ON THE OCCURRENCE OF OBSIDIAN "BUTTONS" IN TASMANIA.

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The little grooved and rounded discs of lava known as obsidian buttons (and among local miners as fossil gum seeds [eucalyptus] or pods) found occasionally in the tin drift at Thomas Plains, Eastern Tasmania, and at Long Plain, near Waratah, have not attracted much attention hitherto, but are now acquiring particular interest from European researches in connection with similar occurrences elsewhere. They are by no means plentiful, and only eight specimens have come into our hands ; six from Thomas Plains ; one from Mr. Cherry's property at Springfield, near Scottsdale ; and another from Long Plain. Their occurrence has been recorded in the work cited below.* They are generally nearly hemispherical in shape, with a few concentric rings or flutings round the hemisphere. The edge of the disc is smoothly irregular, with distant sub-depressions. The flattened side or base is slightly concave, with a central convex elevation, which is ringed round with a distinct beading. In colour they are intense black, somewhat dull from a thin epidermal skin. The merest fracture, which is conchoidal, shows a lustrous glass beneath. On their edges the colour becomes deep grey to yellowish brown, and the glass translucent. They are somewhat constant in size, both as regards diameter and thickness, the largest measuring $1\frac{1}{8}$in. in diameter by $\frac{3}{8}$in. in height.

There are only two exceptional forms which we have seen or heard of, viz., one which has been likened to the outline of the elytra of a large beetle, which is shown by a specimen in the possession of Mr. Aug. Simson, and another of a more elongated form. In the first of these, the general pattern of its grooves, beading, and wrinkles is similar to that of the others ; and it is in fact a circular button drawn out while viscous into an elongated ellipse. This, as well as several other specimens of the normal circular buttons, was obtained by Mr. Simson from Thomas Plains. That from Long Plain is also of an abnormal shape. It was found in the alluvial quartz drift of Smith's Creek, ten feet from the surface, when sluicing for gold in the year 1891. It is sub-cyclindrical or bolt-like, somewhat constricted in the

* "Obsidian . . . has been found in circular and concave or button-like flakes of an intensely black colour in stanniferous drift, apparently igneous ejectamenta, Thomas Plains." Cat. Minerals of Tasmania. W. F. Petterd, p. 64.

middle, measuring $2\frac{3}{8}$in. long by $\frac{5}{8}$in., narrowest diameter, and $\frac{3}{4}$in. at the ends. Its sides are grooved vertically, and what may be called its base is bounded all round by a sharp edge. In both of these respects it resembles a type of button found in West Australia. Its sp. gr. is 2·45.

The occurrence of specimens both on the east and west sides of the island makes their non-discovery hitherto in the central portion remarkable.

The specific gravity of the glass ranges in different specimens from 2·45 to 2·47. This definitely excludes it from the basaltic glasses (tachylyte, etc.). Tasmanian tachylyte, which we have subjected to a specific gravity determination, varies from 2·72 to 2·77. Perhaps the lightest basalt glass recorded is that of the Säsebuhl, 2·50 to 2·54. The Icelandic sideromelane is also very light, viz., 2·53. These are very exceptional figures for the density of the vitreous form of basalt, which in general probably averages near 2·7. We have been asked whether the buttons in question may not consist of tachylyte, but a glance at their specific gravity is sufficient to dispel all doubt, irrespective of their microscopical appearance, to which reference will be made directly. The density, indeed, is that of obsidian. Under this term is understood the glassy form of the acid and sub-acid rocks, namely, rhyolite—and trachyte-glass, the specific gravity of which varies between the extremes of 2·26 and 2·55. Rhyolite glass is stated by Teall to reach a density as high as 2·41*.

Without a chemical analysis it is hazardous to say precisely whether the Tasmanian glass is rhyolite—or trachyte-obsidian, but that it is one of the two admits of no reasonable doubt. Judging by the specific gravity, it is highly probable that it belongs to the trachytic variety.

Its microscopical characters may be summarised as follows:—Transparent, colourless glass, puckered by irregularly sweeping curves in its substance, the result of cooling, and exerting a faint indefinite action on polarised light, indicative of strain. Under a low power the section looks like clear glass, but dusted with minute specks, which under a one-eighth or a one-twelfth objective, are resolved into tiny gas pores and globulites. The latter are sometimes stringed together in threes and fours, forming the linear groups called margarites. These are crystallites, and have no reaction on polarised light; short crystallitic rods also occur. All these incipient devitrification products are most numerous near the margin of the button. The gas pores may be distinguished by their dark refraction border, due to the difference between the refractive index of the empty cavities, and that of the

* British Petrography, p. 49.

glass which surrounds them (1 and 1·488). Some large circular gas pores are seen in the section surrounded by globulites and yellow glass. Here and there aggregations of globulites occur, associated with yellow or brown glass. Glass inclusions are also present. Obsidian from the Thames district, New Zealand (sp. gr. 2·41), has the same globulitic devitrification, but is sprinkled with belonites and forked microlites. The Hungarian and Mexican obsidians are crowded with crystallitic and microlitic forms, and, judging from our slides, are not comparable either with the New Zealand or the Tasmanian obsidian.

The purest natural glass in the world is perhaps fulgurite glass, which is supposed to have been produced by the fusion of rock by lightning. This structureless glass contains no crystallisation products whatever, and contains nothing beyond glass enclosures and gas vesicles*. The Tasmanian obsidian does not attain this degree of purity, but approaches to some extent the clearness of bouteillenstein, which is a remarkably pellucid natural glass. The buttons under review must not be classed with the bombs which are ejected from modern volcanoes in New Zealand. The latter are of an entirely different nature, for they belong to the basic division of eruptive rocks. They are somewhat cylindrical in shape, of a dark grey colour, externally scoriaceous, with the internal texture of a compact lava. A section which we have made of a bomb ejected from Rotorua shows it to be an olivine-basalt lava, containing phenocrysts of olivine, (invaded and corroded by the magma) and augite in a glassy base in which microliths of felspar and augite have crystallised. In accord with these basic features, we find its specific gravity to be 2·737.

The strange feature of the Tasmanian occurrence is that no glass of similar igneous rocks is known in the island, nor any trace whatever of tertiary or recent rhyolites or trachytes. The specimen from Thomas Plains which we figure was found in the old Union claim near Weldborough in 1875 below the surface soil, about 5 or 6ft. deep, in the clay which caps the stanniferous quartz drift. In all, three examples were obtained in comparatively close proximity to each other. A few years later another was obtained from a heap of tailings on Thomas Plains,, only two or three miles from those just mentioned.

Mr. John Cherry, of Springfield, in reply to our inquiry, informs us that he found a button in a bed of quartz wash six inches thick, overlaid by two feet of alluvium, the whole resting upon granite. He found a second specimen about a mile from the first, lying on the surface of the ground.

* On Fulgurite from Mt. Blanc : F. Rutley, Q. J. Geol. Soc. Vol. xli., 1885, p. 152.

Granite crops out in the side of the hill, which is capped by basaltic rock. He also states that he has not heard of any other being found.

Although so few have been actually obtained, it is not unreasonable to suppose that they may be far from rare, for such objects might easily escape the notice of the ordinary miner in his search for more profitable material. They would probably be passed for "black Jack" (pleonaste or tourmaline) or other useless stuff.

But these remarkable productions are not confined to Tasmania. They have been found, according to Professor Krause† on the plains of Northern Victoria, New South Wales, in Central and Northern Australia distant from any volcanic rock. He adds also that they have been discovered embedded in the surface soil and drifts on and adjacent to lava flows, the nature of which, however, is not stated. Mr. B. Hy. Walcott, curator of the Technological Museum, Melbourne, informs us that they occur in the western parts of Victoria at Mts. Elephant, Eccles, etc., and remarks that their occurrence is surrounded with mystery. Mr. H. Y. L. Brown‡ also cites them from South Australia in alluvium, and on the surface, most frequently on the stony downs and table hill country of the far north, likewise distant from any volcanic rock.

Obsidian balls are also met with in Western Australia, scattered, as we are assured, over a large area, but no explanation of their origin has been offered*. We are informed that in the Coolgardie district these buttons are collected by the aborigines and used as charms by pressing them on the part of the body which is suffering pain. We have examined one of these West Australian bombs. It is sub-globose in form, 1in. in diameter and $\frac{5}{8}$in. thick, with one hemisphere rathered flattened. The median line is produced to an edge, which divides the ball into two unequal halves. There is a little indistinct vertical fluting on the larger half in proximity to the equatorial edge. It is, however, without the concentric rings, grooves, and flange which give the majority of the Tasmanian bombs a decidedly button-like appearance. The surface of both is structurally identical, as well as the colour of the dull crust and the vitreous interior. Its specific gravity is 2·45.

A specimen from Thomas Plains, found by Mr. Gaylor in 1895, bears a strong resemblance to those from near Coolgardie, W.A. It is intensely black, sub-globose, with a

† Introd. Mineralogy, F. M. Krause, 1896. p. 214.

‡ Cat. S. Australian Minerals, H. Y. L. Brown, 1893, p. 25.

* "Obsidian bombs are found all over the interior, but where they come from no one knows." Mining Handbook to the colony of W. Australia. H. P. Woodward, 1894, p. 34.

somewhat broad median band, which is irregularly finely indented. The outer margin of one face has a row of extremely minute crenulations which are almost microscopic. This is the only specimen which has come under our notice of the Australian type, as it is without the flange or beading, which is apparently characteristic of the buttons obtained on the East Coast.

The Australian bombs have been compared with the nodules of bouteillenstein (pseudo-chrysolite, moldavite) translucent to brown in colour, found in sand near Moldanthein in Bohemia, and in tuff in the Auvergne, as well as with the glassy marekanite balls of the Marekanka, near Okhotsk, in Eastern Siberia. But the nature of marekanite is now well understood. It is the perlitic or subpumiceous modification of a glassy rhyolitic rock in situ on the Marekanka, the concentric jointing of which detaches onion-like spheroids. The nuclei of these spheroids are the marekanite glass balls, which vary in size from that of a pea to that of an orange. In his paper on marekanite, Professor Judd* refers to the description by Damour, in 1844, of a black obsidian ball from India, $2\frac{1}{3}$in. diameter. This ball had the composition of dacite glass (sp. gr. 2·47), but unfortunately its locality was not known.

The nodules of bouteillenstein are undoubtedly obsidian, but the localities in which they are found do not suggest any serious difficulty in accounting for their presence, though no detailed comparison appears to have been instituted between their nature and that of the rocks belonging to the adjacent volcanic centres. In Australia and Tasmania, volcanic rocks are either absent from the vicinity, or belong to quite a different petrological family, and consequently could not have been a source.

Mr. Verbeek records similar obsidian balls from the quarternary, or perhaps pliocene tin ore deposits of Billiton; from quarternary tuff strata in Java, and from gold and platinum mines of the same age in South Eastern Borneo†. We may here draw attention to the circumstance that all over the wide area of the earth's surface in which these bombs occur, they are found only in deposits of the later tertiary or the recent period.

Analyses of some of the Victorian specimens were made by Mr. Cosmo Newbery, and published in the "Descriptive Catalogue of the Rock Specimens and Minerals in the National Museum, 1868." By the courtesy of Mr. B. H. Walcott, we are able to give the particulars of one of these analyses, and we append, for comparison, Cohen's analysis of a

* On Marekanite and its allies. Prof. J. W. Judd, Geol. Mag., 1886, p. 245.

† "Nature," May 13, 1897.

"compact basalt obsidian" (basalt glass) from Kilauea, in the Sandwich Islands*.

	Victorian Obsidian Buttons. Specimen No. 21. Sp. Gr. 2·47.	Basalt Glass, Kilauea. Sp. Gr. 2·75.
$Sc\ O_2$	73·70	53·81
$Fe_2\ O_3$	6·08	3·05
Fe O	—	7·39
$Al_2\ O_3$	4·99	13·48
Ca O	4·20	10·34
Mg O	0·10	6.46
Mn O	—	trace
$Mn\ O_2$	—	—
$Ti\ O_2$	—	—
$Na_2\ O$	5·20	3·23
$K_2\ O$	4·83	0·64
$H_2\ O$	—	0·57
Loss by Ignition	0·55	—
Total	99·65	98·94

Under the circumstances which we have detailed, how these bombs came to be where they are now found is a perplexing question, and one which has caused varied speculation. Prof. Krause approves of the suggestion that the aborigines may have used them as articles of barter, and thus distributed them broadcast over the Australian continent. This is not in accord with what is known of the habits of the native tribes. Mr. Brown states the problem, but leaves it in *statû quo*, remarking that their presence is most difficult to account for. Mr. Verbeek has lately offered a solution in his paper read before the Royal Academy of Sciences, Amsterdam, March 27, 1897, on the Geology of Bangka and Billiton. Seeing that the nearest volcanoes are too distant, and over there, as is well known, have emitted rocks of a different chemical composition, he is led to seek an extra-terrestrial origin for these buttons. Assuming the surface of the moon to consist largely of acidic rocks, he believes these objects to have had their source in lunar volcanoes.

That they are volcanic products is unquestionable; consequently it is probable that their spheroidal or discoid form has resulted from masses of fluid lava being thrown up to a great height from the throat of a volcano, separating into independent drops—rotating in the air, and thus acquiring uniform grooves, which remained impressed upon them after

* Petrography of the Sandwich Islands : E. S. Dana.

they had cooled. They are solid to the centre, and this points to their rotation having been comparatively slow† The inference that the volcano was a lunar one is, in our opinion, unnecessary, and is moreover open to more than one objection. Admitting that the energy of a large volcano on the moon's surface may be sufficient to discharge a piece of lava from our satellite, this projectile would then revolve round the earth in an orbit of its own, and as has been pointed out by Sir R. S. Ball‡ if it once completed that orbit it would never fall on the earth. On the theory of probabilities the chances of the orbital path coinciding with the position of the earth in space are infinitesimal; but it must absolutely coincide on the first revolution, if the projected lava disc is ever to find a resting place on our globe. And yet we are asked to believe, not in one such coincidence, but in thousands. It is highly improbable that small bodies like these buttons would survive the friction and heat of their descent through the air. This friction reduces countless meteorites to meteoric dust, or to the small fragments which occasionally succeed in reaching us. Further, it is difficult to believe that objects of such a symmetrical figure had ever begun to revolve in a planetary orbit. To our mind the elliptical form of one of the bombs is decisive against the theory of a lunar origin, showing as it does that it was still in a viscous state when it fell upon the soil.

There seems therefore no other source to resort to than terrestrial volcanoes of an acid or sub-acid type. This hypothesis only requires that the molten spray should have been carried by winds as far as Tasmania and Australia. Having regard to the Krakatoa ash being transported in the air to enormous distances from its point of ejection*, we cannot make distance a reason for denying to these singular buttons of obsidian a source in some pliocene or quarternary volcano of the southern hemisphere. The nearest known source of tertiary obsidian is New Zealand, but whether these objects have been brought from that island, or from the Antarctic continent or elswhere, it is as yet impossible to say.

Note.—Since the above paper was read, additional information has been received from various sources respecting further localities in Tasmania. These are the Norfolk Range, in stanniferous drift ; Camden Plain, Mount Barrow, in auriferous wash ; at Lisle, in auriferous wash.

† The Ancient Volcanoes of Great Britain. Sir A. Geikie, 1897, vol. i., p. 60.

‡ The Story of the Heavens. Sir R. S. Ball, 1892, p. 355.

* "The speed and distance attained by the pumice ejected from the volcano may be conceived from the fact stated in Mr. Douglas Archibald's contribution to the report, that dust fell on Sept. 8th, more than 3,700 English miles from the seat of its eruption." Dr. W. Marcet's address, "Nature," March 20, 1890, p. 477.

EXPLANATION OF PLATES.

Plate I.

Fig. 1. Obsidian button, from near Coolgardie, Western Australia.

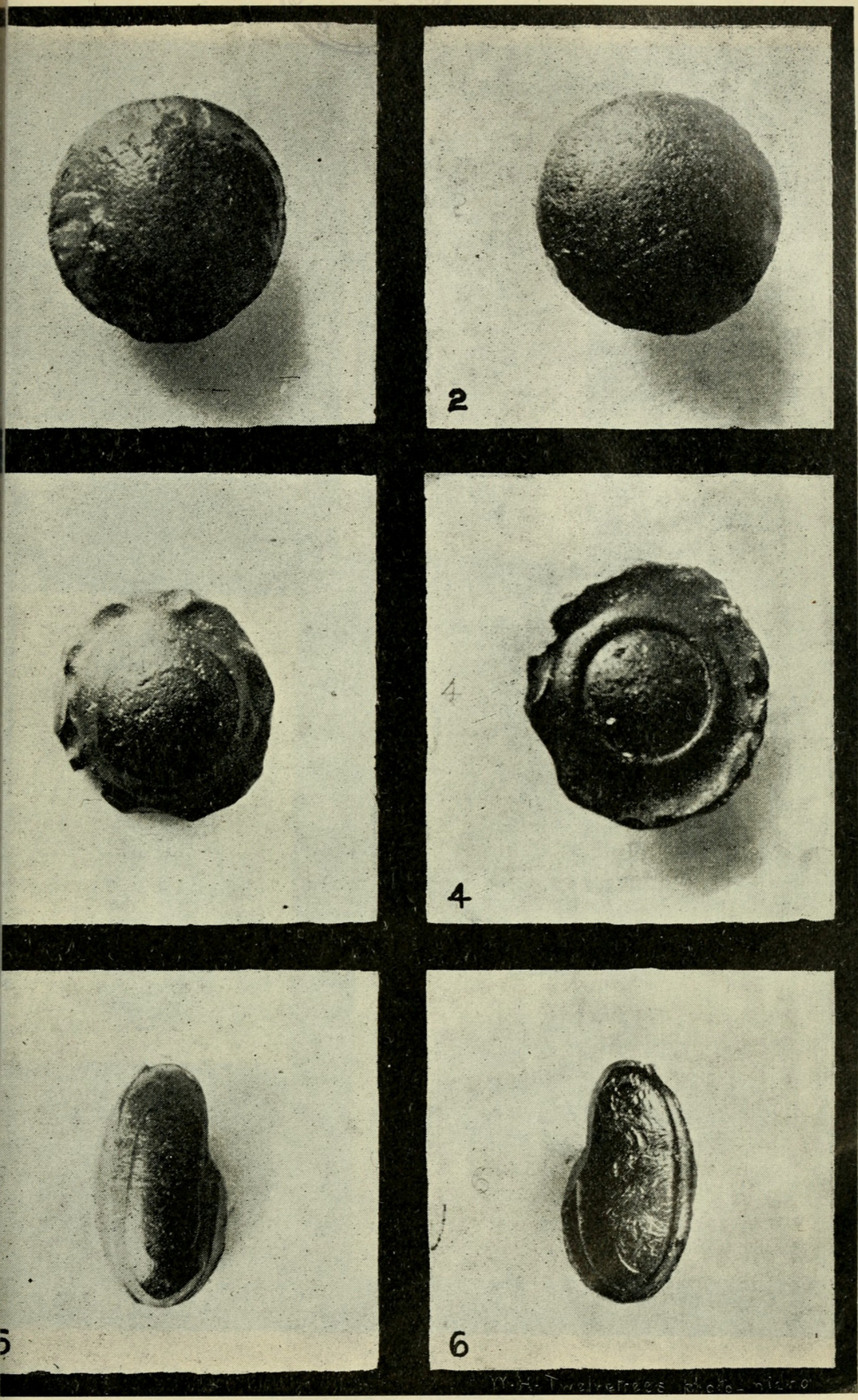
Fig. 2. Do. do. Reverse.

Fig. 3. Do., from Thomas Plains, Tasmania. Convex surface showing annular beading and pittings.

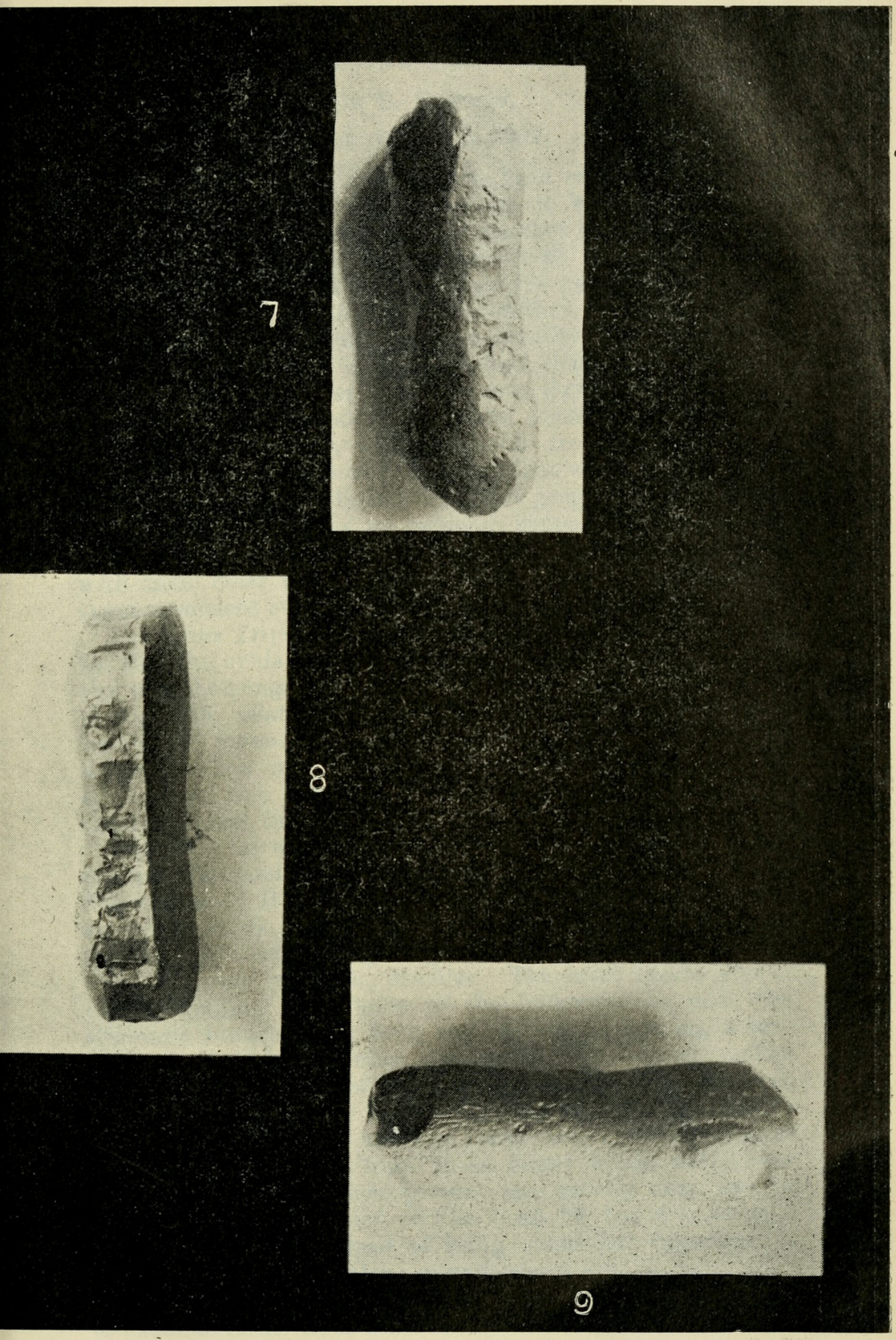
Fig. 4. Do. do. Flat surface with beading, and rounded central area. Slightly enlarged.

Fig. 5. Do., from Thomas Plains, Tasmania. Abnormal form, apparently drawn out in viscid condition.

Fig. 6. Do. Reverse.



OBSIDIAN BUTTONS.



. TWELVETREES, Photo-micro.

OBSIDIAN BUTTONS.