THE LAUNCESTON TERTIARY BASIN.

Second Paper by R. M. Johnston.

[Read 11th August, 1874.]

Having devoted some spare time to the further investigation of the Launceston Tertiary Basin, the taking stock of whatever information I have been enabled to glean since my last communication, may not be uninteresting to the members of the Royal Society.

The association of the fossil pines (so abundant throughout the district) with various leaf impressions of other exogens is of considerable importance, as it favours the inference that they belong to the same period. Some, however, who are entitled to respect, hold a different opinion, and we must confess that although the leaf impressions referred to are, undoubtedly, recent, and belong to the system in which they are now found, it is by no means conclusive that the silicified pines, especially the waterworn specimens, are of the same age. It is quite possible that much of the latter may be the re-wash of a former period. Without committing myself, I may venture to state that my recent discoveries at Stevenson's Bend, and Corra Lynn, tend to confirm the opinion that they are of about the same age as the Breadalbane lignites, at any rate, not older, as the *tuff* or *wacke* overlying the lignite there, contains the remains of a perfect forest of pine trees which, certainly, could not have been washed from an older rock, and no evidence of a foreign matrix can be discerned. Further, as there are numerous instances of the smaller branches maintaining their natural connection with the parent stem, it is almost conclusive that they have not been removed from an older rock, but are really exposed in the original matrix.

Corra Lynn Agglomerate.

In an exposed cliff section, on the North Esk, near to Corra Lynn, figured by me in a former paper (No. 33), I recently discovered the pine Banksia and two other undetermined woods.* One of the latter shows in a transverse section, large porous vessels scattered irregularly, as in the Eucalyptus. The vertical tangential section, however, is very different, the medullary ray bundles being very large, vertically elongated, and have the several rows of cellular fibre presenting a square instead of a roundish net work. Of the other undetermined wood, I have not had time to make a proper transverse section, but I have satisfied myself that it

* I am indebted to my friends, Messrs. A. Weedon and T. Atkinson, for the discovery of two of these woods at Corra Lynn.

is very different to the others. The medullary ray bundles resemble those in the Elm and other woods, being thick, elliptical, and containing somewhat large porous vessels. *See Fig.* 19.20.

The Pine and Banksia in sections No. 10-13, 16-18, are unmistakably clear, being almost identical in every feature with existing woods of the same class. The tree remains are embedded in many cases in a highly crystalline agglomerate* and have been converted into a carbonate of lime. Towards the centre of the branches or trunks the carbonate is of a black crystalline structure, in which it is either very difficult to trace the original woody structure, or it has altogether disappeared.

The exterior and weathered portions are of a dullish white color, and show the structure admirably. Many of the water-worn silicified pines found elsewhere, appear to be identical in structure with those found here almost *in situ*, and it is remarkable that many of them (silicified specimens) correspond with some of the Corra Lynn trees, in that they become opaque and structureless towards the centre. May it not be possible that the waterworn silicified specimens, have been derived from a similar matrix, to that which encloses the numerous Corra Lynn fossils, and may not the change to a siliceous state have been induced subsequently ? Those of the Fellows skilled in chemistry may be able to say whether this is probable or not, so far as chemical change is concerned.

The section in which these fossil woods appear is about 80 feet high, and has been exposed by the North Esk river, which is still undermining its face; the *detritus* is forming a small island in its immediate vicinity. This section is composed of a series of beds of brecciated tuffs, conglomerates and agglomerates, in regular bands, and it abuts horizontally against the Corra Lynn basalt, which latter appears to be much older.

Although the agglomerates are all more or less indurated it is the lowest stratum now forming the bed of the river, which appears to have undergone the greatest alteration. Had it not been that certain angular blocks of an altered claystone, are found embedded in it, I should have imagined that the older basalt was not thoroughly cooled when the first stratum of agglomerate was thrown down on its surface, but as the altered claystone is found *in situ*, overlying and in contact with the older Corra Lynn basalt, at the bridge over the river, it is most probable that the cause of alteration must have

* I use the term agglomerate advisedly, for although a stray block or two of a foreign element enters into its composition, it is very evidently directly formed from the *ejecta* of a recent volcano in the neighbourhood.

been due to the peculiar state or composition of the agglomerate when deposited in the waters of the lake.

Altered Claystone.

The claystone, a specimen of which has been sent for inspection, has evidently been metamorphosed by contact with the older basalt, for in a section upon the Launceston and Western Railway at Hunter's Mill, Perth, the very same claystone is shown to be of considerable thickness. It presents the appearance of a baked pipe clay, being exteriorly of a whitish colour, and breaking readily into small hardened cubes. When most distant from the underlying basalt, it is soft and friable and internally white; it becomes more hardened as it approaches the igneous rock, until finally at point of contact it is metamorphosed into a dark close grained crystalline chert, which no longer splits into cubes, but has a smooth conchoidal fracture; portions now in my possession have extremely sharp edges, very hard, and from descriptions given of native implements. I think it probable that they were manufactured by chippings from this material. I have been informed that this point was a favourite haunt of the aboriginal tribes—hence the name Native Point, given to Mr. Gibson's estate near to it.

The metamorphosed claystone again occurs overlying the same rock in a cutting of the St. Leonard's road, leading to the railway station, close to Mr. Westbrook's house. The top surface is frequently polished, and vertically, it often takes a prismatic form.

Stevenson's Bend.

Leaving the Corra Lynn agglomerates—of which I hope soon to be able to say something more—I come to the exposed section at Stevenson's Bend. I have already spoken of the richness of the fossil leaf impressions at this point. At low water are to be found numerous hardened ferrugineous nodules, which have been washed by the River Tamar from an overhanging band of brecciated nodules, mixed with siliceous pebbles. Most of the concretions are replete with casts of the elm-like leaf figured (1) in my former communication, with here and there the impress of an imbricated pine twig, or some strange fossil nut. Sometimes a lucky stroke of the hammer discloses the perfect impression of a new leaf form, a portion of the frond of an unknown fern with its furcate venation, or perhaps the well-defined impression of the bark of some ancient type of tree. All this can be dryly communicated on paper, but only the brethren of the hammer, or those who take a lively interest in the evolution

of organic forms, can understand or sympathise with the pleasures of the solitary discoverer.

The following then is a description of several new forms discovered in this way at Stevenson's Bend :—

No. 1 is a very handsome concostate leaf of the Cinnamon type. See *Cinnamomum polymorphum* figured by Lyell from Heer's work on the Œningen beds. The figure there given, though not identical, closely resembles No. 1 in the form of the venation, and in the elliptic shape of the leaf. It is $3\frac{1}{2}$ inches long, and $1\frac{1}{2}$ inches broad. I have only seen the one impression, and may therefore consider it comparatively rare.

No. 14*a*. is the impression of a small, costate, possibly, lanceolate leaf. Primary veins straight, numerous, parallel, running out and upwards, at an acute angle to the extremity. Size when perfect, say $1\frac{1}{2}$ long and $\frac{3}{4}$ broad—not common.

No. 6*o*. seems to have been a lanceolate shaped leaf, with venation somewhat similar to that of the leaf of the *Solanum nigrum*—common.

No. 3, pinna of a fern very similar to the pinnæ of the existing *Lomaria lanceolata* so common in this neighbourhood. Not common.

No. 5 and 6*a* represent beautifully distinct impressions of the portions of fronds of one of the filmy class of ferns. It resembles Trichomanes or Adiantum in the delicate, spreading, repeatedly furcate veins, but differs from most of the species in either, in having a somewhat prominent wavy midrib. It must have been a very graceful fern, and would if now existing prove a formidable rival to the favourite "*Maiden hair*."

No. 4. I was particularly struck with the scale-like appearance of this impression.

The markings bearing so close a resemblance to the stripped surface of the Banksia, I resolved to make a closer comparison. I found by taking a wax impression of the inside face of the dried bark of the existing Banksia, that it was indentical in every respect with the fossil cast No. 4. This, with the knowledge that the Banksia in a silicified forms occurs elsewhere with the pine, prepared me for the discovery of these woods associated together in the original matrix at Corra Lynn.

Breadalbane Lignite.

I have so frequently referred to this deposit that it may be desirable to point out its position and relation with greater exactness. The stratum of lignite has now been ascertained to be between 3 and 4 feet thick. It is generally very impure

and frequently contains the entire, though much compressed, trunks and branches of trees. The woods are evidently a lignified form of those preserved in a carbonate of lime at Corra Lynn. One tree is very remarkably preserved, the concentric rings and medullary rays with the tissue, are most curiously twisted and contorted by compression. Notwithstanding this, the large porous vessels, and the thick medullary bundles are distinctly visible. The tissue of the pines is scarcely visible in most of those which I have examined.*

The descending order of the beds at the Big Cutting is as follows:—

	Thickness in feet.
Superficial chocolate soil	2 to 3
Basalt, more or less consolidated and columnar; with tuffs more or less regularly stratified by water action	50 to 60
Conglomerate, composed of waterworn rounded fragments of the overlying basalt, mixed with waterworn siliceous pebbles	3 to 4
Series of whitish arenacious clays	20 to 30
Lignite more or less impure, with embedded trunks and branches of pine, and other trees with large porous vessels	3
White and greyish arenacious clays—of great though unknown depth.	

The lignite is thus shown to have been deposited long prior to the more recent volcanic eruptions, and therefore belongs to the Lower Zone, as defined by me in my former paper. The beds of clay and sand of the Lower Zone, so far as I can see, preserve a characteristic white or greyish appearance throughout the group. They are of great thickness and extent, and the section cutting through the Big Hill, may be taken as a fair example of the formation of the many curiously rounded hills throughout this very beautiful district.

The metamorphosed claystone at Hunter's Mill, Perth, Corra Lynn, St. Leonards, most probably belong to the group, and if so, the Lower Zone (upper and lower boundary) may be indicated by having its lower members resting upon, and possibly altered by contact with the older basalts, while its upper members are immediately overspread by the more recent.

It is probable from its height, position, and other circumstances, that Cocked Hat Hill has been the central vent of the more recent eruption, in this neighbourhood. Its appear-

* I have since been successful in obtaining sections which show the pine structure admirably. Although the lignites for the most part are composed of the remains of pine trees, yet the intercalated leaf-beds indicate the existence of a rich and varied vegetation of another class. (See figs. 14 and 15.)

ance, now that the trees have been removed, is not very suggestive of the name, whatever it, once, may have been. Its cone, rising from the centre of the lake, and composed for the most part of unconsolidated tuff would soon yield to that greatest of all levellers—water—and this may account for its present tame and rounded appearance.

Probable Extent of the Lake Basin.

Taking into consideration the existing levels of the plains and valleys, whose water-shed is received by the Tamar, and bearing in mind the great altitude of the highest beds of the system, the waters of this old lake must have covered not less than 600 square miles of what now is the most fertile and cultivated portion of the island of Tasmania. It is also evident that had it not been for the distribution by the waters of the lake of the ejecta of the more recent volcanic eruption, that those plains which are now so fertile, would be most sterile and unproductive.

In support of the opinion that the waters of the lake extended along the great valleys and plains in the direction of Fingal, Ross, Westward Plains, and the Tamar Valley, I may state the following observations.

Stratified beds of the system are found at least 500 feet above the existing beds of the water courses.

In a shaft sunk to a depth of 40 feet, by Mr. Grant, of Tullochgorum, near to his house, he passed through arenacious clays containing lignites identical with those of Breadalbane. Fossil leaves are also found closely resembling those found at Muddy Creek. The same whitish arenacious clays and sands were found to nearly a depth of 100 feet, in a well sunk by Mr. Fincham near to Cleveland. It is evident, therefore, that the extent is not over-estimated, and that there must have been a very slight separation between the borders of the lake and the Derwent Valley.

Denudation.

Another remarkable feature is the amount of denundation of the system that appears to have taken place. Throughout the whole basin, but more especially in the Launceston and Breadalbane districts, the waste in scooping out the existing valleys must have been immense. The level of the swamp at Launceston is at least 500 feet below the stratified drift of the same system in its immediate neighbourhood, and it is no exaggeration to say that 15 to 20 miles of strata 400 to 500 feet thick, have been swept away from the immediate vicinity of Launceston alone.

Relation to Similar or Contemporaneous Deposits.

The irregular upheaval of the coast line at Table Cape must have been local, and occasioned probably by the same forces which erupted the recent lava. Mr. Allport also speaks of the travertin, near Hobart Town, having been altered by recent intrusion in that neighbourhood. Admitting the eruptive forces to be contemporaneous, which is extremely probable, we should be able to classify these respective deposits as belonging to, or rather contemporaneous with the Lower Zone of the Launceston Basin. The resemblance of the leaf impressions in the tavertin, and the nature of the fossil shells at Table Cape, tend to confirm this opinion.

Among the Table Cape shells now in my possession I have noted the following genera :—

Bivalves	*Univalves*
Lima	Murex
Pecten	Conus
Ostrea	Pleurotoma
Pectunculus	Typhis
Cucullea	Siliquaria
Tellina	Natica
Astarte ?	Turritella
Corbula	Trochus
Crassatella	Cerithium
Trigonia	Scalaria
Terebratula	Cypræa
Cardium ?	Ancillaria
Leda	Voluta
Nucula	

Dentalium, Sponges and Corallines, abundant.

In the stratigraphically arranged British fossils, by J. W. Lowry, F.R.G.S., it is interesting to notice how closely the British Eocene fossil shells resemble those of Table Cape ; many species are exactly identical, e.g. Typhis, Nucula, Leda, but yet, the proportion of extinct to living forms will hardly warrant us, in calling the Table Cape Shells *Eocene* unless in the homotaxial sense according to Mr. Huxley.

In conclusion, I may sum up the various points in this communication as follows :—

1st. The association of the fossil pine trees with the *Banksia* and other recent fossil woods, in the original matrix at Corra Lynn, indicates that they belong to about the period during which the Lower Zone beds were deposited, and consequently of comparatively recent date.

2nd. The relations of the lake system with other systems

and deposits may very possibly be according to the following order :—

Launceston Tertiary Basin.	Upper Zone	Deposits of Pig Island, Mt. Stewart, Stevenson's Bend.	
	Middle Zone	Windmill Hill beds. Recent basalt	Travertin Beds, Hobart, and raised beach Table Cape
	Lower Zone	Breadalbane, Cleveland, Fingal, Muddy Creek, arenacious clays, Metamorphosed Claystone. Older basalt.	
Beds of the coal seams of Tasmania.	Mount Nicholas, Ben Lomond. Jerusalem series. Mersey series.		

3rd. The height of the remains of the original strata of the system indicates that the lake must have stretched over a very wide expanse of country in the direction of the lower valleys and plains, and that its extent must have been not less than 600 square miles. The denundation which has taken place subsequently has also been referred to as being very great.

Generally.

The old lake basin carries us back to a time long prior to the recent volcanic period, and is a very important link in the chain connecting us with our Tasmanian coal measures. The Lower Zone, with its many hundred feet of whitish arenacious clays, and intercalated lignites, speak of a time of long continued repose, and of a time sufficiently remote to antedate the present characteristic vegetation of our island.

Certainly we might here and there trace a representative of our existing *Banksia*, and possibly a few near relations to our pines and ferns, but the vegetation fringing the margins of this magnificent expanse of water, would appear very different to that which we are now accustomed to see; and if we may judge from the character and abundance of the leaf remains, the landscape must have presented a scene of wondrous beauty.

Whether those forests ever echoed the "Cooey" of some ancient race of man, or whether the quiet waters of the lake were ever disturbed by some primitive paddle, there is no intelligence. The record of the rocks are as silent as are the voices of that race which, with the exception of a solitary individual, has just passed away.

EXPLANATION OF FOSSIL FIGURES.

No. 1.—Fossil leaf of the cinnamon type; natural size. Locality: Stevenson's Bend.

No. 2.—Section of fossil nut ; natural size. Locality : Stevenson's Bend.

No. 3.—Fossil impression of the pinna. of a fern closely resembling the existing *Lomaria*; natural size. Locality : Stevenson's Bend.

No. 4.—Impression of the inner face of the bark of a fossil *Banksia* ; natural size. Locality : Stevenson's Bend.

Nos. 5 and 6.—Fossil impression of a fern having a close resemblance to the frond of an existing *Trichomanes* or *Adiantum* ; natural size. Locality : Stevenson's Bend.

No. 7.—Fossil impression of a leaf from the stratified *tuff* overlying the *lignites* at Breadalbane ; natural size.

Nos. 8 and 9.—Fossil impressions of leaves from the Lower Zone arenacious clays, Breadalbane, and closely associated with the *lignites* there ; natural size.

No. 10.—Transverse section of a small branch of a fossil *Banksia*, showing the mode in which the medullary rays are arranged ; natural size. Locality: Corra Lynn.

No. 11.—Vertical section of the same magnified 350 diameters, to show the pitted duct.

No. 12.—Transverse section ditto, showing the arrangement of the large porous vessels ; magnified 50 diameters.

No. 13.—Vertical-tangential section, ditto, showing large bundles of medullary rays ; magnified 50 diameters.

No. 14.—Transverse section of an undetermined wood from the *lignites*, Breadalbane ; magnified 50 diameters.

No. 14*a*.—Fossil leaf impression ; natural size. Locality : Stevenson's Bend.

No. 15.—Vertical-tangential section of ditto ; magnified 50 diameters.

No. 16.—Vertical tangential section of a fossil pine ; magnified 50 diameters.

No. 17.—Transverse section of ditto ; magnified 350 diameters.

No. 18.—Vertical section of ditto, showing glandular ducts. magnified 350 diameters. Locality : Longford gravel beds.

No. 19.—Transverse section of an undetermined fossil wood, from the *agglomerates* at Corra Lynn ; magnified 50 diameters.

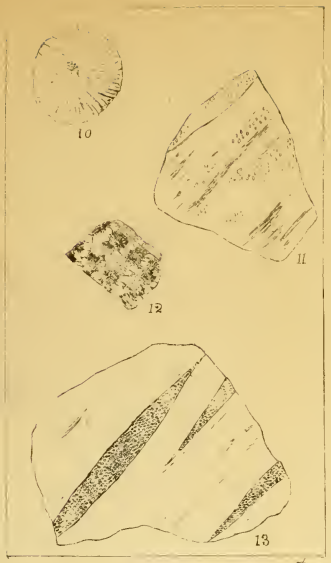
No. 20.—Vertical-tangential section of ditto, showing elongated bundles of medullary rays composed of muriform tissue ; magnified 50 diameters.

Nos. 21 and 22.—Fossil fruit, associated with the *lignites*, Breadalbane ; magnified 2 diameters.

No. 23.—Fossil nut, *grooved*, associated with the fossil pines in stratified tuff or ash, at Fossil Cutting, Breadalbane ; slightly magnified.

No. 24 —Fossil impression of the Cone (?) of a densely imbricated pine ; magnified 2½ diameters. Locality : Stevenson's Bend.

No. 25.—Fossil seed vessel, associated with the *lignites* at Breadalbane ; magnified 2½ diameters.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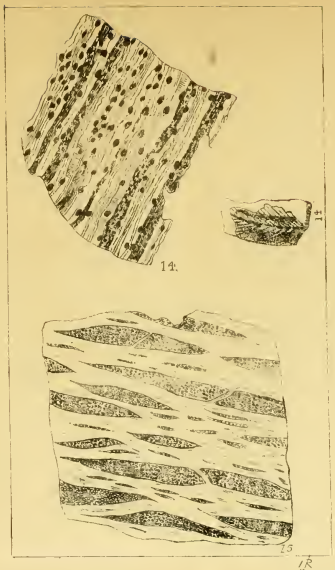
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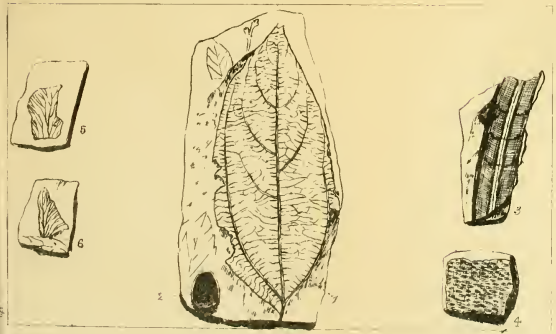
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