REPORT ON THE ASBESTOS DEPOSITS, ANDERSON'S CREEK, NEAR BEACONSFIELD.

Government Geologist's Office,
Launceston, 20th November, 1899.

SIR,

ON the 11th, 12th, and 13th instant I visited the serpentine country to the west of Beaconsfield, where asbestos has long been known to occur; and I now have the honour to submit my Report thereon. The only mine work which is being carried on there at present is on the ground now being leased to the Australasian Asbestos Company, who have taken up five sections,—1772, 1773, 1774, 1775, and 1935–93M, for the purpose of mining for asbestos.

These blocks are on Anderson's Creek, about 2 miles W. of the township of Beaconsfield, as the crow flies, or 3 miles by road. The road first runs N.W. from the township past the hospital, and the track is then taken across the Brandy Creek and the mineral sections of the North Tasmania Gold Mining Company, and Knight and Morgan, running thence due west to the serpentine area. Carts can be taken along without difficulty; but, in the event of the asbestos industry becoming a permanent one, the best way of getting the material away would be to lay down a tramway to Beauty Point, on the River Tamar, between 4 and 5 miles away. I may mention, to help in fixing the locality, that Anderson's Creek runs north through Sections 1772, 1773, and just takes a bend through the S.W. angle of 1774.

The sections are thus all situate in the Anderson's Creek basin, where a strip of serpentine rock is exposed, extending over an area of about 3 miles long N. to S., by 1½ mile wide E. to W. The eastern boundary of the serpentine occurs in the eastern part of Section 1774, where the cart-track from Beaconsfield crosses it: thence this track goes south for half a mile in serpentine country, as far as the bridge over the creek. Light green serpentine, weathering with a ferruginous crust, and traversed by thin veins of chrysotile, is seen *in situ* at intervals protruding through the soil on each side of the track right up to the bridge, but on the S.W. side of the creek the valley bottom is occupied by sand and quartz drift or detritus. At this spot the creek is evidently on the boundary line between the serpentine and sandstone. Proceeding further W., sandstone detritus is found, with the usual covering or admixture of quartz drift. This continues for about half a mile W. of creek, when the foot-hills of the Ironstone Range begin to rise from the valley plain. These ironstone mountains form a pile of ancient schists of apparently sedimentary origin, the exact nature of which, however, is obscured by additions of iron and chromium, and transformation into iron oxide. Reverting now to the eastern or Beaconsfield side-line of the serpentine, the actual contact is hidden under the superficial drift and soil, but can be located within a few yards by the difference of colour in the soil, and by the occurrence of quartz detritus. There is here some metamorphic sandstone or quartzite, which is probably the contact rock. Thence eastwards, for a score of yards, a succession of grey and yellow sandstones and conglomerates occurs, covered, between here and Knight and Morgan's sections, with a heavy layer of sandy and clayey soil and quartz detritus. In those sections the familiar cabbage tree conglomerate and sandstones are exposed by mining, and continue through the North Tasmania blocks across Brandy Creek, where some break in the continuity occurs. This break is, for the present, best explained by a N. and S. line of dislocation, laid down on Mr. Montgomery's map of Beaconsfield as a "probable fault." The road thence to the township continues over sandstone and alluvial gravels along the eastern base of the Cabbage Tree Range.

The indications enable us to form an opinion of the relative age of the serpentine, though in this area there are no data for fixing its absolute geological antiquity. The hardening of the sandstone on its eastern boundary suggests that it is intrusive into the lower Silurian, and therefore, posterior to it. Whether the serpentine of the Colony is, as a whole, older than our granites, is as yet unsettled, the evidence collected so far being contradictory.

Serpentine is not only a rock-forming mineral, but often forms a rock by itself. It is essentially a hydrous silicate of magnesia derived from the alteration of olivine-bearing eruptive rocks. Meteoric waters have attacked and decomposed the olivine and pyroxene minerals, which have re-arranged themselves as magnesian silicate. Excess of silica has been re-deposited as chalcedony and opal, and, combining with manganese, has sometimes formed a manganese silicate in the rock. In the open cutting being worked on section 1774, a large block of rhodonite, the pink or flesh-coloured silicate of manganese, was broken out of the asbestiform serpentine while I was there. In Petterd's Minerals of Tasmania it is stated, doubtfully, that rhodonite has been found at Zeehan.

The serpentine is a compact pale to dark green rock, which is very generally, throughout this area, traversed by small silky or steatitic veins of asbestos or chrysotile. These veins, when they are not dense, are parallel bands of pale green and silvery-looking fibres, with their long axes transverse to the direction of the bands. I have seen a sample with fibres 2½ inches long, but this length is exceptional. Veins ¼″ and ½″ wide are common; less frequent are those of 1″ and 1½″ width. They closely resemble some of the chrysolite mined in Canada, and the best of them are of sufficient width for industrial purposes, but the drawback is that they are usually separated by such wide intervals of compact rock as to make their mining an expensive operation. If they were close enough and sufficiently plentiful, the vein-stuff could be broken out, cobbed, and sorted, but so far there is not much encouragement, and I understand the Company do not intend, at present, to lay out much money on this description of rock, though, if they come across any payable belt of these veins, they will take advantage of the discovery. I have seen them best exposed on the western part of section 1774, but they intersect the serpentine in varying degrees of excellence all over the properties. Sometimes they are picrolitic, or brittle; or densely serpentinous. These veins are not injection

fissures, but may be rather regarded as cracks due to an increase of volume which takes place in the hydration of the olivine and its conversion to serpentine : the cracks become filled with serpentine, fibrous or otherwise. It is, therefore, most likely that the cracks would be developed along the lines of jointing or easy parting of the rock. At the same time it may be conceded that where any faulting has occurred a natural channel would be formed for the crystallisation of the fibrous mineral. Lines of contact would also provide such channels. An example of this is furnished by the Broughton Mine, in Canada, where there is an asbestos seam at the contact of the serpentine with the slate. The fibre there is 6″ or 7″ long, and is of exceptional quality. I should add, however, that the chrysotile veins of the Quebec serpentine belt do not average more than one or two inches in width, and, as they interlace like the veins in a stock-work, the whole rock has to be quarried out and the fibre separated. The fibre usually bears a small proportion to the rock quarried, most frequently only 1 % or 2 %.

Some of the serpentine in the Anderson's Creek field takes a handsome polish, and is easily worked. It would be suitable for small ornaments. I saw a pretty polished paper-weight made from it at the residence of Mr. Joseph Davies, General Manager of the Tasmania mine, Beaconsfield. Suitable blocks of large size do not appear to be common. I have no doubt that small *articles de luxe* of this ornamental stone would find a ready sale in the Colony.

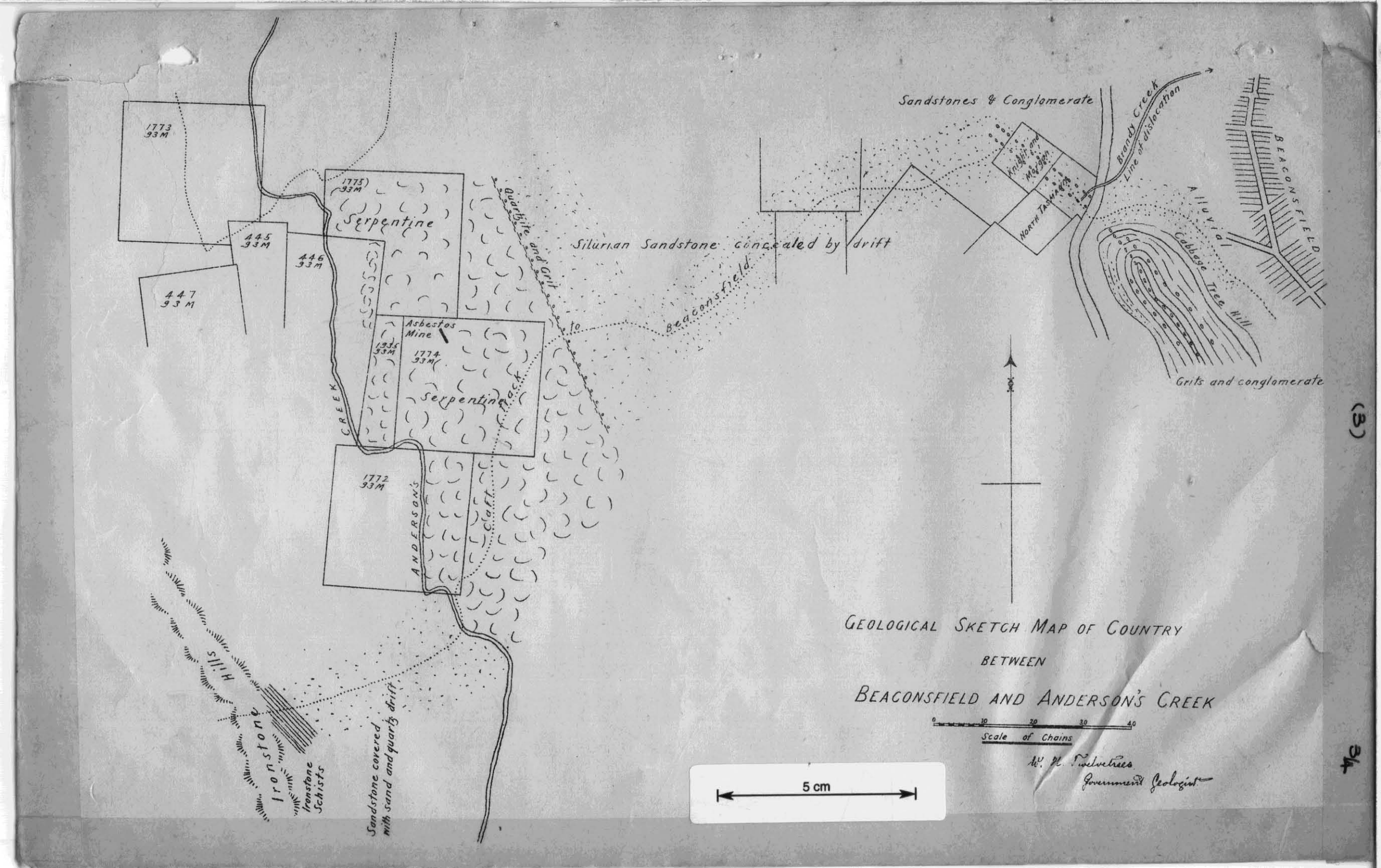
As serpentine is metamorphic, I endeavoured to trace it to its parent rock. A search resulted in the discovery of specimens of the rock from which it originated. Although this rock is much serpentinised, it is still fresh enough for identification. In an old cutting in the lower part of Section 1774, I noticed, among the blocks of stone which had been quarried, a dark heavy granular to compact igneous rock, strongly resembling a peridotite or pyroxenite. Felsparless, and showing glistening faces of bronzite, it is readily recognised as an ultra-basic rock. Its low specific gravity, 2·71, must be due to its serpentinisation. The examination of a microscopical slice shows that felspar is entirely absent, and that the rock is a peridotite, consisting of bronzite (enstatite) and olivine. This variety is known as harzburgite. The olivine is nearly all serpentinised, and the bronzite is in process of conversion into its serpentinous modification—bastite. It will be remembered that it is with such a rock as this that the nickel-iron alloy awaruite of New Zealand is associated. I feel confident that here it does not form an intrusion into the serpentine, but graduates into typical serpentine rock, and is, in fact, the original rock. Further reference to it will be made in my petrographical report at the end of the year. The preceding remarks seemed necessary to show that the serpentine in this locality has been derived from an ultra-basic rock, and not from gabbro.

Asbestos has come to be a term which no longer denotes any true mineral species. Asbestiform means simply a fibrous condition developed in rocks originally actinolitic, pyroxenic, or olivine-bearing. In the present case it is developed in serpentine after olivine. The asbestos occurs in several modifications, more or less distinct : chrysolite, cotton-stone, picrolite, mountain leather, &c.

The company lay great stress upon a variety of asbestiform rock, which is not so pure nor so delicately fibrous as the vein chrysotile, but to which they are devoting their exclusive attention. It is a somewhat massive "cotton-stone," with matted, interlacing fibres, and encloses less decomposed fragments of rather soft, and sometimes pasty, serpentinous rock. On crushing these fragments they are reduced to a talcose, often minutely fibrous, material. This variety is what the company call "asbestic," a fibrous matted asbestos, mixed with earthy, partly decomposed, magnesian rock. A few years ago such rock in asbestos quarries was neglected as so much waste, but it is now worked up and largely used for lining and plastering purposes, for which it is extremely useful, setting quickly and hard, needing no hair nor sand, and being incombustible. Asbestic proper, then, is a manufactured article, an asbestos plaster, in which the short fibre-stuff and impure varieties of asbestos are used. Laid over woodwork, it renders the structure fireproof, under ordinary conditions. It is durable, and, besides being tough, it is elastic, a very valuable quality in a plaster, for it is not liable to crack when walls settle after building. As hair need not be used with it, it is germ-proof. The manufacture of "asbestic" seems to have commenced in 1896, and a large crushing and cleaning mill has been put up at the Danville mines in Canada, the principal centre of production, by the Danville Asbestos and Slate Company. The advantages just enumerated at once created a strong demand for the article, and there is now more asbestic sold in the world than asbestos. The Danville mines, however, are said to be running out of stock, and it is anticipated that the Tasmanian industry will feel the benefit thereof.

About 20 ft. below the S. brow of the hill a face 12 ft. wide has been cut into a seam of natural asbestic for a height of 10 ft. From this bench 100 tons were broken recently, bagged, and shipped to Melbourne. The seam is running N. 22° W., and is traceable 150 ft. further up the hill, where it would gain 10 ft. additional backs. Thirty feet below the floor of this bench a second bench is being cut in asbestic rock, which will give, when advanced into the hill, a face 50 ft. high, and ultimately 50 ft. wide. When I was there nine men were at work in one shift. A tramway 232 ft. long conveys the stone to the tip, the waste forming one side of the embankment, and cobbing stuff being thrown on the other side. The material from this cut, however, is not being bagged, as it is intended to junction with the top cutting and work the face where the fibre is better. The seam or band of asbestiform rock is good jumping ground, and the mining cost, inclusive of dead-work, of the first 100 tons, did not exceed 3*s.* 6*d.* a ton. With a face such as that now in preparation, marketable stuff ought to be broken out for not more than 1*s.* a ton, provided the proper quality is maintained. At present 6*s.* per ton has to be paid for transport to Beauty Point, and thence 9*s.* 6*d.* a ton per Union Co.'s steamer *viâ* Launceston to Melbourne ; but both transport and freight charges can be materially reduced once a regular output is attained.

The seam or filling is not a lode, and its continuity cannot be relied upon, even though the line of decomposition may be discernible for a considerable distance. It is highly improbable that its width will be constant, but if it continue downwards, as is likely enough, its quality may be expected to improve as it gets below the reach of surface waters, which produce an injurious effect by adding iron oxide and other deleterious ingredients. An excess of iron will diminish the elasticity of the fibre, discolour it, and take away its value by rendering it fusible. I took average samples of the stuff broken in the top cutting when work was being begun



GEOLOGICAL SKETCH MAP OF COUNTRY

BETWEEN

BEACONSFIELD AND ANDERSON'S CREEK

0 10 20 30 40

Scale of Chains

W. H. Twelvetrees.

Government Geologist

(3)

34

(4)

there. These came from about 6 feet below surface, and Mr. W. F. Ward, the Government Analyst, assayed them for iron oxide, with the following results :—

Bulk of sample (1000 grains), consisting of impure asbetos and earthy material, contained	28·35 per cent. oxide of iron
Asbestos, unmixed with impurities (180 grains), contained	7·74 „ „

This excessive proportion of iron is no doubt due to proximity to surface, and there is reason to believe that the asbestos will be purer the deeper the works go down. For comparison, I give a few assays of Canadian asbestos, culled from different sources, but it is only fair to remark that they refer to typical asbestos, and not to impure asbestic rock :—

Assay by Boyd	5·75	per cent. iron oxide
„ Prof. Durst...	5·77	„ „
„ Prof. Donald	2·41	„ „
„ „	2·26	„ „
„ „	0·69	„ „
„ „	2·23	„ „
„ „	3·66	„ „
„ „	2·81	„ „

The quantity of water, too, which is in a state of chemical combination, varies somewhat, the most flexible fibre containing the greater quantity. The percentages arrived at in different assays are—12·2, 12·5, 12·62, 13·55, 13·8, 14·05, 14·25, 14·28, 14·31, 14·37, and 14·48.

The chemical composition of serpentine and asbestos is practically identical for both. Thus Professor J. T. Donald gives the following analysis of Canadian asbestos and serpentine :—

	Asbestos, very finest quality, from the Thetford-Black Lake District.	Serpentine, from the Ottawa Laurentian.
	%	%
Silica	40·57	40·52
Magnesia	41·50	42·05
Ferrous oxide	2·81	1·97
Alumina	·90	2·10
Water	13·55	13·46
	99·33	100·10

The uses of asbestos are numerous, and are increasing yearly. It is used for steam-packing, boiler-covering, theatre curtains, knitting yarn, fire-escape ropes, filtering-cloth in chlorination works, brattice-cloth in coal mines, paint, roofing, plaster, paper, millboard, &c.

Eighty per cent. to 90 per cent. of the world's production is supplied by Canada. The first Canadian mine was started in 1878, and that country soon supplanted Italy in the yield of asbestos for common economic purposes, though, as the Canadian fibre, mostly from 1½ to 2 inches long (exceptionally, 4 inches to 6 inches), is shorter than the Italian, the latter commands its own special market. In Canada this mineral is usually quarried. The stone has to be cobbed by hand, or passed through a stone breaker and rolls if the veins are small and separation is difficult. All the Canadian mines are supplied with the necessary reduction machinery, and if the Beaconsfield Company find their enterprise progressing satisfactorily, they intend erecting a suitable plant at the mine.

The face which the company will now operate upon will give a good quantity of marketable low-grade stuff suitable for making asbestic ; and it can be quarried very cheaply. The 100 tons already shipped is evidently of the right quality, for I was shown instructions to ship another 50 tons, so that the company are getting fair returns from the start. I believe the price realised for the mineral, after final treatment in Melbourne, is £5 or £6, but the Melbourne manager of the company writes, that as they are only yet in the initial stage of grinding and getting the produce ready for market, a price cannot be quoted just yet. The directors have, however, instructed their mine manager to ship another 100 tons. The mine ought to contribute a fair share to the world's output, for though the Canadian production has greatly increased, the annual supply does not run into very large figures, as may be seen from the following particulars taken from Rothwell's Mineral Industry :—1879, 300 tons ; 1880, 380 tons ; 1881, 540 tons ; 1882, 818 tons ; 1883, 955 tons ; 1884, 1141 tons ; 1885, 2440 tons ; 1886, 2458 tons ; 1887, 4619 tons ; 1888, 4404 tons ; 1889, 6113 tons ; 1890, 9860 tons ; 1891, 9279 tons ; 1892, 7431 tons ; 1893, 5539 tons ; 1894, 7649 tons ; 1895, 8275 tons ; 1896, 10,380 tons.

A great deal of the permanent success of this mine, however, will depend upon the regularity with which new faces of stone are brought into work, for it must be borne in mind that the seam cannot be trusted beyond the point of the pick. I should recommend that the seam be carefully traced and opened upon in advance of the present works, and exploratory work started in some of the other places where fibrous rock is seen. However encouraging a single face may be, and that which is now being worked is undoubtedly promising, it is insufficient as a basis of constant supply. With so little work done as yet, it is impossible to forecast what the enterprise may not grow into. I have been continually told that several trials of this asbestos have been made from time to time, and to no purpose : but it seems to be forgotten that these attempts were made in the days when only pure and long-fibre asbestos could find a sale, and that the manufacture of "asbestic" does not date back more than four years. The mere fact that 10 or 20 years ago no market could be found for the Tasmanian article does not affect the value of the deposit to-day. It is now available for many uses not dreamed of a quarter of a century ago. While I do not estimate any enormous quantity of fibre as in sight, there is probably enough to make the enterprise fairly remunerative. Provided the work is carried on in a legitimate and miner-like way, all reasonable encouragement should be given to the adventurers, for the success of this novel industry must be productive of benefit to the district, as well as to the Colony at large.

I have the honour to be,
Sir,
Your obedient Servant,

W. H. TWELVETREES,
Government Geologist.

W. H. Wallace, *Esq.*,
Secretary for Mines, Hobart.

Note.—Some boulder-like masses of a grey to greenish quartz-like silicate have been found in the asbestos seam. When first met with they were supposed to be waterworn boulders of quartz, but they are not quartz, nor are they waterworn. The mineral has been determined by Mr. W. F. Petterd as scapolite, a silicate of alumina and lime, and it appears also to be intimately mixed with the rhodonite mentioned in this Report.