(2) The lens like nature of the limestones is readily explained as coral reefs. The habitat of the archaeocyathinae was probably in colonies of the coral reef type and could easily be responsible for the lenses examined.

(3) It is considered the Adelaide System sedimentation ceased with the destruction of the geosynclinal basin in lower Middle-Cambrian. The Rapid Bay sediments are typical of the molasse stage of sedimentation and could thus belong to the last phases of deposition ofthe Adelaide System. This would place the age of the beds as very late Proterozoic or Lower Cambrian.

Glacial Deposits.

Relatively small pockets of a once extensive covering of glacial sands and clays occur throughout the area. Most of the country is still covered with a thin layer of clayey soil which is probably reworked glacial debris in part.

Poole's Flat to the east of Second Valley and Bullaparinga Hills south of the area examined, have extensive and deep coverings of glacial clay.

The most characteristic topographic feature of the glacial material, is the fern-like stream pattern. Being soft and unconsolidated, the clays offer little resistance to erosion, and the creeks are deeply cut and very irregular in direction. This feature shows very distinctly on the airphotos, and in every case was found to be associated with glacial clays.

1. Erratic Bouldrs.

Numerous isolated granite erratics, up to 4 ft. across (Fig. 1D) occur both in the clays and as isolated boulders after the clays have been washed away.

Quartzite erratics are numerous in places, but are never as large as the granite boulders, and do not appear to be a s widely distributed.

From the distribution of t e erractics, it is evident the former cover of glacial debris was much more extensive than is now apparent.

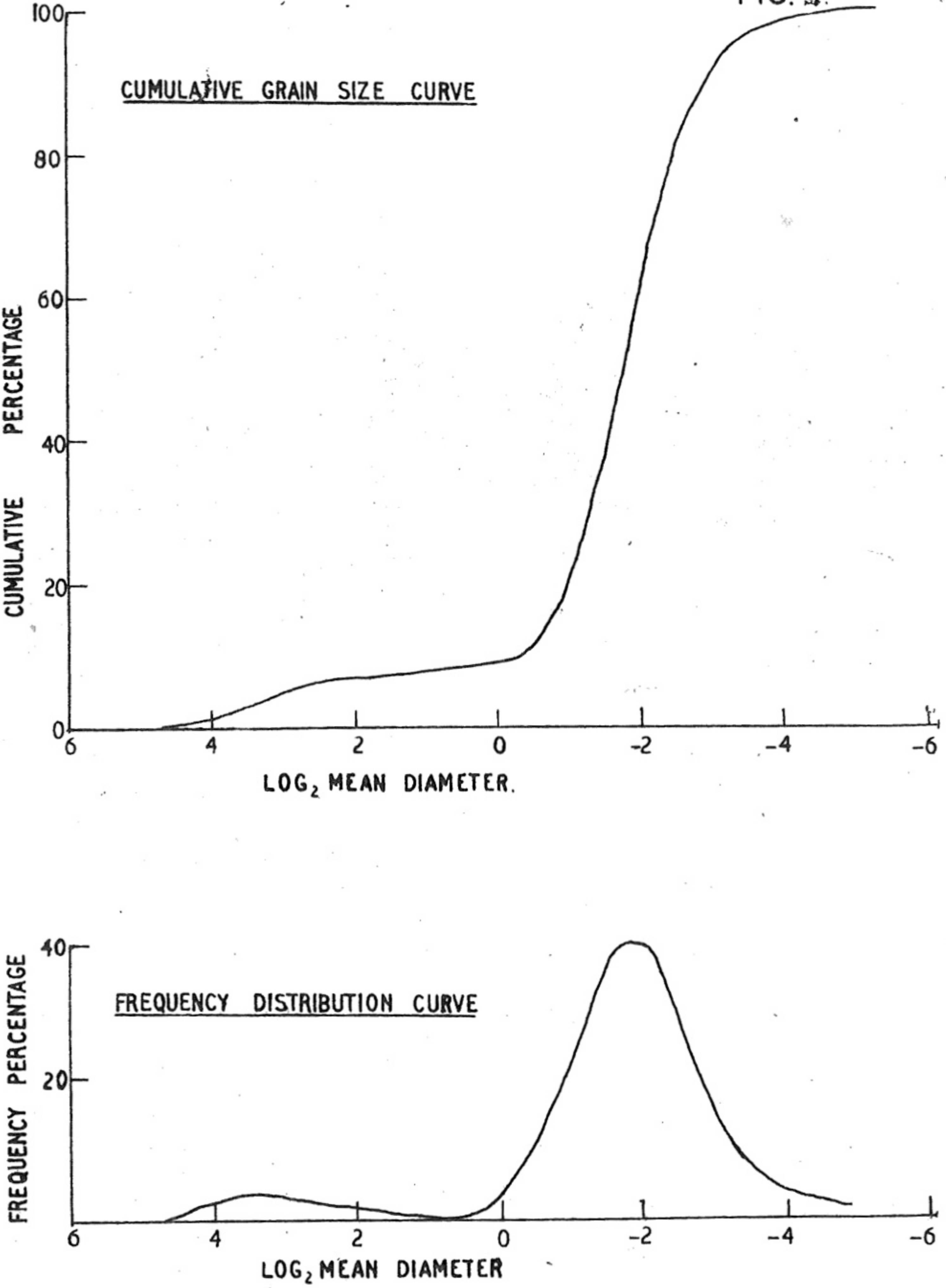
Above the area now occupied by the Rapid Bay marble quarries, a cover at least 20 ft. thick in places, of clay and boulders formerly existed. Drilling done in 1912 (Fig. 6) records 21 ft. 9 inches of "clay, drift and boulders" in one place. This material was probably glacial in origin, but unfortunately has now been cleared away and cannot be checked, nor can the exact location of the boreholeds be stated.

2. Clays

Pockets of clay, completely unconsolidated, remain in some of the valleys and on some of the flat topped hills.

The clays are brown and grey in colour, soft, with local concentrations of sand and gravel. Erratics are generally small,

FIG. 4

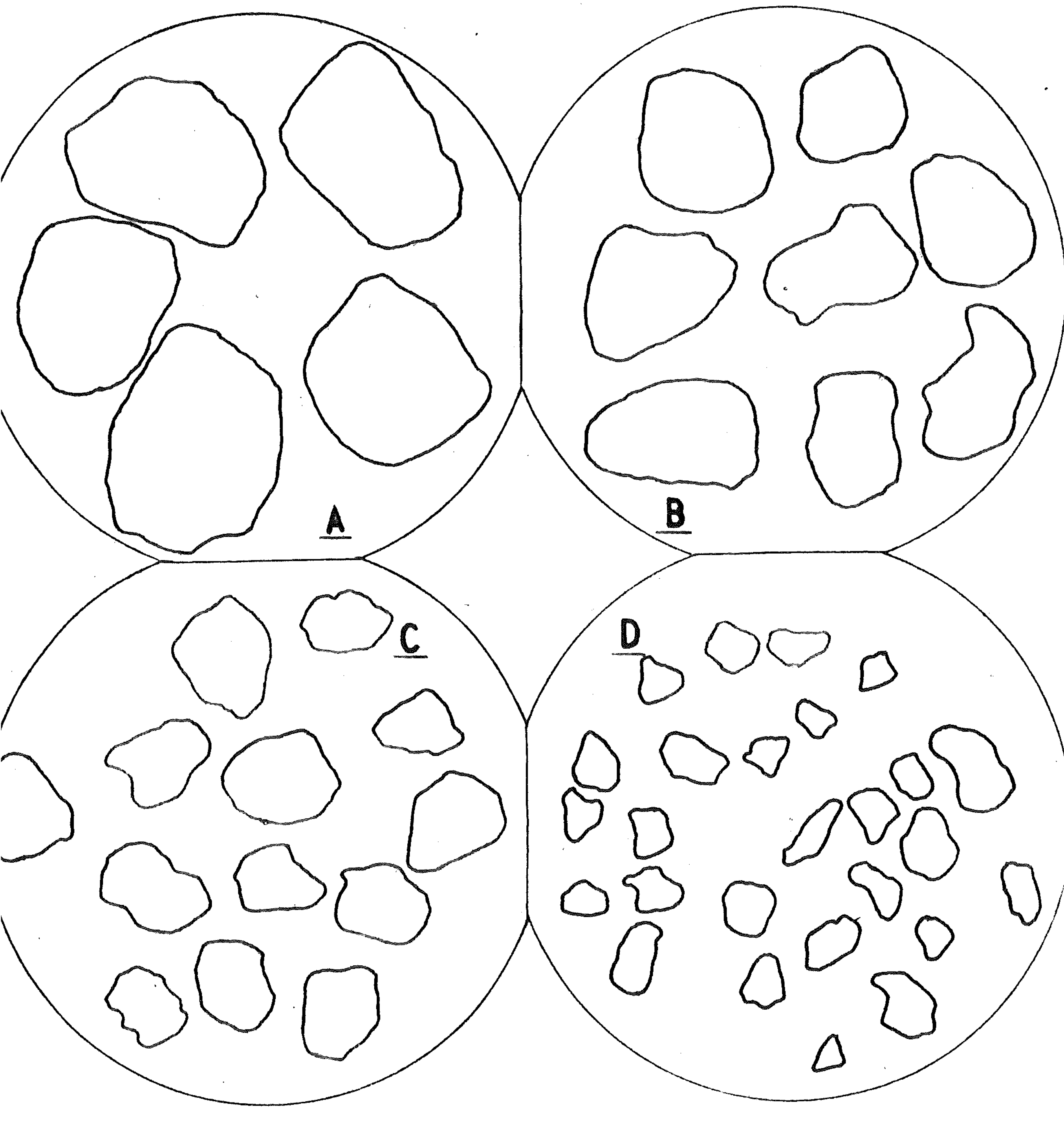


CUMULATIVE GRAIN SIZE CURVE
CUMULATIVE PERCENTAGE
100
80
60
40
20
0
6
4
2
0
-2
-4
-6
LOG₂ MEAN DIAMETER.
FREQUENCY DISTRIBUTION CURVE
FREQUENCY PERCENTAGE
40
20
6
4
2
0
-2
-4
-6
LOG₂ MEAN DIAMETER

Comparative Grain Shapes FIG.5

Glacial Sand

RAPID BAY



A. MEAN DIAMETER > ·417 m.m.
B. " " > ·208 m.m.
C. " " > ·147 m.m.
D. " " > .079 m.m.

about ½ to 2 inches in diameter, with isolated boulders up to 4 ft. across.

It is not possible to state to what extent the clays have been reworked, but it is certain that some amount of resorting has proceeded. The clays on the higher slopes have been washed down into the valleys in many cases, forming unusually thick deposits.

3. Sands

A large area of glacial sand occurs on the southern ridges of Mt. Rapid and shows up very distinctly on the air photos. The sand grades into clay towards No Where Else Creek, but is a typically clean quartz sand on the ridges.

The sand was probably deposited as such and is not due to a washing out of the clay subsequent to deposition, leaving a concentration of sand. A loosely cemented sandstone with glacial pebbles and boulders in its outcrops in numerous places, but is largely broken down on the surface to loose sand. The sand appears to have been deposited as an unconsolidated sand, subsequently cemented to a sandstone, then broken down again by weathering agents to loose sand, probably in a very similar form to that in which it was deposited.

An analysis of the sand indicated it is fairly well sorted, which is what one would expect from a fluvio-glacial deposit. The frequency distribution curve (Fig. 4) indicates a maximum concentration between the limits of 0.4 and 0.19 mm, with another maxima between 5 and 10 mm.

The sand is composed almost entirely of quartz. Below 0.6mm a few grains of felspar, garnet and ilmenite occur, but total only 1% of the sand. Above 0.6 mm rock chips appear. These are predominatly quartzite with a few pieces of shale and granite.

The grains are subrounded and rounded (Fig. 5), using Pettijohns[x] comparative photographs. Quartz grains only become rounded or even subrounded after a great deal of movement or by a reworking of a sediment. It seems feasible to explain the roundness of the quartz, which would normally be angular in a glacial sand, as due to the source rock being a sediments with well rounded sand grains. This is supported by the fact that 95% of

x F.J. Pettijohn "Sedimentary Rocks". 1949.

boulders in the sand are quartzite.

(4) <u>Age of the Deposits.</u>

There is no fossil indication of the age of the glacial beds. They are identical in appearance with certain of the Inman and Yankalilla Valley glacial beds, and it is assumed they are extensions of the Inman Valley deposits and therefore Permian in age.

ECONOMIC GEOLOGY

1. Marble.

The only material at present worked in the area is marble. The B.H.P. maintain a large quarry in the marble of Formation I, on the western side of Rapid Bay.

The marble has a high grade, and makes an excellent flux for the steel furnaces at Newcastle, over 500,000 tons being shipped each year.

The quarry is efficiently run, the material being mechanically handled throughout. Easily manoeverable waggon drills are used for drilling both bench and toe holes. Fragmentation is not very good and a large amount of secondary breaking is necessary.

Electric locos, loaded by an electrically operated mechanical shovel, haul the broken stone to the crushers.

Crushing is done in two stages of jaw crushers.

(1) 6 inch primary jaw crusher.

(2) 2 inch secondary jaw crusher.

The material is screened to remove dirt and gravel less than ½ inch in diameter, and stored in a bin above a conveyor belt leading out to the loading gantry on the jetty.

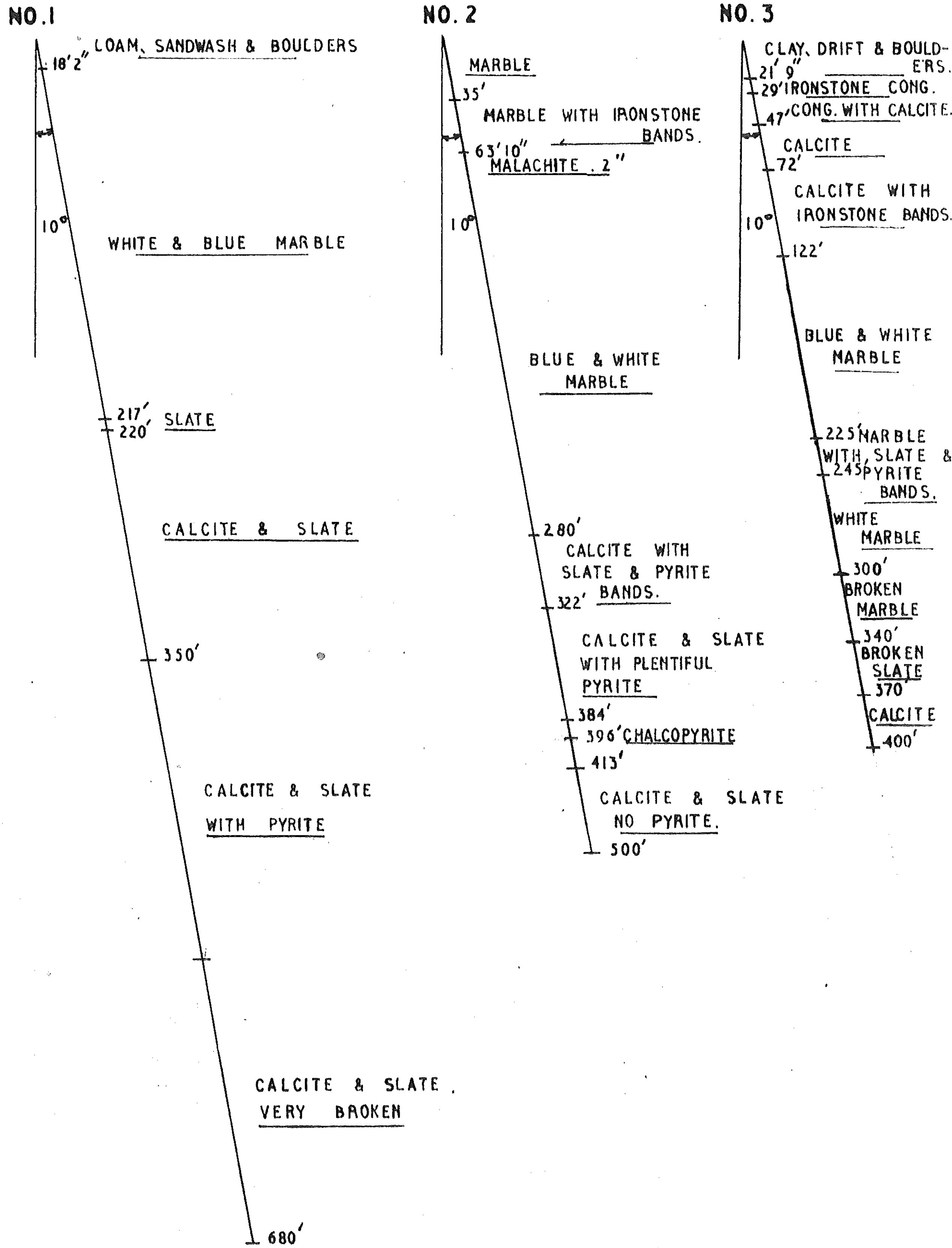
The reserves of marble are enormous, but crush zones associated with the lead and copper mineralisation cause some difficulty for all material from the crush zones has to be discarded due to impurities.

The major problem facing the operators will be the haulage distance as the face recedes from the crusher. If another bench is cut, the crusher must be lowered, or the material raised to the present crusher level.

The position of the crushers with respect to the quarry is not a good one. Had the original survey been more detailed, it would have been realised the most strategic position for the location of the crushers, storage bin and jetty is the gully at the western end of the present quarry.

FIG. 6

BORE HOLES—RAPID BAY COPPER MINE.



2. Copper

The Yattagolinga Copper Mine, later called the Rapid Bay Copper Mine, was originally opened in 1844, and intermittent work seems to have continued until 1912, when the Mines Dept. undertook boring operations in the area. No further record of work exists after 1912 and it is likely activity ceased after the poor results of the drilling.

The main workings are situated on a hill immediately behind the jetty and east of the quarry. One shaft, at least 160ft. deep is still open, with numerous small pits and underlay shafts, on small bedded lodes, covering the hillside. The only record of copper ore being raised, is 8 tons assaying 12.6% Cu,[x] but it is evident from the amount of work done much more ore was won.

Workings once existed at the base of the cliffs just above the weigh-bridge on the present jetty. Local inhabitants say that another adit was driven into the cliffs at sea level in the area now covered by the mullock from the quarry. The workings are completely inaccessible and the only information regarding them was obtained from the Mines Dept. bore holes (Fig. 6) which were put down from the cliff top in 1912.

Two mineralised zones are recognised.

(1) The main workings are situated in a crush zone running behind the present quarry area. The crush zone is probably due to strike faulting, but the lateral extent is not known. The Limestone is extensively broken, and recemented with a matrix of limonite and silica (Fig.5A)

The copper mineralisation is parallel to the bedding and occurs as thin veins of malachite, azurite and chalcopyrite from ⅛th to 1 inch wide. Mining Review 11, 1910[x] states, "several mineralised beds resembling lode formations traverse the leases, conformable to the strike and dip of the stratified rocks". "Ferruginous calcite?, 2 to 8 ft. wide was disclosed with specks of malachite and chalcopyrite, the bulk being low grade with isolated patches being high grade".

[x]Mining Review 11, 1910 p. 18.

(2) The workings at the base of the cliffs are below the main marble horizon and probably in the grey slates. The bo e holes (fig. 6) could not be accurately re-located, but are useful in indicating the mineralised zone. This apparently was below the main marble, in "slates and calcite", which corresponds to the calcareous zone of its grey slates. Examination of the cliff face reveals evidence of another zone of strike faulting, and it is probable that the mineralisation is associated with it.

(3) Silver-lead.

Numerous small workings exist throughout Formation I, all associated with small zones of crushing and contortion. In every case this crushing is parallel to the bedding. The crush zones appear to be very limited in extent, sometimes only a few feet long.
Inaccessible workings all showed the typical limonite cemented breccia on the dump, and it can be safely assumed it came from a crush zone.
Two main mines, Wheal Coglin and Olivaster, are mentioned in Mining Reviews, but among the numerous workings they could not be located. The Wheal Coglin is one of a group of mines in the gully on the western end of the marble quarry.
The amount of ore raised is unknown. One shipment of 270 tons averaging 50% lead and 25 oz/ton of silver is reported, but much more than this must have been won.

The main ore mineral in galena coarse and brittle, with small specks of native sulphur in it. On the surface the galena weathers to a dull grey or black uneven surface, and it is only on the broken face that it can be identified. Quite a deal of galena still shows in the working faces and on the dumps. Enough mineral is available for one or two men to make a living, merely by picking over the dumps and removing the galena in the walls of the accessible workings.

Several small adits and pits occur in the slates below the marble on Rapid Head.

These are all driven on lodes associated with strike faults of very small magnitude. The mineralization is weak and it does not appear to have been a successful working.

4. Alunite.

Two localities were noted in which shallow opening have disclosed alunite. The alunite occurs in the slates below the marble on the west side of Rapid Head, and again below Formation VI on the east side of Rapid Bay. In both places the slates are very weathered and the controlling structure of the alunite obscured.

It occurs as very pure noduler masses similar to those in the slates below the Archaeocyathinae limestones on Carrickalinga Head. The deposits are very small and inaccessible, and have no possibilities for further work.

STRUCTURE

The broad elements of the structure have already been explained under Stratigraphy in discussing the lenslike nature of the sediments.

The strata all have relatively shallow dips of 20 to 40° S.E. with a slight variability in strike due to gentle folding.

The distribution of the limestones suggests faulting, but no evidence was obtained of any major faults. The break between Formation 1 and VI is a puzzling feature as they appear to be a continuous band at first glance. Mapping did not reveal any connection however, and Formation VI is best explained as a separate lens.

Folding

A shallow anticline and a shallow syncline are indicated by slight changes in strike. The axis of the anticline roughly coincides with the River Yattagolinga and the axis of the syncline runs from the Rapid Bay turn off on the Delamere Road, towards Mt. Rapid. The folds pitch about 25 to 30°S.E.

The folds are no more than gentle markings and though they do not constitute major structural features are probably the cause of the crush zones in the marble.

Minor folding and puckering occurs in both the grey and black slates, but is purely local, and does not affect the picture in any way.

Cleavage.

Cleavage is generally parallel to the bedding and is well marked in the slates and some of the silty subgreywackes. The cleavage does not appear to be related to any structural feature in the area, and is probably controlled by some larger, regional structure.

On the headland at Second Valley, faulting has produced a local cleavage which is not parallel to the bedding. The cleavage strike approximately 240° and dips steeply south at 40 to 70°. The bedding direction is highly variable due to contortions, but the cleavage is constant.

Jointing

Jointing was only observed in the subgreywackes and slates. In all cases it was found to be perpendicular to the bedding but parallel to the strike of the strata i.e. a strike of approximately 240°, with a steep northerly dip.

The peculiar markings produced in the joint planes have been referred to before (see subgreywakces).

The cause of the jointing is not known.

Faulting.

Faulting on a minor scale is common in the marbles and the slates. In no instance does it have any bearing on the major structure, but it does appear to be associated with the mineralisation of the marbles.

Small vertical faults are common in the slates and in all cases provided the weakness lines followed by the caves developed in the black slates.

Near the mouth of the Yohoe Creek, several small faults from 1 to 2 ft. wide strike parallel to the coast and dip steeply to the S.E. The faults are filled with "eyes" of quartz and soft micaceous material and though the zone is often quite wide the displacement is small.

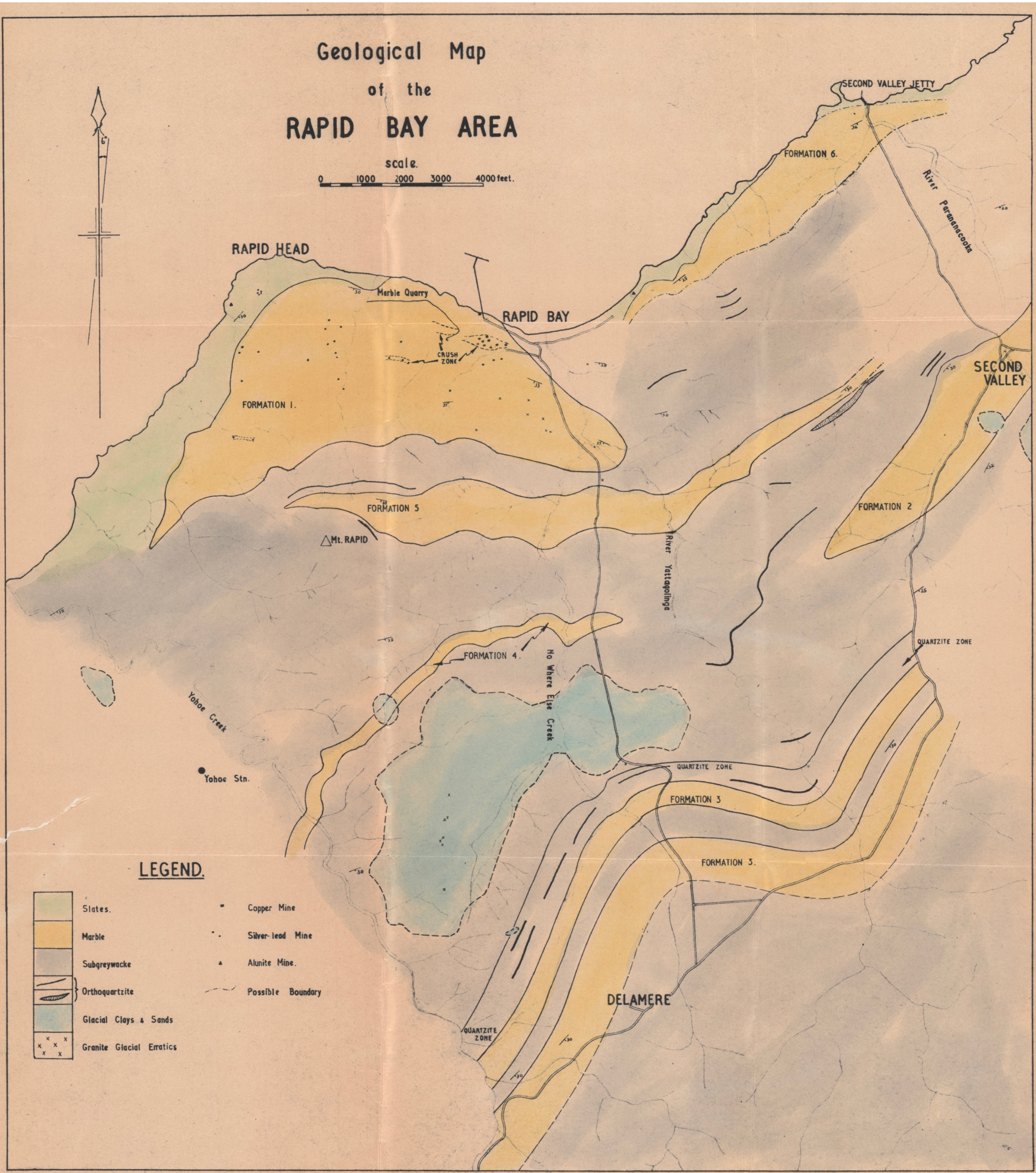
The crush zones in the marble are actually strike faults filled with angular marble boulders cemented with a matrix of limonite and silica.

The largest crush zone occurs immediately behind the east end of the present quarry face, and has necessitated a large zone to be discarded from quarrying operations. The zones do not appear to run for any great distance, but are quite wide at their maximum development.

It is suggested that the crush zones are due to bedding plane slippage during the folding of the strata. The limestones being relatively large bodies of a competent nature would possibly stabilise themselves by bedding plane slippage.

On the headland at Second Valley, very strong deformation of the competent slates and marbles has produced some amazing contortions in the rocks (Fig. 3c). Small faults striking approximately 270° and either vertical or dipping steeply to the south, are common. These small faults have displacements up to 10 ft., but do not produce any contortions in the strata.

It is considered the "zone of contortion" may possibly be connected with a large fault running parallel to the coast line and associated with the Tertiary block faulting.


Geological Map
of the
RAPID BAY AREA
scale.
0 1000 2000 3000 4000 feet.
6°
SECOND VALLEY JETTY
FORMATION 6.
River Parananacooka
RAPID HEAD
Marble Quarry
RAPID BAY
CRUSH ZONE
FORMATION 1.
SECOND VALLEY
FORMATION 5
FORMATION 2
Mt. RAPID
River Yattagolinga
FORMATION 4.
No Where Else Creek
QUARTZITE ZONE
Yohoe Creek
Yohoe Stn.
QUARTZITE ZONE
FORMATION 3
FORMATION 3.
DELAMERE
QUARTZITE ZONE
LEGEND.
Slates.
Marble
Subgreywacke
Orthoquartzite
Glacial Clays & Sands
Granite Glacial Erratics
Copper Mine
Silver-lead Mine
Alunite Mine.
Possible Boundary