



Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at <http://about.jstor.org/participate-jstor/individuals/early-journal-content>.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

island. To the growth of this produce is appropriated one-sixth of the whole area; the remainder is sterile. Of the western plain the greater part is fit only for pasturage, the rest being either barren mountain-land or underwood. There are about 2800 head of horned cattle, 2000 sheep, 1200 pigs, 600 goats, and 100 horses and asses. For these the grass and other fodder of the island do not afford a sufficient supply of food; and they are therefore fed in winter on the bruised leaves of the aloes, which are cultivated for the purpose on the stony ground and the otherwise unprofitable sides of the ravines.

The land communications are extensive, and in dry weather excellent; the nearly exclusive use of ox-carts for transporting produce maintaining a good width, and the firm consistence of the soil giving them a resisting and durable foundation. The island is on all sides easy of defence against external attack, the various landing-places being close to and commanded by high positions, and without cover for a disembarking force. The artificial defences are at present insufficient in number and in bad repair, and the number of landing-places would render a large force necessary for the repelling of invasion; as may be seen on reference to the map, on which they are marked with an anchor.

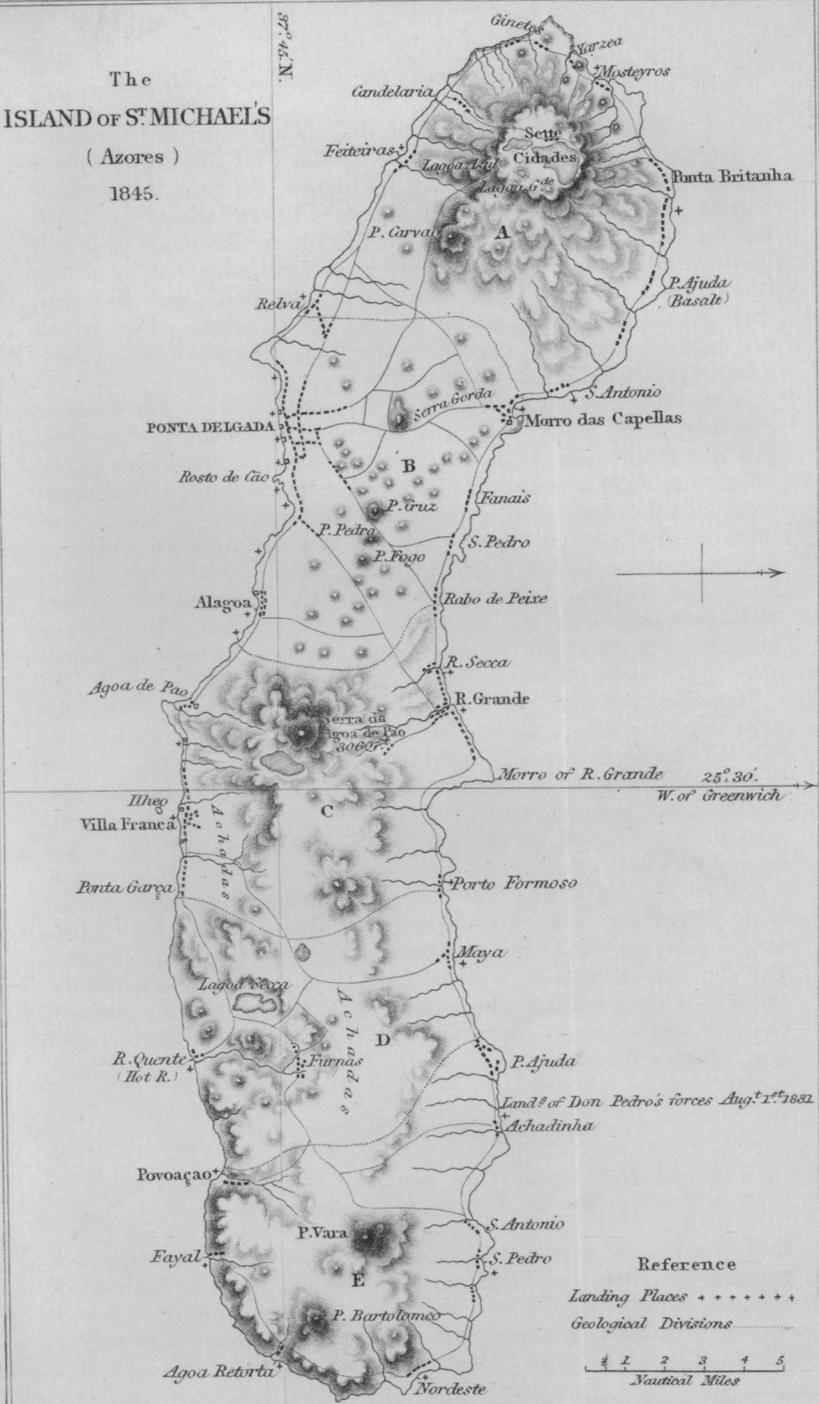
The best internal positions are those on the eastern side, except that any attempt to cross the deep ravines of the western in the face of an effective enemy, would be very disastrous. The deepest of these lies close to the town, and would be easily defended under cover of the houses; while in turning it, a force would be commanded by the adjacent Beacon Hill to the eastward. There are several disused convents and other large buildings in good repair, which would serve as good and easily-defended quarters for an occupying force, and the surplus production of corn and cattle would give for their use an abundant first supply of provisions. On the whole subject, however, the best information could be given by Captain Vidal, whose name has already been mentioned, and whose profession and experience in surveying would render him a high authority on a question of this nature.

VII.—*A Description of the Island of St. Michael (Azores).*

By Mr. Consul CAREW HUNT.

I. THIS island, as delineated in the accompanying map, lies between the 25th and 26th meridians of W. long., a little S. of the 38th parallel of N. lat., describing a curved figure of pretty regular breadth as a whole, and occupying an area of 224 square miles. The chief town, Ponta Delgada, is at the W. side of a

The
ISLAND OF ST MICHAEL'S
 (Azores)
 1845.



Reference
 Landing Places + + + + +
 Geological Divisions
 0 1 2 3 4 5
 Nautical Miles

wide bay on the S. coast, situated, according to the latest published charts, in lat. $37^{\circ} 45' N.$ and $25^{\circ} 35' W.$ long.

There is considerable variety in the aspect as the island is passed from E. to W. The E. end rises from a bluff sea-cliff of between 1200 and 1400 feet elevation to a lofty inland peak, from which a central range, varying in height between 2000 and 2500 feet, runs to the westward, terminating in the Serra da Agoa de Pao, 3060 above the sea. The sea-coast gradually declines in approaching the last point, where it is not more than about 100 feet high. The part next seen is lower, and its outline, as presented by the summits of numerous volcanic monticules of about 1300 feet elevation, united in a central ridge more undulating; the western extremity being marked by the conspicuous Serra Gorda, 1574 feet above the sea:* its shores on both sides are low, broken, and rocky. Of the remaining part the aspect is that of a vast truncated cone, irregularly cut off at an elevation of about 1800 feet, and falling on the N., W., and S. sides to a perpendicular coast of between 300 and 800 feet high. The outline is varied by the intervention of peaks, thrown up on the summit and flanks, and round the foot of the mountain.

In the higher parts the surface is generally covered with an undergrowth of heaths, cedar, laurel, laurestinus, and other evergreen shrubs, which give the mountains an exceedingly rich and wooded appearance, notwithstanding the inroads of cultivation and the more destructive demand for fuel. Like all volcanic countries, the face of the island is uneven and irregular, being deeply excavated by numerous ravines, and roughened by streams of semi-vitrified and scoriaceous lava that resist all atmospheric influences and repel vegetation. Heavy rains falling on the mountains afford a constant supply of water to 4 lakes at the bottom of extinct craters or subsidences, and a number of minor reservoirs, and through them to small streams rapidly running down on all sides into the sea.

The geological formation of St. Michael is volcanic, on a base in some parts of a whitish grey trachyte, in others basalt. The beds of lava lying between this and the surface are neither numerous nor thick, the height of the island being chiefly due to the accumulation of tuffaceous and other softer depositions. Of the 7 or 8 successive beds, only parts of the uppermost have been formed since the discovery of the island, the others being of an unknown antiquity. Local historians have not been wanting, even in the earliest times, to record the various phenomena affecting the

* The ascertained measurements in this paper were obtained through the kindness of Captain Vidal, of Her Majesty's steam ship *Styx*, when that officer was surveying the island in 1844.

geological character of the island, which may be given in the following chronological order:—

A.D. 1445. It is stated that when the island was first discovered, it rose at the E. and W. ends into peaks of equal altitude; but the discoverers then leaving it and returning in the next year, were witnesses of a volcanic eruption that enveloped the W. end, when the peak had lost one-third of its height, presenting a broken line of truncation instead of its former cone. The scene of this change is the so-called valley of the Sette Cidades, a plain occupied partly by two lakes, partly by small hills, of pumice and scorix, 884 feet above the level of the sea, and surrounded by a ridge with peaks of between 1880 and 2810 feet elevation. The division marked A in the map was covered by this eruption and its showers of dust and stones.

A.D. 1522. In the month of October of this year, the town of Villa Franca on the S. coast was destroyed by the fall of two considerable hills from their foundations, during the prevalence of an earthquake.

A.D. 1538. At the latter end of this year a large islet, three miles in diameter, was thrown up in the sea N.W. of Mosteyros; but, being formed of loose matter, it soon disappeared, nor can any trace of it now be discovered. The ejection of islets of this kind has been a common event in the Azores, and many formed of firmer materials still exist to show their usual shape and character. Among them are, an island off Villa Franca, part of one joined to the land and forming a small bluff point at Rosto de Caen, a point N. of Mosteyros, and the moros or bluffs of Capellas and Ribeira Grande.

A.D. 1563. Between the 25th of June and the 7th of July a number of successive streams of lava issued from the sides of Monte Volcam, now known as the Serra da Agoa de Pao; and, on the latter date, the peak of the mountain sunk, as that of the W. end is said to have done in 1445, and left in its place a deep valley nearly 2 miles long and 1 broad, now chiefly occupied by a lake whose surface is 1634 feet above the sea. The lavas of this eruption cover the western points of the mountain, extend to the N.W. as far as Rabo de Peixe (where a solitary and prominent bluff marks their meeting with the sea), and on the N. to Ribeira Grande. The first appearance of the Furnas hot-springs has been attributed to this convulsion; but no account exists as to those of the Caldeiras, at the northern foot of the mountain.

A.D. 1591. Several severe shocks of earthquake occurred between the 26th of July and the 12th of August, when Villa Franca, after having been rebuilt to the westward of its former site, was again destroyed, and the sea broke high over the valley

of Povoação on the S.E. coast, and washed away a great part of the village.

A.D. 1630. On the 2nd of September an explosion took place near the lake of the Furnas, unaccompanied by lava, when the neighbouring mountains were thickly covered with pumice and scorïæ, and the lighter particles carried to Terceira, a distance of 90 miles. A circular hill of regular figure was formed on the spot, in the centre of a plain surrounded by a low ridge, to which the name of "Lagoa Secca" has been given.

A.D. 1652. On the 10th of October an eruption of lava broke out from the sides of the quiescent Pico do Fogo, on the N.E. of Rosto de Cao, forming the rocky slope over the sea-coast and some narrow tracts towards the N. shore. This was followed on the 19th by an eruption from a neighbouring hill, which took the same courses.

A.D. 1707. A torrent, attributed to the breaking of a water-spout, suddenly flowed through Ponta Delgada in the month of November, and caused great damage.

A.D. 1720. A succession of violent shocks of earthquakes injured the towns and villages, and shook down large portions of rock from the shores and inland precipices; where indeed there are numerous traces of catastrophes of this nature. A torrent ran down the sides of the Sette Cidades mountains and cut out a deep ravine near Mosteyros in its passage to the sea.

A.D. 1744. On the 5th of October a similar fall of water took place at the E. end, washing down the valleys of Povoação and Fayal da Leira, and carrying away great parts of the two villages. The cause of such floods, even now not unknown in the Azores, has not been explained, nor has any record been left of the duration of the torrents and attendant circumstances, or the probable quantity of water discharged. With respect to Povoação it may be remarked that the peculiar shape of the valley, wide above and contracting with steep sides to a narrow outlet below, and its proximity to the highest mountains, expose it to heavy falls of rain and a great accumulation of water in that lower part where the village is built; and if to this be added the fact that an inch of rain frequently falls within an hour at the level of the sea, it will appear that the destruction of the village may not have been caused by any very extraordinary meteorological phenomena.

A.D. 1755. The earthquake that destroyed Lisbon was sensibly felt at St. Michael's, where the sea rose high above its usual level and broke over the land, washing down the houses built on the lower parts of the coast.

A.D. 1806. A mass of rock, resting on argillaceous earth, slipped from its place in the precipitous sides of the valley of the Furnas, leaving a chasm of more than 100 yards' diameter.

A.D. 1811. During the summer a similar fall took place, so close to the last-named locality that the two existing chasms are only separated by a narrow ridge about 100 feet high. On the 13th of June an island was thrown up in the sea near Ginites, to which the name of the British man-of-war *Sabrina* was given by her commander, who witnessed the explosion. It was soon worn away by the sea, and is now only to be traced in a submarine cone 15 fathoms under the surface.

A.D. 1838. A land-slip occurred in the summer near the Furnas, opening a cavity more than 400 yards broad and 100 feet deep, in the thick deposit of pumice of those parts.

A.D. 1839. On the 5th of December a rise of the sea, like that of 1755, washed down several houses and parts of the cliffs on the S. coast, subsiding with the fall of the tide. It occurred at the time of spring tides, after a gale of wind from the N.W., which had veered to S.E. without moderating, the barometer standing at 28.82 inches. The change of wind acting in opposition to an acceleration of the great Atlantic current (whose course here is from the N.W.) at the time of full moon and under a diminution of atmospheric pressure, would probably produce an unusual tide; but it is remarkable that it was not observed at St. Mary's, nor did it extend to the westerly islands. At Ponta Delgada the rise was $10\frac{1}{2}$ feet above the high water mark of spring tides, whose ordinary rise is about 6 feet.

The geology of St. Michael's will be more easily illustrated by dividing the surface into 5 districts, each of which has its distinctive characteristics, although contiguous parts pass so confusedly into each other, that, strictly speaking, there is no line of demarcation between them. The first district, marked A in the map, is that of the Sette Cidades mountains; the second, B, that of the Serra Gorda and its succeeding line of peaks; the third, C, of the Serra da Agoa de Pao; the fourth, D, of the Furnas; and the fifth, E, of the Pico da Vara.

In the order of formation the last is probably the oldest; in the fourth there has been no eruption of lava since the discovery of the island, although the surface must have been totally changed by the pumice of 1630; the present covering of a great part of the third has been formed since the middle of the sixteenth century; none of the older lavas appear in the second; while the oldest rocks are found in the first.

The first division, A, contains an area of about 51 square miles. Its lowest bed would appear, from a small exposure near Feiteiras, to be a pure greyish white trachyte, which, it has been thought, may be the original nucleus of the island. Above this is a compact grey lava, with microscopic grains of olivine and hornblende or augite (probably the latter), possessing all the density

of a basalt of submarine formation. It may be traced in the coast near Relva, Feiteiras, Candelaria, Mosteyros, and Capellas. Next above it are three or four beds (in some parts only one) of a porphyritic rock composed of peppercorn grains of green and iridescent olivine, with larger fragments of augite, thickly embedded in a base of semihard compact grey lava; the whole making a stone of great beauty, but too perishable for works of art. These beds are separated from each other and from the rock below by thick deposits of earth and pumice, containing masses of rock of every description and size. They do not appear on the N. coast, where they are concealed by the matter of subsequent eruptions. The next in succession is a delicate dotted grey lava, the spots being of greenish black hornblende which has lost its crystalline structure, and become only indistinctly separate in the trachytic base. Over this are a hard fine grained lava, like the lowest, but cellular, and a softer kind with small bright grains of olivine.

The beds of earthy deposit dividing those of rock are of nearly uniform character, argillaceous, friable, and of yellowish brown colour. The heat of the succeeding streams of fluid lava has converted their upper surfaces into a red ochrey substance, when the roots and other remains of ferns and associated plants of the time are now found in the state of a scarcely coherent charcoal. Among the embedded fragments are pieces of dark brown porphyry with crystals of glassy felspar, and amygdaloid, containing calcedony, arragonite, and other trappean minerals, like the rocks of the Pico Alto at St. Mary's. The great crater of this division is the valley of the Sette Cidades, said to have been formed in 1445. It will, however, be observed that the discoverers of the island, who have transmitted this account, had not at the time explored its interior, nor gone so far to the W., as to ascertain, by a view of its other sides, that the lost peak did not stand at the side of, instead of upon, the present valley. On the other hand the regular position of the beds and form of the cavity, which have not been disturbed by any lateral subsidence, are favourable to the conclusion that the historical account is correct.

In shape the valley is an ellipse of about 3 miles' length from S.E. to N.W., and $2\frac{1}{2}$ miles' breadth from S.W. to N.E. The ridge bounding it is of nearly equal height throughout, except where it runs into peaks; and on the N.W. presents a gap between two hills 1620 and 1770 feet high. On the S.E. a short chain, 2 miles long, points towards Ponta Delgada, terminating in the Pico de Carvao, 2632 feet above the sea. Besides the two great lakes occupying the greater part of the interior, there are reservoirs of water in some of the enclosed monticules; all supplying by filtration the streams of the outside, as well as the aqueduct constructed for the conveyance of water to

the port. The sides of the crater are nearly perpendicular, and display the parallel beds of successive eruptions with great clearness, the whole presenting the most striking specimen of a quiescent volcano to be found in the Azores, and not perhaps inferior to many in the world. The only existing remains of volcanic activity are found in two hot springs near Mosteyros and Candelaria, issuing in the sea below high-water mark.

The surface of this division, as of all the others, varies much in character, being in some parts a yellow argillaceous earth highly susceptible of fertilization, in others a mixture of pumice and scorix, or a vitreous intractable lava which defies the efforts of the husbandman.

The second geological division, B of the map, occupies the least elevated parts of St. Michael's; its low shores forming on the N. side the wide and open Bay of Ribeira Grande, and on the S., in reverse, that of Ponta Delgada. It contains an area of about 44 square miles. Along its middle runs an irregular line of hills and craters of different degrees of elevation, beginning at its W. end in the Serra Gorda 1574 feet high, and continued through the Pico da Cruz 1262 feet, the Pico da Pedra 1224 feet, and the Pico do Fogo 1031 feet above the sea. To the eastward of the latter, the line merges into the acclivity of the Serra da Agoa de Pao and the limits of the succeeding division. The soil is in general more fertile than the last; but it also comprises extensive patches of scorix as well as of vitreous lava, well adapted for vineyards but no other purpose. There are no hot springs or other signs of subterraneous heat, and the whole division is deficient in water, in consequence of its inferior elevation. On the N.W. side of Ponta Delgada, in an orange garden, is a remarkable cavern, 140 yards in length, 8 in breadth, and 5 in height, the walls and roof of lava with a semi-opaline or pearly surface, on which are seen occasional pendulous points, like melted pitch congealed in the act of dropping, and the bottom of rich brown fine-grained earth. At the N. end the passage has been closed by a wall, and at the S. the roof descends until it comes in contact with the bottom. The sides have all the superficial character of the roof, and apparently have not been rent asunder in their present condition; but the lateral surfaces of an existing crevice may have been enamelled by fresh lava, the crevice filled with earthy deposit, and the whole afterwards covered by the stream of fluid matter now forming the roof. The cave might have been opened subsequently by the infiltration of water, which would naturally have the effect of condensing the dry pulverulent deposition, and leaving a cavity above it. On the N. side of the Pico da Pedra is a perpendicular hollow, 140 feet long from N. to S. and 110 feet broad from E. to W. Its greatest

depth is on the N. side, where it measures 74 feet; the comparatively recent fall of loose masses having diminished it at the other end to 51 feet. This appears to have been formed by the sinking of the crust into a vast subterraneous blister, after the cooling of the whole mass of lava, of which a single eruption has evidently supplied the bed where the hollow occurs. The scoriæ underlying it are scarcely visible at the deepest end.

No clear indications of the order of even the greater eruptions of this division are afforded by any sections, nor can those of the numerous smaller craters be satisfactorily ascertained. The most considerable streams have been those of the Serra Gorda and the peaks of Cruz, Pedra, and Fogo. The former, a grey lava, cellular (the cellules coated with oxide of iron) and containing small imbedded grains of olivine, ran over the present site of Ponta Delgada. There are a few patches of the porphyritic lava of the first division, which also forms the upper bed of Cruz and Pedra, and is found to be 70 feet deep near the latter peak, and nearly 40 in the sections of the sea-coast on the S. side. The lava of the Pico do Fogo is full of bright grains of light green olivine, and may be generally seen on the slope towards the sea as well as on the N. side of the island, passing into a similar rock thrown out by the Serra da Agoa de Pao. The depth of this bed near Alagoa is about 40 feet.

Some notice is due to the shape of the hills of the central line of this division. They are mostly rounded cones and entire, but many have the horseshoe shape of the islets round the coast. The direction of their excavation, in the latter case, is irregular, as if it had varied according to that of the wind at the time of their ejection. It is indeed very possible that when the light matter chiefly composing them was thrown out during the prevalence of a strong wind, it fell to leeward of its point of discharge, taking a horseshoe shape in obedience to that veering to which strong winds are subject; and that when the explosion took place in calm weather the products fell perpendicularly, and rose in a cone.

The third division, C, contains an area of about 41 square miles, is high and mountainous, and bears in many points a resemblance to the Sette Cidades. Like that division it runs to a great elevation above the sea, the height of the Serra da Agoa de Pao being 3060 feet; its surface comprises extensive deposits of pumice; the older porphyritic rocks show themselves below its more recent lava, and it contains the trachyte supposed to be the nucleus of the island. Its principal crater is the valley formed in 1563, if indeed there is any other locality deserving the name; for it is doubtful if the whole of the line of heights running to the eastward and losing itself in the plains over the Furnas, have not its origin in

the ejected matter of the terminal craters. The line consists for the most part of a number of separate cones of great elevation, varying between 1800 and 2600 feet, in some places passing into each other, in others divided by deep valleys of small extent. Above Villa Franca they stretch out into a plain of small area known as the Achadas. They are chiefly composed of pumice and pumiceous scoriæ enclosing fragments of lava, porphyry, syenite, and pitchstone; the two former being identical with existing beds, the latter only found as solitary ejected masses. From want of cohesive power in the substance of the cones, the heavy rains cut deep gorges in their sides and cause land-slips and consequent precipices, very dangerous to any unwary explorer, who may be tempted to wander from beaten paths into these solitudes. A lake about a quarter of a mile in diameter, situated in the plain at a depth of 60 feet below the general surface, and accessible only at one side, seems to have been formed by such a subsidence as gave rise to the cavity of the Pico da Pedra; there being no rising ground round it or other existing mark of its having been a crater, to which, in some respects, it bears so strong a resemblance.

In this division the lowest beds are the basalt and trachyte of the Sette Cidades, the former visible on all parts of the coast, the latter in ravines E. of Villa Franca. The next is the grey dotted lava, that at a distance of $\frac{1}{2}$ mile S. of Ribeira Grande (in the course of the river) envelopes the rolled masses of the ancient sea-beach. Above this is lava with grains of olivine, and the succeeding, and perhaps final bed, of simple blue lava. Fragments of brownish porphyry, with crystals of glassy felspar occur, whose beds have been here covered by subsequent eruptions, although visible in the next division, where they seem to have succeeded the fundamental basalt, but preceded the dotted lava. There are the usual intermediate deposits of earthy matter of every degree of density and hardness, enclosing small and large fragments of lava, porphyry, pitchstone, conglomerate, and a syenitic rock composed of opaque and transparent felspar, hornblende, quartz, and schorl, with occasional crystals of mica, specular and octahedral iron and other minerals. A conglomerate is found near Villa Franca consisting of all these fragments embedded in a hard striated base of lava passing to pitchstone; its striæ, of the colour and lustre of obsidian, showing it to have been in a state of fusion. About 1 mile from the shore opposite the town is an islet hollowed out inside, now serving as a harbour of refuge for fishing-boats and other small craft. The date of its rise is not known. It is a rough tufaceous rock containing the fragments of the conglomerate of Villa Franca, and rises from the points at the entrance to a height of 148 feet on the seaward side. The sea has separated a portion of the latter part, and is gradually undermining

the whole through several lateral fissures, as well as round the exterior.

The fourth division, marked **D**, comprehends the formations in the neighbourhood of the Furnas valley, and occupies an area of about 40 square miles. The lowest beds are those of the preceding division; while the upper, as seen in the valley, have the characters of the next, some in being porphyritic, others in a disposition to crystalline structure, and all in exhibiting great compactness and absence for the most part of the cellules so common in lavas of other parts.

As the first and third divisions have their central craters, so this appears to be due to the eruptions of the valley, where, apparently, a former elevation has subsided after emission of the lavas. The other craters are clearly defined and bounded, but of this the limits in some parts cannot be ascertained, either from the sides having given way, or being concealed by the elevation of the plain. The extreme breadth at present from W.S.W. to E.N.E. is more than 2 miles; its interior being occupied partly by a lake 1 mile long and $\frac{1}{2}$ mile broad, partly by the circular enclosed plain of $\frac{1}{2}$ mile diameter called "Lagoa Secca," or dry lake, partly by the undulating valley and its village of the "Furnas," and partly by the hills separating this valley from the lake and "Lagoa Secca." The surface of the lake is 995 feet above the sea, and about 100 feet above the village; and the peaks overlooking the whole, between 1500 and 2300 feet above the former level. Lofty mural precipices bound the northern and more distinct parts, showing in their sections three beds of lava, not far below the upper surface, on a deep bed of earthy tufa. On the E. are hot and cold mineral springs, much resorted to by invalids, and near the N.E. margin of the lake other spots with a high degree of volcanic heat, to which probably are owing both the temperature and impregnation of warm chalybeate springs issuing at the opposite side of the adjacent ridge.

The surface of the hills on the S. is covered with pumice, in one part of which the land-slip of 1838 took place. On the N. are the plains, known as the "Achadas," of argillaceous soil, in most respects like those near Villa Franca. This division is abundantly watered by constant showers in summer, and more continuous falls of rain at other seasons, supplying the visible and subterraneous reservoirs from whose unabating sources numerous streams run through the ravines. The Riberia Quente (or Hot River, so called on account of the boiling springs in its course), the largest river in the island, rises in and is supplied entirely by the waters of the Furnas. It runs a tortuous course of rather more than 4 miles, and reaches the sea in a mouth 20 feet wide and a mean of about 18 inches deep.

In the common spring water there is no vegetable adulteration or impregnation with mineral elements; but when it rises to the surface, after traversing parts under the influence of present heat, or changed by that of the past, it takes up their chemical constituents, and appears, according to *their* nature, a hot or cold chalybeate, saline or alkaline spring, simple or mixed. The result is the production of the mineral waters of the place, held in high estimation locally for their medicinal qualities, and not unknown to men of science abroad, on this account as well as for their siliceous and alkaline constituents and deposits.

These waters are divided, according to their particular elements, into the following four kinds:—*First*, the Caldeiras, or Boilers, containing a volume of carbonic acid, with sulphuretted hydrogen, and about two thousandth parts of solid residuum, one-sixth silica, and the remainder alkaline carbonates and neutral salts.* *Second*, hot chalybeate of the Quenturas, containing a volume of carbonic acid, and one thousandth part of residuum, two-thirds carbonates of lime and soda, with muriates and silicates of soda and potash, and nearly a fourth oxide of iron. *Third*, “Agoa Feuca,” a tepid chalybeate, containing less carbonic acid and more iron than the second; and *fourth*, the cold “Agoa Azeda,” or acid water, containing a volume and a quarter of carbonic acid and two grains of residuum in an Imperial pint. Of these two grains about a fifth is carbonate of iron; the remainder, alkaline, carbonate, and sulphate, with silica and carbonate of lime.

Of these waters the first is used for baths only; its softness to the sensations and tranquillizing effect on the system, united with stimulant qualities, eminently recommending it for this purpose. It is found to be very useful in cases of chronic rheumatism, and in removing the fat and bloated habit brought about by high living and inaction. It has been further recommended by an intelligent traveller for paralytic loss of power in the limbs, gravel, secondary syphilitic symptoms, chronic gout, dry and hard skin, whether as a specific disease or symptomatic of internal derangement, unless attended by inflammation, liable to be increased by stimulants; and, finally, for the prevention of diseases to which the full habit of an indolent life may be tending.† The temperature of this water is nearly 210° F., the boiling point at the height of the Furnas above the level of the sea.

A similar use is made of the second water, efficacious in re-

* Dr. Webster, of Cambridge, Mass., was the first to discover (in 1843) a minute proportion of lithia in this water.

† Dr. Bullar, of Southampton, one of the authors of a recent work, ‘A Winter in the Azores,’ the best existing account of the climate, waters, and diseases of the islands.

storing strength to convalescents, and giving tone to the habit of those in want of it, who can at the same time bear its active qualities. By Doctor Bullar it is particularly recommended for diseases peculiar to the female constitution.

Less use is made of the third water, although it is a valuable adjunct to the medicinal virtues of the valley. It contains more iron than that usually drunk, is free from its salts, and, being tepid, may be taken internally in cases where cold water would be improper.

The fourth spring is only used for drinking; its transparency, sparkling appearance, and acid taste rendering it agreeable, notwithstanding its strong chalybeate character. The sick, convalescent, and healthy drink it indiscriminately; nor do any bad consequences appear to ensue from its universal application, although it acts on the kidneys of those who are not accustomed to it. Dr. Bullar praises it as an exhilarating beverage, giving tone to the stomach and energy to the system, as adapted for calculous complaints, and as highly strengthening, in the shape of a cold bath, when the invalid has sufficient vigour to support the re-action.

Most of these waters rise in a locality very interesting to geological observers. The boiling spring, as it runs towards the river, deposits its earthy matter as a sinter, and has by successive layers raised a bank of this substance, interstratified with a loose and dry argillo-siliceous powder, nearly 6 feet above the intersecting road. The water of the chalybeate springs throws down a thick loose coating of oxide of iron of deep orange colour, and that of the cold springs covers the stones in its course with a thin but perfectly formed and visible film of bright black sulphuret of iron. An adjacent hillock composed at one time of earthy matter, enclosing fragments of lava, porphyry, and amygdaloid, has been altered in its whole mass by the streams of sulphurous gas rising everywhere through it; while the iron alumina and alkalis of both earth and stones have been converted into ochre and alum, and their silica disengaged and left to mix with numerous small crystals of brilliant yellow sulphur and the other products. In breaking up the larger stones their interior is found scarcely changed, but passing gradually to the decomposed substance of the outside and the loose matter surrounding them.

Appearances of the same kind show themselves at the lake and other parts of this division. Carbonic acid rises in the running streams, giving them the disturbance of ebullition, and in a few spots where it is emitted in dry cavities, the graves of accumulated heaps of coleoptera, juli, lithobii, glomeres, and other insects.

The fifth and remaining geological division, marked E in the

map, comprising an area of about 48 square miles, is perhaps the most ancient, as it is the highest part of St. Michael's; the Pico da Vara, near its centre, rising 3560 feet above the level of the sea, and the fundamental and succeeding rocks partaking of the character of St. Mary's. The base appears at Ponta da Ajuda in columns of basalt covered by the sea, and in some parts near Ribeira Quente is disposed to the same structure. Over this are deep beds of tufaceous earth, as is usually the case in the island, the greater part of its elevation being due to them; and these are succeeded by lavas, porphyry, and the finer covering of earth more argillaceous than in the other divisions. Besides Vara the peaks of Bartolomeo and St. George rise here to a height of 2927 and 2455 feet above the sea. The cliffs of the eastern shore are proportionately high, probably from the encroachments of the sea, having, abreast of Bartolomeo, between 1267 and 1347 feet height; and here a long shoal stretching to the N.E. seems to point out the destruction of a former constituent part of the island.

This division is distinguished from all the others in being without craters, and having on its surface no loose scorïæ or streams of vitreous lava, and no pumice of its own ejection. It is abundantly watered, but possesses no mineral springs or signs of volcanic activity.

The original minerals of St. Michael's are not numerous or of large size, yet they are not all without interest to mineralogists. Quartz is formed in brilliant minute crystals in the ejected syenite of Agoa de Pao, and in cells of the amygaloids of the Furnas, Pico da Vara, and Sette Cidades. At the last place it is simple and stalactitic, associated with milk-white calcedony and uncrystallised and radiating arragonite. With the arragonite the base is so much imbued, that muriatic acid produces effervescence, even where none of the mineral is visible with a lens of quarter inch focus. Olivine is found imbedded in most of the lavas, not large or distinctly crystallised but of highly brilliant lustre and colour, in concretions varying in size from a pigeon's to a goose's egg, and also in rolled crystals among the sea and river sands when it has been freed from its matrix. Augite is generally small and uncrystallised or fractured, but in the scorïæ of the Pico da Pedra it occurs, though very rarely, in crystals of half an inch diameter, retaining all their regularity of form under a dull scoriaceous surface, and in a few well-formed crystals in reddish wackè at the Sette Cidades. The pumice of Agoa de Pao contains innumerable fragments of black pitchstone, mostly porphyritic, seldom of even a tolerably fine kind, yet interesting on account of the beautiful iridescent tarnish presented by its fresh fractures.

Titanitic iron forms nearly ninety per cent. of the sea sands N. and S. of the Serra da Agoa de Pao, where its greater specific

gravity has lodged it during the abrading process by which its softer matrix was washed away. In the ejected syenitic masses of the same parts are minute but brilliant crystals of specular, with others of oxidised octahedral iron; and to the felspar and shorl of these masses are attached microscopic but distinct and sharply-formed red-yellow octahedral crystals, the angles giving a mean of $109^{\circ} 28'$, of which the writer has not yet learned the name. It has been suggested that they may be "Pyrrhite," a mineral found by M. Perowski of St. Petersburg, near Menziusk,* in a drusy cavity of felspar; in which case they will merit the attention of collectors. The minerals of the Furnas are siliceous sinter, (inferior to the Icelandic) rare coatings of fluorite, sulphur, in small crystals and larger crusts; silica, separated by local heat from its parent earths and rocks; supersulphate of alumina mixed with an alkaline base; muriate of soda; films of sulphuret of iron, of which Dr. Webster found masses under the surface; and substances in amygdaloid decomposed, which are no doubt common trappean species. Glassy felspar abounds in the porphyries, but always in small crystals.

The particular geological features of St. Michael's having been described, it will not be improper to consider to what era its earlier formations may be referred. Its fundamental basalt, the brown porphyry of the Pico da Vara, the Sette Cidades, and Agoa de Pao, and the arragonitic amygdaloid and augitiferous wackè of the Sette Cidades are rocks of St. Mary's, for which island the pliocene station of Sicily has been proposed, but there are no organic remains to prove the connection. If, however, the sulphur of the Furnas and Ribeira Grande is derived primarily from the decomposition of animal matter, as Professor Gemellaro of Sicily has shown with respect to the substance generally, it is possible that the same testaceous mollusca exist in another form below St. Michael's, which are found in a fossil state at St. Mary's; and that these two islands are linked in a chain of tertiary formation, extending through the Azores to the westernmost island of Flores, where a subcrystalline limestone, without organic remains, occurs in abundance.

In its Botany the Flora of St. Michael's represents the whole Archipelago, in which the most recent investigations have found 437 phænogamous and 139 cryptogamous species. Of this number, excluding 63 indigenous, two-thirds are British, and the remainder peninsular and Madeira plants. The following are the peculiarly Azorian given in Scheubert's "Flora Azorica" (Bonn, 1844), and Watson's Amplification in the London Journal of Botany for November, 1844:—

* Nertchinsk?—ED.

Cryptogamous.

Bryopsis penicillata.
 Ulva subrii.
 Rhacotheca Azorica.
 Gymnomitrium erythrorhizum.
 Hypnum Hochstetteri.
 Allantodia Azorica.
 Lycopodium cernuum.

Phænogamous.

Holcus rigidus.
 Deyeuxia cæspitosa.
 ——— Azorica.
 Gaudinia fragilis.
 Festuca petræa.
 Carex Guthnickiana.
 ——— Azorica.
 ——— lævicaulis.
 ——— rigidifolia.
 ——— Hochstetteriana.
 ——— Floresiana.
 ——— Vulcani.
 Luzula Azorica.
 Juncus lucidus.
 Smilax tetragona.
 Habenaria micrantha.
 ——— longibracteata.
 Juniperus oxycedrus (variety).
 Myrica Faya.
 Euphorbia Azorica.
 ——— Stygiana.
 Urtica Azorica.

Persea Azorica (two varieties).
 Plantago Azorica.
 Scabiosa nitens.
 ——— neglecta.
 Bellis Azorica.
 Solidago Azorica.
 Senecis pseudo elegans.
 ——— malvæfolius.
 Tolpis microrrhiza.
 ——— nobilis.
 Microderis rigens.
 ——— filii.
 ——— umbellata.
 Rubia splendens (variety).
 Asclepias fruticosa.
 Erythræa diffusa (variety).
 Myosotis Azorica.
 Convolvulus Sepium (variety).
 Euphrasia Azorica.
 Lysimachia Azorica.
 Myrsine retusa.
 Erica Azorica.
 Vaccinium longiflorum.
 ——— cylindraceum.
 Sanicula Azorica.
 Nasturtium flexuosum.
 Cardamine Calderarum.
 Cerastium Azoricum.
 Hypericum foliosum.
 ——— decipiens.
 Rhamnus latifolius.
 Rubus Hochstetterorum.

No other wild animals are seen than the rabbit, ferret, weasel, rat, mouse, and bat; to which may be added the frog, introduced a few years ago by a landed proprietor, and now inhabiting every pool. The fish are mostly the same as those of Madeira, described in the Reverend Mr. Lowe's excellent work.

The birds permanently belonging to the island are the buzzard, which gave its name to the "Açores," little owl (*Strix passerina*), starling, blackbird, chaffinch, mountain finch, canary finch, yellow wagtail, redbreast, black cap, willow wren, golden-crested wren, wood-pigeon, rock-pigeon, red-legged partridge, quail, sanderling, green sandpiper, Sandwich tern, herring-gull, common gull, and stormy petrel. In addition to these, of which some are rare, others common, the following are occasional visitants:—the swallow, eagle-owl, raven, crow, pied woodpecker, hoopoe, bullfinch, goldfinch, heron, crane, bittern, spoonbill, cur-

lew, woodcock, snipe, kingfisher, water-rail, coot, puffin, wild swan, widgeon, and teal.

Although the climate is variable both in heat and humidity, it is of the most temperate kind, and the changes do not materially affect health, personal comfort, or the operations of out-door business. As in summer it is seldom that clouds do not float in the atmosphere to offer an occasional mitigation of the sun's heat, so in winter there are few days when this is not felt, and during the whole year there is not one of necessary total suspension of agricultural labour.

Taking the average of the five years 1840, 1841, 1842, 1843, and 1844, and reducing the observations to apply to the level of the sea at half-tide, the barometer ranges between 30·69 in. and 29·46 in., the extremes having been 30·87 in. and 29·10 in., and the mean pressure 30·166 in., varying between 30·240 in. of 1844, and 30·067 in. of 1843. The mean of the summer half of the year (April to September, both included) is 30·212 in., of the winter 30·120 in., both the maximum and minimum having been always attained during the latter season. In summer the average range has between 30·57 in. and 29·62 in., in winter between 30·69 in. and 29·46 in., the greatest, a mean of 1·23 in., taking place about the time of new year, and the least, 0·95 in., near Midsummer.*

There is no regular characteristic in the winds except a prevalence at times from the N.E. or N.W., and the ordinary change from a S.W. gale to a moderate N.W. breeze. The latter circumstance is well known to mariners of the trade, and taken advantage of by them in returning to port after having been compelled to go to sea by a gale of wind from seaward. During the last five years there has been a mean number of 9 calm days, and the following number, omitting fractions, of each wind: N. 27; N.E. 110; E. 20; S.E. 40; S. 17; S.W. 51; W. 20; N.W. 71; indicating that the island is removed from that part of the Atlantic where westerly winds generally prevail, and has a preponderance in the ratio of 37 to 26 of northerly and easterly over those from other points of the compass. Storms are not frequent or generally of long duration, but they are heavy while they last. They have been found by observations, carefully registered on 5 of the islands, to possess a decidedly rotatory character (interfered with, however, by the great altitude of Pico), but not a

* Three years' observation at Archangel, in the N. of Russia, gave a different result. The mean of the winter half-year, calculated for the Estuary of the Dvina (which is probably higher than the ocean), was 30·08, of the summer half 30·01; the terrestrial range being 1·35 in the former, and 1·30 in the latter season. At New York, Mr. Redfield found the mean of the barometer to be higher in winter than in summer; whereas in Newfoundland, at London, and Cadiz, it is higher in summer than in winter.

regular course of progression. Some tend to the S.E., others to the N.E.; none appear to pass to the westward or to range from due E. more than between N.N.E. and S.S.E. S.W. gales, the most formidable in an open port of southern exposure, shift as has been stated, generally to the N.W., and moderate at that point, proving that they have a south-easterly course, their centres passing to the northward of the island. With respect to the mean force of winds, it appears to be distributed as follows:—N. and E. less than 4 of the table of forces used in the Royal Navy; W. 4; N.E. and S.E. more than 4; S. and N.W. $4\frac{1}{2}$; and S.W. nearly 5. Of the summer months the average force is little more than 3, of the winter under $5\frac{1}{2}$. Observations having been made to ascertain how far the state of the sea prevents communication with the shore at Ponta Delgada during the year, it results that there are 50 days of interruption; 41 in winter, and 9 in the summer half-year.

A Table is subjoined to exhibit the averages of atmospheric temperature, and it is only necessary to add that the extremes of the whole year have been 46° and 84° ; 46° and 76° of the winter; 46° and 84° of the summer; 46° and 72° of February; and 64° and 84° of the month of August.

Winter Half-year.	Average.				Summer Half-year.	Average.			
	Maxi- mum.	Mini- mum.	Mean.	Daily Range.		Maxi- mum.	Mini- mum.	Mean.	Daily Range.
October	75	$58\frac{1}{2}$	$66^{\circ}6$	6	April	72	50	62	$6\frac{1}{2}$
November	71	$50\frac{1}{2}$	$63^{\circ}3$	7	May	$75\frac{1}{2}$	56	$65^{\circ}3$	$5\frac{1}{2}$
December	70	$48\frac{1}{2}$	$59^{\circ}1$	7	June	$78\frac{1}{2}$	61	$68^{\circ}9$	$5\frac{1}{2}$
January	69	$48\frac{1}{2}$	59	$5\frac{1}{2}$	July	$82\frac{1}{2}$	$63\frac{1}{2}$	$73^{\circ}1$	$5\frac{1}{2}$
February	69	48	58	$6\frac{1}{2}$	August	$82\frac{1}{2}$	65	$74^{\circ}4$	5
March	72	$48\frac{1}{2}$	60	$6\frac{1}{2}$	September	80	$64\frac{1}{2}$	73	$5\frac{1}{2}$
The half-year . .	75	48	61	$6^{\circ}4$	The half-year . .	$82\frac{1}{2}$	50	$69^{\circ}5$	$5^{\circ}6$

A much greater proportion of vapour exists in the air in all seasons of the year than is known in England, in consequence of the small size of the island and its higher mean temperature. The mean hygrometrical dew point of the summer half year has been $58\frac{1}{2}^{\circ}$; of the winter, 55° ; making the quantity of vapour in a cubic foot of air $5\cdot35$ grains and $4\cdot87$; and the mean dryness $11\frac{1}{2}^{\circ}$ and $6\frac{1}{2}^{\circ}$ respectively. Either in consequence of this greater humidity (whose extremes, in grains of vapour, are $7\cdot80^{\circ}$ and $2\cdot90^{\circ}$), or the conducting power of the mountains, heavy thunderstorms are unknown, although ships have been struck by lightning in the neighbourhood, a circumstance deserving investigation.

In different years there is a considerable variation in the quantity of rain and dew, the mean of the whole year being nearly

30 inches near the level of the sea, and the maximum 42; while it is probably not less than 50 on the mountains. There is not the same irregularity in the evaporation, its annual amount neither greatly exceeding nor falling short of the mean of 45 inches. The rain of the summer months amounts to 9, of the winter to 21 inches, the evaporation being of the former season 28 inches, and of the latter 17. As a natural effect, vegetation languishes in the lower parts of the island during the drier part of the summer, and plants, whose roots grow near the surface, are dried up, while agricultural crops are not unfrequently lost from excessive dryness. The soil of the island being endowed with little capillary attraction, its surface becomes dry and dusty, when there is still sufficient moisture 9 inches below to support plants whose roots descend to that depth; and although the proportion of clay is small, there is sufficient to retain water and prevent its loss by filtration.

It was ascertained by the census of 1840 that the population numbered 80,809 souls, living in 19,726 houses, and divided into classes as follows:—

Above 7 years old.	Total.	Males.	Females.
Proprietors of land	1,828	874	954
Farmers not proprietors	2,628	1,258	1,370
Agricultural labourers	38,830	18,575	20,255
In trade	306	145	161
Artisans and apprentices	6,998	3,304	3,694
Fishermen	2,980	1,426	1,554
Mulleteers and ass-drivers	972	462	510
In civil employments under government	617	296	321
In professions and the like	4,959	2,370	2,589
Clergy and nuns	256	179	77
No fixed employment	4,003	1,905	2,098
Mendicants	514	224	290
Military	365	365	..
	65,256	31,383	33,873
Under 7 years of age	15,553	7,715	7,838
Total	80,809	39,098	41,711

This does not include about 200 foreign residents, of whom two-thirds are British subjects.

Of this number rather less than 20,000 live at Ponta and in its subordinate villages; nearly 9000 in villages of the west end of the island; 8000 in the district of Capellas; 15,900 in the town and district of Ribeira Grande; 7000 in the town and district of Alagoa; 7800 in the town and district of Villa Franca;

8600 in Povoação and its villages; and 4500 in the eastern district of Nordeste.

The military are stationed at Ponta Delgada, where also reside the majority of the traders, artisans, fishermen, nuns, and mendicants; the landed proprietors are nearly divided between the three towns of Ponta Delgada, Ribeira Grande, and Alagoa; the other classes are distributed proportionately over the island. The ratio of the productive to the unproductive part of the population is $\cdot453$ to $\cdot547$; taking the whole as unit. Of the productive part, the agricultural, including the labours of women and older children, is 328; of other branches, 121; leaving a loss of $\cdot004$ for ineffective children. The profits of agriculture support $\cdot660$; trade and its employments, $\cdot010$; other classes of labour, $\cdot240$; professions and private means, $\cdot069$; the public revenue, $\cdot015$; and charity, $\cdot006$.

There is a considerable predominance of females over males, chiefly in the ages above seven years, owing no doubt to the emigration of male labourers to the Brazils. The authorities make great efforts to prevent this drain of the best part of the population, by peculiar observance of the passport laws, but without effect. The emigration is, however, less extensive at St. Michael's than in the other islands, because the labourer can find nearly constant employment at adequate wages; for while at St. Mary's the proportion of males to females is 477 to 523, at Pico 473 to 527, and at Fayal 446 to 554, at St. Michael's it is 483 to 517.

During the year before the census there were 708 marriages, 3860 births, and 2252 deaths; making for every thousand of the population 8 \cdot 7, 47 \cdot 7, and 27 \cdot 8. If the public document conveying this information be correct, the proportions are very striking, and show that, as no increase has taken place in the number of the population of late years, the emigration is very great. But even in the extreme of this case there will be a considerable excess of births unaccounted for. The proportion of births to marriages is also unusual, and would fix a character of immorality on the people—that is, indeed, apparent in their habits. An establishment is maintained at Ponta Delgada for the support of illegitimate children, which receives an average yearly number of 168 of both sexes, or 21 for every 100 of the whole number born; but as this does not include the children of many who support them privately, or those dying before they can be sent to the establishment, it may be affirmed that considerably more than a fifth part of the births are illegitimate; and that, large as this proportion is, the numbers are greater in the towns than in the villages, in spite of the means notoriously in common use to anticipate parturition.

In physical characteristics the people present a much greater

variety than would be expected within such narrow limits, and marked local distinctions show that comparatively little amalgamation has taken place between the inhabitants of different districts since they were peopled by the first settlers. Light hair, a round face, and grey eyes, distinguish the natives of the N.W. parishes; brown hair and eyes, a lower forehead, and narrower face, those of the S.W.; black hair, round and full dark eyes, oval face, expanded forehead, and compressed mouth, those of Ponta Delgada and its neighbourhood; black hair, dark elongated eyes, heavy eyebrows, low forehead, pointed and wide nose, large mouth, protruded lips, and generally a sharp face and diminished facial angle, those of Ribeira Grande. Nothing can be ascertained as to their various origin; but it may be conjectured that the first inhabitants of the N.W. parts, where the principal village is called Britanha, came from Britain; of Ponta Delgada and its neighbourhood, from Spain (possibly during her dominion over the Azores); and of Ribeira Grande from the N.E. of Portugal. Both men and women are of about a middle size, and great height is a rare characteristic; but they are well, though sparsely, made, and active. The men are capable of long continued labour and exertion; as they prove in working day after day with a short-handled hoe, and in the ease with which they accomplish journeys of 30 miles on foot without stopping.

A constant exercise of this capability for active habits, joined to a temperate use of stimulants, simplicity of food, and a mild and equable climate, renders the diseases of the people as simple as they are few. Dr. Bullar had more opportunity, during a stay of 150 days in 1839, of forming an opinion on the subject than the local physicians, who are not often consulted by the sick poor; as he resided in the rural districts, he gave his advice gratuitously, and earned a reputation for kindness of manner and readiness of access, which must have brought great numbers of cases under his notice. He states that he treated 465 patients, and on this experience founds a conclusion that the common diseases are not so much active as atonic, less inflammatory than nervous. He found a prevailing complaint to be a painful affection of the nerves of the stomach, coming on soon after meals, and lasting for years, without much disorder of the digestive functions or general health. The existing cause among the poor he believes to be vegetable diet (also too much used by the rich), and advises one of a more stimulating kind. He does not allude to the relaxing influences of a constantly humid atmosphere, which possibly has great effect in the creation of such a condition. To this complaint he adds rheumatic neuralgia and loss of sensation in single nerves; asthma, with and without hypertrophy of the ventricles of the heart; leprosy, unfrequent: a few scrofulous

diseases; bronchial inflammation; fever, with inflammation of the mucous membrane; simple tumours, requiring removal; and bronchocele.* Consumption is so rare that Dr. Bullar saw only two cases; and he considers this further evidence of the effect of great vicissitudes of temperature in multiplying cases in other countries; and also that humidity in this climate is favourable to those predisposed to the disease.

There are in the island three public hospitals for the sick, where poor patients receive treatment gratis; one is at Ponta Delgada, one at Ribeira Grande, and the other at Villa Franca. Their aggregate annual income is more than 6000*l.*; their expenditure 5500*l.* The whole average number entered yearly is 2725; of whom 2650 are cured, and 75 die; the small proportion of deaths being rather a consequence of mild diseases than of an effective system of management in the hospitals.

The people are generally industrious, sober, frugal, and, with an exception common in southern climates, cleanly in their persons. Their address is mild and engaging, but they are of passionate temper and vindictive disposition; and, notwithstanding the familiarity of their salutations, naturally distrustful of each other, and deficient in real cordiality of feeling. In domestic life they are harsh and cruel; men beating their wives, and mothers their children, with the greatest ferocity. Their moral character is also of a low standard, whether as regards truth, honesty, or chastity; nor in any class are breaches of these virtues sufficiently reprobated to correct the popular neglect of them. As if sensible of their dangerous propensities, the people never live in retired situations at a distance from the protection of neighbours, but construct their habitations in villages, where they can at all times command assistance.

This precaution so far gives security that fewer crimes are committed than would be expected from the passions of the people. During the years 1842, 1843, and 1844, 279 offences were reported to the authorities—16 murders, 11 violent rob-

* Bronchocele is not so common as to be in any degree a popular feature; but being in a great measure confined to the mountainous part of the island, it would be interesting to ascertain how far its occurrence may arise from causes operating among the people of Switzerland. Dr. Johnson, in treating of the goitre of that country, states that he found twenty cases above the lake of Geneva for one below it, and attributes its greater prevalence to the water used for drinking, which loses its bad qualities by deposition of suspended matter in the lake. The Rhone, it may be observed, rises at the foot of primitive mountains, and in its passage through the Valais, is fed from similar sources, taking up in its rapid course the elements of primitive rocks. Now, if the constituents of granite and gneiss are a mean of .69 silica, .16 alumina, .01 lime, .11 alkali, and .03 iron—and those of lava, .60 silica, .17 alumina, .05 lime, .05 magnesia, .10 alkali, and .03 iron—it follows that water flowing through both formations will have very similar qualities; so at St. Michael's the effects of the mountain-water may be the same with those of the Rhone above the Lake of Geneva.

beries, 54 common thefts, 126 riots (mostly attended by woundings), and 72 minor offences—giving a mean of little more than one offence for every thousand souls of the population per annum; of which one-tenth may be called of a grave nature. As there is no efficient system of police, the perpetrators of crime frequently elude discovery; or, if discovered, may escape punishment by the intimidation of principal witnesses (accomplices deriving no advantage from giving evidence); or, being convicted, suffer punishments very little proportionate to their offences. In spite, however, of this practical encouragement of crime, the island enjoys great tranquillity; and it may be inferred from this fact that the people present great susceptibilities for improvement.

Some progress has been made towards this object by the institution of local schools for gratuitous education, but the number requires to be increased. According to public documents there are only 13 in the whole island; the number of private establishments being 54; and the total of pupils being 848 males and 451 females. This number bears a proportion of $\cdot 0161$ to the population—the males of $\cdot 0105$, and the females $\cdot 0056$; the proportion of male pupils to the total of the sex being $\cdot 0216$, and that of the females $\cdot 0108$. Assuming that one-fifth of the population is within the usual ages of scholastic education, it will follow that only one-twelfth of the number requiring instruction actually receive it; yet this is above the proportions of the continental provinces of Portugal, where the highest number is 1 in 14. As the parochial clergy are paid by government, and do not discharge very active duties, the charge of keeping schools might be laid on them; and a much smaller sum than it would be necessary to pay to lay teachers, added to the priest's stipend of about 30*l.*, or the curate's of 20*l.*, would induce them willingly to regard education as one of their regular parochial functions.

There is nothing peculiar in the popular costume except the carapuça of the men, with a wide front and longer points than that of St. Mary's, now fast giving way to common straw and felt hats, and the large hooded cloak of blue cloth worn by the women. With respect to the higher classes, it is almost unnecessary to say that their dress and customs are those of other civilized countries. In their manners there is a remnant of the courteous forms of bygone days; the requested permission to visit, the ceremonious conducting of the visitor to the seat of honour, the studied polite inquiries, the prolonged leave-taking, the formal offer of services, the special communication of domestic events, and many other polite offices—which, if not valuable for their sincerity, are agreeably contrasted with the gradual introduction of more republican manners among younger members of society.

No manly sports, the holiday amusements of other countries,

engage the many days of abstinence from labour authorised by the church; the few with which the people are acquainted are confined to boys. The popular recreations are church processions, street masquerades and their accompaniment of water-throwing during the carnival, rustic feasts and imitation royal levees in celebration of the Whitsuntide holidays, and the evening "charamba," where a crowded circular dance is performed, with immovable gravity, to the unvarying yet melodious strains of a wire-strung guitar accompanied by a doggrel vocal recitative.

Though small in size, the houses of the poor are strongly built, well roofed with straw or tiles, and provided with ample doors and unglazed windows. The interior, however, is finished with no attention to comfort. It is generally divided into compartments by screens of cane or basket-work, on an earthen floor beaten hard by use, but often damp by absorption from a humid atmosphere; the walls are seldom plastered; and, on the whole, the houses seem intended to afford shelter from the elements, but no other advantage. It can indeed scarcely be otherwise, as the people, with few exceptions, build their own habitations. A man setting up in life takes a perpetual lease of a small plot of ground, and, according to his means, raises on it a house costing between 10*l.* and 40*l.* There are few whose means allow them to expend money on comfort; their object being to provide the necessary shelter for their families, and, if they can, storehouses for their stock and crops.

In a proportionate degree the same may be said of the middle and higher classes; with rare exceptions, of persons who, having resided in foreign countries, decorate one or two reception-rooms. An open entrance and condensing stone staircase introduce damp, to be deposited on the bare whitewashed walls; the badly fitted doors and windows give rise to draughts of air when not swelled by humidity; the want of ceilings below admits to the first floor sitting-rooms either the cold of vaults or effluvia of horses and other animals occupying them; no fire-places warm the rooms; no grate furnishes the kitchen; and, to complete the style of arrangement, there is either a total want or inconvenient adaptation of other desiderata deemed indispensable in England. It is not then surprising that, while the climate and mineral waters invite invalids—despite the defective means of transport and the length of the voyage—they are repelled by the known want of accommodations; which, if somewhat superfluous to the healthy, are almost necessaries to the sick. If houses were built, as in most other countries, purposely for letting, the appreciation of better arrangements might induce the proprietors to adopt them, and the general style of construction be gradually improved. But from the slow progress made by all artisans employed in

building, rather than the greater expense of rough materials, houses cost more than in England, and are not profitable investments for capital. A dwelling-house, built in the usual manner, of two stories, the upper for residence, the lower for stables and store-rooms, and having within its foundations an area of 2000 square feet, costs about 1500*l.*; and one of 1500 square feet, 800*l.*; but the highest rent that could be expected for them would not exceed 30*l.* and 20*l.* per annum respectively—an income of between 2 and 2½ per cent. This, in a place where the rates of discount for bills vary between 10 and 20 per cent., is sufficient to prevent any speculation in house-building. Fortunately, however, for persons in situations under government, and other temporary residence, there are always empty houses requiring tenants, and the supply is equal to the demand; but it is a general complaint that, although other domestic expenses are the same as at Lisbon, rent is as much dearer as the houses are less finished and comfortable.

Although the means of living at the command of the people, judged according to usual criteria, should be more than sufficient for their necessities, their condition is generally low, and there is even much indigence to be found. Higher wages are paid for daily labour of all kinds than in England, taken according to the prices of the common bread-corn in both countries, wheat in England and Indian corn at St. Michael's. The wages of agricultural labourers in the former at 18*d.* per diem, are in a ratio of 2·5 to the price of 60*s.* a quarter for wheat; the artisan's at 30*d.*, nearly 4·17. The average price of Indian corn at St. Michael's is 22*s.* per quarter; the labourer's wages of 7*d.* being as 2·65, and the artisan's of 17*d.* as 6·44; to which may be added, that the effective value of English labour, whether in the field or the workshop, is double that of St. Michael's. There is a constant demand for labour of both kinds, without improving the condition of the labourer; and among the tenant population there is a general complaint of irresistible pauperization by the exactions of landed proprietors.

A common estimate of the whole landed rental is 150,000*l.* per annum; and this would appear, from the average exportation of 30,000 quarters of corn valued at 50,000*l.*, and 90,000 boxes of oranges valued at 40,000*l.*, to be correct. Subtracting from it the value of oranges, and 10,000*l.* for the wine produced by vineyards, the rental paid by arable land is found to be 100,000*l.* Of the 147,200 acres of area, the official accounts give 2100 to orange gardens, 2400 to vineyards, 40,100 to arable land, and 102,600 to mountain grounds, lakes, rivers, roads, and dwellings. So little of the mountain-ground pays rent, that the 40,100 acres of arable land may be considered as charged with 100,000*l.* The

total average quantity of corn produced is stated by the tithe-contractor to be 45,000 quarters of Indian corn, worth 50,000*l.*; 15,000 quarters of wheat, worth 35,000*l.*; and 24,000 quarters of beans, worth 30,000*l.*; a total of 120,000*l.* Rents vary, according to locality and other circumstances, between 10*s.* and 7*l.* per acre, but the average would appear to be 2*l.* 10*s.*; against which the cereal crops place no more than 3*l.*, paying rent, seed, and tithes, but leaving all other charges to be provided for by the secondary crops of green vegetables. Of these the chief are potatoes and cabbages, both articles of extensive consumption, whose average produce is 6*l.* 10*s.* per acre; a sum sufficient to support the farmer, but not to raise him from his dependence on his landlord. The average rent ought not to be more than 25*s.* an acre, but the landlord will not propose a reduction; and so long as a rural population of 40,000 souls is apportioned on the same number of acres of land, he will scarcely be requested to make it. The true remedy lies in clearing the mountains, and thus increasing the quantity of disposable land, and improving the modes of cultivation; but both require capital, and therefore are not within the reach of those whose condition would be improved by them.

So far as the means of the husbandman allow, his system of agriculture is good: the great principles of cleaning and manuring being well understood and generally put in practice. Manure is sown with the crops requiring it, and weeds are kept down by frequent hoeing; yet the want of natural fertility in the soil prevents it from yielding at any time the occasional heavy crops of other countries. An acre of potatoes produces between a hundred and fifty and two hundred bushels; of Indian corn, between twenty-five and forty-five; of wheat fifteen to twenty; and so, proportionately, of other crops. A rough analysis of the soil gives in 100 parts a mean of 3 water, 88 silica, 5 alumina, and 4 oxide of iron; and it is therefore deficient in the powers both of absorption and capillary attraction, liable to become dusty on the surface soon after the heaviest rains, and without those salts which in other soils are brought up and lixiviated for the nourishment of plants. The implements of husbandry are a light plough, whose rough iron-pointed mould-board serves as coulter and share; a hoe, made of a 10-inch square plate, narrowed at the back, and set on a 2-foot handle at an angle of 45°, a most awkward instrument in an unpractised hand, but serving all the purposes of hoe and shovel for its master. These, with a bill-hook for fences, form the whole stock of implements of a small St. Michael's farmer; his means of transport for produce being the ass, with its heavy pack-saddle and panniers, or the old Portuguese ox-cart, labouring heavily on its ungreased revolving axles.

The ass carries a load of about two hundred weight a distance of ten miles; the ox-cart, drawn by two, four, or six oxen, according to circumstances, from ten to twenty hundred weight; the transport costing about a penny per hundred weight for every English mile of distance.

To the poor cultivator belong, such as they are, the profits of arable land, pasturage being confined to the mountains, and dry forage consisting of the leaves of Indian corn; the proprietor generally holds in his own hands the management and returns of vineyards and orange-gardens. Two thousand four hundred acres of land are occupied by the former, producing annually between 2000 and 10,000 pipes of a thin pale white wine, carelessly made from grapes that in their best state are deficient in saccharine matter. A pipe gives a fifth of lees for distillation, and these their twentieth part of proof spirit, the whole liquid yielding less than 5 per cent. As the average value of a pipe is about 2*l.* 10*s.*, the value of an acre of vineyard 16*l.*, the annual charge for tithes, pruning, and manufacturing, 1*l.* 8*s.*, and the average production little more than a pipe, the profit on vineyards is about 7 per cent. of the capital invested. The cost of an acre of orange-garden is 50*l.* for the ground (twenty years' purchase of the rent), and enclosing and planting, 18*l.* It pays its charges in cereal crops during the first ten years, when it comes to yield 30 boxes of oranges, worth 10*l.*, increasing this progressively to 20*l.*, or even 25*l.* per annum; its charges for pruning and dressing in the latter state being repaid by the firewood, and its nett return amounting to between 15 and 30 per cent. per annum.

Taxation is generally light on land, although bearing on trade in proportion to the prohibitory policy of the Portuguese government. The whole local revenue amounts to 35,000*l.* yearly, land paying in tithes and minor charges, 12,600*l.*; trade, in duties of customs, 10,800*l.*; national property, judicial fines, post-office, and others, 11,600*l.* The rate paid by land is about one-twelfth of the rental; by trade nearly 29 per cent. on chargeable foreign products. In Portugal land pays 5*s.* per head of the population, at St. Michael's 3*s.*

Few articles of any kind are manufactured by the people, whose dress consists chiefly of British fabrics. Some strong linen was formerly made for exportation to the Brazils, but the market has been lost since the independence of that country, and the trade is now confined to the place. A coarse thin woollen drugget employs a few domestic looms; a rough, weak, red pottery is made at Villa Franca from the clay of St. Mary's; an oil is expressed from the berries of the mountain laurel (*Persea Azorica*), consumed when it is made; and an inferior lime is made from Lisbon limestone with faggot-wood, to supply the moderate de-

mand for building purposes. To this brief account of industrial products, it may be added, that there are in the island, according to official documents, 151 stone-cutters, 618 masons, 496 carpenters, 256 tailors, 71 tanners, 434 shoemakers, and 56 blacksmiths.

There is a considerable external trade in proportion to the population; the imports of 1844 having amounted to 102,156*l.*, and the exports to 120,432*l.* Of the imports, 28,500*l.* of textile fabrics, and 11,500*l.* of corn and other articles came from England; 1000*l.* of hides, and 6400*l.* of colonial produce from Brazil; 1500*l.* of wood and whale-oil from the United States; 10,000*l.* of liquors; 6000*l.* of textile fabrics; 6500*l.* of colonial produce; 10,500*l.* of silver coin (Spanish and Brazilian dollars); 5000*l.* of stamp-paper and soap, and 14,000*l.* of other articles, from Portugal. Of the exports, 60,300*l.* of oranges went to England; 59,800*l.* of corn and other agricultural produce to Portugal; and 400*l.* of various articles to America: a great part of the difference between exports and imports having been remitted to absentee proprietors resident at Lisbon. Ships anchor in the open bay of Ponta Delgada, at about a mile from the shore, in 30 fathoms' water, where they can easily slip and go to sea to avoid the dangers of a southerly gale of wind. The aggregate number engaged in the trade annually is 200 British, and the same number of Portuguese and other foreigners. At the time of spring-tides the rise and fall is six feet, high water occurring at three-quarters of an hour after noon; and as this is the same at all the islands, it would appear that the course of the tidal current being perpendicular to their line of position, is from S.S.W. to N.N.E. With respect to the rise of water however, there is a considerable difference: at St. Mary's it is 6½ feet, at St. Michael's 6, at Terceira 5, at Fayal 4, and at Flores 3 feet; the difference amounting, in a distance of 325 nautical miles, to 3½ feet, or more than 1 foot for every 100 miles. At Madeira the rise increases to 7 feet, its distance from St. Mary's being nearly 500 miles.

It is remarkable that a port of such active trade as Ponta Delgada is wanting in three important requisites: banking establishments, mail packets, and a repairing dock. Money is lent by private individuals on immovable securities at usurious interest, which is at once deducted for the whole term of the loan, from the principal advanced. Letters are made up by a local post-office, and sent to Lisbon by private ships; and the correspondence with England is carried during the winter months by obliging shipmasters; both uncertain modes of transmission, yet resulting, as it happens, in wonderfully few cases of miscarriage. A small basin, called the "Arcal," has generally served for the repair of ships of light draught, without offering any facilities for

the trade generally, or to the more valuable traffic passing near the Azores between other countries. It is now in course of reconstruction, having been destroyed by the gale of December, 1839, and will be deepened to 15 feet for the purpose of receiving such ships of that draught as may come for repairs. A larger dock, capable of holding 400 ships, to be formed in front of the town, has long been projected, and finally proposed to be built, at an outlay of 150,000*l.* How far this proposal will be carried into effect it is impossible to say, the resident capitalists being unwilling to undertake it, and the guarantees offered being insufficient to satisfy foreigners that they will have due security for their investment. If the resident monied men (whose aggregate capital, not including landed property, is probably not less than half a million of pounds sterling) are unwilling to provide the means of making a dock, of which the advantages are entirely local, is it to be expected that foreigners will be found to do it? It is, indeed, a proof of great want of patriotism, that a large amount of money is kept without employment in this island, which might be used to confer an inestimable benefit upon its people, to advance its prosperity and improvement, with a certainty of secure returns for its employment. In the meantime, nearly a hundred millions sterling of outward and homeward bound cargoes annually cross the Atlantic in the neighbourhood of the Azores, without a single secure harbour between the termini of their voyages, into which ships can be taken for shelter or necessary repairs, which at present are sought only by those in the utmost extremity.

The internal communications are generally indifferent, from the want of an efficient system of public inspection and management; although there exist the best possible materials for making them, and one or two good lines, offering in their ease of draught and durability the best encouragement for the repair of the others, where 6 oxen are required to draw the load of 1 horse on an English road. In their present state the roads of the island are less useful for transit than for impeding the advance of a hostile force. As they wind along the coast they are frequently interrupted by deep ravines, practicable only by a sloping descent at one side, and a parallel rise at the other, where the advancing force would be exposed to a destructive fire. As the capture of the chief town would be the conquest of the island, the advance would always be on that point, and this could be better effected by landing in some part of the bays of Ribeira Grande and Ponta Delgada than elsewhere. There are many beaches and landing-places on the coast, marked with a cross in the map, but they are mostly commanded by high cliffs or small forts. During the last civil war the commander of Dom Pedro's forces attacked the island on the N. side, landing on a stony beach, undefended ex-

cept by strong natural obstacles, when his 1500 men, clambering up a precipitous water-course, succeeded in routing 5000 strongly entrenched, and supported by a park of artillery.

It now only remains to refer to the publications affording the best information about St. Michael's. The best charts, at present, are those by Laurie and Norie of London, which will soon be superseded by the results of the survey made in 1844, under the direction of Captain Vidal, of her Majesty's steam ship "Styx." This survey will supply extensive soundings, correct topographical details, and faithful views of land, not found in any existing charts. Of books, the best on geology is an account by Dr. Webster (Boston, 1821); on the climate and diseases, the 'Winter in the Azores' of Dr. and Mr. Bullar (London, 1841); on the botanical flora, Scubert's 'Flora Azorica' (Bonnæ, 1844), and a more complete list by Mr. Hewitt Watson in the London Journal of Botany, of November, 1844. But the thorough examination of the island is still to be undertaken; and there is no doubt that it would afford interesting discoveries to the geologist, naturalist, and philosopher in all branches of knowledge on which this paper is offered only as an imperfect communication.

VIII.—*Notes of an Excursion from Batúm to Artvin.* By M. Fred. GUARRACINO, H. M. Vice-Consul at Batúm. Communicated by Mr. Consul BRANT.

I LEFT Batúm on Sunday morning at 6 o'clock, and proceeded along the beach in a northerly direction. I chose the longer road round the peninsula rather than that across its neck, as in some places the latter was difficult to pass on account of deep mud. I, however, soon had reason to repent of the choice, when, half an hour after starting, I found myself unexpectedly before a rapid and deep run of water. I say unexpectedly, because two days before I had passed by the spot, and did not observe the least sign of a stream; but during the night the snow on the edge of the marsh had thawed, and the water rising, forced a passage through the bank of shingle into the sea. I have since learned that a similar occurrence is frequent after heavy rains, but the streams soon dry up, and the action of the sea, throwing up the shingle, obliterates every vestige of them. We managed after some difficulty to cross the water, which though deep was only 3 yards wide, by throwing over it a branch of a tree, and holding on by it as we passed on our horses. For half an hour we continued along the sea-shore, which turns gradually to the W., and reached the plain of Cahaber, on which a tribe of Koords have