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REPORT ON AN INVESTIGATION OF ASBESTOS DEPOSITS IN THE ROBERTSTOWN AND TRURO DISTRICTS

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SUMMARY

A field investigation of asbestos occurrences in the Robertstown Truro-Angaston Area has revealed the following features:-

1. All the asbestos occurrences are localised within dolomitic marble or talcose marble host rocks.
2. The same types of mineralisation are found at three stratigraphic levels, ranging from the Lower Torrensian dolomites of the Robertstown district to post-Sturtian and Cambrian (?) marbles of the Truro-Kapunda-Keyneton area.
3. Each of the same marble horizons is also characterised by widely distributed rock phosphate deposits occurring independently of asbestos.
4. Two types of asbestos with distinctive modes of occurrence are represented:-
   (a) A blue crocidolite which is most commonly found in association with locally metasomatised zones in the marbles. These altered zones are characterised by the presence of abundant albite, biotite and tourmaline, and some iron ores and rutile, and appear to be localised in fault zones and to be of individually restricted size.
   (b) A white tremolite which occurs in small amounts as a metamorphic rock mineral in talcose marbles, and in at least one locality near Truro is locally more abundant and comprises about 10 per cent of a limited area of rock exposures.
5. The physical properties of the crocidolite and tremolite vary considerably from place to place. Both yield comparatively weak fibres - with the tremolite being somewhat superior to the crocidolite in this respect - and have the same peculiar property of emulsifying in water, by reason of which a matted product can be readily obtained by wet separation.
6. The potential market value of the asbestos occurrences depends upon the industrial applications of the asbestos matte.
7. The survey has indicated that the asbestos mineralisation is very widespread, but no ore reserves have been proven, or can be proven, without sub-surface testing due to the very limited

amounts of surface exposures. The desirability of additional investigations embracing prospecting for new occurrences and shallow drilling of some of the known deposits depend upon the commercial adaptibility of the minerals (Item 6). Accordingly, it is recommended that bulk parcels be obtained for mineral dressing and the products be circulated among asbestos buyers for comment.

LIST OF PLANS

LIST OF PLATES

1. INTRODUCTION

This report outlines the results of a preliminary regional survey of asbestos occurrences in the Robertstown-Truro-Angaston area which has been conducted over the past three months. The investigation was initiated as a special economic project by the Chief Geologist, to determine whether asbestos from local sources could be profitably operated to compete with the high priced raw materials being imported from Canada (£80 per ton).

In particular, the survey was intended to establish whether any large low-grade deposits exist which would be amenable to bulk treatment, and this aspect has influenced the nature of the field work and the framing of the report.

The project has involved a re-examination of previously known asbestos deposits. A large number of other occurrences were found as a result of information supplied by local farmers and by the investigation of certain geologically favourable areas. However, no systematic prospecting has been undertaken.

The deposits described are all located within fifty to ninety miles of Adelaide, and within a few miles of railway sidings and pipe-line water supplies. In practically all cases the land is privately held, with mineral rights alienated from the Crown, and there are no existing mineral claims.

Section 19, hundred of Bright and Section 295, hundred of Apoinga, were reserved from the Mining Act by the Government on 4/8/55 pending the findings of the present survey.

2. REGIONAL GEOLOGY

The regional geological setting of the asbestos occurrences described in this report is shown on the accompanying plan Fig. I. All of the deposits lie within dolomitic marble and talcose beds, at three different stratigraphic levels. Two types of asbestos have been recognised in this enviroment, ~~including~~ namely a blue crocidolite which is always associated with highly metasomatised zones in the marble, and a white fibrous tremolite which is more widely developed as a metamorphic rock mineral.

In the Robertstown district, deposits of crocidolite asbestos occur in dolomitic marbles of the Lower Torrensian Series which are regionally folded along north-south axial lines; the mineral is

localised on the west limb of an anticline (Robertstown Anticline*) and on the eastern limb of a syncline (Lapford Syncline). Crocidolite most commonly takes the form of a vein mineral in zones of fracturing and intense metasomatism. Albite, biotite and tourmaline are consistantly abundant constituents of the asbestos bearing rocks. The occurrences are all confined to a stratigraphic horizon which contains an abnormal abundance of magnesite.

A sample of the dolomite adjacent to an asbestos vein at the old Robertstown workings (No. 1 Hole, Section 3A, Hd. Bright) was chemically analysed with the following result:-

	per cent
Silica	4.16
Oxides of Iron and Alumina	6.68
Calcium Carbonate	48.8
Magnesium Carbonate	39.9
	99.54

Some earlier investigators consider that the albite-biotite-tourmaline host rocks are weathered dolerite intrusives (Wymond and Wilson, 1951). However, the irregular form of the individual occurrences and their mineral composition are considered by the writer to be more characteristic of metasomatic alteration effects produced by soda-rich solutions or vapours of acid igneous origin.

South of Robertstown, the Torrensian dolomites are overlain by progressively younger Adelaide System and Palaeozoic sediments.

In the Truro and Kapunda districts, crocidolite and tremolite asbestos occur independently in talcose marbles (Kapunda-Truro marbles) overlying the Sturtian series of glacial deposits. Here the crocidolite is similarly found accompanying albite-rich replacement zones in the marble. Tremolite is more widely distributed as a minor rock mineral associated with and partly replaced by talc. It is present in all of the limited exposures of the marble horizon near Truro. In most places, the tremolite content of the marble would be less than one per cent, although it comprises up to 10 per cent of the whole rock in at least one locality.

Tremolite asbestos also occurs in the younger (Early Cambrian?) Angaston Marbles near Keyneton.

* The terms "Robertstown Anticline" and "Lapford Syncline" are not in general use but are adopted in this report for convenience.

Numerous deposits of rock phosphate are known to occur in each of the marble horizons described above (see Fig. I). The influence of common stratigraphic controls in the localisation of asbestos and phosphate mineralisation is very evident from this map, but the minerals are not closely associated with each other and have evidently formed by unrelated processes.

3. DEPOSITS OF CROCIDOLITE ASBESTOS

(a) Properties of the Crocidolite Asbestos

The blue asbestos from deposits near Robertstown has been identified by chemical and mineragraphic determinations as a crocidolite, comprising a mixture of the amphiboles glaucophane and riebeckite (Wymond and Wilson, 1951).

Specimens of fibre from two formerly productive workings have been analysed with the results shown in Table I. These samples differ in chemical composition from normal crocidolite in containing higher amounts of magnesia and alumina at the expense of ferrous oxide.

The crocidolite occurs in various physical states, each having some distinctive properties affecting its possible applications as a raw material, and a consideration of which is essential in assessing the overall value of the deposits. Such variations in the properties of the crocidolite appear to be closely related to the mode of occurrence, as detailed hereunder:-

1. Slip Fibre: The asbestos obtained by hand cobbing from slip fibre veins was found to be the most acceptable and highly priced material obtained from the former mine workings in the hundred of Bright. Apart from the greater fibre length (Plate I, Fig. 1), it has a moderate tensile strength and durability. Crocidolite of these specifications is a rarer form of the mineral.

2. Cross Fibre: Cross fibre vein crocidolite is generally composed of short and weak fibre and is partly reduced to a powder by milling. It readily disperses in water and the filtered product takes the form of an interwoven matte. The majority of the asbestos occurring near Robertstown has these properties.

3. Crocidolite "Wool": A distinctive type of crocidolite

TABLE I

CHEMICAL ANALYSES OF CROCIDOLITE ASBESTOS

	A per cent	B per cent
SiO_2	54.87	53.48
Al_2O_3	1.78	5.32
TiO_2	0.68	-
Fe_2O_3	16.41	15.16
FeO	5.38	3.44
MgO	11.34	10.90
CaO	0.45	0.72
Na_2O	6.77	6.30
K_2O	0.25	0.70
H_2O+	1.62	2.32
H_2O-	0.51	0.72
MnO	trace	present
CO_2	nil	0.22
	100.06	99.28

A. Long slip fibre crocidolite from "Blue Hole Deposit, Section 295, hundred of Apoinga. Analyst A.P. Wymand, 1951.

B. Marketed crocidolite from Ruedigers Workings, Section 2A and 3A, hundred of Bright. Analyst W.S. Chapman, 1920.

common to all the deposits and found particularly in the narrower veinlets is composed of an aggregate of interlocking minute fibres and platey grains which crumble into small particles between the fingers (Plate I, fig. 3). This crocidolite "wool" is particularly amenable to flocculations in water and its uses have included the commercial manufactur of medical absorbents (e.g. "A silican Compound") and filters in the chemical and wine industries.

4. Crocidolite Prisms in Marble: In one locality (Section 19, Hundred of Bright), crocidolite occurs as interlocking prisms forming alternate bands of an altered marble. (Plate I, fig. 5). The fibre length is consistently short, and a large proportion of the mineral obtained from the weathered outcrops reduces to a powder rather than a fibre when crushed. It is questionable whether this form of crocidolite - weathered or unweathered - has any market value.

5. Radial Aggregates of Crocidolite: Crocidolite in locally found (section 30, hundred of Bright) as radial or decussate aggregates intergrown with crystalline dolomite (Plate III (a)), which together comprise tough segregations up to two feet in diameter. In this case the mineral is fibrous with a deeper blue colour and more brittle character than the vein asbestos.

6. Incipient Crocidolite: In many of the vein deposits a dull lavender-coloured earthy crocidolite occurs interstitially among the fibrous variety, and in places comprises entire veins. This material breaks down to a fine dust on exposure, and is considered to be an incipient form of crocidolite.

In this report, types Nos. 1, 2 and 3 are regarded as raw materials of potential commercial use to which the following comments apply:-

In general, the physical properties of the Robertstown type crocidolite are markedly different and in most respects inferior to other crocidolites, and this is no doubt related to peculiarities in its chemical composition (Table I). Previous experience has shown that the fibre is weak, so that the

mineral is unsuitable for some of the important industrial uses of asbestos. However, a favourable feature is the unusual property of flocculating in water, by which it can be readily separated from impurities, and on drying forms a matte which has some special applications in industry - such as a filter medium and as a medical absorbent - and which can be regenerated by dispersion and reforming. It is reported that the crocidolite also has superior insulating properties (Gartrell, 1929); the matte product obtained by wet separation should be a particularly favourable form for uses in insulation.

(b) Crocidolite Asbestos Occurrences North-East of Robertstown

Sections 2, 2A and 3A, hundred of Bright, nine miles north-east of Robertstown.

In this area, numerous small deposits of crocidolite asbestos occur in Torrensian dolomitic marbles and magnesites over an area of some hundred acres along the eastern limb of the Lapford Syncline. These deposits were important producers in the past, having yielded over 600 tons of crude crocidolite of a good grade (mostly slip fibre).

The now abandoned workings have been described in detail in several earlier reports, (Jack, 1921; Dickinson and Cornelius, 1943; Dickinson 1943 (a) and (b)). The asbestos occurs as small and sporadic veinlets and pockets in association with pyritic albite-mica schist, in fault zones and other fissures in the dolomite. The individual occurrences are of very limited size, both horizontally and in depth.

A brief examination of these deposits confirmed the opinion of Dickinson (1943) that the surface showings are now practically exhausted, and that the results of the work undertaken do not justify any further exploration for deeper deposits of this type.

(c) Crocidolite Asbestos Occurrences North-West of Robertstown

The following occurrences of crocidolite asbestos are located along a low, scrub-covered range of hills extending north north-westerly from Robertstown. This range consists entirely of Lower Torrensian dolomitic sediments forming the outcropping core of a south pitching regional anticline. (Robertstown Anticline). All of the asbestos deposits are found in cream-coloured dolomitic marbles, which have also yielded numerous workable pockets of

magnesite, and which are repeated over wide areas by a complex system of minor folding on the anticlinal limbs. The majority of the known crocidolite showings are located along the western limb of the anticline (Fig. I).

Blue Hole Crocidolite Deposit

Section 295, hundred of Apoinga. On private land held by Mr. T. Farley, three miles north-west of Robertstown. No existing mineral claims, and temporarily reserved from the Operations of the Mining Act

This deposit is located on a low ridge consisting of massive magnesian marbles. The main showing of crocidolite asbestos is in a quarry measuring 70 feet by 50 feet by 10 feet deep, known locally as the Blue Hole. Asbestos was also intersected in three shallow holes sunk by prospectors for magnesite about 150 yards south-east of the quarry (Sect. 19, Hd. of Bright), and an outcrop of asbestos bearing dolomite was observed ¼ mile north of the quarry (Sect.295,Hd. Apoinga).

The dolomitic country rock occurs as small scattered outcrops throughout the area of asbestos mineralisation. Detailed mapping of these exposures has revealed that the main deposit (Blue Hole) is localised in a brecciated and highly altered zone along the axis of a south-westerly pitching synclinal dragfold (Fig. 2). The structural setting of the other occurrences cannot be resolved due to the lack of outcrop, but it seems certain that each are independent deposits without any sub-surface connection.

In the quarry exposure, the crocidolite occurs as ramifying narrow veinlets filling joints and other fissures in a highly decomposed albite-biotite-tourmaline replacement rock. Crocidolite also occurs to a lesser degree along bedding planes in adjacent dolomites. The asbestos veins vary from a fraction of an inch to three inches in width, and consist predominantly of cross fibre of corresponding lengths; some of the narrower veins are composed of a powdery, incipient asbestos. A thin coating of emulsified and redistributed crocidolite has developed over practically the whole of the quarry face and the rejected rock in adjacent dumps.

No systematic grade appraisal by bulk sampling or sectional measurements has been undertaken at this stage, and cannot be

satisfactorily done without cleaning of the secondary asbestos coating from the waathered quarry faces. However, crude asbestos production recorded from the quarry, amounts to 73 tons or the equivalent of three per cent of the total rock broken (2,600 tons), and this percentage was produced by hand-cobbing involving a high waste factor. It is therefore considered a reasonable estimate that asbestos comprises three per cent of the whole, and it would appear visually that such a grade is generally consistent over the bulk of the Blue Hole deposit.

The only direct evidence of the size of the deposit is provided by the open excavations. In the Blue Hole area, the western and southern limits of asbestos mineralisation are well marked against massive talcose marbles showing in the ramp entrance to the quarry, but elsewhere the quarry face comprises asbestos bearing rock of reasonably regular composition. Similarly mineralised ground has also been revealed in a number of small test pits beyond the northern and eastern margins of the quarry.

The possible surface extent of the deposit based on these observations is shown on the accompanying plan (Fig. 2) to cover some 1700 square yards, or the equivalent of 1130 tons of mineralised rock per vertical foot of depth, (factor - 2 tons/cubic yard). Crocidolite mineralisation continues beneath the quarry floor and can be reasonably expected to extend at least to a depth equal to quarter the radius of the surface area of the deposit, namely 30 ft. Cheap take-all quarrying methods could be readily adopted to this depth, and allowing for the tonnage already removed (about 2600 tons) the 31,000 tons of rock broken to the 30 ft. level should yield at least 1,000 tons of asbestos product.

A deposit of these specifications is not an attractive proposition for independent mining and treatment.

The quantities of asbestos represented by the occurrences south-east of the Blue Hole quarry are indeterminable from surface evidence, but may well be comparable to the above.

Crocidolite Marble Prospect

Section 19, hundred of Bright. On Crown Land three miles north of Robertstown, and in the adjoining section to the Blue Hole deposit.

In the north-west corner of section 19, prismatic crystals

of crocidolite occur as an important rock constituent of banded dolomitic marbles which are associated with serpentinous marble and albite biotite schist (replacement rock). The crocidolite marble is intermittently exposed in the bank of a creek over a width of some 60 yards, in an area of crushed and drag-folded Torrensian dolomites. The areas on both sides of the creek bank are covered with soil and secondary limestone (Fig. 3). A smaller occurrence of the same type was seen, however, in the creek bank about 400 yards downstream from the main prospect (Section 17E, Hd. Bright).

The banding of the crocidolite marble and the attitude of adjacent dolomites indicates that the deposit comprises a bedded formation exposed on the west of a minor anticlinal fold, and is of considerably less size than the width of exposure would at first suggest.

The crocidolite is present in alternate bands of the marble as lavender-coloured interlocking prisms averaging about ¼ inch in length and in amounts varying from about five to fifty per cent of the whole rock (Rock No. A4 Appendix I). The possible usage of this form of crocidolite as an asbestos requires further investigation, as described in item 1 of the succeeding recommendations.

Hallelujah Hills Crocidolite Deposit:

In the south eastern corner of section 30, hundred of Bright. Seven miles north-west of Robertstown.

Large boulders of a tough crocidolite bearing marble occur sporadically in the surface soil over an area of several acres on the crest of a low north south saddle following the strike of Torrensian magnesitic dolomites. Similar crocidolite marble has been uncovered in three shallow trenches, in which it can be seen to be associated with irregular patches of fine-grained albite biotite-tourmaline rock (Rock No. A1 , Appendix I), the crocidolite marble consists of interlocking crocidolite prisms (Plate III (b)) in a matrix of dolomite, perthite, epidote and tourmaline (Rock No. A3 , Appendix I).

An inch wide vein of deep blue short fibre crocidolite (crocidolite wool) is showing in one trench.

Other Occurrences

Small amounts of crocidolite were observed in silicified

dolomitic marble on section 294, hundred of Apoinga, and in an excavation in dolomitic marble on section 316, hundred of Apoinga. At another place on section 316, a few cobs of good grade crocidolite fibre were seen on the surface of a rabbit warren located in kunkar limestone.

(d) Crocidolite Asbestos Occurrences Near Truro

Crocidolite asbestos is found in a number of places in the Truro district within dolomitic marbles ("Kapunda-Truro Marble") lying stratigraphically above the boulder beds of the Sturtian Series (Upper Pre-Cambrian). The mineralisation and the associated alteration effects of the country rock have the same characteristics as the Robertstown deposits.

Truro Crocidolite Deposit

Section 53, hundred of Dutton, and one and a half miles north of Truro.

The occurrence and prospecting of crocidolite asbestos on this property are described in previous reports by Jack (1921). The workings have since been filled in and the land cultivated, so that no evidence remains of the nature and extent of mineralisation.

Dutton Crocidolite Deposit

Water Reserve, hundred of Dutton. One mile south-west of Dutton township.

The identification of this deposit during the course of the present survey resulted from earlier observations of geologist R. Coats (Regional Mapping Section).

Crocidolite asbestos veinlets up to two inches in width are exposed in a few places beneath creek bank alluvium over a width of about 100 yards. The asbestos is associated with several poorly exposed zones of tourmalised and pyritic albite-biotite rock, which are developed in talcose magnesian marbles. Traces of crocidolite were also found in the only other bedrock exposure in the locality, in a road cutting 50 yards south of the creek.

No proper assessment of this deposit is possible from the limited areas of outcrop. A promising indication, however, is the presence of unusually wide zones of tourmalinisation and albitisation which elsewhere accompany asbestos mineralisation.

Other Occurrences

Traces of crocidolite asbestos were also found in a rail cutting on Section 233, hundred of Moorooroo, and at the surface of a ploughed paddock in Section 227, hundred of Jellicoe.

4. DEPOSITS OF TREMOLITE ASBESTOS

The occurrence of a white tremolite asbestos in a talcose dolomitic marble was discovered on Section 228, hundred of Jellicoe (Truro or Hicks Deposit) in 1920, and subsequently a small amount of developmental work was undertaken on this deposit without any noteworthy production. The claim was abandoned in 1940.

The present survey has shown that deposits of a similar type but somewhat inferior grade are very widespread in marbles throughout the Truro and adjoining districts.

(a) Properties of the Tremolite Asbestos

Mineragraphic and X-ray determinations indicate that the mineral is a highly fibrous variety of tremolite. Two samples of the asbestos have been chemically analysed with the results shown in Table II. These confirm the identifications of the mineral as tremolite.

The crude tremolite asbestos has the form of white to pale-cream coloured fibre bundles up to 2½ inches in length and one inch in diameter. The average length of fibre at the old workings is one inch. It can be readily separated into silky threads which are of variable but generally low-medium tensile strength, and develops weaknesses if bent. The flexibility and strength appear to depreciate with weathering, and also vary with the various stages of alteration to talc.

The fibres flocculate in water in the same way as the crocidolite from Robertstown and Truro, and where exposed to weathering the fibrous aggregates are converted to a matted woolly material.

Ore dressing experiments conducted by the Govt. Metallurgist in 1920 (M.R. 32, p. 49) on bulk samples from the Truro workings indicated that an asbestos of potentially high market value could be obtained from the tremolite marble by dry processing. He reports as follows:-

"The sample as received was put through the jaw breaker and reduced to a maximum size of about ½ inch. The crushed sample was then sieved on a sieve having openings 1-10th. inch square. A certain

TABLE II

CHEMICAL ANALYSES OF TREMOLITE ASBESTOS

	A	B
	per cent	per cent
SiO_2	55.70	56.96
Al_2O_3	0.81	1.85
TiO_2	0.12	
Fe_2O_3	0.77	2.16
FeO	0.32	0.14
MgO	25.20	23.88
CaO	8.24	9.58
Na_2O	2.10	1.47
K_2O	0.58	0.43
H_2O+	0.73	0.60
H_2O-	3.30	1.34
CO_2	1.37	1.02
SO_3	0.19	
Cl	0.19	
	99.58	99.43

A. Long fibre tremolite asbestos selected microscopically from talcose marble, Section 228, hundred of Jellicoe. Analyst P.C. Hemingway, Mines Dept., 1955.

B. Unclassified tremolite asbestos separated by dry processing, Section 228, hundred of Jellicoe. Analyst W.S. Chapman, 1920.

amount of fibre matted together, and was removed, giving 1.8 per cent of fibre of a maximum length of about one inch or a little over. The remainder of the material on the 10 sieve was passed slowly through the rolls set at about 1 - 16th. inch, and the crushed product was again sieved and picked. By this means 3.2 per cent of fibre was recovered. After the operation four per cent by weight of the crude ore still remained on the 10 sieve, and probabl 10 per cent of this would be recoverable as fibre with proper appliances. That total quantity of fibre recovered was therefore five per cent by weight of the original ore.

So far as could be observed, the fibre was of good quality, but rather short, no pieces much over one inch is length being niticed With suitable machines it would not be unreasonable to expect a yield of about 10 per cent from material similar to that treated."

No information is available regarding the actual usage of the asbestos taken from the Truro workings.

(b) Truro District:

Truro (Hicks) Tremolite Asbestos Deposit

Section 228, hundred of Jellicoe. One and a half miles north-west of Truro. Private land held by K.W.R. Crook, with mineral rights alienated from the Crown.

Fibrous aggregates of a silky white tremolite asbestos embedded in marble are exposed in a small pit and adjoining 30 feet long inclined drive in the south-western portion of this property (Fig. 4). The occurrence of asbestos in this limited exposure is confined to a band of granular talcose marble measuring upwards of three feet wide, which appears to be conformable with bedding, and is gently inclined to the horizontal with a general north westerly dip. The asbestos marble is overlain by several feet of kunkar limestone and surface soil, and underlain by ferruginous and talcose marble.

A cross-section of the mineralised bed may be observed in the collar of the inclined drive, where asbestos bundles averaging about one inch in length and a quarter-inch in diameter comprise between 5 and 10 per cent of the marble over a thickness of three feet. Asbestos marble comprises the roof of the drive, which trends north-westerly at a 10 degree underlie over a length of 29 feet, and which has apparently followed down the dip of the underlying bed. A short

south westerly cross cut from the drive reveals that the dip steepens here to 45 degrees westerly due to drag folding.

The deposit is located in a ploughed field, with no outcrops to indicate the extent of asbestos marble, but pebbles of asbestos-bearing rock and silicified tremolite can be seen on the surface over a considerable area to the north of the old workings. Asbestos marble was intersected in a shallow pit 15 yards south west of the workings (Jack, 1920) and in a trench 180 yards to the north-north-west (Cornelius, 1940). Small amounts of fibrous tremolite can also be seen to occur in the same talcose marble formation in road cuttings along the western boundary of the property (Fig. 4).

Crocidolite asbestos is found in marble in adjoining sections to the north-east (53) and south (227), as described previously.

The evidence presented above indicates that at least small amounts of tremolite are contained in the marble over a large area of the property, ~~and property,~~ and probably over a greater width of the marble than represented in the old workings. Accordingly, it is recommended that some explorations by shallow boring with suitable hand equipment be undertaken to assess the extent of the better grade (per cent) tremolite marble - which is at present virtually untested - concurrently with an investigation of the possible industrial uses and market value of the fibre (see recommendations). The proposed sites for 14 shallow boreholes (8-10 feet) have been pegged, and their locations are shown on Figure 4.

Other Occurrences

Tremolite asbestos is a minor rock constituent of altered marbles in the following localities near Truro:-

Hd. Belvidere, Section 325. Traces of minute fibre in roadside cutting.

Hd. Belvidere, Section 322. Small amounts of well developed fibrous tremolite, with abundant talc, in creek bank.

Hd. Belvidere, Section 578. Traces of fibrous tremolite in coarsely crystalline talcose marble in creek bank.

Hd. Moorooroo, Section 242. Tremolite asbestos is a minor constituent of some bands in granular marble in road cuttings.

Hd. Moorooroo, Section 233. Some narrow bands of tremolite marble in rail cutting. Traces of crocidolite occur here also.

Hd. Dutton, Sections 36 &37. Kunkar limestone covering marbles contains residual aggregates of tremolite.

Hd. Dutton, Section 34. Boulders of marble in ploughed field contain needles of silicified tremolite.

(c) Kapunda District

Fibrous tremolite is a minor constituent of marbles exposed in Section 1508, hundred of Kapunda. Other extensive areas of marble outcrops in the district have not been examined during the present survey.

(d) Keyneton District

The occurrence of asbestos in the Keyneton district was first recorded by Hossfeld (1935). An area indicated by Hossfeld two miles north-west of Keyneton was briefly examined during the present survey and it was found that fibrous tremolite with the same physical properties as the Truro asbestos is developed over considerable but undefined areas of poorly exposed marble country rock.

In the southern portion of section 359, hundred of Moorooroo, small amounts of white to pale blue tremolite asbestos were seen in all places where the marble bedrock is exposed by quarries or well-sinking, and the mineral is present in surface boulders over practically the whole of the southern portion of the block.

Similarly, tremolite occurs in marble one and a half miles to the west, in section 412, hundred of Moorooroo.

5. CONCLUSIONS

The survey has shown that the distribution of both crocidolite and tremolite asbestos is far more widespread near Robertstown and Truro than has formerly been appreciated. This is despite the fact that no systematic prospecting has been undertaken in these areas, either previously, or during the current investigation, so that there is a probability of many other unrecorded occurrences of the same type.

The asbestos occurs in marbles ranging from Upper Proterozoic (Torrensian) to Cambrian (?) in age, and these marble host rocks characteristically comprise low, rolling (and usually cultivated) hills, with very few bedrock exposures. Due to the paucity of exposures, it has been impossible to make any individual or overall assessment of ore reserves, which in fact can only be established by sub-surface testing methods.

The desirability or otherwise of any such additional testing

depends upon the potential market value of the processed minerals. It is stressed that both the crocidolite and tremolite varieties have the peculiar property of dispersing (or flocculating) during wet processing, the industrial applications of which have not been determined but would superficially appear to be highly advantageous- particularly for the production of insulation materials. In this respect, the crocidolite and tremolite can be regarded as comparable types of asbestos, and can be jointly considered in respect to possible methods of treatment and market value of the asbestos matte product.

6. RECOMMENDATIONS

Additional investigations are recommended along the following lines:-

1. As outlined and approved in a previous minute of 14/10/55 (DM 1332/55 and DM 1416/55), it is recommended that parcels be obtained of each type of mineral recognised to enable beneficiated products to be prepared and distributed among asbestos buyers for valuation. These samples should be obtained from the following deposits:-

(a) Blue Hole Deposit. Section 295, Hd. Apoinga (blue crocidolite)*
(b) Crocidolite Marble Pros. Section 19, Hd. Bright. (Crocidolite prisms).
(c) Truro Tremolite Deposit. Section 228, Hd. Jellicoe (white tremolite).

2. A systematic programme of asbestos prospecting be undertaken by a Departmental prospecting party in the favourable areas of marble bedrock near Robertstown, Kapunda, Truro and Keyneton, such as indicated on the accompanying preliminary geological map. A search for additional phosphate deposits which are localised in the same formations should be carried out concurrently.

Such a project could be most economically conducted by two prospectors operating with a Departmental vehicle and caravan, and in which case it would involve about two months of field work.

3. Shallow boring with manual equipment in several areas surrounding promising exposures of asbestos mineralisation. This applies particularly to the tremolite asbestos deposit on Section 228, hundred of Jellicoe (Truro Tremolite Deposit), where sites for

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Footnote *Sample (a) has subsequently been obtained and stored at the Research and Development Branch pending beneficiation.

boreholes have been pegged and proposals for drilling outlined in this report; and to showings of crocidolite asbestos in soil-covered areas on section 19, hundred of Bright (near Blue Hole deposit) and section 316, hundred of Apoinga. It is intended that this work be carried out shortly by the field geologist and a technical assistant when suitable hand auger equipment will become available.

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APPENDIX I.

PETROGRAPHIC AND MINERAGRAPHIC REPORTS ON ASBESTOS SAMPLES*

Rock No. A1 Blue Hole Deposit, Section 295, Hd. Apoinga.

This rock is from the quarry floor at the base of the ramp entrance. It consists of plagioclase felspar (albite), which is intergrown with small flakes of a pale biotite; and a very dark iron-rich tourmaline (schorlite) which is opaque in some grains, ~~size of the felspar and the tourmaline is grains.~~ The grain size of the felspar and the tourmaline is 0.2 - 0.6 mm., and the edges of the crystals are ragged. Crystals of alkali-amphibole occur in places.

Rock No. A2 Blue Hole Deposit, Section 295, Hd. Apoinga.

This specimen taken from the north-eastern face of the quarry consists of decaying feldspar, with abundant tourmaline. Some quartz is associated with the latter. Along one side is a layer of crocidolite, and adjacent to this is a band consisting almost entirely of tourmaline. The rock is a coarser and more decayed variety of the one above. Crocidolite also occurs in small patches throughout.

Rock No. A3 Hallelujah Hills Deposit, Section 30, Hd. Bright.

A sample of tough crocidolite bearing rock from this locality contains decussate aggregates of alkali amphibole (crocidolite) associated with columnar masses of epidote, and grading into it in places. The columns appear to have been formed under stress and then torn apart, felspathic material being subsequently deposited in the gaps. The zones divide areas of the rock where a felspathic groundmass contains large crystals of dolomite with alkali-amphibole developing in some; other areas have an intimately mixed groundmass of calcareous and felspathic constituents which is shot through with laths of epidote. Rectangular laths of opaque mineral (ilmenite?) occur in the amphibole zones, and at one place in the felspathic groundmass. Alkali-amphibole is not nearly so concentrated in this rock as the color would lead one to expect.

Rock A4 Crocidolite Marble Prospect, Section 19, Hd. Bright.

A representative sample from this deposit consists

Footnote * Extracted from reports by M. Bucknell, Parkside Laboratories, who conducted the petrographic studies under the direction of A.W. Whittle (Chief Petrologist).

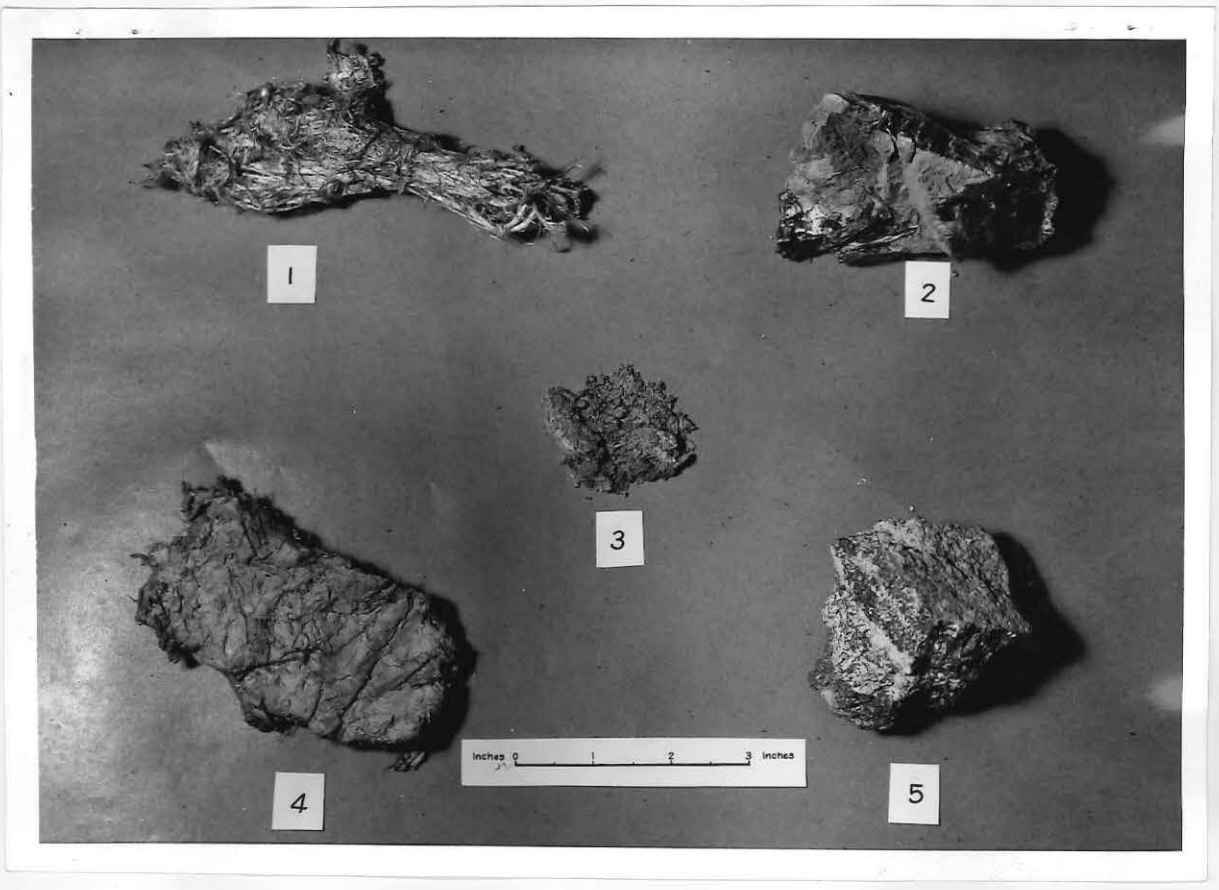
of a groundmass of calcareous, and probably dolomitic composition, containing porphyroblasts of orthoclase, microcline, muscovite and crocidolite, the last occurring as short columns and equant grains. The crystals of the groundmass have a diameter of 0.02 - 0.06 mm. with some larger grains. There are signs of recrystallization, and the muscovite laths have been corrugated by the growth of these grains, or by external stress. The porphyroblasts have a mean diameter of 0.15 mm., and the muscovite flakes are about 0.2 mm. across.

Dolomite is suggested by euhedral or subhedral forms. Some of the larger grains have recrystallized around centres rich in haematite, the latter patchily mixed with the dolomite.

In one band, the dolomite and the larger crystals are both much finer (less than 0.01 mm. and 0.6 mm. respectively) and there is considerable ferruginous material occurring interstitially or as disseminated grains, giving a darker and redder color.

The crocidolite which is similar in composition to the fibrous variety (see P. 169/55), occurs here as grains intermediate in size between the felspar porphyroblasts, and the dolomitic crystals of the groundmass. Accessories include one or two well shaped crystals of rutile and sphene.

PLATE I



CROCIDOLITE ASBESTOS

1. Best quality slip fibre crocidolite from old workings, Sections 2A and 3A, Hd. Bright.

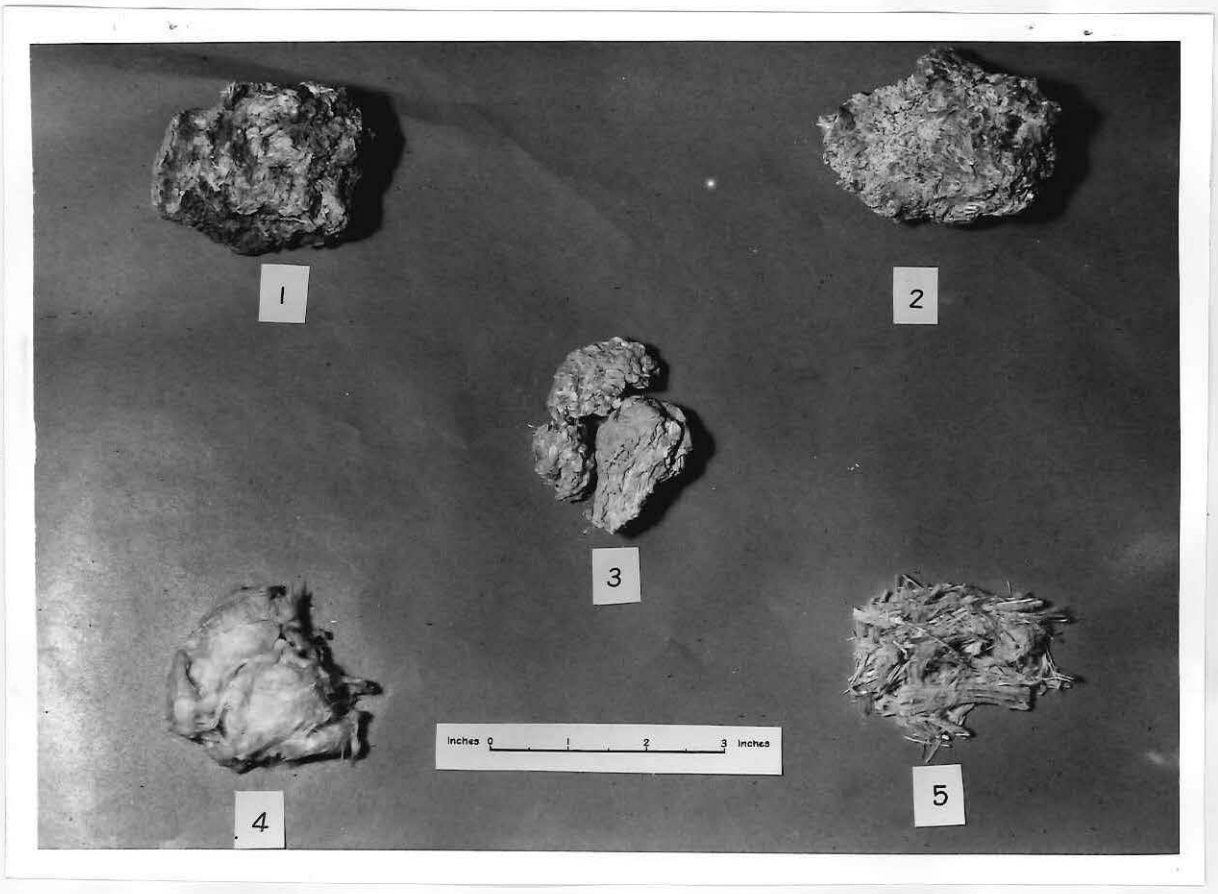
2. Best quality slip-fibre crocidolite enclosing core of an earthy incipient form of crocidolite. Section 2A-30, Hd. Bright.

3. Typical "crocidolite wool" consisting of platey grains and minute fibres of crocidolite. Sections 2A - 3A, Hd. Bright.

4. Matted crocidolite obtained by wet processing of the crude mineral. This is the form used for filter and medical asorbents.

5. Banded crocidolite marble from section 19, Hd. of Bright. Dark bands consist predominantly of short interlocking prismatic crystals of crocidolite.

PLATE II



TREMOLITE ASBESTOS

1. Typical tremolite marble from old workings at Section 228, Hd. Jellicoe. White material is tremolite.

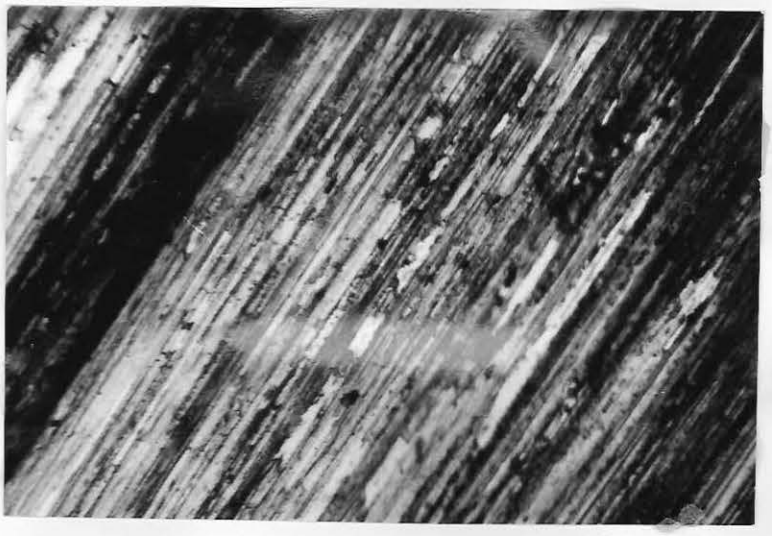
2. Typical tremolite marble from roadside quarry near Kyneton. Section 359, Hd. Moorooroo.

3. Tremolite in an advanced stage of alteration to talc. Section 322, Hd. Belvidere.

4. Matted tremolite resembling cotton-wool, produced from the crude tremolite by wet separation.

5. Typical crude tremolite asbestos obtained by screening the friable talcose tremolite marble country rock. Old workings on Section 228, Hd. Jellicoe.

PLATE III



(a) Micrograph of cross-fibre crocidolite asbestos from inch-wide vein at Blue Hole deposit, Section 295, Hd. Apoinga. Note banded nature due probably to variations in composition, and ultramicroscopic width of fibres.

(b) Decussate aggregates of fibrous crocidolite in tough segregations of crocidolite marble from Section 30, Hd. Bright (Hallelujah Hills). Interstitual minerals are albite and dolomite.

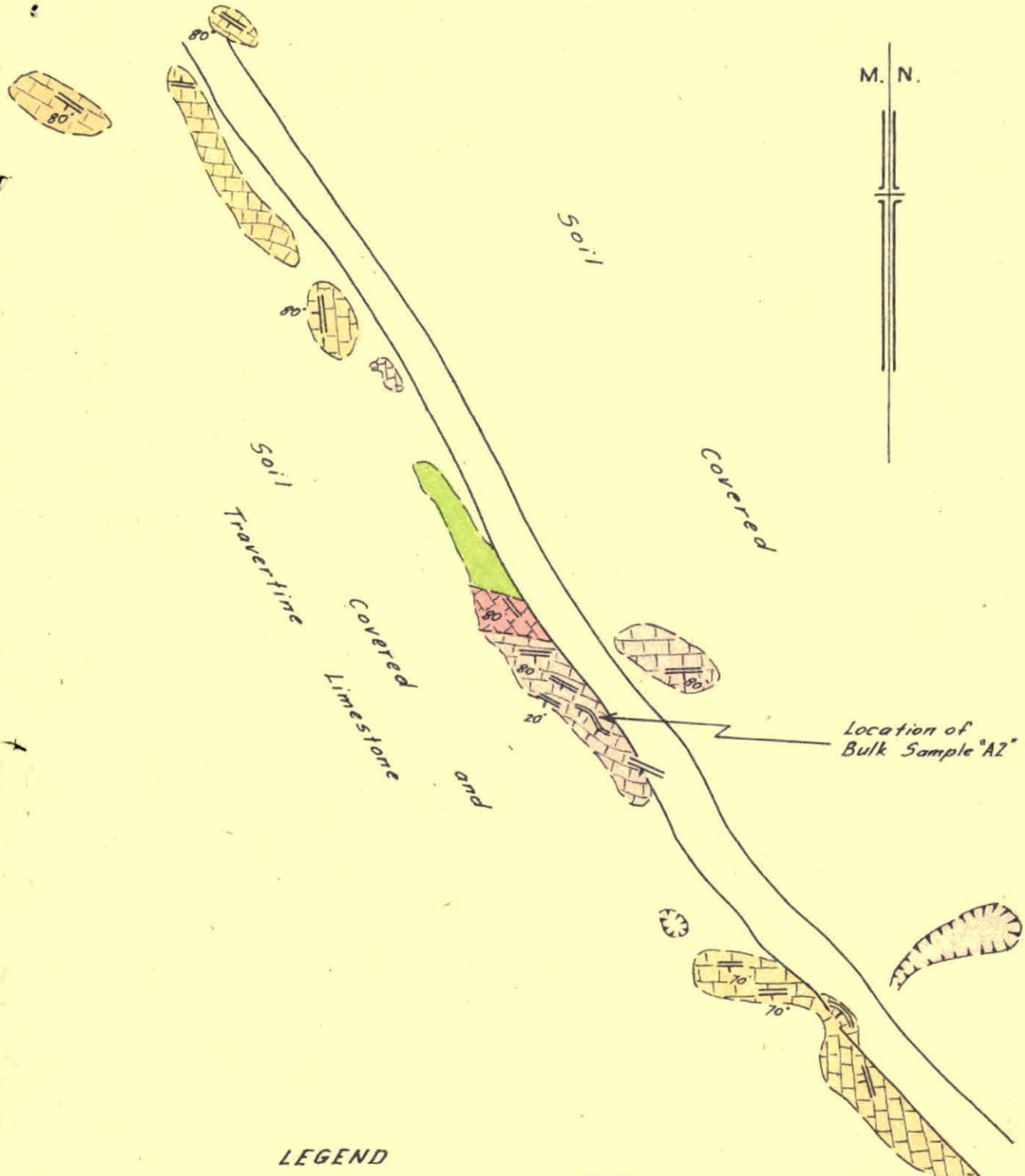


Fig. 3.

To accompany report by D.King. Geologist.

S.A. DEPARTMENT OF MINES					
Approved	Passed	Drn.	CROCIDOLITE MARBLE OCCURRENCE SURFACE GEOLOGICAL PLAN SEC. 19 HD. BRIGHT.	D.M.	Scale 1In = 40Ft.
		Tcd. R.G.C.		Req.	S1144
		Cd. R.R.			G.e. 10
		Exd.			Date 18-10-55

S.A. DEPT. OF MINES

PRELIMINARY REGIONAL GEOLOGICAL MAP
ROBERTSTOWN-EUDUNDA-ANGASTON REGION
LOCATION AND STRATIGRAPHIC SETTING
OF ASBESTOS OCCURRENCES

Req. No. D.M.
Compiled from

Scale 2 Miles to 1 inch

55-298
Gpa-K1

Date 1.9.55

Approved
Passed
Director of Mines

Drn.
Tpd.
Cpd.
Engd.

Accepted Drawing No.
No.
Amendment
Init.
Date

BURRA
KOORINGA
KOORINGA
BALDINA
HANSON
Co STANLEY
Co BURRA
Princess Royal
Utica
Burra
Koorinoka Falls
WORLDS END (LAPFORD)
Edelweiss
Fairview Phosphate
Creek
St Elmo
BLACK SPRINGS
APOINGA
BRIGHT
STANLEY
Hallelujah Hill Deposit
Ruediger's Deposits
Asbestos Marble Prospect
Finley's Blue Hole
WATERLOO
MANOORA
ROBERTSTOWN
SADDLEWORTH
ENGLISH
SADDLEWORTH
WATERLOO
MARRABEL
JULIA CREEK
EUDUNDA
GILBERT
NEALES
To Morgan
Co LIGHT
Co EYRE
To Tarlee
KAPUNDA
Light
KAPUNDA
DUTTON
Dutton Deposit (Water Rds)
DUTTON
Marble Quarry (Truro Rds)
River
LIGHT
BELVIDERE
FORD
Carrara Marble Quarry
Truro Deposit
TRURO
To Blanchetown
STOCKWELL
FREELING
GREENOCK
River
NURIOOTPA
Service Quarry
I.C.I. Quarry
ANGASTON
TANUNDA
Sibley's Quarry
MOOROOROO
JELLICOE
Gawler
KEYNETON
To Swan Reach
LYNDOCH
GAWLER
BAROSSA

N

SCALE
0 1 2 4 6 8 10 MILES

LEGEND

I STRATIGRAPHY

CAMBRIAN

Kanmantoo Group, predominantly greywackes

Angaston Marbles

Kapunda-Stockwell Marbles

PROTEROZOIC

Sturtian Series of Boulder tillites, Quartzites and laminated shales — Upper glacial sequence; Lower glacial sequence

Torrensian Series of Dolomites, Dolomitic shales and Magnesites

II MINERALIZATION

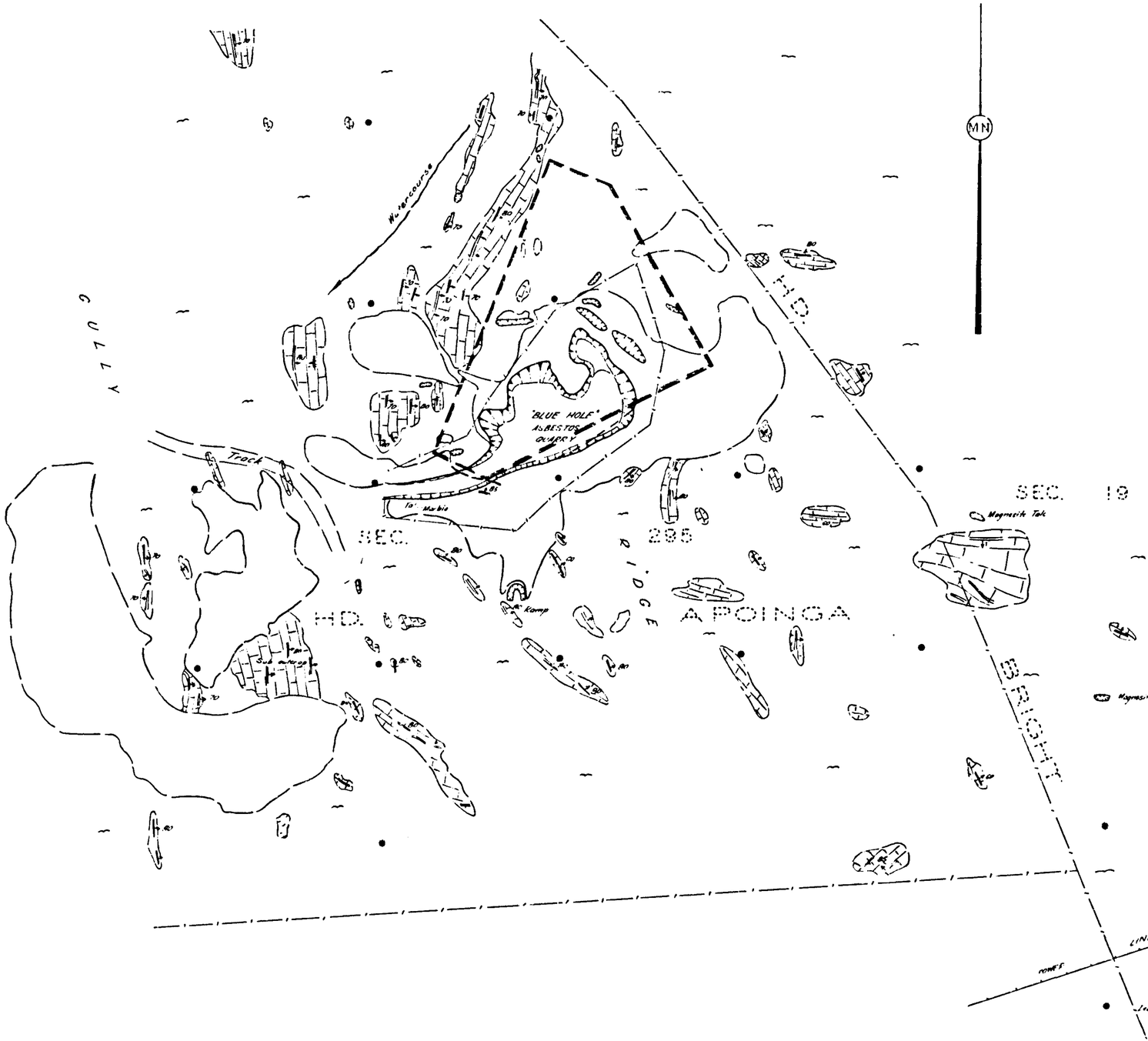
Blue Crocidolite Asbestos
- Workings
- Occurrences

White Tremolite Asbestos
- Workings
- Occurrences

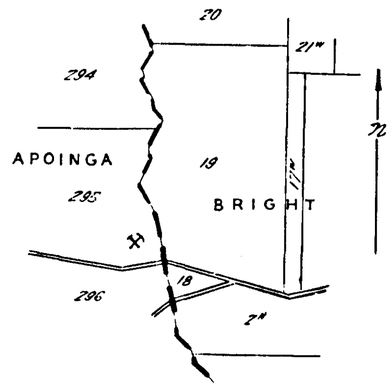
Phosphate Rock Deposits

(Numbers adjacent to mineral occurrences refer to sections in which located)

Geology compiled from field observations by S.B. Dickinson, R. Coats and D. King.



LOCALITY PLAN
Scale: 40 chains to inch



Albite, biotite, tourmaline rock veined with crocidolite asbestos.

Massive dolomitic marble.

Waste heaps of quarried stone coated with asbestos.

Soil overburden heaps.

Open excavations.

Assumed limits of Asbestos mineralization.

Location of survey pegs.

To accompany report by D King, Geologist. FIG. 2

S.A. DEPARTMENT OF MINES

Associated Drawing No.	No.	Amendment	Ent.	Extd.

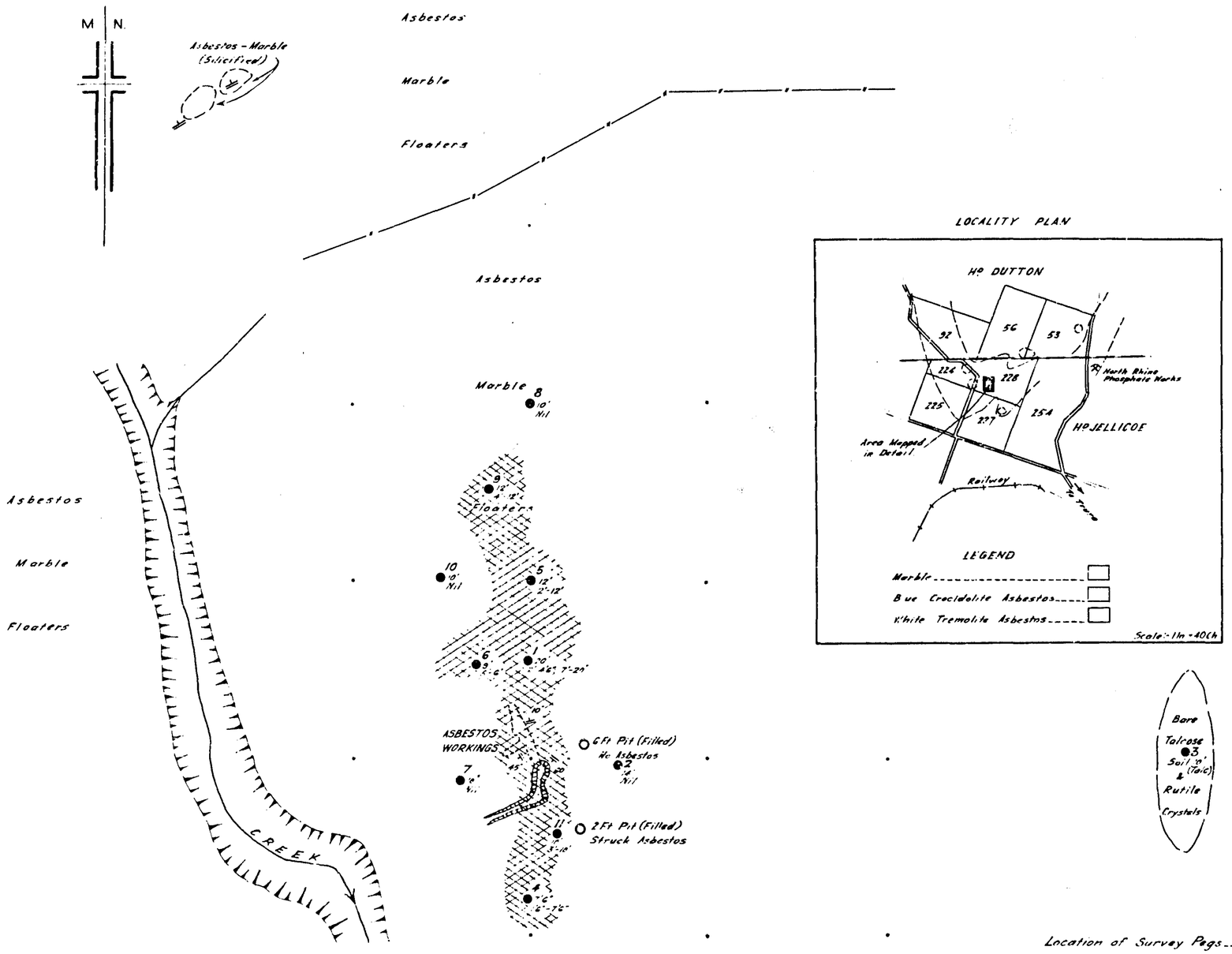
Reg. No.
D.M.
Compiled from

SURFACE GEOLOGICAL PLAN
'BLUE HOLE' CROCIDOLITE ASBESTOS DEPOSIT
SEC. 295 HD. APOINGA

Approved	Passed
Director of Mines	

Drn.
Tcd. P.J.B
Ckd.
Fxd.

Scale 40 feet to inch
55·326
Geol
Date 7/10/55



LOCALITY PLAN

LEGEND

Marble
Blue Crocidolite Asbestos
White Tremolite Asbestos

Scale:- 1 In = 40 Ft

Bore
Talcose
3
Soft 'n' (Talc)
&
Rutile
Crystals

Location of Survey Pegs •

Test Bore-hole ● 5 (Bore No)
12' (Depth of Bore)
2'-12' (Intersection of low grade (1.2%) Tremolite mineralisation)

Proven Area of low grade Tremolite Mineralisation

To accompany report by D. King Geologist.

Fig 4

S.A. DEPARTMENT OF MINES

Associated Drawing No.	No. Amendment Exd. Date	Req. No. D.M. Compiled from originals by D King Geologist	TREMOLITE ASBESTOS WORKINGS SURFACE PLAN SEC 228 HD JELLICOE	Approved Passed Director of Mines	Drn. Tcd. R G C Ckd. R A Evd. Scale: 1 Inch = 40 Feet 55-337 Date 18-10-55 G.I. 11.