

(3.) Broken fragments and plaits equal to about six teeth, chiefly belonging to adolescent and aged individuals.

b. Tusks.

1. Fragment of a tip, $3\frac{1}{2}$ in. in length, perfectly straight; greatest circumference, $2\frac{7}{10}$ inches.

2. Portion of a curved central part of the tusk, length 6 in. by $6\frac{3}{10}$ inches in circumference.

c. Skull.

1. Fragments showing diploë.

2. Portion of right lower ramus, with tooth *in situ*, of a very young individual. The tooth is well worn, and indicates the second of the milk-series. The symphysial canal is wider in proportion than in *E. Africanus*, making the chin less pointed.

3. Mastoid processes of temporal bones of at least two adult individuals. This portion of the skull is common among the elephant remains I have found in other situations.

d. Vertebral Column.

1. One cervical vertebra.

2. Five dorsal ditto.

3. One caudal vertebra.

4. Numerous fragments of ribs.

e. Upper Extremity.

1. Two portions of scapula.

2. Four heads of humerus.

3. One inferior extremity of radius.

4. Two upper extremities of radius.

5. Seven carpal bones.

6. Eight metacarpal bones.

f. Lower Extremity.

1. Two portions of os innominatum.

2. Two inferior extremities of tibia.

3. Five tarsal bones.

4. Six metatarsal bones.

g. Thirteen phalangeal bones.

h. Three sesamoid bones.

i. Numerous fragments of long and flat bones.

II. MYOXIS MELITENSIS.

a. Two lower jaws and teeth.

b. One tibia.

III. BIRDS' BONES.

Not determined; several of large dimensions with long shafts, possibly belonging to *Grallæ* and *Anseres* of enormous size. The breadth across the lower condyles of the femur and humerus in many average respectively $1\frac{2}{10}$ inches.

N.B. This last includes also the remains found by Dr. S. Agius.

IV. ON THE GEOLOGY OF HOBART TOWN.

By THOMAS HARRISON, Esq.

THE island of Tasmania is connected, as it were, with the continent of Australia by two chains of islands, the lines of which are afterwards continued in the mountain-systems both of Tasmania and Australia. The Tasmanian systems pass from north to south in a strangely zigzag course, throughout which the mineralogical cha-

enabled to take its measurements before it was partially destroyed in removing the matrix. The extreme length of the crown was $8\frac{4}{10}$ inches; the length of surface in wear, $6\frac{6}{10}$ inches; number of plaits, 10, and a talon ridge; number of disks of wear, 8.

racter of the rocks varies considerably. The land, therefore, may be presumed to have once presented a very different line of contour to what it does at the present day.

In bygone geologic ages, Tasmania must have been represented by at least five rocky islets. Then the intervening sea-bottom became raised, and the area appeared as one continuous mass of land, deeply indented, however, by two gulfs, which being in time filled with aqueous deposits, now constitute the respective coal-basins of Campbell and Hobart Towns. It is to the geology of the latter basin that the following notes bear reference.

Following the road from Hobart Town to New Norfolk (a township situate on the Derwent, and about twenty miles from the metropolis), there are met with a succession of Carboniferous shales and sandstones, cut by numerous dykes and masses of eruptive greenstone and black basalt, or covered over by gravel and other aqueous deposits, until near Bridgewater (ten miles from Hobart Town), where there is exposed a dense claystone, which is in turn succeeded by thick beds of highly fossiliferous limestone. The latter, after extending for several miles, and presenting a gradually rising series, dip in quite a contrary direction, so that at New Norfolk the claystone of Bridgewater is again met with, and then, still further on, towards Hamilton, are beds of sandstone, shale, and coal, appearing in the reverse order of the succession passed over in journeying from Hobart Town to Bridgewater. It would seem, therefore, that an anticlinal axis exists near the latter place (see fig. 1).

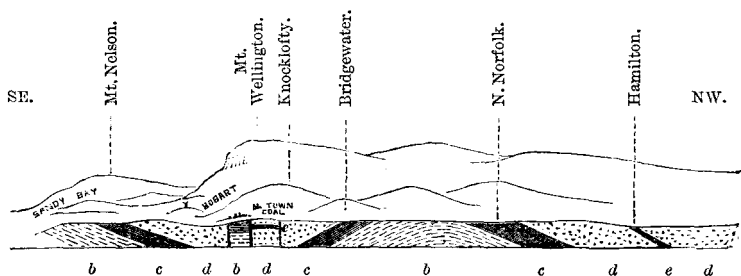


FIG. 1.—SANDY BAY *via* HOBART TO NEW NORFOLK.*

(The whole of this section is much cut up and disturbed by dykes of basalt, &c., which are not shown.)

Along nearly all the other routes pretty much the same series of rocks is met with, only that the limestone seldom appears at the surface: in the lines leading up Mount Wellington, however, the last-named rock is met with at barely a mile from the boundary of Hobart Town. This is simply the result of great disturbance and denudation having taken place thereabout.

The area of Hobart Town is traversed by a series of broad stripes alternately of sandstone and basalt. In one locality—near Trinity

* For an explanation of the letters, see fig. 2.

Church—the claystone appears as a surface rock; the oval patch crowning Knocklofty is a compact greenstone, resembling that of Mount Wellington.

It is worthy of remark, that nearly all the sand and claystones have a dip in the direction of Mount Wellington. This peculiarity of dip is not confined to Hobart Town alone, but seems to be general over the whole adjacent district, the only exception being upon the immediate sides of the mountain, and here the dip is directly opposite to that prevailing elsewhere.

By the accompanying section (fig. 2) it will be seen that, ex-

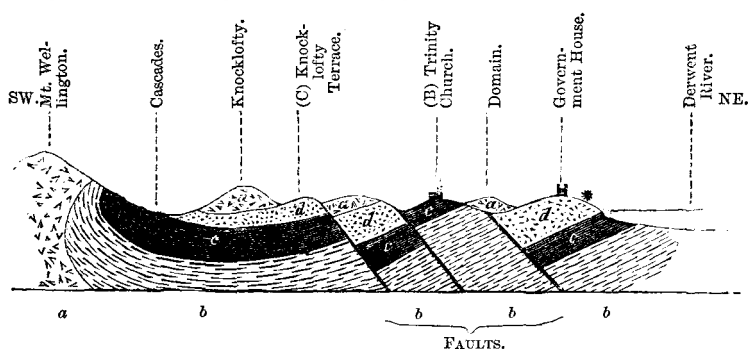


FIG. 2.—IDEAL SECTION OF HOBART FROM MOUNT WELLINGTON TO DERWENT RIVER.
a. Basalt and Greenstone. b. Limestone. c. Claystone.
d. Sandstone. e. Coal-beds.

* Indicates the spot where the femur of *Labyrinthodon* was discovered.

cluding Mount Wellington and the basalts, the arrangement of the sandstones somewhat resembles a series of ratchet teeth, rising one above the other from the Derwent towards the south-west. As a very homely illustration, we may suppose a set of wooden cubes to be laid out upon a yielding foundation, say a sofa cushion, so that the surface of the whole represents a perfectly level superficies. Some disturbing force having changed the horizontal plane of each cube into a gently sloping incline, at every joint a diminutive escarpment was formed. If we now imagine that some molten substance, such as wax, has been forced from below through the various interstices, so that the overflow partially fills up the miniature valleys, we shall have a model representation of Hobart Town, with its sandstones, dislocations, and eruptive rocks.

It will probably be asked why the dip of the various beds remains so constantly the same, and towards instead of from an evidently upheaved rock? Perhaps the local dip in the opposite direction, mentioned as occurring on the sides of Mount Wellington, may, in some measure, explain the difficulty.

If a vast level plateau, such as once existed hereabouts, should ever become broken up by the protrusion of a 'massif' like the Mount Wellington range, it is not unreasonable to suppose that many fractures would take place at a distance *from*, and perhaps parallel *to*, the intrusive mass. In addition to this simple fracture of

the beds, a lateral pressure may also have led to a phenomenon somewhat analogous to what takes place when the pieces of ice in a large floe begin to pack one upon the other. Hence the apparent anomaly just alluded to.

From whatever cause these secondary fissures arose, they do not seem to have been filled up with the basalt which they now contain contemporaneously with their formation. Still, the time elapsing between the fracturing and eruptive forces may have been extremely short; what is meant being, simply, that the fissures referred to do not owe their origin to the protrusion of the basaltic dykes by which they are now completely occupied.

Of the rocks met with in the district, the lowest is of an extremely fossiliferous character, and is called by the colonists Mountain or Carboniferous Limestone (?). It appears to be divided into two distinct beds. The lower contains much lime and a profusion of bivalves (*Spirifera*, *Pectinidæ*, and *Producta*), and the upper being more arenaceous, and inclosing a large quantity of corals (*Fenestella* and *Stenopora*).

On the sides of Mount Wellington are a number of erratic blocks, containing a larger number of spiral univalves. Such blocks are of great hardness, and seem in some instances to be nearly made up of arenaceous particles; but it must not be supposed that this variety in organisms and texture indicates a formation upon a horizon different from that of the adjacent limestone.

Above these beds is a dense compact stratum, locally known as 'mud' or 'clay stone.' According to Mr. Selwyn, it is upwards of 400 feet in thickness. In a few places impressions of shells are discoverable; but generally fossils are of rare occurrence. Scattered here and there throughout the mass are numerous pieces of quartz and other rocks.

It was probably the prevalence of vast quantities of turbid water, originating this deposit, which so completely destroyed the immense growth of corals characteristic of the upper beds of limestone.

Immediately over the 'clay-rock' is superimposed a great thickness of sandstone. This stratum, also, is especially barren of any remains of animal life; but sandstone generally forms a bad matrix for the preservation of fossils.

Interstratified with the upper portion of the sandstone beds are layers of shale bearing impressions of 'fern-leaves' and 'calamites,' together with one or two layers of coal, changed, for the most part, into anthracite. The absence of *Sigillaria*, *Stigmara*,* *Lepidodendron*, and other genera characteristic of the English Coal-measures, would seem to suggest that the coal of Tasmania, like that of Victoria, is not of the true Carboniferous period.

What may, in some measure, go to confirm the opinion so hazarded, is the discovery in the sandstone of a bone, said by Professor Owen to be the 'femur of a Labyrinthodon,'—a reptile, if I mistake not, generally associated with rocks of the Triassic age.

A Hobart Town geologist, Mr. Morton Alport, speaking to me

* See Note at the end.

upon the subject, stated his belief that the bone in question was found in beds situated above the coal. It is with extreme diffidence that I venture on a conclusion contrary to that of a gentleman whom I believe to be both an enthusiastic and a careful observer; but, from a rather rapid examination of the beds in question, I had certainly thought differently. The section (fig. 2, p. 493) will show both the position of the fossil, and also the nature of the rocks adjacent.

It will be seen that, from the western boundary of the stripe of basalt occupying the 'Domain,' to the sandstone of 'Knocklofty Terrace,' the strata present a gradually ascending series of outcrops; although it is more than probable that, in consequence of faults, the sum of the outcrops is not exactly an expression of the real thickness of the series exposed.

At the point B (Trinity Church) beds very low in the succession appear on the surface, the upper ones having evidently been denuded. As the coal-seams appear to lie near the top of the series, it is plain that a comparatively small amount of denudation would remove both such seams, and also a portion of the immediately underlying sandstone. The position of the beds wherein the fossil was discovered, close to the Government House, near the centre of the valley of the Derwent, would seem to give no promise of being spared the influence of denuding agencies; so that although through faults, the points B (Trinity Church) and C (Knocklofty Terrace) are evidently more upheaved and denuded than the ground near Government House, it is hardly probable but that some strata were cut off from the latter locality also; and as I believe no coal-beds have been discovered thereabouts, it seems but reasonable to suppose that the carbonaceous strata have been swept away, and that the beds now remaining, although of newer age than the claystone of Trinity Church, are decidedly of older age than the coal.* This would make the fossil referred to of great use in determining the geological position of the Tasmanian beds, and show that they were deposited, at the very least, during the existence of the Batrachian forms of the Secondary period.

It may be asked, as the limestone is of Palæozoic, and the coal of Mesozoic age, whether the surface was unsubmerged during the intervening time, or whether there has been a subsequent removal of rocks once deposited?

Perhaps it will appear that neither of these alternatives is absolutely required. The Permian group may, after all, be represented by a portion of the strata intervening between the two formations, although, through the absence of fossils, evidence of such fact is nowhere discernible. The Magnesian Limestone may have been so far local as to be excluded altogether from Tasmanian waters. Probably the beds, during the course of their deposition, resembled not a little the accumulations of sand now gathering upon the coasts both of Tasmania and Australia; deposits which, it is likely, will be entirely barren of fossils. Such beds would necessarily present

* I have dwelt particularly upon the above facts, since they appear to bear so especially upon the question of the age of the Australian coal-deposits.

but few evidences of changes going on elsewhere, or even in their immediate neighbourhood.

In speaking of the section passed over between Hobart Town and New Norfolk, mention has been made of certain recent aqueous deposits. Among these the most remarkable feature is the enormous amount of pebbles accumulated in many places. Such pebbles are of every size, from that of coarse grains of sand to boulders measuring many feet in circumference. They are composed of a variety of materials—quartz, granite, sandstones and limestones, basalt, diorite, and, in a few instances, what I judged to be fragments of Silurian slates. The whole of these are waterworn to a great extent. In some places an accumulation of pebbles only occupies the whole of an exposed section; but in many cases the pebbly deposit rests upon or is interstratified with loam, clay, or sand.

One or two local geologists suggested whether the pebble-bed might not be due to the former existence of glaciers. The more likely cause, however, would seem to be one involving tidal action. The Derwent, as may be seen on the map, is of very different width at different parts of its course; in some places it contracts into a narrow channel, and in others expands into a wide lake-like basin. As may be supposed, this conformation, by the expansions acting as reservoirs receiving and giving out the tidal wave, is productive of currents, running with great rapidity, quite sufficient to hurl onwards masses of stone as large as those spoken of. It is probable, too, that as the land gradually emerged from the sea, these irregularities in width may have been still more disproportionate than they are at present; or, on the other hand, such disproportion might, for a time, have disappeared altogether, as various heights above the sea were attained or exceeded. Hence we seem to have an ample explanation of the clay and sandy beds interstratified with what may be called the boulder-deposit.

Scattered at intervals over much of the district near Hobart Town, are numerous beds of shells differing but, little, if anything, from those still found in the adjacent seas. Some of these beds are met with at the height of many feet above the highest tides. Similar beds are seen in many places round the shores of Port Phillip Bay, and are supposed to indicate that a progressive elevation of the land has taken place at no very distant period, even if such elevation is not still going on.

Igneous rocks, as may be supposed from what has been already said, have played no unimportant part in developing the beauties of Tasmanian scenery. These consist principally of basalt and greenstone, forming mountain-ranges, capping the tops of hills, or protruding, as dykes, from the clefts of sand or limestone. Owing to the unequal wearing of the two rocks, the igneous and the sandstone, as much as to the tremendous disruptions, in some measure connected with outbursts of the former, Tasmania appears as a thickly-wooded Caledonia; and Hobart Town reminds the Scotchman not a little of his much but not too greatly lauded Edinburgh. True, there is no Castle Rock; but Knocklofty, 1,700 feet in height,

forms no bad substitute for the Calton Hill, and Mount Wellington far exceeds Arthur's Seat in altitude and grandeur. The greenstones, too, on the top of the latter are strikingly columnar, rising above the densely timbered base in a colonnade of Titanic pilasters—a gigantic Staffa superimposed on an exaggerated Mount Edgecombe.

Along the shores of Storm Bay, igneous rocks are developed in cliffs of the most romantic form. Where a columnar structure prevails, many separate masses may be traced from the top downwards for many hundred feet; and so regular is the line that bounds these tremendous crystals, that a stranger could easily mistake a group of them for baulks of timber set on end. Those who are acquainted with the features of New Zealand military architecture will understand me when I say that Cape Rauol—one of these basaltic headlands—may be aptly compared to a tremendous 'pah' erected by a race of giants, and subsequently battered by some colossal artillery. 'Cape Pillar,' farther down the bay, is alike, or even more, romantically shaped. The base is worn into chasms, or fretted with caves, that might—so regular is the outline—be Gothic doorways leading to what would almost seem some towering castle keep above.

These basaltic outflows have also tended to modify denuding influences brought to bear upon the somewhat friable sandstone which such outflows often surmount as a thin capping. This is especially seen along portions of the eastern coast, much of the cliff-line of which is composed of what may be termed two stories—sandstone below, and black amorphous basalt above.

At Schouter's Island, near Oyster Bay, the conservative power of igneous rocks is strikingly displayed. Northernly, this island is of granite. Against the granite, sandstone and layers of coal have been deposited. Then has come a period of convulsion, breaking up the sandstone-plateau and dislocating the beds. Currents sweeping over what was still a sea-bottom have washed away much, both of coal and sandstone; but, in one spot, an outlier of the latter containing seams of the former was left undenuded until an eruption of greenstone covered the district, and preserved this isolated mass from the effect of any subsequent ocean-currents. It is simply the story of flies in amber, or the preservation of the bones of Bruce in melted bitumen, illustrated on a large scale. And so here coal is dug from a seam which but for such agencies must have been swept away by ceaseless ocean-surges rolling uninterruptedly from the far-off Southern Pole.

NOTE.—In 'A Sketch of the Principal Geological Features of Hobart, Tasmania, by S. H. Wintle, Esq.,' in the 'Quarterly Journal of the Geological Society' for November last, '*St. Mariae*' are mentioned as having been met with in the New Town Sandstone. With all due deference to the opinion of Mr. Wintle, a resident on the spot, I can but think the above statement is an error. Whilst in Hobart last winter, I especially made enquiries respecting any true

Coal-measure fossils which might have been met with ; but the only fossils shown me or spoken of were ferns, and what are called calamites. There seems among Hobarton geologists a strong desire to have their coal-deposits ranked with the English coal-measures ; and any person venturing a statement to the contrary is looked upon with disfavour. Yet, notwithstanding this feeling, I could hear no hint whatever that either *Stigmaria* or *Sigillaria* had ever for certainty been found in any of either the shale or the sandstone beds. Mr. Wintle's *Stigmaria* was probably the stem of some tree-fern, which is a very common fossil in the Tasmanian coal-deposits. If I am not greatly mistaken, Mr. W. admitted as much to myself in a conversation which took place after the paper referred to was posted for England. Of this, however, I am by no means certain.—T. H.

V. NOTES ON CHARNWOOD FOREST.

By D. MACKINTOSH, F.G.S.

IN the midst of a comparatively tame and highly cultivated plain of New Red Sandstone near the centre of England, there rises up a part of the under crust of the earth which presents so much the appearance of an island as to lead the imagination at once to those remote ages when its Porphyritic Peaks and Syenitic Knolls were surrounded by the sea. The geological history of this celebrated spot has been skilfully unravelled by Professors Sedgwick and Jukes (Article in Potter's Charnwood Forest) ; the Rev. W. H. Coleman (Article in White's Directory) ; Mr. Edward Hull (Memoirs of Geol. Survey) ; and others. It has lately been invested with additional interest by the announcement of the opinion that it is one of the 'uncovered areas' or wrecks of the Laurentian or pre-Cambrian continents, which Dr. H. B. Holl* and others suppose may have extended or may still extend underground, from Scandinavia to Charnwood, from Charnwood to the Malvern Hills, and from the latter to North America. The late Mr. Coleman founded his opinion of their pre-Cambrian age on the absence or extreme paucity of organic remains.† But Dr. Bigsby has well shown that this characteristic would rather favour the idea of a formation being posterior to the Laurentian (Quart. Journ. Geol. Soc., vol. xix. No. 73) ; and whatever may be the age of the *Syenitic* Knolls or Bosses of Charnwood Forest, the stratigraphical dissimilarity of its slates and porphyries from the Laurentian formation of America, and their resemblance to the Cambrian rocks of North Wales, ought to make us cautious in assigning to them a very remote antiquity. In many respects there is not perhaps in England a district more puzzling to the geologist than Charnwood Forest ; but all agree with Professor Sedgwick in believing its

* Quart. Journ. Geol. Soc., vol. xxi. No. 81, p. 72.

† Apparent traces or impressions of vegetable or animal life have been discovered in the Southland slate-quarries on the eastern side of the Forest.