ST. HELENA:

A

PHYSICAL, HISTORICAL, AND TOPOGRAPHICAL DESCRIPTION OF THE ISLAND,

INCLUDING ITS

Geology, Fauna, Flora, and Meteorology.

BY

JOHN CHARLES MELLISS, A.I.C.E., F.G.S., F.L.S.

LATE COMMISSIONER OF CROWN PROPERTY, SURVEYOR AND ENGINEER OF THE COLONY.

THE BOTANICAL PLATES FROM ORIGINAL DRAWINGS

By MRS. J. C. MELLISS.

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1875.

PART II.—GEOLOGY AND MINERALOGY.

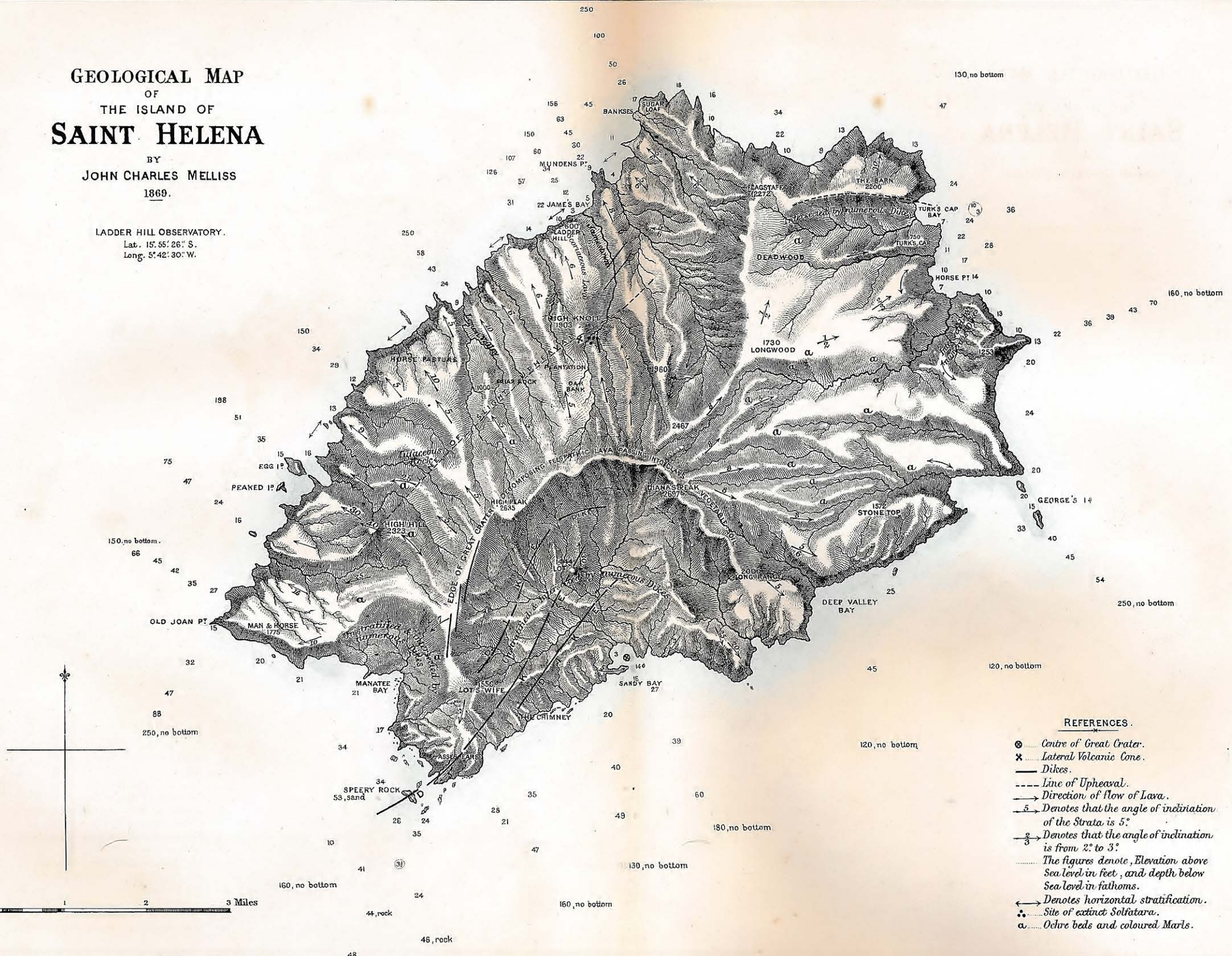
The map of the Island shows it to be a most irregular-shaped piece of land, with an extreme length from East to West of ten and a quarter miles, an extreme width from North to South of eight and a quarter miles, and having several small islets dotted here and there around its jagged coast. A high central ridge, varying in altitude from two thousand to nearly three thousand feet, commences on the south-eastern side of the Island, and, taking a semicircular course towards the south-western side, separates the Island into two portions; that portion to the south of the ridge takes the form of a huge bowl with its edge partly broken away, now known as Sandy Bay; while that on the East, North, and West, slopes gradually away, at angles varying from 8° to 10°, towards the sea, terminating at the coast line in perpendicular cliffs from 450 to 2000 feet in height. This great wall of rock, which, on approaching the Island from all but a southerly direction, seems to defy an entrance, is intersected by a number of deep and narrow gorges running at right angles from the coast line towards the central ridge, where they lessen considerably in depth and width. The only town is situated in one of these gorges on the north side of the Island; it being one of the largest, may, probably, in some measure, account for its selection as a site for the first settlement. In size they vary considerably, and in some places lie close together, separated only by a narrow ridge several feet in width, while in others they are more than a mile apart.

The soundings, which are of much value in computing the original line of coast, are quoted from a chart by Mr. George Thoms, of H.M.S. *Northumberland*, under the command of Rear-Admiral Sir George Cockburn, in the year 1815; they show that the sea bottom slopes gradually to depths of 60 or 70 fathoms at a distance of about a mile and a half from the present coast, but immediately beyond that there appears to be no bottom recorded at a depth of, in some places, as much as 250 fathoms. It will be quite necessary

GEOLOGICAL MAP
OF
THE ISLAND OF
SAINT HELENA

BY
JOHN CHARLES MELLISS
1869.

LADDER HILL OBSERVATORY.
Lat. 15° 55′ 26″ S.
Long. 5° 42′ 30″ W.



REFERENCES.

- ⊗ ..... Centre of Great Crater.
- ✕ ..... Lateral Volcanic Cone.
- —— Dikes.
- ---- Line of Upheaval.
- ⟶ Direction of flow of Lava.
- ⟶ 5 Denotes that the angle of inclination of the Strata is 5°.
- ⟶ 2/3 Denotes that the angle of inclination is from 2° to 3°.
- ..... The figures denote, Elevation above Sea level in feet, and depth below Sea level in fathoms.
- ⟷ Denotes horizontal stratification.
- ∴ ..... Site of extinct Solfatara.
- a ..... Ochre beds and coloured Marls.

to obtain some further information relative to this very remarkable submarine ledge, which appears to surround the Island, before entertaining the theory of a general subsidence of the land, or indeed any theory with reference to the cause of its existence.*

The geological structure of this remarkable land has often been curtly described in the few words, "it is volcanic," and the explanation as often considered sufficient, inasmuch as the truth of such an assertion cannot be doubted, even by the most casual observer. This rocky pile, however, so often briefly dismissed as troublesome to inquire into, presents not a few points, in searching out truth, well worthy of the student's attention. The manner of its formation, together with the time occupied therein, and the period that has since elapsed in bringing it to its present shape and dimensions, are each subjects affording unusual interest in reading that page of nature's book which throws light upon the ancient geography of the Southern Atlantic region.

Its isolated position, its peculiar fauna, and its very remarkable insular flora, together with its geological character, present strong reasons for placing St. Helena amongst the oldest land now existing on the face of the globe. It represents a very fair type of an oceanic volcano similar to Palma of the Canaries, St. Paul's Island, in the Indian Ocean, and others, of which Sir Charles Lyell makes the following remarks:—"Every crater must almost invariably have one side much lower than all the others, viz., that side towards which the prevailing winds never blow, and to which, therefore, showers of dust and scoriæ are rarely carried during eruptions. There will also be one point on this windward or lowest side more depressed than all the rest, by which in the event of a partial submergence the sea may enter as often as the tide rises, or as often as the wind blows from that quarter. For the same reason that a sea continues to keep open a single entrance into the lagoon of an atoll or annular coral reef, it will not allow this passage into the crater to be stopped up, but will scour it out at low tide, or as often as the wind changes."† There is, in the Island of St. Helena, precisely such a

* I hope that this subject may be investigated during the present cruise of H.M.S. *Challenger*, as Mr. Gwyn Jeffreys has most kindly promised to bring it before the notice of Professor Wyville Thomson.

† Manual of Geology, by Sir Charles Lyell, M.A., F.R.S., 1855, p. 513.

crater, as is thus described, of enormous dimensions, forming that side of the Island called Sandy Bay. The southern edge of this crater, being that exposed to an ever prevailing south-easterly trade wind, is broken away below the level of the sea, and the crater itself which measures four miles across, thus exceeding in size the remarkable La Caldera of the Island of Palma, is covered by the sea to the extent of about two-fifths of its full size. The remaining three-fifths stand above the sea, resembling the larger part of a broken bowl, its edge rising to an elevation varying from 2000 to 2697 feet, and forming the central ridge or backbone of the Island known as "Sandy Bay Ridge." On this ridge are situated the highest mountain peaks in the Island, viz., Diana's Peak 2697, and High Peak 2635 feet above the sea level. The ridge itself, for about five or six miles along its central portion, is tolerably horizontal, but slopes at its eastern and western extremities towards the sea, meeting it at its terminations in steep precipices. On its south side the fall into the crater is very nearly perpendicular for some six or seven hundred feet down, where, amongst the vegetable soil and indigenous plants now clothing the upper portion, are still easily traced thick lava strata running in a horizontal direction around the side of the bowl, assuming here and there the appearance of gigantic steps, and dipping northwards at an angle of about 6° to 8°.

This ridge, or crater edge as we shall now call it, is covered with a layer of rich vegetable soil, under which can be traced felspathic lavas in all stages of decomposition. First comes, as seen above Swampy Gut, the damp red, yellow, or bluish white clay; a little deeper the semi-decomposed lava; and finally, at a depth where the influence of atmospheric moisture has failed to penetrate, we find the compact hard lava in its natural cool state. Many lumps of these decomposing lavas have become detached and slid away down into the crater; above Sandy Bay School large masses of basalt are to be seen embedded in the soil, which have evidently rolled down from some lava strata, now itself quite passed away into surface soil. Amongst the grass below Rose Cottage also may be seen cropping up large masses of basalt, which have there found resting-places in their descent, while many more, some of a deep reddish tint, lodge in the neighbourhood of Bay House and Cole's Rock. Some of them are huge in size and angular in shape, while they vary in composition

GEOLOGICAL SECTION THUGH THE ISLAND OF SAINT HELENA,

FROM NORTH TO SOUTH TRANSVERSELY ACROSS THE GREAT CRATER.

(From Leis's Point to Sandy Bay Beach.)

BY

JOHN CHARLES MELLISS.

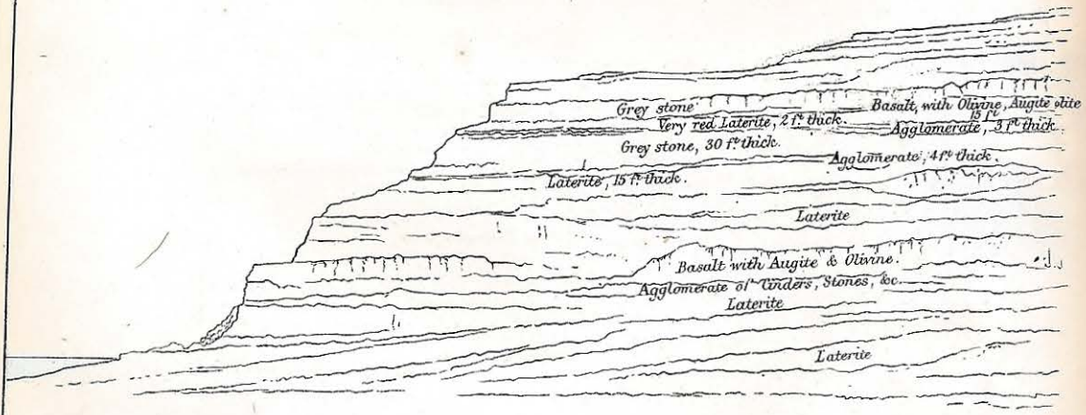
1869.

Vegetable soil.
Felspathic lavas.
Basaltic lavas, alternating with beds of laterite, or volcanic mud baked red, and volcanic agglomerate of small stones, ashes, and cinders.

0 ¼ ½ ¾ 1 2 Miles.

ENLARGED SECTION THROUGH NORTH COAST

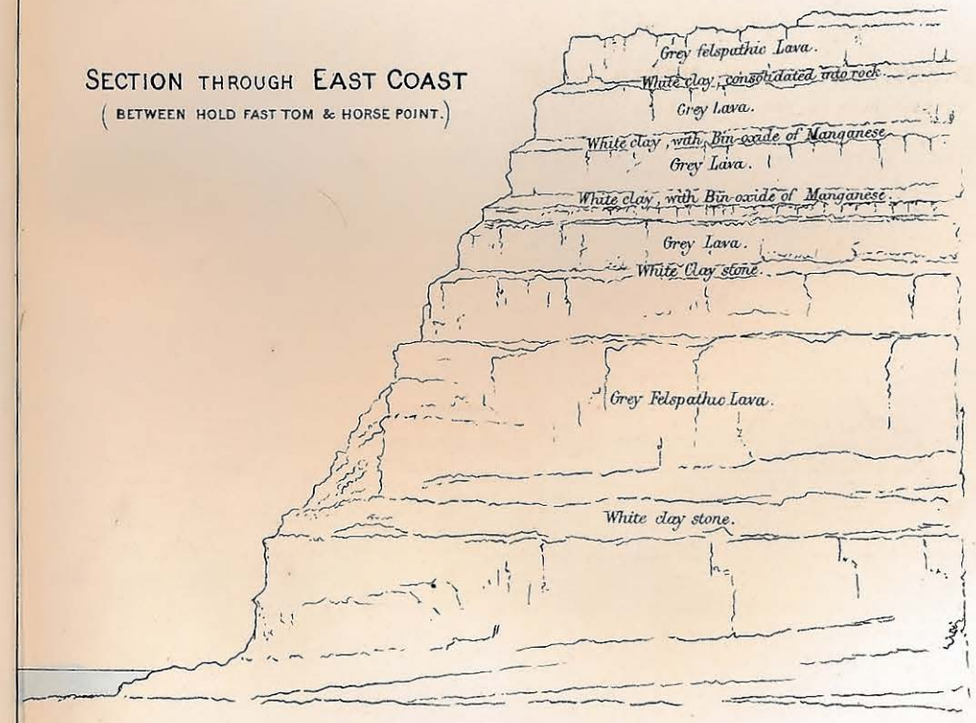
(MUNDEN'S POINT AND PART OF RUPERT'S HILL.)



0 100 200 300 400 Feet.

SECTION THROUGH EAST COAST

(BETWEEN HOLD FAST TOM & HORSE POINT.)



from greystone to basalt; the formation in which they lodge appears for the most part to be a conglomerate of spheroidal nodules of greystone, variously coloured marls, and basaltic earths, overlying lava beds which have flowed back to some extent into the crater; the surface soil scarcely exceeds eighteen to twenty-four inches in thickness. The edge of the crater at an early period is apparently traced at Cole's Rock, where massive perpendicular faces of basalt occur, showing little sign of inclination or stratification, excepting at one point where a dip of twenty degrees towards the north is observable. Below Fairy Land, also, a further indication of an early edge of the crater seems to be apparent, where several thick layers of lava incline towards the north at an angle of thirty degrees.

Thick vegetation, for the most part indigenous plants, now clothes the central portion of the crater edge for about four miles in length, and extends down into the bowl for near three-quarters of a mile, where it is met almost abruptly by barren ground, producing at most only stunted grass with a few straggling shrubs, including those indigenous plants whose habitat is the low rocky land near to the sea-coast.

The inside of the crater is thickly peopled, and the civilizing influence of man's presence, exhibited in houses, vineyards, fruit gardens, and cultivated plots scattered all around its sides, tends to add to the peaceful, quiet aspect now worn by this once seething, fiery cauldron. The descent from the edge, for a considerable depth, is by a very steep winding carriage road, from which bridle paths branch and ramify right and left in and out of the ravines which heavy rains and much surface water have deeply cut into the sides of the bowl. This descent into the crater, although rather trying to the nerves of those who visit it for the first time, well repays the undertaking. The scenery, though on a small scale, is truly grand. Labourers' cottages, with neat little gardens, scattered here and there amidst bright green grassy slopes and hay fields, have more than ordinary claim to picturesqueness; while almost every turn in the road reveals a pretty rural English-like dwelling, snugly placed in some romantic glen, amidst thick groves of trees, whose bright verdant foliage charmingly contrasts with the grey lichen-clad rocks and the rich purple red and yellow tints of the more distant sides of the crater, occasioned by the presence in the soil of manganese and iron in composition. The most striking view of the crater is

obtained from the somewhat perilous summit of the mass of rock called Lot, where the spectator, elevated nearly 1500 feet, on a pinnacle almost in the very centre of the huge bowl, obtains an unintercepted view of the whole. The ascent of Lot is a tedious climb, but well repays the labour bestowed upon it.

At the foot of the almost perpendicular fall from the crater's edge, the ground begins to slope more gradually, but very irregularly, down towards the sea. The formation, as we proceed towards the floor of the crater, becomes unstratified and confused, and is intersected by numerous dikes, varying in thickness from a couple of inches to a hundred feet or more. As the centre of the crater near Sandy Bay Beach is approached, these dikes increase in number, sometimes lying closely side by side, even also crossing each other at right angles, and varying in composition just as much as in their outward form and colour. They soon appear numberless, and are so complete that scarcely a fault or displacement of the adjacent ground can be traced; they have much the appearance of brick or stone walls running up and down and across the crater sides in all directions, even extending out to sea like so many well built landing-piers. Of some of the largest of these dikes, three or four are very remarkable features in the structure of the Island, striking, as they do, in parallel lines from the north-east to the south-west right across the crater; and, when viewed from its edge, much resembling the trail of some great serpent or monster which had wended its way across it. Some of them testify strongly to the amount of disintegration and denudation that has, through long ages, been in progress on the surface of the Island. One especially of them, which may be traced for four miles or more, being formed of a fine hard crystalline felspathic greystone, much harder than the surrounding rocks, has worn away much less rapidly than the adjacent ground, and left huge monolithic columnar remains of itself at intervals throughout its length. One of these great piles of rock has just been mentioned as bearing the name of Lot. It stands almost in the middle of the now remaining portion of the crater, at an elevation of 1444 feet above the sea, having a base 100 feet in thickness, and an altitude of 290 feet. A second, called Lot's Wife, stands about a mile and a half further to the south-west, elevated 1550 feet above the sea, with an altitude of 260 feet, its upper portion being considerably larger than the base

Vincent Brooks Lith

VIEW IN SANDY BAY.

upon which it stands. A mile further on, in the same direction, stands a third of these columnar remains, called the Ass's Ears; and still further on for about another mile, rising as an islet from the sea, detached from the main land, is seen Speery Rock, the last visible portion of this great dike.

There is no difficulty in tracing the relationship of these rocks as portions of the same great dike, because in character and composition they agree exactly, while the rocks which enclose them are of a very different construction, consisting for the most part of unstratified blue basaltic, hard-red, and other marls, containing embedded crystals of augite, and traversed in all directions by numerous very small dikes. These features are so intimately associated with the great crater of Sandy Bay that it is difficult to omit noticing them in connexion therewith; but, in tracing out the geological structure of the Island in due order, their introduction at this point is somewhat out of place, as will be understood when it is remembered that they were certainly formed after, perhaps long after, the great volcano had ceased to be active; and as yet we have not seen what became of the products cast outside of the crater-walls during its activity.

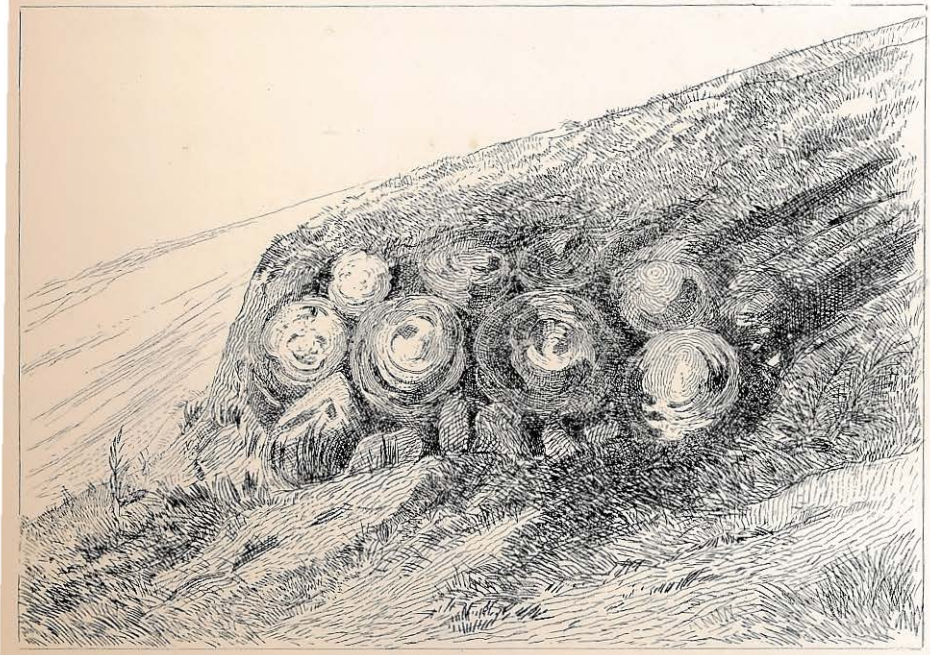
With the intention, then, of returning to this subject in connexion with the denudation and probable age of the Island, let us take a view of what surrounds the great crater edge, or Sandy Bay Ridge, on its northern, eastern, and western sides—in other words, the great masses of lavas, ashes, and mud, which, ejected from the crater, have built up the remaining portions of the Island.

We find no trace whatever of granite or any other primitive or plutonic rocks, or indeed any formation to encourage the slightest suspicion of a continental land having ever occupied that particular latitude and longitude where St. Helena now stands. Continental land may at some *extremely* remote period have occupied the same place, but, be this as it may, there can be little doubt that, previous to the appearance of St. Helena, the broad expansive South Atlantic swept over the site it occupies; and the first sign of disturbance there was probably a bubbling and spouting up of the water on a vast scale, just at or near to the spot now called Sandy Bay Beach. Then followed a stream of molten lava, shot up from the depths of the ocean, and, guided by the south-east wind, falling into it again more on one side than the other, laid the foundations of that pile,

which, in the course of future events, became the prison of one of Europe's greatest monarchs.

Repeated outpourings of lava would in time raise the crater-edge above the surface of the water, and the flow of lava inclining from it would eventually bring up the land to the same elevation. At an early period the crater would doubtless have its edge intact, and would necessarily contain water, which, during the interval between volcanic action, would mix with bits of broken rock, débris, and dust rolling down into it from the disintegration of its sides, and produce volcanic mud. A renewal of volcanic activity would first of all discharge from the crater this mud, accompanied with steam and water; the rubble, or small fragments of rock, which, being heaviest, would sink to the bottom, would next be shot forth, and finally the molten lava would follow, thrown up high into the air amidst smoke, dust, and heavy clouds, just as in the present day we witness it at Vesuvius; sometimes so high that detached fragments of lava, rendered spherical by their passage through the air, would descend in the form of bombs weighing half a ton or more. The lava would, for the most part, however, descend in huge sheets of liquid matter. A period of quiescence, or rest from volcanic discharge, extending over a century or two,* would then intervene, when another similar outpour would follow: first mud, then rubble, followed by the pure lava, and this would, with intervals of rest, be repeated through hundreds of centuries until the edge of the great crater was built up to thousands of feet in height, with the land on its outer sides, excepting that towards which the prevailing wind blows, sloping outwards at such angles as the flow of lava naturally takes, probably 5° or 7°. Now this is precisely what we find on examining that part of St. Helena which is outside of the crater-walls. The whole of this portion of the Island is thus built up of numerous layers of mud, rubble, and lava; occasionally the former two are missing in the regular order, and beds of lava overlie beds of lava, but such is the exception; and although it is difficult now, in consequence of disintegration and surface-soil overlying them, to trace the distinct strata, it is easy to count, on the northern face of the Island, at least forty or fifty

* C. Piazzi Smith states, with reference to Teneriffe, that volcanic outbursts occur once in a century.



VOLCANIC BOMBS. ROAD SIDE, SWAMPY GUT. *p. 52.*

J.C.Mellis. del.

E.W.Robinson. lith.

BELL STONE. A MASS OF PHONOLITE NEAR SHIPWAYS.

WHICH WHEN STRUCK EMITS A SOUND RESEMBLING A DEEP TONED BELL.

layers of lava, besides eleven of volcanic mud; while at Horse Pasture, on the same coast section, seventy layers of the former and six of the latter, are plainly distinguishable.

These layers or strata vary considerably in composition and very greatly in thickness, so that their examination next claims our attention. The volcanic mud or laterite beds are in colour generally of a yellowish brown passing into red, and where the non-intervention of rubble happens their bright red edges show plainly the effect produced by immediate contact with the burning hot lava. They vary from eight or nine inches to several feet in thickness, and, where the mud has fallen into irregular hollows or bowls in the surface of the lava, they attain a greater thickness, exhibiting also quite a sedimentary form of deposit. In many places this mud is to be seen burnt as hard as a brick, while in others it is little harder than cheese; some extremely thick massive beds of it exist at the Red Quarry, Rock Cottage, &c., passing into the form of a vitrified scoriaceous kind of slag, in which state it is a good deal used for building purposes; being easily dressed for faced work, many of the principal buildings in Jamestown are constructed of it; when protected by a thin coating of plaster or cement it is found to be durable enough for such uses. Traces of small roots of plants occur in some of these beds of laterite. I have noticed them especially near Pierie's Revenge, but they are probably recent, and no fossiliferous remains are found in them beyond embedded fragments of volcanic rock, scoriæ, and pumice, similar to those which make up the beds of rubble. Some of these mud or ochre beds, as they are called, exhibit the most brilliant red, yellow, and purple tints, which at first sight are suggestive of fitness for colouring pigments; but no use being made of them in this respect, their real value seems to exist in forming indicatory records of subsequent disturbance, or otherwise, in the general strata.

The rubble or agglomerate beds of small fragments of stones, ashes, and cinders, which generally immediately overlie the mud strata, range from two to three feet in thickness; the stones of which they are made up are about two or three inches in size, in appearance much worn and slightly rounded, and somewhat adhering together. The face of the hill between Jamestown and Ladder Hill affords a good opportunity for inspecting these rubble beds. Generally the lava has flowed over them without disturbing them much,

but in some places it has, in its sluggish course, pushed the rubble before it until a great heap has accumulated, when either it has broken through the mass and continued its course underneath, or poured over it in order to resume its way on the other side. An instance of this is to be seen to the south of Ladder Hill signal station, where an immense accumulation of rubble has been forced forward by the huge stream of lava overlying Pierie's Revenge. In some of the earliest, as well as the latest of these beds, there exist cylindrical holes, which are now quite empty, but close examination removes almost any doubt as to their once having been filled by stems of trees. It is most improbable that trees grew upon any part of the Island at that period when the rubble beds were being formed, and whether the stems embedded in them grew on some near adjacent land, or were floated from some distant country across the sea and through the agency of currents into the crater, cannot now be determined; but the latter theory seems very probable because in the present day seeds of plants which grow eastward of the Cape of Good Hope are conveyed and cast up by the sea on to Sandy Bay Beach, the very centre of the crater. Had these stems been enveloped in the lava, they would have been quickly burnt; this may have occurred with some of them of which no trace now remains, but it seems most probable that they would be cast out of the crater with the rubble before the ejection of lava commenced; and we thus find them in these beds. The heated rubble would suffice to burn the wood, converting it into carbon, which in conjunction with steam and other gases would easily cause its disappearance in the form of carbonic acid gas, &c., so that, while the rubble would have sufficiently hardened to retain a cast of the external shape of the stem, no trace of the tree itself would remain. Possibly, remains of the wood may yet be found in some newly-opened cast. I have only seen those which have been long ago cut through in making roads, when perhaps if they contained anything it was never noticed. Although no remains of the original wood were to be seen in those which I examined, there was no difficulty in tracing, on the side of the casts, an imprint of the coarsely imbricated form of the stem, showing it to have borne the characteristics of a palm or large tree fern.

A very complete cast of this kind, which measures nine inches in diameter and forty-two inches in length, occurs in one of the

earliest rubble beds, and may be seen on the western side of "The Shy Path," opposite to the storehouse called "California" in Jamestown. Another occurs in a bed of more recent formation, six hundred feet or more higher up on the same hillside, just behind the observatory on Ladder Hill. And in various parts of the Island others, in a more or less perfect state, are to be seen.

The lava beds which follow on the rubble, and of which, as already stated, at least sixty or seventy may be easily counted, vary so much more in composition than either the mud or the rubble that more time and space need to be devoted to their examination. The first layers of lava which are seen above the sea line along the northern, eastern, and western coasts, excepting that portion between Holdfast Tom and Horse Point, are for the most part composed of a very dense compact basalt, containing very few cavities; they vary in thickness from a foot or two to ten or twenty feet. Although the cavities are few, some of them in these lower basaltic strata contain a most interesting relic of the age when they were formed, being filled with sea water, which through hundreds of centuries has been hermetically sealed up in them. I discovered this one day, while looking at the blasting of stone for the public works, in a small quarry on the western hillside in Jamestown; during the operation, immediately that a fresh fracture of the rock took place, a wet circle appeared surrounding some of the little pea-shaped cavities which had been split open by firing the blast. The water thus released from its long imprisonment was not sufficient to admit of its being collected, but, by a quick application of the tongue, its nauseous flavour afforded tolerably good evidence of its really being sea water. Little were those rough quarrymen aware of the extremely interesting fact they were revealing in disentombing water which had existence thousands of years before, and which had been so carefully preserved by nature through all that time from any change.

After several layers of this hard basaltic character, in which either augite or felspar slightly predominate, at an altitude of two hundred feet, the nature of the lava changes; and a single layer of quite a different composition intervenes, viz., a very heavy dark blue basalt, much more augitic in character than the lower basalts, and containing embedded crystals of augite and olivine. Next in order, above this, the layers are again simple basalt, only changed sometimes by strata of a more felspathic nature, such as greystone

and phonolite. This order of succession is repeated several times, the occurrence of the layers of heavy blue basalt, with embedded crystals as before mentioned, being at altitudes of 200, 300, and 400 feet above the sea line, until the whole Island is built up to the crater's edge.* While some of the lava beds are very compact, others are more or less scoriaceous and cellular,† their elongated almond-shaped cavities clearly indicating the direction of their flow. In addition to this evidence, and that of the angles of inclination, that the strata have scarcely been disturbed from their original positions, when flowing from Sandy Bay northward, we also find the embedded crystals of augite, one of the most brittle of minerals, to exist in a perfect state only around the neighbourhood of Sandy Bay. All the embedded augite, on the northern side of the Island, has been broken into small irregular fragments, evidently by attrition while flowing to so great a distance. Scarcely is a complete crystal of this mineral to be found beyond the walls of the crater, while inside the crater itself, as at Lot and other places, the most perfect crystals exist in large numbers.

It is somewhat remarkable that, excepting the beds of hard basalt containing embedded crystals, the lavas show a gradual tendency to a more felspathic composition as they approach the highest part of the Island; the most recent being also the most felspathic. Lavas of such a character are more readily acted on by atmospheric influences, and, being more easily reduced by disintegration into alluvial soil, seem to indicate a thoughtful care on the part of the Great Creator, in thus facilitating the process for forming a surface soil to this rocky land. Still more strikingly is this illustrated by the fact that all the uppermost layers of lava which once existed, and have now through disintegration entirely worn away from the high central parts of the Island, had felspar for their chief constituent.

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* These Basaltic layers are seen cropping out on Munden's Point and Hill; they appear also at the following places: above Chubb's Spring House, immediately over the bridge and little waterfall at the foot of Barnes' Road, about half way up Barnes' Road, at Francis Plain and along the watercourse road, and also at Southerns, where a thick flow on the roadside is most probably the same as that seen at Francis Plain; "The Rock" in Plantation grounds, as well as a stratum at Arnos Vale entrance iron gates, show the same composition; while immediately over Cat Hole there occurs a layer of greystone with only a few small widely scattered crystals of olivine. It is not these but the *pure* basaltic lavas which generally follow on the beds of laterite.

† Towards the lower part of Barnes' Road a layer of very cellular lava, with cavities about the size of peas lined with very minute zeolitic crystals, occurs.

Having thus noticed the building up of the Island to the present edge of the crater, and turning our attention to those thick, almost horizontal, beds of lava, highly felspathic in their composition, which appear on the eastern side of the Island, and are plainly visible at Horse Point, we cannot resist coming to the conclusion that the Island was at one time very much higher as well as much longer and broader than its present dimensions, and that these beds are the fragmentary remains of the latest lava ejections from the crater.

We get a further sight and knowledge of these recent lavas, which once capped the whole, by a visit to the high conical hills situated on the south-eastern corner of the Island, called Great and Little Stone Top. Here, together with the broad thick layers at a lower altitude not far distant, running round the promontory on the eastern coast, known as Horse Point and Holdfast Tom, we see the last remnants of a series of greystone lavas, which were the most recent of all, and once, so to speak, crowned the whole mountain top of this volcanic pile, but, being subsequently worn away, left it as it now exists. Portions of these layers of lava, nine or ten in number, still remain, in resemblance much like gigantic steps, where they reached down to the sea at Horse Point, of quite a different formation from the remainder of the coast. They are composed of a very finely crystalline felspathic greystone lava, separated by beds of white marl, produced through the decomposition of the lava itself, and traversed by veins of pyrolusite or black oxide of manganese. They incline seawards at an angle of one to two degrees. The greater the altitude at which this lava exists, the more has it passed into a sort of whitish clay or marl, thus exemplifying the facility with which it would, by atmospheric action be removed from the highest parts of the Island. The few fragments which still remain on the very summits of Great and Little Stone Tops, as well as on the loftiest portion of Horse Point itself, show plainly the influence produced upon it by the higher regions.

It is this formation in the eastern portion, differing so much from other parts of the Island, which has given rise to the idea that it once was part of a Continent. Could we glance at the Island as it stood when volcanic action ceased, we should see its mountain peaks rising high into the clouds, a thousand feet perhaps, or even more, above their present altitude; the huge crater lying on one side, and on the other sloping plains, stretching several miles further out to sea than

the coast line now, and we should fail to recognise, in its present form, the same Island. Atmospheric action upon the rocks, through long ages, bringing about gradual denudation, has reduced its elevation, and, with the aid of heavy rains and slight upheaving force, rendered its surface irregular; while the unceasing wear and tear of the restless ocean on its rocky coast has reduced its area to almost one half of its original size.

With this figure of the Island in mind, we may next proceed to view the effects produced by such causes, as have just been mentioned, upon its surface; and first in order examine the water-cut gorges which have been already referred to as intersecting the northern, eastern, and western portions. These ravines, the largest of which number about sixteen, originate on the high land near the crater's edge, but deepen and widen as they approach the sea coast, where some of them measure not less than one-eighth of a mile across at the bottom, three-eighths of a mile across the top, and a thousand feet in depth. Lemon Valley, viewed from Thompson's Hill, affords a good type of these huge channels. The strata on each side correspond in position so regularly, that any suspicion of their being caused by convulsive fractures is dispelled. The passage of rain water from the mountain tops towards the sea is doubtless the chief agent by which they have been formed, and the process of deepening and widening may still be seen going on during heavy rains. The water which falls on the high land rushes down towards the sea, and, in its course washing out the rubble and mud beds, undermines the lava until it splits off in great fragments, rolls down, and in its turn is carried away. Many caves, formed by the undermining of the lava beds in this manner, may be seen along the hillsides which enclose these ravines, and they also abound along the sea shore where the waves have washed out the laterite beds for many feet in a horizontal direction. Some of them constitute the only habitations owned by fishermen; others nearer the water level are in consequence inaccessible, and serve only to increase the roar of the waves as they roll in and out of them. There is a large one at Frying-pan Cove, twenty feet in depth, and there are some situated on the coast near Deep Valley, which are stalactitic, but these latter are only accessible by boat at low tide.

In this manner these channels or gorges have, in course of time, been gradually increased in size, their enlargement doubtless being

J. C. Mellish, delt

VIEW NORTHWARD DOWN LEMON VALLEY. *p. 58.*

E. W. Bohnet, lith.

DETACHED PORTION OF CLIFF N.E. SIDE OF GREGORIES. *p. 65.*

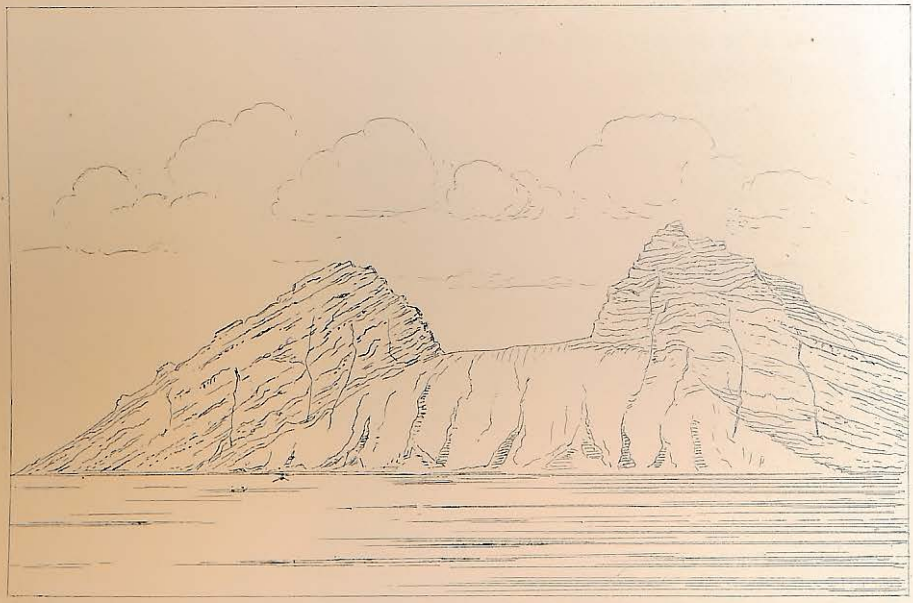
more rapid at that period when the land being higher attracted more clouds, and consequently there was greater rainfall, and probably snow water, to assist the process. Although this action is sufficient to account for the present size and appearance of these ravines, I am inclined to think that they had their rudimentary origin, or their courses traced out previous to their enlargement by running water, in the sheets of lava as they spread outwards from the crater's edge in a semi-fluid or viscous state. Flowing in a sluggish manner, the outer edge of the lava would naturally terminate in a form somewhat similar to that of the fingers of a human hand when spread out flat upon the palm; each subsequent flow or stratum taking the same course and shape, the spaces left between the fingers, as it were, would represent the commencement of the ravines. That the lavas have travelled very slowly is evidenced by the elongation, in the direction of the flow, of the air cavities contained in them, as well as by the remarkable forms which the scum has assumed where it has accumulated, before cooling, very like the froth on the surface of stagnant water. In the locality of High Knoll and Ladder Hill, this hardened scum so greatly resembles in texture the stems of trees as to be commonly mistaken for petrified wood. Some of it is so scoriaceous or full of minute cavities that it floats for a considerable time when placed in water; it is, in fact, a kind of coarse pumice.

A confirmation of the opinion that the larger ravines had their origin in the flows of lava, I think, may be obtained by walking along the ridge, or present crater edge, and noticing the natural forms of the spurs or divisions which separate one from the other. Standing on Diana's Peak, and looking down eastward, the flow of lavas appears to have taken two directions. One stream, that nearest to the hill on which stands Sunberry Cottage, has flowed irregularly for about a quarter of a mile easterly, when it seems to have divided; one branch has flowed northerly towards Prosperous Bay, on which is situated Arnos Vale, and now shows a very rugged steep ridge for about a mile, until it reaches "Shark's Valley," when it turns in an easterly direction towards George's Island, and then gradually slopes down, losing itself in Shark's Valley, about three-quarters of a mile distant from the sea shore; the other branch seems to have travelled on still more easterly, forming that very irregular portion of the Island lying between Stone Top Bay and Deep

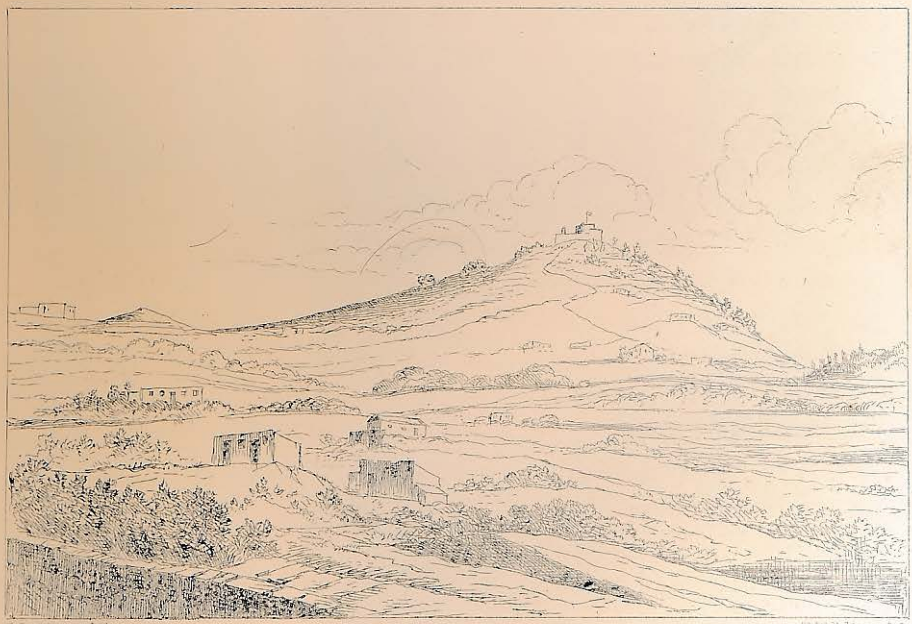
Valley Bay. In this second direction the flow appears still to form the side of the crater for about a quarter of a mile down from the top of the Peak, indeed, until it reaches Cuckold's Point, where it separates into two streams, one running south-easterly down to Deep Valley, the other south-westerly, overlying and destroying the edge of the crater, and then winding down to Green Hill and White Hill. In a similar manner may be traced the courses of Halley's Mount and Alarm Ridge, Casons and Merryman's Hill, with several others, as one travels westward towards High Peak, from whence also a lava stream takes its course north-westerly towards Horse Pasture, with an adjacent arm to the westward. A little distance eastward of West Lodge is seen another, forming a narrow low hill between Horse Pasture and High Hill. The next is plainly traced as High Hill itself, and then westward, in succession, come Bottleys, Man and Horse, Churchyard, and Devil's Hole Ridge.

The features we shall next notice are the effects produced by a slight upheaval, which some subterranean force, volcanic or electrical, or both, has caused. This force, though doubtless considerable in itself, has in its results been moderate. It has acted vertically throughout an imaginary line drawn from the crater-iform hollow of Turk's Cap Bay on the north-east, to the similarly formed hollow at Manatee Bay on the south-west, across the northern part of the Island, and slightly tilted more seawards that portion which lies on its outer side. Inasmuch as it would be impossible to walk, because of its intersecting nearly at right angles the deep and rugged water-cut ravines with ridges and plateaux separating them, let us glance along this line commencing at the Barn Rock on the eastern corner of the Island. Here, between it and Flagstaff Hill, we see a strange upheaval of the unstratified cinereous sub-base of the Island* protruding high out of the sea, and causing the lava strata which overlie it to dip eastward and westward at angles of 35° and 20°. As might be expected, small dikes abound at this spot, traversing in a vertical direction both

* From the Barn to the King and Queen or Prosperous Bay Telegraph, this formation, which consists of cinereous rocks of a yellowish reddish hue, intersected in all directions by numerous small dikes, may be seen underlying the lava strata similar to the formation on the face of Ladder Hill, &c.



VIEW LOOKING SOUTH FROM SEA, OF THE BARN & FLAGSTAFF HILL. *p. 60.*



J.C. Mellins, del.

E.W. Robinson, lith.

VIEW LOOKING SOUTH, OF LATERAL VOLCANIC CONE. HIGH KNOLL. *p. 61.*

the unstratified and the stratified formations. The Barn itself is a long, huge pile of alternating strata of mud, débris, and lavas, similar to what has been already described, rising almost perpendicularly to 2000 feet; the strata inclining 20° to the eastward, and 35° to the northward. Passing along in front of Longwood, over Deadwood and Rupert's Valley, to the ridge which separates the latter from James' Valley, the upheaval is plainly recognised at a point situated some little distance north of Sampson's Battery, by the sudden change in the inclination of the strata from about 6° to 8°, or 10°, and the presence of two very felspathic dikes, each fifteen or twenty feet in thickness, which intersect the ridge in a south-westerly direction; one of these dikes, the material of which may be fused at no very high temperature into a kind of coarse black glass, can be traced across James' Valley, passing above the Military Hospital, and up the eastern side of the plateau which supports the hill called High Knoll, a lateral volcanic cone formed by lavas ejected through the fissure which this disturbing force had caused. This cone has a height of its own of about 500 feet, while its entire altitude above the sea is 1903 feet. It is composed of very frothy, scummy lavas, tufas passing into breccias or pudding-stones, mixed with ashes and cinders. None of the lavas are compact, but sufficiently close in texture to form a good building-stone easily worked with the chisel, hence "High Knoll stone" is much in request for the best style of building, including the fortifications and other military works. Most of the lava is however very scoriaceous, resembling a coarse kind of pumice-stone, and bearing more recent marks of fire than any other rock in the Island. The formation of the cone exhibits in a most interesting and striking way the influence of the wind upon ejected matter from a volcano. That side which immediately faces the south-east trade wind is quite perpendicular, while the whole of the ejected matter has been blown in the opposite direction and built up three sides of a most complete cone, with its slopes inclined at angles of about 20° or 25°. It is remarkable that the decomposition of this High Knoll lava produces an ashy kind of soil, in which few plants will grow and scarcely any thrive. Upon the top of this cone I picked up what appeared to be a lava internal cast of a bivalve shell, about six inches in length, and very much resembling *unio sheppardianus*, or some similar species. It is quite possible that

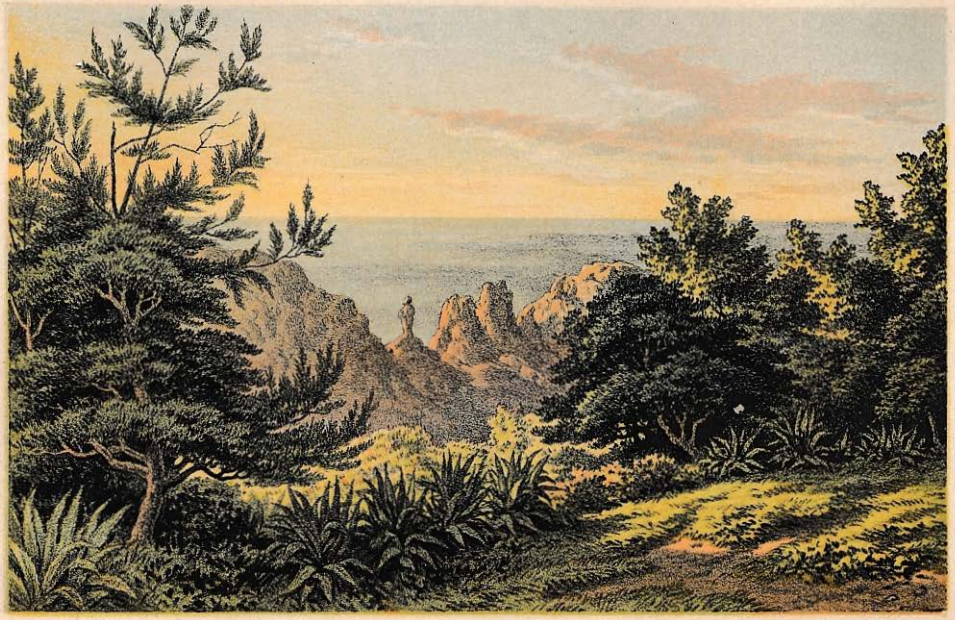
the hot, frothy lava scum obtained admittance into the shell, and, while cooling itself, so as to retain the form of an internal cast, burnt the shell, causing it to fall away as quicklime; but how a sea shell, if such it really was, got on to the top of this lofty volcanic pile has yet to be solved.*

The ejection of lava appears to have occurred more in the form of bubbling up and overflowing, while the cinders were thrown to a considerable height. The former, in many places, is twisted into almost all imaginable tortuous shapes, by a fresh flow running over the half-consolidated one which preceded it, and pushing or curling up the frothy scum into the fibrous forms which the scoriæ still retains. On the western side of the cone, low down in the valley adjoining New Ground, the thin flows of lava down the face of the cone, at an angle of 30°, are easily traced.

Leaving High Knoll, and proceeding westward along the line of upheaving force, across the plains and ridges called New Ground, Rock Cottage, Friar's Ridge, High Point, Horse Pasture, High Hill, and Bottleys, on this side of Manatee Bay, we see evidences of a disturbance in the strata at each point. The high sharp division between two ravines, called Friar's Ridge, exhibits a striking illustration of shattering and squeezing up of very compact lavas, the lateral pressure having been so great as to cause a sort of columnar structure to appear, while the angle of inclination of the lava-beds northwards is changed from 5° and 6°, to 10° and 12°. Much crumbling away of the rocks at this point has occurred, through the extreme narrowness of the ridge, and on its very crest there still remains a pile of stones about twelve or fourteen feet in height. Worn, weather-beaten, and lichen-covered, it has stood for many years until it has assumed, when viewed from a distance, a most strikingly correct resemblance to a cloaked and hooded figure, giving rise to the following legendary story:—

"The place where the Friar now stands was supposed once to have been the site of a Roman Catholic Chapel, adjoining which was the residence of the officiating priest, a monk of the Franciscan order, who was considered as an example of Christian piety and humility, his life being passed in the performance of acts of charity and

* I still have this specimen packed away with others, and hope to get it carefully examined.



Vincent Brooks, Lith.

THE FRIAR ROCK

benevolence, such as attending the sick, relieving the oppressed; and often did he interpose his charitable interference between the severe taskmaster and his wretched slaves, when the latter were condemned, for some trifling offence, to undergo fearful mutilations or the cruel lash. Thus, in acts of piety, this man of God pursued his way, blessing and blessed, till his senses became enthralled by the surpassing beauty of a mountain nymph, who dwelt in a cottage not far removed from the friar's lonely habitation. It was in one of his rambles, in search of some object of charity, that his eyes first encountered this lovely daughter of the Atlantic Isle, tending a herd of her father's mountain goats on the adjacent hill, called 'Goat Pound Ridge.' They had strayed so far that she had vainly tried to collect them, and was returning tired and sad to her dwelling, when encountering the monk, she humbly told her tale, and asked his assistance. It was readily accorded, for who could resist such an appeal, enhanced by so much beauty? The scattered flock was re-united, and the young girl, gracefully acknowledging his services, with a light heart returned to her home. It would have been well for the good Father had that interview been the last, but fate ordained it otherwise. Again and again he sought her mountain cot, pouring into the maiden's ear his tale of love and adoration, and finally besought her to be his bride. She promised, but on one condition only, to listen to his suit—he must renounce his creed and become of her faith. Upon these terms alone would she consent, and until he had resolved thus to prove his devotion he must not hope to see her again. The struggle was a fearful one in the breast of the monk, but love triumphed in the end: he forsook the faith of his fathers, broke his vows, and became a renegade.

"In due course of time the wedding day was fixed; the ceremony was to be performed in that very chapel which had so often re-echoed the apostate's pious prayers for his suffering flock, and the bride, accompanied by her attendant maidens, approached the altar. The service was read, and just as the bridegroom was clasping the hand of his beloved a fearful crash resounded, the rock was rent asunder, and every vestige of the chapel, and of those it contained, for ever disappeared. In its place stands the gaunt image of the grim friar, an example and a sad warning to those who suffer their evil passions to prevail over their better judgment."

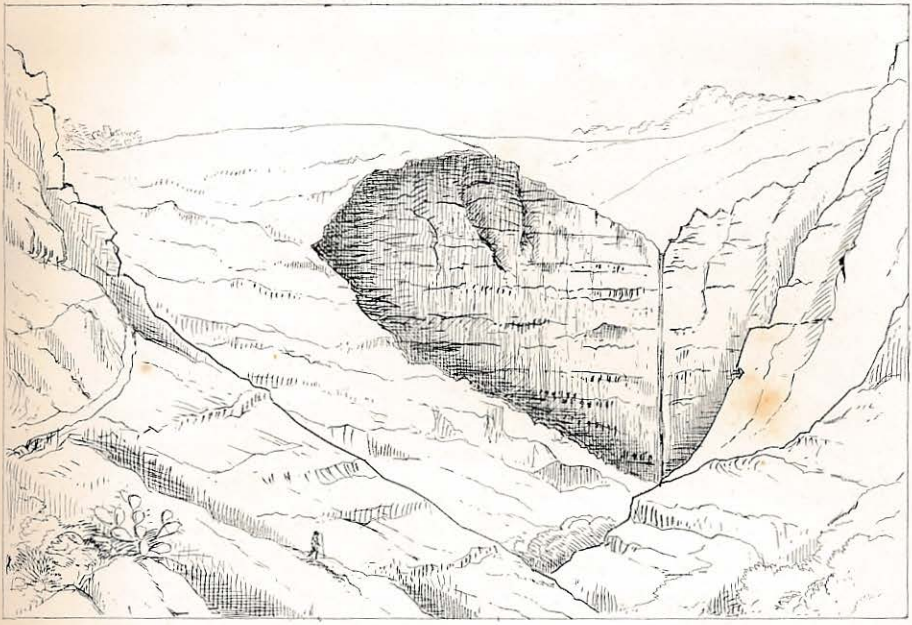
At Burnt Rock, on Horse Pasture, near the back of Woodlands

Farm, the angle of inclination of the strata changes from 6° to 20°, while at High Hill, 2323 feet above the sea, the effects of upheaval are, with the exception of The Barn, much more strikingly visible than at any point along the whole line. Here the ridge, on the northern side, has been forced up and elevated some hundred feet above the southern portion, and its strata have been inclined seawards or northwards at an angle of 25°, while the strata abutting against it on the southern side are nearly horizontal, leading almost to the idea that they flowed from the crater after instead of before the upheaval.

The next ridge in succession, known as Bottleys, shows, though in a less degree, a complete disjointing, with one portion forced higher than the other, and the strata inclining seawards at a greater than their original angle. From Bottleys we obtain a good view looking down into Manatee Bay, a large crateriform bowl with its grassy green edge in the foreground, its many-tinted barren lava sides intersected by numberless variously-coloured dikes as a middle distance, and for a background, Speery Island rising like a pillar of silver from a sea of the deepest azure blue, the whole making up one of the finest landscapes in this grand and striking scenery.

Throughout the length of this upheaval line, the occurrence of a substratum of red marly earth is visible, where it intersects the ridges, particularly at the Red Quarry, Rock Cottage, and Horse Pasture.

That a volcanic, suboceanic as well as subterranean, force did however exist at parts of this line of upheaval, previous to the Island itself being formed, may be inferred, after a careful examination of a locality situated on the eastern side of High Knoll, and called "The Waterfall;" here, in the ravine or upper part of James' Valley, there is a perpendicular drop of three hundred feet. Each flow of lava, as it took its course northwards from the great crater of Sandy Bay, appears at this point to have been abruptly stopped in its progress. It was not driven back so as to accumulate to a thickness greater than that it originally possessed, but seems to have had its edge cut clean off and removed away from the spot: in this manner a sort of horseshoe-shaped crater, about 150 yards in diameter, with perpendicular sides on the east, south, and west, rising to 300 feet, and its fourth side open, has been



VIEW, LOOKING SOUTH, OF THE WATERFALL, SITE OF AN EXTINCT SOLFATARA. *p. 65.*

J. C. Melliss, del.

E. W. Robinson, lith.

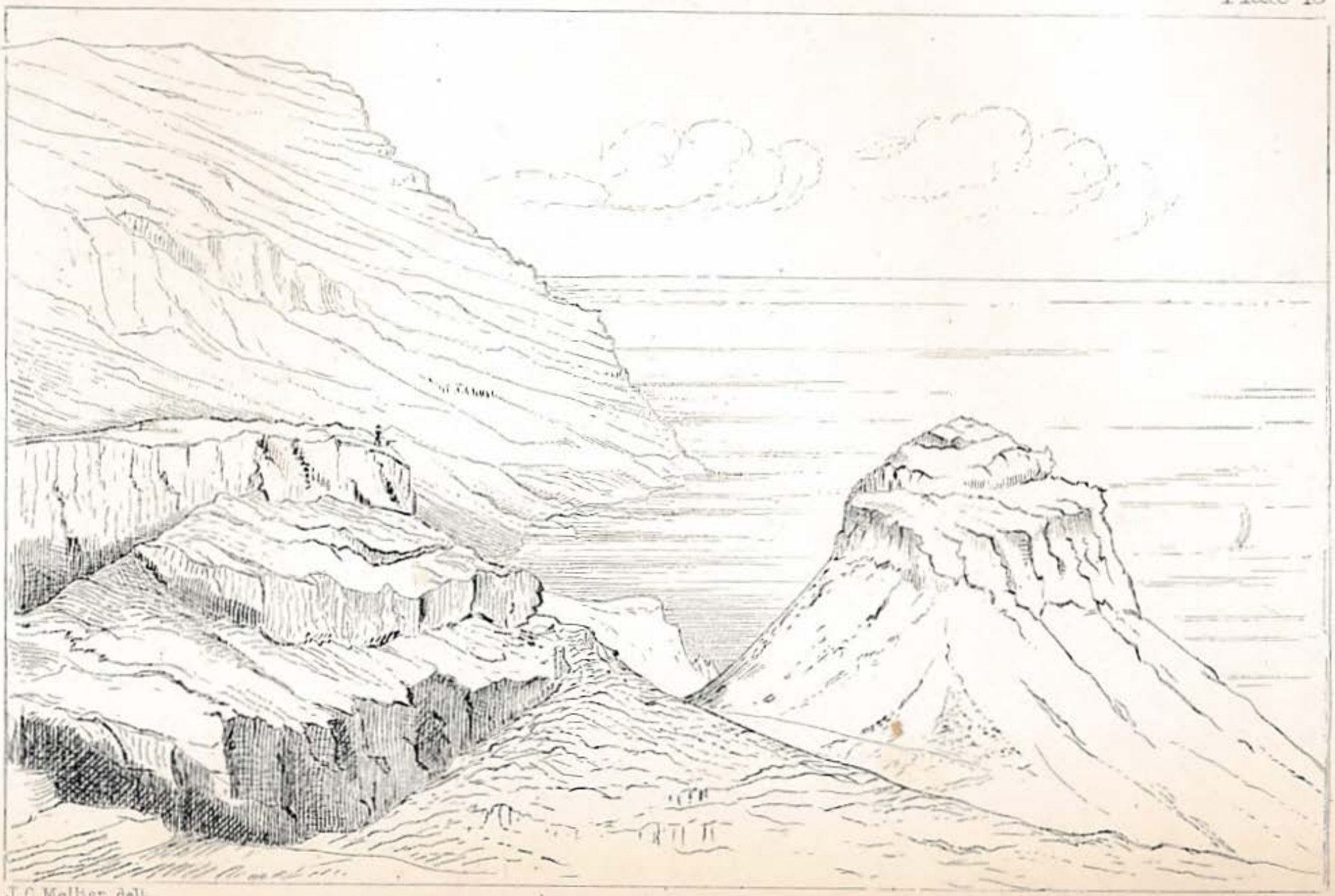
DIKE: CALLED THE CHIMNEY ON SOUTH COAST. *p. 72*

formed. It is not unreasonable to conclude that, long ere fiery vapour and lavas began to belch forth from the Sandy Bay crater, or the work of building up the Island commenced, this spot, where now simply a mountain stream trickles over the cliff falling in showers of spray to the bottom, was the site of a Solfatara of no moderate size and force, emitting water, aqueous vapour, and other gases, unaccompanied by the ejection of lava, cinders, or ashes. Such being the case, the discharge of steam and water must have continued with great force until after the lavas and other matter ejected from the Sandy Bay crater, which was distant three and a half miles south-westerly from it, had built up the Island to a height of a thousand feet or more above the level of the sea, each flow of lava northwards being checked in its course and so flowing round the watery discharge of the Solfatara. At a subsequent period, perhaps after the Island had been built up to its full height, this Solfatara or fountain of steam, probably at a time of its minimum power, became choked by an accumulation of fragments of rocks and other débris; and to its imprisoned force, struggling to obtain an outlet, may be attributed that shattering of the whole Island, which resulted in the upheaval of its northern portion, and the numerous rents across it, which being subsequently filled with lavas from below formed the various dikes we now see traversing the Island in the same direction as the line of upheaval—viz., from north-east to south-west. Although the large bowls at either end of this line of upheaval—the one situated at Turk's Cap Bay and the other at Manatee Bay—are very crateriform in appearance, there are no traces of lava strata which by their position can be said to have come from them.

Turk's Cap Valley, as it is called, lying between The Barn, Gregories, and Deadwood plain, presents an interesting part of the Island. From Deadwood it is easiest of access. Walking being out of the question, one has to slide down a number of deep furrows or narrow valleys cut in the ochres and variously coloured clays for near two thousand feet, in order to reach the bottom. The furrowed and rugged surface of these steeps is intersected in every direction with dikes of all sizes. I noticed some of them less than two inches wide, while others are as large as three or four feet in thickness. In almost every case they present marked instances of vitreous edges, showing plainly that they were formed after the mass in which they occur had cooled. In this

space, not exceeding fifty acres in area, I counted hundreds of them, in some places lying almost side by side, in others crossing one another, and varying so much in composition that the difficulty was to find two alike. Some are almost entirely of augite, and I observed one much resembling granite in mechanical structure. In this valley I saw masses of compact calcspar of a pale yellowish colour and translucent nature, in form, apparently, as though it had bubbled up and over the lava rocks previous to its hardening. At a depth of about thirty feet below the surface there occurs a kind of yellow jasper which turns red in colour when exposed to heat. It is, however, not obtainable in any great quantity. Crystals of augite occur in this valley embedded in the lava, which, from their perfect form, scarcely seem to have travelled all the way from the Sandy Bay crater. The surface of the ground in many places is, similarly to Deadwood plain, thinly covered with small nodules of brown hematite.

The ground lying between Bottleys and Churchyard, extending down to Manatee Bay, is very similar in formation to that of Turk's Cap Valley just described. Streams of lava have flowed from the Great Sandy Bay crater's edge, on one side towards Man and Horse, and on the other towards Speery, inclosing a crateriform space of some considerable size, the most practicable descent into which, and down to the sea shore, is along the ridge of an arm or lateral branch caused by a divergence of the lava streams towards Man and Horse. This part of the Island is certainly not without great interest. It is barren, excepting here and there, where, being inaccessible, the grass has escaped the reach of cattle, goats, or sheep, and grown luxuriantly. The marks of fire and fusion are evident on all sides, and the whole valley strikingly illustrates the appropriateness of its local name, "Shaken Rocks." It certainly has been shaken and rent throughout, and is intersected by thousands of dikes crossing one another in every direction. Scarcely fifty square yards exist in any part, altogether in extent about forty acres, that are not crossed by a dike. These dikes vary greatly in composition; some are highly augitic, others felspathic, and in some instances these different formations lie side by side with each other. They do not, however, so distinctly show a vitreous selvage as those on the north-eastern side of the Island, thus, I think, proving the existence of greater heat of longer duration in this part. Descending into the bowl, the strata become more augitic and basaltic in character, and then lower down



J. C. Mellish, del.

E.W. Robinson, lith.

NORTH EAST VIEW OF TURKS CAP AND BARN.

showing denudation. *p. 71.*

very zeolitic. In some places the zeolite occurs in bands and seams an eighth of an inch in thickness, but there is a marked absence of laterite beds when compared with the other parts of the Island. The sea has worn away the rocks to a distance of fifty feet or more at the beach, forming a plateau of dikes. The beach itself is formed of loose shingle, and the ground around is covered with fragments of a laminated phonolitic-looking dike. A greystone laminated or schistose dike, traversed by one purely augitic, may also be seen amongst the many varieties which occur at this spot.

It is asserted that Manatees have been seen on shore at this portion of the coast; if such be true they have proved their race to be able navigators to have traversed the tortuous passages formed by the projecting dikes, which, running out into the sea, have resisted the destructive action of the waves, and stand up from the water like masses of crumbling masonry and tottering castle walls. The naturally wild, desert-like aspect of this portion of the Island is somewhat increased by the appearance here and there of the dead carcase of a sheep, and the wild scream of the sea fowl mingled with the ceaseless voice of the ocean.

To investigate the probable age of the Island, apart from the time occupied in building it up from its foundation to its summit,* recourse must be had to an examination of the denuding action of the atmosphere upon the surface, and of the sea upon the coast line; and although no exact estimate can be arrived at, it is possible, by a calculation formed upon careful bases, to approximate near to it.

The possession of a peculiar fauna and flora in itself points to *very* great antiquity, but its geological formation alone is sufficient to distinguish it as perhaps the most ancient volcanic production of its character.

It may even still be startling to some who cling to the idea that the world is no older than six thousand years, to be informed that the Island is a veteran of at least eight or ten times that period; and that there it has stood, alone, weather-beaten and worn, unvisited perhaps by any save wild seabirds, through hundreds of centuries before the birth of man. But, be this as it may, we are bound to read the Book of Nature aright, knowing well that

* At St. Helena sixty or seventy distinct flows of lava can even still be counted, and if these occurred at intervals of a century, it would give a period of six or seven thousand years for the building up of the Island.

in doing so, prejudices must disappear, and that scientific investigation only helps us the better to understand revealed Scripture.

Without taking into consideration the period occupied in building up the Island, the data we have to guide us in fixing its birth so long ago are those changes which have manifestly occurred in the contour of the land. If then we are able to fix definitely the outline of the formation as it originally stood, and then assume, after careful observation, a rate for its disintegration and decomposition, we may easily arrive, by a simple calculation, at a fairly correct estimate of the time required for it to assume its present size and shape. If we pick up a piece of stone anywhere on the higher land and break it across, we see directly that its interior presents a hard bright metallic lava fracture very different in colour and texture from its external coating, which for about a quarter of an inch in thickness is soft and friable. We quite fail, indeed, to recognise the inside and the outside of the stone as the same substance; but it is only exposure to wet and dry weather alternately that has thus oxydized or rotted and changed the external surface, which crumbling away and falling into clay or dust allows the atmospheric influence to continue acting on the stone, eating deeper and deeper into it until it becomes, in time, completely reduced to powder. This process is continually going on in large rocks as well as small stones, and the higher the altitude, where the most moisture exists, or the nearer the rocks are to the influence of the sea, so much quicker does disintegration and decomposition take place. There remains no landmark whereby to judge how much higher the edge of the great crater, or central mountain ridge, once was than it is at present, but that it was much higher is certain. Its lava edges have through ages (just as is still the case, with the assistance also of vegetation), gone on passing into alluvial soil, which in its turn has been washed down by rains to the valleys and plateaux of the lower districts. Much of the upper surface of the Island has in this way been removed, while much also still remains as marl in a transition state from lava rock to surface soil; indeed most of the upper parts of the Island are now covered with these grey, blue, or yellow marls, but they do not extend to more than a few feet in depth, when the hard lava again occurs. There are many opportunities of observing this in the road-side pits which the road-menders, searching for material, have opened.

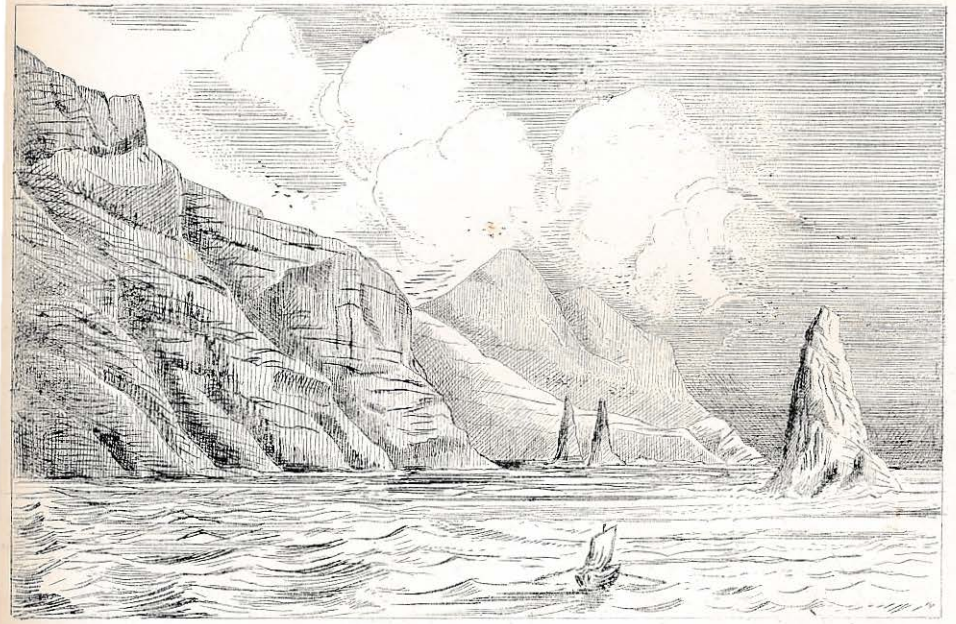
The rapidity with which rocks disintegrate or wear away varies

according to their nature; often the harder rock, lying side by side with those of different quality, is left standing while its adjacent ground disappears. We have already noticed this in the case of the large dike traversing the Sandy Bay crater, and to which we shall again recur in connexion with the subject now before us. There are, however, in addition to that dike, other large ones intersecting the edge of the crater, which by the same process have been laid bare; some of these are of considerable size, and, although not so conspicuous and easily traced as the Great Lot dike, they all partake of the same general direction and lie parallel with it. At intervals, where the directions coincide, the crater edge itself is at present formed for some distance by the exposed edge of a dike. This may be seen to the westward of Diana's Peak, where the narrow roadway leading to the highest mountain top appears to pass along the top of a wall, this wall being nothing more than the dike itself, with perpendicular faces of a hundred feet or more, and a width of only eight or ten feet. But for the ferns and other native vegetation which thickly clothe it, and conceal the danger, this perilous way would certainly be less popular with pleasure-seekers and pic-nic parties *en route* for Diana's Peak. The edge of the crater, about three miles further to the westward, a little beyond West Lodge, is again cut by some of these dikes crossing it at very acute angles. Three of them of considerable thickness, but not rendered so strikingly conspicuous by denudation of the surrounding rocks, lie within the space of half a mile; and, although placed in such near proximity to one another, differ entirely in composition. Proceeding in the direction already indicated, to a short distance beyond the old Piquet House on the ridge, we arrive at the first of these dikes. It is composed of a compact dolerite, of a deep brownish hue, containing disseminated augite and chrysolite, partly amygdaloidal and zeolitic, the cavities being filled or lined with minute white transparent crystals in form resembling chabazite. Massive boulders of this rock have become detached and rolled down the hillside, where they lie scattered about, protruding above the grassy slopes on either side of the road leading from West Lodge down to Thompson's Wood. Upon nearing Thompson's Wood House, where a small patch of weather-beaten Pine trees stands in its rear, other boulders similarly lodged occur, but of a somewhat more laminated character. Their composition also is found on exami-

nation to be very different from those already passed, and, being composed of phonolite or clinkstone with a very whitish-grey fracture and a perfectly white marginal surface, afford a good illustration of the decomposition which atmospheric influences are working on their exterior. These masses of rock have rolled down several hundred feet from the dike which crosses the crater-edge above, while, on the other side also, similar boulders have fallen down into the crater, where, on the steep sides, they lodge in strange positions. Along the road to Lot's Wife Wood, just after passing Lufkins, one or two of these great stones, measuring some forty or fifty feet in length, may be seen perched up in most curious positions.

Further still to the westward, on the main ridge or crater edge, occurs the third dike to which allusion has been made. It is composed of altogether a different material from the others, being of a dark blue basalt, with embedded crystals of augite and olivine; boulders have also become detached from it, and rolled down the sides of the hill; many of them, weather-worn into fantastic shapes, have lodged on a plateau, and, through their resemblance to mammoth tombstones, have obtained for the locality the name of "The Churchyard."

It is the great Lot dike, however, which is best suited for illustrating our present subject. The average height of those elevated columnar portions of it, called Lot and Lot's Wife, above the adjacent ground which has been worn away, is 275 feet. They are, as has been mentioned, formed of a hard felspathic finely crystalline greystone, and would, as is seen to be the case, naturally wear down more slowly than the surrounding rocks, which are much softer and altogether of a different composition. Supposing, then, the latter to weather away at the rate of one-tenth of an inch faster each year than the hard dike, which seems to be a fair estimate, we should obtain the period of 33,000 years as that which has elapsed since the dike and the inclosing land stood at the same height, which they undoubtedly did when the dike was formed. A still longer period of existence is indicated by the denuding effect of the sea waves. Rocks exposed to their action have not only the corroding and oxydating influence to wear them away, but are in addition subjected to a mechanical mode of destruction. The sea undermines the layers of lava, by washing out the volcanic mud and rubble beds which underlie them; consequently pieces split off, roll



SOUTH WEST PORTION OF GREAT DIKE. SPEERY. p 51.

T. Mollins delt. E.W. Robinson lith.

SOUTH WEST VIEW OF GREAT DIKE. LOT, LOT'S WIFE, ASSS EARS &c. p 50 & 70.

down into the sea, are broken into fragments and washed away. Many instances of this undermining may be seen around the coast; at Bankses there is a very good example, where a thick layer of lava is deeply undercut. It is, however, not so quick a process as may at first sight appear, and such falls around the coast of St. Helena rarely occur, though, when they do, a good slice of rock comes away. The northern coast has in this manner been cut into by the sea making its way inland for a distance of 1233 yards, or nearly three-quarters of a mile, leaving a perpendicular face to the cliff of 600 or 1000 feet. This is what we find on the leeward side, where the sea is generally calm, excepting occasionally when disturbed by the rollers; but the denuding action of the Atlantic waves, which sweep with great force before the south-east trades against the windward side, has been much greater. There, at Holdfast Tom near Prosperous Bay, Stone Top, and Old Joan Point, the Island has been worn away until perpendicular cliffs of full 2000 feet have been formed.

An effect of this kind is visible also at Ascension, which, being a more recent formation, has been less acted on by the rollers along its northern coast, but has been considerably denuded on that side which is exposed to the prevailing winds. Again, at Madeira it is seen that those parts of the coast which are exposed to the broad sweep of the Atlantic are the most worn away.

By prolonging the direction of the strata, and making due allowance for any displacement, the original coast line can be ascertained with tolerable correctness, and this we find at Holdfast Tom was once 3300 yards, or nearly two miles, further seaward than it is at present. If then the wearing away, in a horizontal direction, of the coast at this exposed point, was at the rate of three inches in a year, it would require a period of 39,600 years to elapse since the action of the sea commenced to produce this change; or, taking the less exposed side of the Island, as at Ladder Hill, an encroachment by the sea of one inch horizontally per year would suffice to give 44,388 years. This estimate of the encroachment by the sea on those hard iron-bound basaltic cliffs, is, to one who has for many years carefully watched its progress, rather a minimum than a maximum rate. Year after year passes without any perceptible change in the line of cliff; the undercut strata at Bankses, already mentioned, has through a number of years remained appa-

rently unchanged, and though occasionally slices of cliff do fall away, such instances are rare, at long intervals, and scarcely ever known by any one person to happen at the same spot. At the present time progressive rates of three inches and one inch per year are certainly too great, but we may fairly take such an average, because the horizontal advance of the sea would lessen each year as the vertical depth of the cliff to be removed increased.

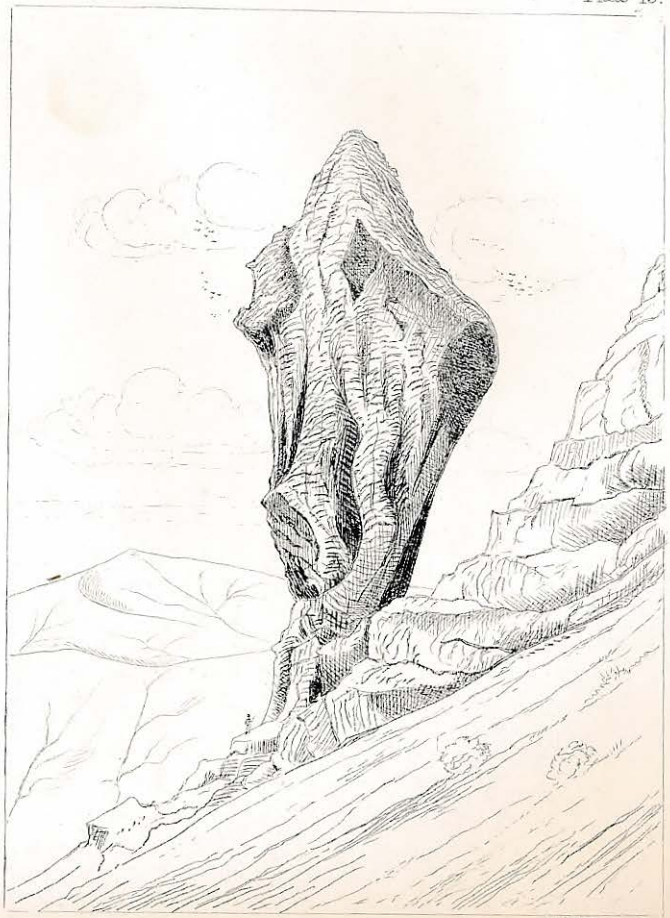
The Island is now bounded by a coast line of 30 miles. Its superficial area measures 45 square miles, or 28,800 acres. A careful calculation estimates the entire encroachment of the sea at 30 square miles, or 92,928,000 square yards, while no less than 11,587,280,000 cubic yards of solid land have been removed through its denuding power. Now assuming, from our previous calculation, the Island to have existed only 40,000 years, we have an annual encroachment of the sea on the land of 2323 square yards, and a yearly removal by denudation of the enormous mass of 289,682 cubic yards. The numerous dikes which jut out around the windward coast from Turk's Cap to Man and Horse show this action of the sea, especially at a place called "Lot's Wife Ponds," where a fine illustration of this terribly destructive agency is seen in the ruins of many dikes, which the devastating power of the waves has brought down to their own level. They have all the appearance of regularly built jetties running out through the surf into the sea. It would be difficult, however, to land at the spot, as they cross each other and lie in almost every direction just below the surface of the water. A portion of one of the hardest, a very dense block of black basaltic rock, has long defied the force of the water, and stands in a striking position, about twenty feet away from the mainland. It measures about fifty feet in height, thirty in width, and from four to six in depth, and from its remarkable appearance bears the name of "The Chimney."

Several small islets, some of which stand sufficiently away from the coast to allow a ship of large size to pass between, also testify to this destructive action of the sea. Both Egg Island and George's Island show the same formation of lava beds as the adjacent coast, while Speery Island marks a portion of the great Lot dike, and Peaked, or Lanark, Island is a curious remnant of a scoriaceous mass of cinders firmly cemented together, the counterpart of which is seen in a thick bed of rubbish on the mainland opposite.

At a time when the plains of Rupert's Hill, Half-tree Hollow,

J. C. Melliss. del.

PORTION OF GREAT DIKE. ASS'S EARS. *p. 51.*



E.W. Robinson. lith

PORTION OF GREAT DIKE. LOT'S WIFE. *p. 50 & 70.*

New Ground, Horse Pasture, and other portions of the Island, sloped gently down to the sea without intervening precipices, there doubtless existed long, low-lying coasts, upon which accumulated a white sand of broken shells, finer in grain but not unlike that now found at Ascension. This sand, having drifted into secluded places, and becoming compressed and hardened, now appears in the form of limestone beds, fragments of which occur at Lot's Wife Ponds, Bankses Ridge, and Rupert's Beach. These beds vary very greatly now in altitude, some being on a level with the sea, others as much as four or five hundred feet above it. They contain embedded fragments of very old looking lava rock, and are inclined inland, as at Lot's Wife, at an angle of 20°, but whether this inclination is due to drift or slight upheaval it is difficult to determine. The stratification of the beds, however, rather indicates the latter. The hardest of this limestone, when burnt, yields an excellent building mortar, but it exists in small quantities.

In many respects there exists evidence of the great mass of the Island having cooled slowly. It is indicated by the entire absence of obsidian, as well as by the vitreous edges of the dikes. The hot matter which formed the dike, coming into contact with the cold sides of the opening which it filled, would quickly cool and account for the glass-like edges, in some places passing into serpentine, which occur in many of the dikes at St. Helena.

Earthquakes happen so rarely, and when they do are so slight, that they scarcely need be noticed as occurring at all. Four only have been recorded during the last 370 years—viz., one on the 15th June, 1756; another in 1780; one on the 21st September, 1817; and the last on the 15th July, 1864.

It is not a little remarkable that in so complete a volcanic formation no traces of sulphur occur, either native or in combination with other substances; and of the numerous springs of water which exist only some few appear impure, and that caused only by the presence of sea salt, which is plentiful in some of the higher beds of laterite and rubble. Not a single instance of a spring above the ordinary temperature is found, and, indeed, no recent signs whatever exist anywhere to indicate proximity to a volcanic locality.*

* The St. Helena Monthly Register for 1810 states that "a warm mineral spring was a short time ago discovered near Longwood. It rises from under an immense body of solid rock, its temperature is 66° Fahr. which was 6° above the temperature of the surrounding atmo-

The large supply of water found in the Island is remarkable, there being, apart from the numerous small brackish springs which occur on the outskirts and the low lands, no less than 212 fresh water springs, yielding daily about 8000 tuns of the purest quality. There is, indeed, scarcely a paddock or meadow without its spring of the very clearest water. For such a bountiful gift to this Island, while the neighbouring one of Ascension is entirely dependent upon condensed sea water and collected rain water stored in tanks, I think the difference in geological structure accounts. Clouds very frequently envelope the high mountainous parts of both these Islands, as they do at Madeira and the Canary group, though not to so great an extent, and, except on those bright cloudless days which sometimes occur, a condensation of moisture is taking place night and day. The water thus deposited soaks into the soil, and, flowing along the impenetrable upper surface of some substratum of thick lava, finds its exit, where the edge of that stratum crops out, in the form of a fresh water spring. Ascension appears to differ in this respect; the lava strata do not exist in such broad massive sheets or layers, but the whole formation partakes more of a cindery, scoriaceous, and porous nature, so that whatever moisture is deposited from the clouds on the mountain top penetrates vertically down through the Island, and is not, as at St. Helena, arrested in its progress by any solid strata.

The lava beds on the high land, where they have now passed into a hard grey or whitish marl, are considerably perforated by cylindrical holes, measuring from three-quarters to an inch in diameter and two or three inches deep. These holes pass occasionally into one another, and generally terminate in a conical form. Upon close examination their interior surface shows a roughly-grooved texture, the furrows running transversely round the sides, plainly indicating the marks of some apparatus by which they have been bored. In considerable numbers these perforations may be seen along the roadside banks, in the neighbourhood of Joho's Hole, Green Gate, Halley's Mount, and very generally at the same

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sphere at the time of examination. It is found to hold in solution a considerable quantity of neutral salts, principally sulphate of magnesia, and is a mild and effectual cathartic. It very nearly resembles the Bristol Hot Wells, but is not so unpleasant to the taste and would most probably be found equally useful in the cure of those diseases for which that celebrated spring is used." My failing to meet with this spring would not be altogether conclusive that it does not now exist.

altitude of about 2000 feet above the sea. Mostly they are filled with mud, and altogether present a very ancient appearance. It being contrary to all evidence that these rocks were ever in such positions as to be bored by pholades, or any creatures inhabiting the sea, we may reasonably form the conclusion that the litho-domous perforations which we now find in them have been made by the great land snail of St. Helena, the *Bulimus auris vulpina*, previous to its becoming extinct in the Island. This opinion is strengthened by the non-existence of any other creature likely to have bored them, as well as by the fact that a comparison of some of the shells with the holes shows a very accurate correspondence. Some additional force may also, I think, be derived from the fact mentioned to me by Mr. Gwyn Jeffreys, that this extinct bulimus must have lived in water or swamps, as well as on land. It is true that nothing like a lake or a swamp of any size now remains in the Island, but there is no reason why, previous to its being so broken up and drained by denudation, large ponds and swamps should not have existed—indeed it seems most probable that they did, and also that their edges or coasts were formed of these very rocks in which the perforations occur. The existence of so much moisture would have greatly facilitated the passing of the lavas into felspathic marls, and thus account for the large masses which occur in a tumbled, displaced position from what they must originally have occupied as strata.

The subsequent disappearance of swamps by drainage, as the Island became smaller, would very probably account for the death and extinction of this bulimus by depriving it of its natural element, and perhaps also of its food, in some semi-aquatic plants, the existence of which might also be brought to an end as the land became drier.

It is also not a little remarkable that the dead bulimus shells are now found on the north-eastern side of the Island, where, no doubt, judging from the appearance of the land, swamps would have existed at a more recent period than at any other part.

The Island cannot be said to be rich in minerals, nothing having yet been discovered of much commercial value. Pyrolusite, or black oxide of manganese, has been exported to Europe and obtained a fair market price, but it is an ore of a hard description, and difficult to separate from the clay-beds in which it occurs. This,

combined with the heavy expense of transport, prevents it from being worked.

A very large variety of clays exists in many places between the lava beds and on the high land. Several of them are of a pure white, which leads to the idea that some value might attach to them as material for the manufacture of porcelain. They have, however, been pronounced valueless for such a purpose. In the year 1868, a large and carefully-made collection of them was tested by Mr. John Mortlock, of Oxford Street, London, and he reported that trials made with them showed that, without an exception, they all contained more or less iron, which rendered them totally unfit for potter's purposes.

Such rocks and minerals as are found chiefly to occur are, together with localities and particulars, as follows :—

Dense, very finely crystalline basalt.

Ditto, containing disseminated crystals of augite and olivine—s.g. 2·83 to 3·13.

Ditto, with iron chrysolite.

Dense basalt, with few cavities containing sea water—s.g. 2·84; James' Valley.

Highly scoriaceous lava.

Amygdaloidal lava.

Phonolite or clinkstone ; great Lot dike, Ass's Ears, &c.

Numerous varieties of felspathic lavas, varying from basalt and greystone to trachyte—s.g. 2·61.

Volcanic bombs or pear-shaped masses of lava.

Porphyritic basalt, containing crystals of felspar, augite, &c.—Dike in Turk's Cap Valley.

Amygdaloidal greystone, containing embedded augite and iron chrysolite, some of the cavities being lined with very minute, brilliant, and perfect cubic crystals of zeolite, probably chabazite.

Amygdaloidal greystone, the cavities filled with zeolite in very small boitroidal masses, composed of extremely minute radiating fibrous crystals, probably natrolite.

Amygdaloidal lava filled with perfectly spherical, very minute cavities, coated on the inside with a thin layer of zeolitic mineral.

Cellular Lava.—Many varieties.

Trachyte.—s.g. 2·523.

Ditto, passing into white clay; below Bamboo Hedge, at Ladder Hill, &c.—s.g. 2·75.

Lamelliferous greystone dike from immediate proximity to augite and other dikes; Manatee Bay.

Laterite.—Various colours and degrees of hardness, between beds of Lava.

Volcanic tufa, between layers of lava.

Volcanic breccia or pudding stone; Ladder Hill, &c.

Volcanic scoriaceous agglomerate.

Compressed tufaceous rock.

Compressed tufaceous rock, coloured red by oxide of iron, and containing augite, &c.; Red Quarry, Woodlands, Rock Cottage, Ruperts; a compact variety, much hardened by plutonic action and pressure between the thick layers of lava, is largely used as a dressed stone for building purposes. A coating of mortar on the exposed face preserves it from atmospheric action. The basalts and harder rocks are used chiefly for rubble building and for macadamizing roads.

Agglomerate rocks formed of masses of scoriæ and volcanic ashes lying between the beds of laterite and lava.

Porphyritic lava, containing disseminated crystals of carbonate of lime; Holdfast Tom.

Volcanic scoriæ and pumice; High Knoll.

Volcanic ashes.

Fossiliferous-like masses of scoriæ; High Knoll.

Augite rock; Turk's Cap, Manatee Bay, &c.

Siliceous rock—Flint, coloured by oxide of iron, chiefly in pebbles on seashore at Manatee Bay.—s.g. 2·60.

Dolerite, containing disseminated augite and chrysolite, partially amygdaloidal and zeolitic. The cavities containing crystallized chabazite.—s. g.2·85. Dike on crater edge above Thompson's Wood.

Red porphyritic lava from dike at Prosperous Bay.

Trachyte dikes, very laminated, exhibiting, through colouring by oxide of iron, a false appearance of stratification.—s.g. 2·64. Prosperous Bay.

Selenite—Sulphate of lime or gypsum, foliated, fibrous, crystalline, and stalactitic; Bankses, Ruperts, in veins on rocky outskirts.

Augite crystals; Manatee Bay, Lot, Turk's Cap, &c.—s.g. 3·08.

Olivine.—Crystals.

Ditto, having undergone change to iron chrysolite.

Calcite or calcspar in masses, fibrous and compact.—s.g. 2·78. Turk's Cap Valley.

Yellow jasper, changes by the application of heat to a reddish-brown colour; Valley near Turk's Cap.

Quartz.—Various varieties of chalcedony and agate.

Zeolite from cavities in basalt, in radiating acicular crystals, probably natrolite or skolecite.

Boitroidal nodules of inferior brown hæmatite (iron ore) varying in size from half an inch to four inches in diameter. s.g. 3·11.—Large quantities on the plains at Horse Pasture, Rock Cottage, Flagstaff and Deadwood.

Silicate of iron (very impure iron ore) near Shipways.—s.g. 2·92.

Pyrolusite.—A very hard binoxide of manganese, containing 66·47 per cent. of manganese, occurs in veins in beds of claystone at Holdfast Tom, Fisher's Valley, Turk's Cap, &c. The ore protrudes through the clay in scraggy scattered boitroidal forms.—s.g. 3·62, 4·18, 4·40.

Carbonate of lime, zeolitic, in radiating boitroidal masses, measuring about eighteen inches across, containing embedded nodules of trachyte and carbonate of lime; Prosperous Bay.

Ditto, pure crystals; s.g. 2·77.—Prosperous Bay.

Ditto, crystals and almond-shaped nodules from cavities in basalt; s.g. 2·96, 3·02.—James' Valley.

Ditto, stalactitic and stalagmitic.

Ditto, limestone.

Ditto, dog-tooth spar; face of Sandy Bay Barn.

Serpentine.—Near The Barn.

Asbestos.—Fibrous white silicate of magnesia from Horse Point, near Turk's Cap and Holdfast Tom.

Rock salt.

Argillaceous clay.—Many varieties.

Rich vegetable soil, produced by disintegration of felspathic lavas.