PRELIMINARY NOTE ON THE ROCKS USED IN THE MANUFACTURE OF THE TRONATTAS.

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(Read 12th July, 1909.)

The observations here recorded are based on the examination of more than 5,000 specimens, all collected by myself chiefly in the southern and central parts of Tasmania. The results derived from the study of such a large number may be taken as fairly accurate, yet I must consider them as preliminary only, because they are solely dependent on macroscopical observations, while the very important microscopical examination is still outstanding. I am aware that this is a serious drawback, but the results obtained without the aid of the microscope are full of interest, and they will be a great help to those who may eventually take up the microscopical part.

Brough Smith (1) was probably the first who recognised the nature of the rocks used by the Aborigines for their implements, but it was left to Mr. Johnstone to ascertain the fact that "the cherty rock from which the natives of Tasmania for the most part manufactured their flints was undoubtedly derived from upper palaeozoic mudstones, which are frequently metamorphosed into a cherty substance by contact with the later eruptive greenstones" (2). Localities where this particular kind of rock occurs are not uncommon, and most of them, if not all, have been habitually visited by the Aborigines in order to obtain suitable pieces of rock.

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(1) The Aborigines of Victoria, London, 1878, Vol. II., Appendix, pages 400 and 401.

(2) Geology of Tasmania, Hobart, 1888, page 334.

In a paper previously read before this Society (1) I have demonstrated that another, probably still more important source where suitable substances were obtained from are the gravel deposits of glacial and recent age. It is needless to say that the pebbles contained in these gravels are in a secondary position, and they must have been derived from outcrops similar to those which were used as quarries.

If the metamorphic theory is correct, it stands to reason that there must be a considerable number of varieties of cherty rocks. A metamorphosed sandstone must be considerably different from a rock whose origin is a shale. But not only are the primary rocks widely different in chemical composition, but each kind, whether sandstone, shale, or anything else, varies considerably. The cement which binds together the grains of quartz in the sandstone may be calcareous or siliceous, and, above all, the percentage of iron varies considerably in each class of rock. It is therefore a priori very probable that a large number of varieties as to colour and other physical qualities must be the result of metamorphism, and I wish to deal in this paper with the main types that can be distinguished.

Whenever a collection of native stone implements is made in the island, and such collection be sorted afterwards, it will be found that two large groups can be distinguished at once, viz.—

1. Volcanic rocks,
2. Metamorphosed sedimentary rock of a highly siliceous nature.

Though I propose to deal here only with the siliceous rocks, it will be advisable to say also a few words about the volcanic rocks. One fact becomes conspicuous at once—not a single chipped implement has been found that is manufactured from a volcanic rock. All the chipped implements, the tronattas s.s., are invariably manufactured from the siliceous rocks.

Not in a single instance has this rule been broken, and the reason for this is, as we will see later on, quite

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(1) Notes on a Chipped Boulder found near Kempton. "Pap. and Proceed. Roy. Soc., 1908."

obvious. The implements made of volcanic rocks, mostly if not exclusively of Diabas, consist of rounded natural pebbles, which were partly used as hammers, partly turned into sacred stones, and natural pieces of columnar Diabas most probably used as choppers, but they were never subjected to the elaborate flaking of the cherty rocks.

The tronattas were exclusively manufactured from cherty rocks, and even the untrained collector will notice a large variety of colour. There are specimens of a deep jet-black, and others of a dazzling white; there are rocks of a blood-red or a bright yellow colour; there are others of a grey tinge, and those of a more indifferent colour are too numerous to mention. In fact it seems that all the colours of the spectrum are represented except that which is so common in another island of the Pacific, the green of the New Zealand stone implements.

On closer examination it will be noticed that besides the colour there are other differences in the appearance, and after a short time the observer will be able to distinguish at least four different main types of the siliceous rocks. These are:—

1. Chert, or preferably called Hornstone (1).
2. Porcellanite.
3. Breccia.
4. Other siliceous rocks not included under the above headings, such as Chalcedony, Wood-Opal, Fossil Wood, Quartz.

1. CHERT OR HORNSTONE.—This is generally a finely-grained rock, showing a dull lustre, but a fine conchoidal fracture. Its colour varies from a light grey to almost jet black. Dark grey and bluish tinges are the most frequent; light grey is somewhat rarer; and a dark reddish-brown colour is the rarest of all. On the whole the colour of the hornstones is somewhat dull, and the bright tinges exhibited by the next group have so far not been observed among the hornstones. Fre-

(1) Dana, System of Mineralogy.

quently the colour is streaky, darker and lighter coloured bands regularly alternating, particularly in the grey varieties.

Tronattas made of hornstone are unquestionably the most common. As stated in a previous paper, hornstone was obtained from Clarke's quarry (Mount Communication), Johnstone's quarry (Coal Hill, Melton-Mowbray), Hutchison's quarry (Front shelves run, Beaufront, Syndal), Nichols' quarry (Melton-Mowbray), and probably also from Bisdee's quarry (Great Lake) and Walker's quarry (River Plenty). At most of these quarries a dark blue hornstone was obtained, only at Nichols' quarry and the eastern part of Hutchison's quarry a grey hornstone occurs. This seems to indicate that the blue hornstone is of more frequent occurrence than the grey one, a fact which is borne out by the number of implements manufactured from either rock.

The hornstone has a peculiar chemical feature not observed in the other kinds of rocks used for implements; when exposed to the action of the atmosphere it becomes coated with a peculiar earthy-looking crust of whitish or more frequently yellow or rusty-brown colour. This "patina" so completely covers the rock that it is frequently impossible to ascertain its true colour without breaking the specimen, or at least striking off a small particle. There can be not the slightest doubt that the patina is the result of a superficial chemical decomposition, the more soluble elements were removed, while the less soluble, in particular iron and alumina, were left behind. But not only do the stone implements show this crust, in a still higher degree is it exhibited by the rock as found in the quarries in situ, where it often attains as much as three-quarters of an inch in thickness.

The tronattas are usually covered with a thin patina only, which in no way obliterates the sharp edges produced by chipping. There are, however, other specimens in which the patina has reached such a thickness that the original chipping begins to disappear. There can be no doubt that the thickness of the patina is a function of time, and the thicker it is the older is the implement. Unfortunately no data are available to estimate the number of years it takes to form a patina of a certain thickness. The process must, however, be a very slow one. At Maryvale I found some specimens which were unquestionably re-chipped. Though this must have been done at the very least 75 years ago, the later fractures did not show even a trace of patina, but exhibited the deep jet-black of the hornstone, strangely contrasting with the whitish patina which covered the whole surface. This being so, I doubt whether we will ever be able to ascertain this factor, because it is unquestionable that centuries must lapse before any patina of any appreciable thickness is formed. There is, however, no doubt that if by the combined work of generations this factor could be ascertained, one of the most valuable data for the estimation of the length of the past would be obtained.

When exposed to the action of blown sand, the hornstone takes a fine polish, exhibiting a peculiar shiny lustre, quite different from the original dull one. Blown sand, however, apparently prevents the formation of a patina.

The heat of fire affects the hornstone in a peculiar way; the surface becomes covered with a number of fine cracks, generally running in parallel lines, and connected by short cross cracks. It appears that these cracks are only superficial, and never penetrate deeply into the stone. If such a cracked hornstone is exposed to the air parts of its surface commence to break off, leaving a rough jagged surface, which greatly differs in appearance from the even, smooth surface produced by flaking. There is no doubt that in this way the finest tronatta can be destroyed beyond recognition.

The natural crust which is still preserved in a number of specimens is always more intensely affected by the heat than the original stone. It breaks into a number of irregular polygonal pieces, strangely resembling a tesselated pavement in miniature.

Hornstone flakes exceedingly well, and with a little practice large flakes, showing a fine, flat face and a sharp cutting edge can be struck off a larger block. There can be no doubt, however, that in certain instances the blow must have been carried out with tremendous force. The largest specimen I have so far found measures 7.4

inch in length, having a weight of 3½lb. It is safe to assume that this specimen was struck off a block of much larger size, and, what is still more remarkable, the plane face (pollical face), which has a superficial area of about 17 square inches, cuts the lines of stratification at a right angle. If the cleaving had been done along the line of bedding it might perhaps be easier to understand how such a large plane could be the result of a single blow; but as it cuts it at a right angle, the blow which struck this specimen off must have been administered with tremendous force. It is probably the fine flaking qualities that made the hornstone the favourite material used for the tronatta, and there can also be no doubt that the valued "mora trona," the black flint of the vocabularies, specially refers to hornstone.

While the true cretaceous flint of Europe is a sedimentary siliceous rock, the hornstone of Tasmania is of different origin. Primarily it is a sedimentary rock, but this sedimentary rock has subsequently been altered by the eruption of volcanic rocks such as diabas or basalt.

According to the nature of the original rock, a large number of varieties were produced, but foremost of all are dark blue and grey varieties, showing an extremely fine banded texture. For the present I am unable to say anything about the original rock, because none of the quarries shows the gradual passage from the unaltered to the highly metamorphosed rock; but there is every probability that the original rock was a finely-grained, thinly-bedded shale, such as occur in the coal measures of Permian age.

I have taken the specific gravity of 19 specimens of hornstone collected at different localities, which are given in the subjoined table:—

1. Grey Hornstone, from Mona Vale	2.500
2. Blue Hornstone, from Mona Vale	2.566
3. Blue Hornstone, Syndal Quarry	2.610
4. Reddish Brown Hornstone, Mona Vale	2.616
5. Blue Hornstone, Syndal Quarry	2.631
6. Blue Hornstone, Mona Vale	2.644
7. Dark Grey Hornstone, Mona Vale	2.645
8. Dark Blue Hornstone, Kempton	2.666
9. Blue Hornstone, Kempton	2.679

10.	Grey Hornstone, Mona Vale	2.681
11.	Dark Blue Hornstone, Mona Vale	2.701
12.	Grey Streaky Hornstone, Melton Mowbray	2.701
13.	Blue Hornstone, Johnstone's Quarry, Melton Mowbray	2.703
14.	Grey Streaky Hornstone, Melton Mowbray	2.735
15.	Blue Hornstone, Johnstone's Quarry, Melton Mowbray	2.746
16.	Blue Hornstone, Mona Vale	2.750
17.	Blue Hornstone, Johnstone's Quarry, Melton Mowbray	2.761
18.	Grey Hornstone, Nichols' Quarry, Melton Mowbray	2.780
19.	Light Grey Hornstone, Mona Vale	2.847

The above figures prove at once that the Tasmanian Hornstone is rather a heavy rock; the average specific gravity being 2.687, it will be seen that only two specimens are under 2.600, while all the others are well above this. The figures for specimens obtained directly from the quarry are rather interesting. They are for:—

Hutchison's Quarry, Syndal—a very dark blue hornstone—

(3) 2.610.
(5) 2.631.

Johnstone's Quarry, Coal Hill, Melton Mowbray—a dark blue hornstone—

(13) 2.703.
(15) 2.746.
(17) 2.761.

Nichols' Quarry, Melton Mowbray—a grey hornstone—

(18) 2.780.

These figures seem to indicate that the hornstone from different places varies somewhat, and that, strange to say, the light grey variety is the heaviest of all, while the dark blue stone found in Hutchison's quarry is, contrary to expectations, the lightest of all. On the other hand, the figures for one and the same locality vary, and I am afraid that, however tempting it may be to ascertain the locality from which a certain implement came by means of the spec. gravity, it is impossible to do this for the present.

2. PORCELLANITE.—This is a much coarser grained rock than hornstone, always showing a shiny waxy lustre, thereby strongly differing from the dull hornstone. Its colour varies from a pure white to almost black; most frequent are red, yellow, and brown tinges; grey is not infrequent, the dark tones being the rarest; sometimes several colours, for instance red and yellow, alternate, and the rock becomes streaky.

Tronattas made of porcellanite are much less frequent, and so far I know of only two localities where porcellanite is found in situ. One is near Pontville station, and this was used as a quarry (Weston's Quarry); the other is an outcrop near Maryvale, which, however, was probably never worked. In Weston's Quarry the colour of the rock varies from white through grey and red.

Porcellanite never shows a patina, and this proves that its chemical composition must considerably differ from that of hornstone.

The fracture is conchoidal, and some of the porcellanites flake as well as hornstone; yet it was a much less favourite rock than the latter. I believe the reason for this is the coarser grain, because tronattas made of porcellanite are generally never so elaborately worked as those of hornstone.

Blown sand does not affect the porcellanite as much as the hornstone. Of course it also gets the peculiar coating due to this cause, but inasmuch as it has a shiny lustre of its own, the blown sand does not affect it much.

The heat of fire acts quite differently on porcellanite. Instead of a multitude of superficial cracks there are only a few, which divide the rock in small polygonal pieces of rather peculiar appearance, such as are found in Weston's Quarry, near Pontville station. If exposed to a very strong heat porcellanite apparently loses its waxy lustre, and becomes dull; at the same time the surface gets covered with a glassy coat.

Porcellanite is, like hornstone, a metamorphosed sedimentary rock, and at Pontville it can be distinctly seen that it is an altered sandstone. Opposite the railway station the western hills are formed of sandstone, and immediately on the other side of the line the porcellanite occurs, which in its turn is followed by Diabas. Though the line of contact is not clearly seen, there can be no doubt as to the true relations of Diabas, porcellanite, and sandstone. The specific gravity of 12 specimens is as follows:—

1. White Porcellanite, Weston's Quarry, Pontville	2.308
2. White Porcellanite, Weston's Quarry, Pontville	2.346
3. Red Porcellanite, Melton Mowbray	2.362
4. White Porcellanite, Weston's Quarry, Pontville	2.382
5. Grey Porcellanite, Melton Mowbray..	2.500
6. Grey Porcellanite, Mona Vale	2.506
7. White Porcellanite, Melton Mowbray	2.522
8. Red Porcellanite, Weston's Quarry, Pontville	2.558
9. Brown Porcellanite, Old Beach	2.566
10. Pink Porcellanite, Kempton	2.578
11. Reddish Grey Porcellanite, Kempton	2.654
12. Dark, nearly black Porcellanite, Mona Vale	2.700

The average specific gravity is 2.498, and the above figures seem to indicate that as a rule the coloured varieties are heavier than the white ones, and that the darker tinges are again heavier than the lighter ones. If these few figures permit of such a conclusion, it seems that the specific gravity increases with the following scale of colour:—

Lightest Heaviest
White .. Grey .. Red .. Brown .. Black

As the colour is unquestionably dependent on a certain percentage of iron, this peculiarity explains itself.

3. BRECCIA.—Under this heading I include all those siliceous rocks used in the manufacture of tronattas in which angular fragments are embedded in a finely-grained matrix of different colour. The colour of both fragments and the matrix varies a good deal, but most common is a yellow or brown matrix containing lighter-coloured fragments.

The fracture is splintery, and, though a little conchoidal, the breccia does not flake as well as hornstone or porcellanite.

Like porcellanite, the breccia never develops a patina, but when exposed to blown sand it takes a fine, smooth polish. Fire acts differently on breccia—in fact the result is more like that of chalcedony than of either hornstone or porcellanite. The whole specimen is covered by numerous cracks, intersecting each other in all directions, but apparently not penetrating deeply into the interior.

Breccia is much less frequently used for implements then either of the foregoing rocks, and I never found a specimen showing careful chipping on the indical face. All tronattas consisting of breccia are of the crudest types. I think that this is due to the inferior quality of the fracture, but in particular to its splintery nature.

Breccia does not seem to occur very frequently. Only one actual outcrop is known to me, at Droughty Point. The rock occurs here in large, loose blocks and boulders, lying near the shore on the top of a volcanic rock. There is no doubt that this occurrence has been made use of by the Aborigines, though it cannot be termed a regular quarry, but the ground close to these boulders contains a large number of implements which have been manufactured from this breccia. Mr. Stephens kindly told me that there is another occurrence near Ulverstone, and it appears that the tronattas found near Devonport were derived from that source.

Geologically speaking the breccia is perhaps the most interesting of all. There can be no doubt that the Droughty Point breccia must be considered as a deposit of hot springs. In fact it is a silica sinter, as is conclusively proved by the fine banded texture of the matrix.

On the other hand, the beautiful black and white breccia from Mona Vale appears to be a true breccia porphyry. Here the molten magma penetrated through a conglomerate, breaking it up into angular fragments, which floated in the magma, and became thereby metamorphosed. It further appears that a certain group of rocks found near Margate, which I provisionally classify with the breccia, is a really micro-crystalline porphyry of yellow colour. It is impossible to decide these questions without a microscopical examination, but should this be carried out the most interesting results are certain to be obtained.

I determined the specific gravity of 11 different pieces, which gave the following figures:—

1.	Red Breccia, Droughty Point	2.540
2.	Brown Breccia, Droughty Point	2.588
3.	Grey Breccia, Droughty Point	2.590
4.	Red Breccia, Droughty Point	2.610
5.	Brown Breccia, Droughty Point	2.616
6.	Brown Breccia, Droughty Point	2.621
7.	Red Breccia, Bellerive	2.653
8.	White and Black Breccia, Mona Vale	2.654
9.	Grey, Streaky Breccia, Droughty Point ..	2.655
10.	Red Breccia, Droughty Point	2.686
11.	Brown Breccia, Droughty Point	2.782

The average specific gravity is 2.636, but it does not seem that there is a connection between colour and specific gravity. The range is apparently a much smaller one, as there is only 0.242 difference between the lightest and the heaviest variety examined.

4. OTHER SILICEOUS ROCKS NOT INCLUDED UNDER THE ABOVE HEADINGS, SUCH AS CHALCEDONY, QUARTZ, WOOD OPAL, FOSSIL WOOD.

This group includes rather a heterogenous mixture of siliceous minerals, which have been provisionally placed together. It is remarkable to note that not a single implement made of any of this mineral has come under my notice which shows a good finish. All the specimens are of the very crudest type, and generally mere fragments only. The reason is obvious. None of them except wood opal shows that fine conchoidal fracture which is so essential for a good tronatta. Chalcedony in its numerous varieties has a very splintery, rough fracture, which is still stronger in the ordinary quartz. Wood opal has a fine conchoidal fracture, but it appears that it is too soft for rough use. Anyhow, none of these minerals played an important role in the economic life of the Aborigines.

The heat affects these minerals in a way quite different from hornstone or porcellanite. In wood opal the fire produces a few cracks, which appear to penetrate deeply into the interior. The cracks are rather irregular, fairly wide apart; in somewhat this comes closest in appearance to hornstone, but the cracks are more irregular, further distant, and deeper.

Very different is the appearance of the white, milky chalcedony. This is intersected by a large number of irregular cracks running in all directions, and penetrating through the whole mass of the specimen. A more brownish rather transparent chalcedony shows the same features, part of the surface is broken off, and instead of the smooth surface produced by flaking, it is rough and jagged.

These pieces of chalcedony resemble very closely to the famous cracked flints from the Oligocene of Thenay in France; in fact, the darker specimen can hardly be distinguished from the European ones.

The examination of 11 specimens gave the following results for specific gravity:—

1.	Opaque Wood Opal, Maryvale	1.940
2.	White Chalcedony, Maryvale	2.289
3.	White Chalcedony, Baskerville	2.433
4.	Milky Opaque Chalcedony, Mona Vale	2.436
5.	Fossil Wood, Mona Vale	2.465
6.	Wood Opal, Mona Vale	2.533
7.	Chalcedony, Melton Mowbray	2.583
8.	Do., Melton Mowbray	2.592
9.	Do., Melton Mowbray	2.606
10.	Fossil Wood, Droughty Point	2.666
11.	Milky Quartz, Mona Vale	2.680

The average specific gravity, if it be permissible to take it of such a heterogenous group, would be 2.472.

Before proceeding any further, I must explain why I never mentioned the hardness. The old method of determining the hardness of a mineral or a rock is a most crude and unsatisfactory one. If determined in this way, all the rocks and minerals here enumerated have exactly the same hardness, namely, that of quartz; that is to say about seven, though this would probably represent the maximum. The hardness of the rocks here mentioned ranges between 6 and 7, though most will be about 6.5 to 6.75, but it would be absolutely impossible to distinguish the finer grades, which are certain to exist. If determination of hardness were made, it should be carried out according to the more improved methods suggested by Rossival, but this is a very tedious operation, which requires a lot of mechanical appliances not at my disposal. It is therefore unnecessary to make a special reference to the hardness, because it must be a matter of course that rocks consisting mostly of silica must have a hardness closely approaching to that of quartz. I fail to understand why under these circumstances Herr Klaatsch could have stated that the rocks used in the manufacture of tronattas were rather soft. This is by no means the case —in fact some of the grey hornstones appear to be harder than flint, the ordinary material of the European rocks. Herr Klaatsch's statement is one of those superficial observations by which this author has gained rather a notoriety, and in this particular case his erroneous opinion is either due to insufficient mineralogical knowledge or insufficient material, or both.

When we compare the specific gravity of the rocks here mentioned we obtain some rather interesting results. Taken as a whole we have:—

1. Hornstone.—Range, 2.500—2.847; difference, 0.347; average, 2.687.

2. Porcellanite.—Range, 2.308—2.700; difference, 0.392; average, 2.498.

3. Breccia.—Range, 2.540—2.782; difference, 0.242; average, 2.636.

4. Others.—Range, 1.940—2.680; difference, 0.740; average, 2.472.

It will be seen that the breccia shows the smallest difference between extremes, while that of the fourth group has, as might be expected, the largest. Hornstone and porcellanite show a fairly wide range, which seems to indicate a rather varying composition of the original rock from which they are derived. Hornstone is the heaviest of all, and it is closely followed by the breccia, while there is a considerable difference between these two and porcellanite, as will be seen from the following figures:—

Hornstone, 2.687;
Difference, 0.051.
Breccia, 2.636;
Difference, 0.138.
Porcellanite, 2.498;
Difference, 0.022.
Others, 2.472.

According to these figures there is less difference in the specific gravity of the more pure siliceous minerals and the porcellanite than between the porcellanite on the one side and the breccia and hornstone on the other. If a conclusion can be drawn from this, it seems to indicate that the porcellanites are a fairly pure siliceous rocks with a comparatively small admixture of other substances, while in the breccia, but particularly the hornstone, the percentage of non-siliceous matter must be fairly high.

If we compare these rocks to other substances, the following table of specific gravity will be of interest:—

Obsidian buttons, average 2.388, maximum 2.500, minimum 2.312.

Fragment of white glass, 2.424.
Fragment of green bottle glass, 2.674.
Flint Salzinnes (Belgium), 2.565.
Flint St. Symphorien (Belgium), 2.535.

The heavy weight of the green bottle glass is most conspicuous, and, as we know that this is chiefly due to the high percentage of iron, the conclusion I have drawn with reference to the hornstone and breccia is well supported.

Now, if we take the specific gravity of the cretaceous flint to be 2.500—2.600, we can arrange the rocks here described in a very illustrative table. They are:—

SPECIFIC GRAVITY.

	Number of Specimens.	Less than 2.400	From 2.401 to 2.500	From 2.501 to 2.600	From 2.601 to 2.700	From 2.701 to 2.800	From 2.801 to 2.900
Hornstone ...	19	0	0	2	8	8	1
Breccia... ...	11	0	0	3	7	1	0
Porcellanite ...	12	4	1	5	1	1	0
Others	11	2	3	3	3	0	0
Total	53	6	4	13	19	10	1

If calculated in per cents, this table can be condensed to a little one, particularly if we assume three groups of specific gravity in comparison to flint, viz., lighter, equal, and heavier than flint. We have then

	Specific Gravity lower than 2.500 lighter than Flint.	Specific Gravity 2.500 to 2.600 equal to Flint.	Specific Gravity more than 2.600 heavier than Flint.
Hornstone... ...	nil	10.5 %	89.4 %
Breccia	nil	27.2 %	72.7 %
Porcellanite ...	41.6 %	41.6 %	16.6 %
Others	45.4 %	27.2 %	27.2 %
Total	18.8 %	24.5 %	56.6 %

This table is of the greatest interest, because it proves that the majority of the rocks used for the manufacture of the tronatta were considerably heavier than flint, from which the European eolithes and archaeolithes were made.

These figures will be more illustrative still if we compare the ratio of frequency of the different kind of rocks used in the manufacture of tronatta. The following figures are arranged according to localities:—

	Geilston per cent.	Old Beach per cent.	Shene per cent.	Melton-Mowbray per cent.	Mona Vale per cent.	Mount Morriston Trefusis per cent.	Maryvale per cent.	Average per cent.
1. Hornstone	52.4	62.2	79.4	86.8	86.9	89.9	90.9	78.35
2. Porcellanite	26.2	16.3	11.8	7.3	9.6	7.8	4.5	11.93
3. Breccia ...	14.4	13.5	2.7	0.7	0.0	0.0	2.2	4.78
4. Others ...	7.6	7.9	5.9	5.1	3.4	2.3	2.3	4.91

The average figures, based on the examination of such a large number as 5,000 specimens, conclusively prove the preponderance of hornstone. We may say almost eight out of every 10 tronattas are made of hornstone, and, in comparison to it, the use of the other rocks is insignificant. Next to hornstone comes the porcellanite, while the use of breccia and other rocks is very limited.

The figures obtained for these seven localities are rather interesting, inasmuch as they seem to prove that the selection of the rocks was influenced by local conditions. In the neighbourhood of Hobart, where hornstone is rather rare, while porcellanites and in particular breccia are common, the last two rocks show a much higher percentage than at any other place. There is no outcrop of hornstone known to me near Hobart—certainly not one that has been used by the Aborigines. The nearest quarries—Clark's Quarry, or Mount Communication and Walker's Quarry, near Plenty, are about 20 to 22 miles in a straight line. Johnstone's and Nichols' Quarries are about 30 miles distant. Unless we assume that the Aborigines broke the stone at these quarries and carried it to their camping grounds, near Geilston and Old Beach—a view which is not very probable—we must suppose that they collected the rough stone locally in gravel deposits. The proportion in which the different rocks occur in these deposits is therefore reflected in the above figures. Where quarries were handy, at places like Mona Vale, Mount Morriston—Trefusis, and Melton Mowbray, the hornstone was used in preference to all other rocks. It seems, however, remarkable that at Shene, but particularly at Maryvale, where no quarry is known to be near except the porcellanite outcrop (Weston's Quarry) near Pontville, the percentage of hornstone reaches the highest figure, and that, though a porcellanite quarry was handy, the percentage of that rock is not more than 11.8 per cent. of the total. This seems to prove more than anything the preference for the hornstone.

To me all this seems to show that though the hornstone was by far the most valued rock, and if possible was used in preference to any other, porcellanite and breccia were made use of only when the supply of hornstone was not ample.

Now, if we compare how many specimens would be lighter, equal, and heavier to flint, according to the above figures for the frequency of occurrence we find that

	Average percentage of Frequency.	Specific Gravity lighter than Flint.	Specific Gravity equal to Flint.	Specific Gravity heavier than Flint.
Hornstone ...	78.35 %	nil	8.30 %	70.04 %
Breccia	4.78 %	nil	1.30 %	3.47 %
Porcellanite ...	11.93 %	4.97 %	4.97 %	1.98 %
Others	4.91 %	2.30 %	1.33 %	1.33 %
Total	100 %	7.27 %	15.90 %	76.82 %

In comparing this table with that on page 15, it seems at the first glance that there is a great discrepancy between the ratio of lighter, equal, and heavier than flint. It must be borne in mind that the 53 specimens whose specific gravity was determined were not selected according to the proper ratio of occurrence. In order to bring the two tables in harmony I ought to have ascertained the specific gravity of 78 hornstones, 12 porcellanite, 5 breccia, and 5 others, or at the reduced ratio of say 16—3—1—1, while the actual determination was made at the ratio of

Hornstone.	Porcellanite.	Breccia.	Others.
2	1	1	1

In other words, if the determination of the specific gravity had been carried out in proportion to the frequency of occurrence, I ought to have determined it off 16 pieces of hornstone and 3 pieces of porcellanite for every one piece of breccia, and others that I examined. But instead of this I weighed only two pieces of hornstone (that is to say, one-eighth of the number that should have been examined) for one piece of breccia and others.

This explains, therefore, the difference in the figures, and it is obvious that those of the last table represent the actual figures. If I therefore collect 100 tronatta there will be

Heavier than flint 76 specimens, composed of 70 hornstone, 3 breccia, 2 porcellanite, 1 other.

Equal to flint 16 specimens, composed of 8 hornstone, 1 breccia, 5 porcellanite, 1 other.

Lighter than flint 7 specimens, composed of 0 hornstone, 0 breccia, 5 porcellanite, 2 others.

Therefore, taking weight for weight, 100 tronatta were considerably heavier than 100 European implements of exactly the same size.

The above investigation has conclusively proved that there is a great variety of rocks used in the manufacture of the tronatta. This variety of substances stands in a sharp contrast to the monotony of the material used in the manufacture of the European implements. For eolithes and archaeolithes nothing else but the well-known flint of cretaceous age was used, at least as far as I can judge from the collections at my disposal. The eolithes from the Mafflien, in Belgium, seem to form the only exception, inasmuch as a dark blue hornstone, somewhat resembling that from Johnstone's or Hutchison's quarry, has been used. Variety of material and monotony of the same are the chief distinguishing feature of an otherwise undistinguishable collection of eolithes and archaeolithes from Tasmanian and Europe.