servations. The excessive humidity of our climate on the West Coast has not, I think, been done justice to. It is stated that the rainfall at Macquarie Harbour exceeds 100in.* It averaged 67in. on the Hampshire Hills, 1837-9,† and in one year exceeded 80in. How much of this is due to the vast forests which still clothe that region, covering 5000 or 6000 square miles, and how much to permanent physical conditions, cannot now be guessed, but it is of considerable importance to ascertain the facts before any material change is effected in the aspect of the country by settlement. With regard to these instruments which only require attention once a day, such as registering thermometers and rain-gauges, I cannot imagine that there would be any difficulty in multiplying them. In some colonies, as, for example, Canada, use is made of the masters of the common schools, who are highly intelligent men, very stationary, and can all be instructed; and I am disposed to recommend, as a beginning, the provision of instruments for instructional purposes at the Central School. Attention was pointedly called, as you are aware, at the Intercolonial Meteorological Conference, held at Sydney in November, 1879, to the importance of this colony in relation to weather telegrams. I have reason to believe that we shall shortly be invited to take part in a general plan of intercolonial observation, receiving and interchanging them, and otherwise contributing our share to a species of Australian confederation, which can alarm no susceptibilities and arouse no jealousies.

Gentlemen, I feel that I have taken up a great deal of your time, and have said very little; I have only now to thank you for the kindness and attention with which you have listened to me.

NOTES SHOWING THAT THE ESTUARY OF THE DERWENT WAS OCCUPIED BY A FRESH-WATER LAKE DURING THE TERTIARY PERIOD.

By R. M. Johnston, F.L.S., etc.

[*Read 12th April*, 1881.]

Apart from the circumstance that the extensive tertiary fluviatile and lacustrine formations of Australia have been the principal sources from which we have derived our rich treasures of gold and tin in the free state, their study from a naturalist's point of view is also peculiarly interesting from the nearness of their deposition to our own time.

* "Wallace," p. 244. † "Backhouse," p. 126.

The greater opportunities to examine the immediate features of one's own neighbourhood, to some extent, determine the direction of our studies in any branch of natural history, and thus, perhaps, my residence for ten years in Launceston—itself cradled in the undulations of an old tertiary mudbank—may have had something to do with my choice of a subject for this evening.

Many present may have noticed along the shores of the Derwent, particularly in the neighbourhood of Sandy Bay, One Tree Point, and Cornelian Bay, a series of sandy and clayey beds sometimes of considerable thickness and extent. They frequently dip irregularly at various angles, and in various directions, as if they had been much disturbed subsequent to their deposition, but they are never found at an altitude of much more than 40 feet above the existing sea level.

The sandy portions, in some places, may readily be mistaken for members of the older or primary rocks, but they are invariably closely associated with thinly-bedded clays—white, yellow, and grey,—and they are coarsely granular and irregularly bedded.

The clays, on the contrary, are generally most regularly and thinly bedded like the sheets of a huge volume. Now if we examine any one of these beds a little more closely, we may discern that it is in turn composed of innumerable filmy leaves, finer than the most delicately prepared paper, all in the plane of the lines of bedding. I have purposely drawn the parallel with a book, for, like it, each of the clayey pages are crowded with characters—Nature's own handwriting, telling many an interesting story of the times when they were impressed and deposited beneath the waters of this ancient lake; while the rifts, contortions, crinklings, overlying rocks and drifts, and the waste of the ever encroaching sea, tell of the vicissitudes to which the beds have been subjected subsequently. Since my recent arrival here, I have spent much time in studying their characters, and I have carefully traced their extent by inspecting every foot of coast line, watercourse, railway and road cuttings, and natural faces exposed, within a seven mile radius of this City. My acquaintance with the "solitary patch of limestone" at Geilston, which is still quarried by Mr. Albury, and of the old limestone quarry at the head of Burnett-street, to which I was at one time guided by Mr. Legrand, enabled me to decipher their signs more readily.

Indeed many of the characters of the leaf and fruit remains, are identical with those found so abundantly in similar lacustrine formations throughout Australia and Tasmania, the relations of which with the Geilston Travertin I have already

discussed most fully before the members of this Society,* and which have subsequently received additional illustration in the interesting paper by Dr. Barnard, in respect of the vegetable drifts of Gulgong. In order that I may establish the characters, relations, and position of this interesting formation, which indeed lies within as well as around the fair city of Hobart, I shall perhaps be enabled to do so more effectually if, in the first place, I confine myself to a description of the principal sections as they occur at particular places, some of which I have already referred to, viz :—One Tree Point, Sandy Bay, Cornelian Bay, Pipe Clay Bluff, Prince of Wales' Bay, Beauty Bay, Lindisfarne Bay, Geilston Bay, and the neighbourhood of Burnet-street, Hobart. It will be seen upon the Map which has been kindly prepared for me by Mr. Frank Lovett that, on the one hand, all the points lie within the basin, and are subject to the wasting advance of the waters of the existing estuary; while, on the other hand, they abut against the older rocks, and the eruptive diabase represented by Mount Nelson, Knocklofty, the Domain, Mount Direction, the lofty ridge terminating in Point Rosny, and the more distant but majestic crest of Mount Wellington.

These latter diabasic rocks constitute the chief characters, and have rendered famous the features of our neighbourhood, and they surround both city and the formation being described, as with a great encircling arm.

The formation at One Tree Point lies at the base of Mount Nelson. It forms a gentle eminence of a triangular shape, whose base, washed by the Derwent, stretches from opposite Sandy Bay Point to a creek which runs into the Derwent nearly opposite Trywork Point, while its apex lies between two hollows which radiate from that elevated saddle which forms so conspicuous a feature beyond the Flagstaff Station, at Mount Nelson.

A section underneath the new defence works on the Brown's River road presents the following appearance, which, with some of the leaf figures, have been graphically sketched for me on a larger scale by my friend Mr. F. Salier. *(See Plate* 1.*)*

The beds marked *a. b.* dip at a considerable angle to the south-east in the direction of the existing channel. Were it not that the laminæ in the plane of bedding are rich in certain well-known tertiary leaf impressions, the appearance of some of the lower members of the group, which include a motley assortment of coarse and huge angular blocks, principally of the fossiliferous mudstone of Palæozoic age, would be apt to mislead, and perhaps may have hitherto misled the casual observer.

* Proc. Roy. Soc., 1879.

The latter included blocks, huge, irregular, and tilted at all angles, so as to obscure, if not conceal, the true lines of bedding, are very puzzling; but, if we accept a conclusion which is forced upon us from independent considerations, we can easily conceive how the otherwise regular lines of bedding with the true sedimentary laminæ may be harmonised with the included angular blocks of a previous age.

I have already observed that one of the limits of the base of the formation was opposite Sandy Bay Point. There, on the Brown's River road, a section exists, clearly showing the older mudstone rock *in situ*, against which the upper members of the tertiary lacustrine formation may be seen to abut. *(See Plate* 2.*)*

Now all who have travelled along the Huon Road, or who have sailed under the cliffs at Bedlam Walls, must at times have been struck with the regularity of the beds of the older mudstone series as they lie over each other in vertical sections, and quarrymen at the new battery at Kangaroo Point will tell you how easily one of the layers may be separated from the adjoining one. Some of the layers, however, are of softer texture than the rest, and consequently a wall of such rock must wear away unequally. The rocky cliffs below the Shot Tower are good illustrations of this unequal waste of certain beds. At this spot there may be seen the rapid destruction of a softer layer at the sea level, which, when far enough advanced, will cause, as it has already done, the fall of immense faces of the superincumbent mass, which, by degrees will, by wind-driven waves of terrific force, be strewed as angular blocks among the finer sands of the advancing sea.

Now, if we assume that the ancient tertiary lake here spoken of had an extensive surface, of which, from other sources, there are proofs almost amounting to demonstration, we can readily conceive how the strewn angular blocks of fossiliferous mudstone at *a*, fig. 1, came to be included among the more regularly stratified clays and sands, and associated with the fruit and leaf impressions of a later age. Nay, more, the assumption thus forced upon us will enable the observer, as it enabled me, to anticipate in great measure what other observations in the neighbourhood can verify and amplify.

Let not the over-cautious, therefore, frown upon anticipations of this kind, for in truth they are the half-lights or the natural fruits of former observations, and when recognised as such they constitute the more valuable part of that inestimable possession which Professor Tyndall has happily designated the "Scientific Use of the Imagination." From this momentary digression let us again turn to our section as

exposed at One Tree Point. The overlying basalt marked *c*, is essentially a dark, close-grained, feldspar basalt, with abundant grains and crystals of olivine. It is full of small fragments, scarcely altered, of the surrounding stratified rocks. The rock itself is in every respect very similar to the basalts at Deloraine, Breadalbane, Table Cape, Geilston, Campbell Town, Ringarooma, Latrobe, Fingal, and various places in Victoria, in nearly all of which places it overlies fluviatile and lacustrine formations similar to that at One Tree Point. Towards the south the basalt seems to have flowed in repeated layers at different times. This may be inferred also from the marked difference in the form and density of the various sheets. The flows of basalt to the south, which I assume to be the more recent, are very unlike the massive beds at the northern point of junction with the underlying clays. At certain points towards the creek southward, they are highly vesicular, and present very much the appearance of pumice stone, although of a more dense character. This also is the character of the soft underlying feldspar basalts of Beauty Bay, Lindisfarne Bay, and Cornelian Bay, good sections of which may be seen at low water all round the sea margin.

The feldspar basalt on the northern and western shores of Prince of Wales' Bay is identical with that at Cornelian Bay, but the cavities are filled with lime, and is thus converted into a true amygdaloid. It is very curious that all the great basaltic sheets of Tasmania and Australia of tertiary age should be so closely associated with the great fresh-water systems of the period; and it is also worthy of note that the mode by which they were ejected was probably by fissure-eruption, and not by the more familiar type of conical volcano. The immense level sheets of basalt in the Midland and Northern districts of Tasmania, together with the vast plains composed of similar basaltic sheets in Victoria, support the views recently advanced by Professor Geikie,* who states positively upon the subject, that the volcanism of earlier periods as exhibited in the great sheets of the Western States of America, Abyssinia, India, and elsewhere, can with difficulty be explained by reference to any modern volcanic phenomena.

The persistent horizontality of the tertiary basalts in Tasmania and Victoria, also offer strong reasons in favour of the fissure-eruption theory.

With respect to the flows at One Tree Point there is another interesting feature, which, if correctly interpreted, proves that there were repeated flows of basalt also at the

* *Nature*, November, 1880.

point where the rocks are most crystalline and homogeneous in character. This evidence consists of the discovery of bone breccia in what I believe to be the cooling joints of an older sheet of basalt. From close personal examination of the bones *in situ*, and from replies made by Mr. Moore, the intelligent overseer of defence works,—who first, through Mr. Roblin, drew my attention to the "bone discovery"—I feel assured that the bone breccia was washed into the cooling joints of an older sheet of basalt, and was subsequently overlaid by another flow.

Unfortunately the bones are so broken up that they are of little service in determining the exact nature of the animals to which they belonged. Mr. Roblin, however, by careful pulverization of some of the fragments of breccia, among other undetermined matter, obtained a small well-preserved tooth, which undoubtedly belonged to a marsupial of the genus Hypsiprymnus, or Kangaroo Rat family. I also succeeded in obtaining one or two bones of interest, among which is the well-preserved incisor of a marsupial allied to the existing Wombat.

I have made enlarged drawings of the more important fragments, which probably at some future time may be serviceable at least in correlating the existence of the same animal elsewhere, even if of little value in determining its exact specific rank. The bones obtained by the late Mr. Morton Allport from the Geilston travertin are most probably the remains of the same species.

It would be interesting to make comparisons with the collections referred to, but I fear they have not been preserved. It will be remembered by some that Mr. Allport and others at first inclined to the opinion that the fragments of bones preserved at Geilston belonged to existing species, but this opinion was formed at a time when the relative position of the travertin beds was not very clearly understood. It is probable that the bone remains could only be identified with existing genera, and that there is not sufficient evidence to declare specifically their exact nature. However, some of the members present may be able to give us further information regarding this matter.

Before leaving the section at One Tree Point, it is desirable to draw particular attention to the fault at *d*, fig. 1. It is evident that by the fault *d*, the beds *a* and *b* have again been thrown up, so that we have, in travelling towards Kingston, a repetition of the section *e* to *d*. Between *e*, fig. 1, and the northerly limit opposite Sandy Bay Point, *c*, fig. 2, there is evidence that considerable denudation has taken place, and consequently we are unable to fix, with satisfaction, the probable thickness of the stratified sands and clays at

this point. The overlying sheet of basalt is only about 6ft. thick at the extreme point, but becomes massive, probably from repeated flows, towards the west.

The observations which I was enabled to make regarding the conditions under which the One Tree Point leaf beds were deposited, predisposed me to expect that in the protected bays on either shore of the estuary at a similar level I should find further evidences of the lake system, which even then I had reason to infer must have included the Geilston travertin, which I now regard as a deposit formed in a small bay of this old lake. In this respect my expectations were more than realised, for in carefully examining the coast lines at the first three points I selected for examination, viz., Sandy Bay, Cornelian Bay, Lindisfarne Bay, I discovered sections proving their close relationship, even more remarkable than that at One Tree Point, which first arrested my attention.

SANDY BAY DEPOSITS.

At Sandy Bay there are several interesting sections belonging to the formation. One of them, beyond Dunkley's Point on the Brown's River road, is composed of a series of clayey and arenaceous beds, irregularly disposed about 30 to 40 feet high. It is capped by what appears to be a tufaceous loamy soil. The surface of this loamy bank, like many other points on either side of the Derwent, is covered with a layer of the comminuted remains of existing marine shells, about 1 foot in thickness. The shells appear to have been subjected to fire, for which also there is evidence in the abundance of wood-ashes and charred remains of timber belonging to existing vegetation which enveloped the shells.

The best and most interesting section at Sandy Bay is to be seen at a small projecting sandy promontory nearly opposite the new Rifle Range. At this point a series of finely bedded blue and reddish clays more or less arenaceous are tilted at a very high angle against a thick-bedded reddish sandstone of doubtful age. There appears to be a fault at the point where the clays are inclined at a very high angle against the sandstone, and it is evident that a strong lateral pressure has bent them up into their present form. When we take into consideration the eruptive disturbances subsequent to their deposition, of which, in their vicinity, I have already given evidence, we may reasonably expect considerable crumplings and fractures of this kind.

Sketch 3 gives in outline the principal features, and the relations of this section. *(See Plate No. 3.)*

The fine blue and red clays *b* are extremely rich in fossil leaf impressions, but as the purer clays are often very soft, and the sandy beds friable, it is difficult to get perfect

specimens. The forms common to One Tree Point, Geilston, Pipe Clay Bluff, Burnet-street, and elsewhere, are found here in the greatest abundance (see figs. 1, 34.)

The sapindaceous-like form so common about Launceston, is also found throughout the local formations where the beds have been exposed. Between the sandy point referred to, and the elevated diabasic bluff to the north against which the fossiliferous clayey beds are again seen to repose, there is evidence of the great thickness of the system, although the denudation, which has been great, together with superficial drifts, have obscured the junction with the series to the southward. There is every reason for the belief that the district known as Sandy Bay proper was almost altogether beneath the waters of this ancient lake.

PIPECLAY BLUFF, CORNELIAN BAY.

The next important section illustrative of the nature and extent of the system is to be found in Cornelian Bay, at a place called the Pipeclay Bluff. The beds at this place are nearly horizontal, and they quietly repose upon the Domain diabase at a short distance beyond a small gravelly point which juts out into the bay. The lower members are composed of a fine whitish pipeclay, which is sometimes used by the poorer classes as a whitewash. These clays are readily reduced to a milky state in water, and have most probably been derived from the waste of the white mudstone rocks of palæozoic age, which abound in the immediate neighbourhood, *e.g.*, Geilston. It is in these white clayey beds where the leaf impressions of many extinct species of trees are most perfect and abundant. The impression of the fine secondary veinlets of the leaves are preserved with faithful delicacy. The impression of fruit valves are also seen occasionally. I have on several occasions obtained the casts of *Pleisiocapparis leptocelyphis, F.V.M.*, both here and at One Tree Point. This particular fruit is very common on the opposite shore in the Geilston travertin beds. There is no doubt of the identity of some of the leaf forms with those found at Breadalbane and Muddy Creek on the Tamar, while their relations with all the local leaf deposits, which I believe to be members of the same lake system, are so abundant as to place the matter beyond reasonable dispute. The upper members of the Pipeclay Bluff series are of a more arenaceous character, and they are coloured red with the surface water from the diabase above on the Domain.

They are, however, rich in similar leaf impressions, though of course less perfectly preserved.

The sketch 4, although not drawn to scale, gives a fair idea of the section at this point. It is most probable that had

not denudation scooped away the beds in the direction of Cornelian Bay Cemetery we could trace the clays as they dipped under the basalt at Cornelian Bay Cemetery Bluff. *(See Plate No. 4.)*

The basalt sheets at Cornelian Bay Cemetery are soft, vesicular, and sometimes disposed in hexagonal columns in the exposed vertical faces. There is scarcely any doubt but that the similar sheets, at a short distance across the estuary, (*i.e.*, at Beauty and Lindisfarne Bays), were at a recent period connected. It is also probable that the soft vesicular masses at Cornelian Bay bear the same relation to the more dense and crystalline sheet overlying the travertin at Geilston as the dense and porous sheets at One Tree Point already described. The basaltic sheets to the north and west of Prince of Wales' Bay are also mostly vesicular. Most frequently the cavities are filled with lime, and are thus converted into true amygdaloids.

The best illustration of the extent of the pebbly drifts overlying the basalts may be seen at Lindisfarne Bay on the seaward margin of His Honor Mr. Justice Dobson's property, of which No. 5 is a sketch. *(See Plate No. 5.)*

The water-worn pebble beds are sometimes of considerable thickness. The pebbles have been derived from various sources :—Fossil pines silicified from the coal measure sandstones, fossiliferous water-worn blocks from the palæozoic mudstones, waterworn boulders of diabase of secondary age, feldspathic basalt from the underlying rock, and fossilized trunks of a well-known exogenous tree of tertiary age, evidently silicified *in situ*. The appearance of the latter wood, rough, angular, not worn, presents a marked contrast when compared with the polished water-worn silicified pines and other pebbles from the older rocks. The sections of the fossil wood of tertiary age under the microscope appear to be identical in every respect with similar sections obtained by me from kindred deposits near Little Badger Corner, Flinders' Island, and also at Corra Lynn, Launceston.

SHELL BEDS.

I have also shown that the pebbly beds occur in the same position relative to the basalt on the opposite western shore, and some of them with the shelly deposits at Cornelian Bay have already received attention. Mr. Wintle, who is a very intelligent observer, has drawn attention to them on several occasions. Some of his interesting observations have already been discussed before the members of this Society. In one of them he has correctly shown that the agates, cornelians, and jaspers, so abundant around the beautiful

Cornelian Bay, have been derived from the waste of the older gravel drifts which overly the basalt.

Mr. Wintle inferred that the pebbly beds with the overlying surface layer of comminuted shells, and the underlying basalt, were upheaved at a recent period from the bed of the existing estuarine sea. That the shelly accumulations are in reality indications of a "raised sea beach."

The comminuted shells which are all of existing littoral species, (viz. *Ostrea edulis, Mytilus latus, Venus aphrodinoides, Rupellaria diemenensis, Risella melanostoma, Littorina unifasciata Trochocochlea constricta, etc., etc.)*, favour this very natural conception.

My acquaintance with the undoubted raised sea beaches of the islands in Bass' Straits, and along our northern coasts, predisposed me to concur with Mr. Wintle's view of the question prior to my discovery of the true relation of the basalts with the tertiary leaf beds at the various points already described in this paper. But a careful examination of the shell beds themselves from Blackman's Bay to Rosetta Crossing on the western side, and from Geilston to Frederick Henry Bay on the eastern shore, has convinced me that the views of the late Mr. Gunn, the most illustrious among Tasmanian naturalists, are most in accord with all the facts which are now known to me. You are all aware of the close observing powers possessed by the late Mr. Gunn, and the many opportunities which he had of making observations as regards the life and habits of the aboriginal tribes which frequented the coasts, especially the sheltered coves and beautiful headlands of the Derwent and Tamar. I cannot do better than give a description of their shell feasts in his own words:—

In a paper contained in vol. 2 of the Tasmanian Journal of Science, 1845, to which my attention was first specially directed by Mr. Calder, after preliminary remarks regarding the shell heaps, Mr. Gunn goes on to say:—"I was led to infer, at first, that they had been artificially and recently applied as manure. It was not until long after when I had an opportunity of observing some lately formed heaps of shells on the West Coast of the island that I ascertained the truth. As some persons otherwise well informed still believe that changes in the relative levels of land and sea may have led to the appearance of the shells in their present places, I have thought it best to record my observations on the subject. The aborigines of Tasmania appear at all times to have derived a considerable portion of their food from the sea, and* as they seem to have no effectual means of catching

* Mr. Calder states, that in their wild state they did not eat scale fish.

fish in any quantity, the testaceæ and crustaceæ constituted the principal and almost only supply they drew from that element.

From the reports of early navigators, it would seem that the aborigines existed in considerable numbers along the coast of Tasmania; and we may thence infer that the consumption of shell-fish must have been very great, as they ate no vegetables or substitute for bread. In cooking, the shells appear in all instances to have been merely roasted in the simplest manner, as I have never traced any indications of ovens or stones arranged to be heated. The burning of the shells has hastened their decay. In obtaining the shell-fish the women were, I believe, almost exclusively employed, wherever diving was requisite, as for the species of haliotis and oyster, these being brought to the surface in baskets formed from various sedge-leaved plants.

In the majority of cases they consumed their food as near as possible to their fishing stations; occasionally going a little inland to avail themselves of a spring or stream of fresh water. I have, however, observed in a great many instances that there were unusually large accumulations of shells on projecting points, headlands, and places commanding extensive views, whence I suppose that they adopted these sites for their repasts to protect them from the attacks of hostile tribes."

He elsewhere describes that the heaps of comminuted shells are various in extent and thickness, and invariably burnt and intermingled with charcoal, etc.

In corroboration, I have to offer the following observations:—

1. Wherever the shells are found undisturbed by recent landslips,* I have found them always more or less comminuted with a burnt-like appearance—unlike the northern raised beaches—and enveloped in what appears to be ashes, for they are invariably full of the charred embers of the wood of existing trees.

2. At Pipeclay Bluff, Lindisfarne, New Town Bay, and elsewhere, I have frequently found the ordinary rude chipped flints of the natives intimately associated with the shells. I have given samples of these flints to His Excellency the Governor Sir John Lefroy, and to His Honor Mr. Justice Dobson, who will be able to testify as to their genuineness so far as they are chipped native flints. I have also dug out from the undisturbed beds the split bones of existing marsupials, which appear also to have undergone roasting.

* The section which Mr. Wintle refers to is due, I believe, to the subsequent re-distribution of landslips caused by the encroaching waves at Sandy Bay.

The shelly layers invariably follow the irregularities of the surface along the coast line upon a vegetable loam irrespective of level. The layers are very irregular in thickness and extent. On favourite promontories of the natives, such as New Town Bay Point, the burnt heaps are over four feet thick.

4. Inland where the levels, free and open, are far under the undisturbed heights at which the shelly layers frequently are found along the coast, I have never found traces of the shells anywhere at or near the surface. This would not be the case if there were an upheaval sufficient to have raised the shells along the estuary to their present position.

5. The gravelly and pebbly beds have evidently been distributed by fresh water, most probably at a period long anterior to the introduction of the existing marine fauna, because in my opinion they contain remains of an extinct tertiary vegetation *in situ;* and I have never been able to trace any recent or marine shells in their beds.

6. Extensive isolated patches occur, in every respect identical in character, at such heights upon the Domain as to make it difficult to conceive that they were deposited there by other than human agency.

7. Frequently where the surface soil gives evidence of having been least subject to aërial erosion the shelly accumulations suddenly cease entirely, to reappear again and again in such a manner as would be difficult to account for if we supposed they were produced in the bottom of a shallow estuary, or at any limit within the influence of its waters.

8. The accumulations are certainly not due to the agency of winds.

Taking all these points into consideration I think it is clear that the accumulations are solely due to human agency; that they are in reality, as described by Mr. Gunn, the "kitchen middens" of the extinct Tasmanians. That they are vast in extent and thickness along our estuaries is to be expected when we consider how much this rude people depended upon the marine shells for subsistence. It must be borne in mind also that the Tasmanian race, from an ethnological point of view, must have existed for countless generations upon the island; for otherwise how can we account for the marked racial type when compared with the natives of the Australian mainland and elsewhere? I think therefore that I am justified in separating the surface shell layer from the underlying gravels and drifts as shown in sections 4 and 5.

The latter I conceive to be the upper members of the

lacustrine deposit of tertiary age; the former, an artificial accumulation belonging to the existing period.*

It may be well now to summarise some of the leading features of the system with which, in detail, I have endeavoured to make you familiar.

If in imagination we carry ourselves far back to the epoch which immediately preceded the reign of the eucalypts, when the Araucaria and Cinnamon trees graced the slopes of the neighbouring hills, we might from some commanding eminence (such as Mount Nelson) look down upon a magnificent sheet of water at our feet which would, in a general way, resemble in outline the existing estuary of the Derwent. With a few minor exceptions its sinuous boundaries would follow the same lines, but its waters would be fresh, and the Domain and Trinity Hill would be almost isolated in their midst. The great features of the surrounding country, Mount Wellington, Mount Nelson, Knocklofty, The Gunner's Quoin, Mount Direction, would be almost unchanged. On a stormy day we might also see its surface broken into crested waves; and in the neighbourhood of One Tree Point and Geilston we might watch how the chalky-looking cliffs of mudstone rock were undermined and crushed by their repeated blows, and also see the milky sediment the result of such waste as it was floated away to eventually settle in the quieter waters of the sheltering bays.

The vegetation which luxuriously fringed its shores would appear new, although its general features would not strike us as being altogether unfamiliar.

The botanist would find, instead of the sombre gum and the green wattle, a large number of trees with elm-like leaves and walnut-like fruits with 4 and 5 valves. In the slopes of the bay near Geilston a species of Araucaria (A. Johnstonii), like A. Cunninghami, would rear its curiously imbricated branches crowned with their singular spiny cones. If we searched among the dead wood in the shady places we should find an abundance of strange land shells (Helix Huxleyana, H. Geilstonensis, Bulimus Gunnii), one of which a larger species (Helix Tasmaniensis) would be specially interesting in the eyes of a conchologist. At times our imaginary conchologist might espie, however, a single individual whom he would recognise as an old acquaintance (Helix Sinclairi). It is even possible that no fresh-water Unio would be found to inhabit the waters of the lake; and thus it would exhibit a similar relation to that which at present distinguishes the northern

* Having examined a number of the shell heaps near Hobart, I have no doubt whatever of their artificial character. They resemble shell heaps that I have seen along the Atlantic and Pacific Coasts of America, which were deposited by the Indians living on the coasts.—W. Denton.

and southern waters of Tasmania. Of the higher animals we can only conjecture, but we are at least sure that many of the marsupial tribe, allied to the existing Wallaby and Kangaroo Rat, abounded in the scrub close by.

This imaginary scene may fairly be taken to represent what we know of the earliest stage of this ancient lake of the Derwent, which I consider to belong to the same horizon as the lower zone of the Launceston Tertiary Basin.

The second stage is indicated by the disturbances caused by repeated eruptions of feldspathic basalt along the margin of the old lake, and spreading over a portion of its floor. Cornelian Bay Cemetery and One Tree Point represent this stage clearly. It is evident that a very long period must have elapsed between the formation of the first sedimentary deposit of the lake and the period when the eruptions began. It is also clear that the period of disturbance must have been of long duration. The Sandy Bay deposits are good illustrations of the first period referred to. The second stage I recognise as the equivalent of the middle zone of the Launceston Tertiary Basin.

The third stage marks the distribution of the gravel beds with their agates, jaspers, cornelians, and fossil woods. At this time the lake must have been rapidly shallowing. It is even possible that the mere horizontal advance of the sea is alone necessary to explain the final draining of this ancient fresh-water system. If the outer lip of this lake basin was pierced by the slowly advancing sea, it would sufficiently account for all the appearances with which I am now acquainted.

There is no need to assume a general depression of the land surface or a subsequent elevation, although I do not wish to be understood to mean that a slight alteration of the general level may not have been associated with the causes already cited.

The horizontal encroachment of the sea in the direction of its present limits must have been very slow, and long enough in duration to admit of a complete transformation of the characteristic flora and fauna of the period.

When we reflect that the changes which take place within our own observation, with respect to existing animals and plants, are so slow and imperceptible that many otherwise intelligent minds have a rooted repugnance to recognise the facts which support the evolution hypothesis, we can, even better than in terms of years, estimate the immensity of time which separates the extinct species of vegetation of even the upper members of the lake system from the artificial shelly accumulations of recent origin which now alone remain to give evidence of the extinct Tasmanian race.

Such then is the story which I have been enabled to

decipher from the clayey pages of this old lake of the Derwent. There are, however, myriads of leaves still uncut, unread, and I trust the members of this Society will assist in the future in adding to our knowledge regarding them.

DESCRIPTION OF TWO NEW MARINE SHELLS DREDGED OFF THREE HUT POINT, D'ENTRECASTEAUX CHANNEL, TASMANIA.

By C. E. Beddome.

[*Read* 10*th May*, 1881.]

Delphinula Johnstoni, n.s.

Shell minute, obliquely turbinate, nucleus smooth, whorls 3½ to 4, convex, latticed by spiral and diagonally transverse liræ; spiral liræ alternately fine and coarse, increasing in number towards aperture; base convex, the surface of which is also finely latticed; there is a well-defined, relatively broad, and somewhat concave band, transversely lirate, between last spiral liræ and the tortuous marginal rib of umbilicus, which latter joins and forms a partly closed channel at anterior angle of aperture. Aperture round, outer lip simple, obsoletely channelled at anterior and posterior angles. Inner lip reflexed and nearly concealing umbilicus and marginal rib.—Long. 2 mil. Lat. 2 mil.

This shell is closely allied to *D. tetragonostoma*, Tenison-Woods (fossil sp.), and forms an interesting link with the marine life of the tertiary period.

Hab., off Three Hut Point, D'Entrecasteaux channel, about 17 fathoms.

I have great pleasure in dedicating this species to my friend R. M. Johnston, Esq., who has interested himself so much in the present and past fauna of the country.

Leda Lefroyi, n.s.

Shell minute, thin, translucent, much compressed, narrowly elongate. Under the lens the exterior surface appears finely striated, radiately and concentrically, and is covered with a very delicate olive epidermis. Anterior side short, arched; posterior side with a gently curved depression, and produced into a long, narrow, tapering rostrum, which, upon the inside, is divided into two well-defined channels by a raised longitudinal callosity in both valves. Rostral area scarcely truncated at the tip. Umboes slightly elevated. Ventral margin slightly convex. Long. 9½ mil. (a line passing vertically through umboes would