A DARWIN MANUSCRIPT ON HOBART TOWN

by

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ABSTRACT
The collection of Darwin's papers in the Library of Cambridge University includes a 22-page manuscript on the Geology of Hobart Town. Consideration of the manuscript suggests that Darwin's collection of fossils described in 'Geological Observations' came from the Bundella Mudstone at Porter Hill, the Cascades Group near Barossa Road, Glenorchy, and the Malbina Formation at Eaglehawk Neck. The manuscript further demonstrates his assiduity and acuteness as a geological observer, and suggests a considerable fund of geological knowledge of Van Diemen's Land in 1836.

INTRODUCTION
During consideration of a manuscript by the late Edith Smith dealing with the fossil polyzoa described by Lonsdale in Darwin's 'Geological Observations' (1844), the question arose as to the most likely places from which Darwin had collected his specimens. In following this up, contact was made with the Librarian, Cambridge University, where Darwin's papers are lodged, and the Librarian made available a microfilm of a manuscript memoir on the geology of Hobart Town. Because of the importance to palaeontological taxonomists of this memorandum in revealing Darwin's collecting spots and because of the additional light it throws on Darwin's activities while in the area as well as on his geological ability, the manuscript has been deciphered and is reproduced here with Darwin's original notations.

I would like to acknowledge the help of the staff of the State Archives, Morris Miller Library at the University of Tasmania, the Under-Librarian of Cambridge University Library, the Curator of the Darwin Collection at Down House, and Miss E. Geddes, Librarian to the Royal Society of Tasmania.

Mr R. F. Wise, British Museum of Natural History, kindly made available fragments of the matrix of some important Tasmanian fossils held therein and rubber moulds of some of these fossils. I would also like to acknowledge helpful criticism from Professor S. W. Carey, Mr D. E. Leaman and my wife.

Memo on Hobart Town by Charles Darwin, transcribed by Maxwell R. & Doris M. Banks. 1836 February Hobart Town 837 (I

In the neighbourhood of Hobart town, two\(^1\) distinct formations occur, both accompanied by rocks of igneous origin, I will begin by the most modern of the two. In this formation the prevalent rock is white, fine grained Sandstone, composed of minute grains of Quartz\(^2\) with a little white cementing matter. Within the town it is associated, with reddish laminated Aluminous Sandstones, other ferruginous ones and some Clay Shales. On a hill close behind the town, there are strata of a very impure Coal, carbonaceous Shale, and while Sandstone banded with the finest lines, stained black, by a similar substance. Here such layers are penetrated (crossed out is 'with all at a high angle and being disturbed') by a great mass or dyke (a hundred yards wide) of a decomposing Greenstone; on one side the strata dip away at an angle of 60\(^\circ\) or 70\(^\circ\) and fragments\(^3\) of Porcelain rock and indurated sandstone, lying in the lines of junction, point out the effect of an igneous mass — on the other side, the confusion is even greater; layers of impure Coal, being now in a nearly vertical position.

Footnotes:
The following comments occur in the margin of the manuscript at the place indicated:

i. 'R.N. p. 120; Granite on E. coast

ii. Examine flints in 'Flo' formation for Infusoria

iii. Dr Scot's paper on Van Diemen's Land


Comments:
A. This probably refers to dolerite dyke which cuts and indurates the Upper Triassic succession between Clare St Oval and Waverley Ave, and is cut by Augusta Road at 516.25 E. 722.55 N. The dimensions of the dyke and the lithology of the intruded rocks fit the description: the tilting of the strata is considerable but the vertical strata mentioned are no longer visible if this is the locality described. Another, less likely, possibility is that it refers to a Tertiary basaltic dyke which intrudes, bakes and disturbs the Triassic sediments which include carbonaceous siltstone at the top of Arthur St, West Hobart, in the eastern abutment of the former Crisp and Gunns Quarry (516.55 E. 720.9 N). However the width of this dyke is only 10 to 20 yards, not a hundred as stated by Darwin.

B. 'R.N.' refers to one of Darwin's notebooks marked on front and back cover. Page 120 contains the pencilled comment 'Bailly talks of much granite on all East side of Van Diemen's Land' (Miss J. Dobson, Curator of Down House, pers. comm.) Bailly was one
of the naturalists with Baudin during his exploration of Van Diemen’s Land in 1802 (Péron 1807).

C. Presumably a reference to a paper by the Rev. Archdeacon T. H. Scott in Annals of Philosophy, Vol. 7, p. 462 for June 1824. This very brief paper commented on the similarity in geology of ‘New Holland’ and ‘Van Diemen’s Land.’ It noted the presence of rocks of the ‘coal formation’ at Hobart and Georgetown, of fossiliferous limestone between Hobart and New Norfolk and near Georgetown, of a rock like ‘the Millstone Grit’ and salt in the Midlands and ‘elevated primitive ridges’ on both sides of the Midlands valleys. 1836 February Hobart town 838 (2) In the Government domain and in other places I saw the Sandstones and Green-stones abutting against each other in straight lines. In all parts of the hill, on which the town stands dykes of Trappan rock and those of aqueous origin alternately appear; and I am doubtful which class is most abundant—the Stratification in some places, as has been shown, is exceedingly disturbed and inclined strata generally are common; in many cases however, this is the result of the manner deposition, as has been described near Sydney, and hence the two classes are not easy to be distinguished. Following the coast down to the South of the town frequent patches of this formation are met with. I found a coarse ferruginous Sandstone containing numerous thin strata of Clay and highly ferruginous matter reposing in layers, inclined apparently from original deposition, on a mass of coarse greenstone; the lower

Footnote:
The following comment was made on the back of page 1—On a yellow substance in Cavities in Trap. Daubrisson vol. 2, p. G 569.

Comments:
D. Such a straight line abutment of dolerite against Triassic sandstone may be seen along the shoreline near the Naval Depot (co-ordinates 519.3 E. 721.8 N to 519.4 E. 721.4 N) and was revealed by the excavations for the Olympic Pool (co-ordinates 519 E. 721.25 N).

E. Dykes of dolerite are common in the Triassic sandstone of the City area (see Lewis 1946, pp. 116, 120; Banks et al. 1965).

F. This probably refers to Tertiary sands and clays resting on dolerite at Battery Point near Quayle Street (519 E. 719.2 N) and steeply tilted near Sayer Crescent (518.9 E. 718.6 N). Dolerite boulder beds were exposed in excavation for blocks of flats at the back of Maryville Esplanade near Sayer Crescent (co-ordinates 518.9 E. 718.55 N) (fig. 1 B). The steeply tilted beds are no longer exposed but were referred to by Johnston (1888, p. 282) and illustrated by him (1888, plate opposite p. 280).

G. Presumably a reference to a book by D’Aubisson de Voisins. ‘Traité de Géonosie’ published in Strasbourg and Paris in 1819. D’Aubisson was one of Werner’s pupils who became a Plutonist (Zittel 1901, p. 61).

1836 Feb. Hobart town 839 (3) parts passed into a Conglomerate, from containing so many pebbles of the under­lying Greenstone and a white flinty rock, bearing peculiar Organic impressions and Sandstone, all which belong to the older formation and will be subsequently mentioned.—Again further onwards, a H coarse Sandstone containing some in­durated clay is covered by some thick­nesses of strata of a white soft aluminosandstone, somewhat like the substance of Huelpiaucy at Chiloé. These are ha'ped by a stratum of basalt, a few feet thick, compact with scarcely even a minute vesicle and abounding with very small crystals of red Olivine 3(7) This is separated from a superior and exactly similar stratum of Basalt by one, which has an irregular outline, contains masses of hard basalt, but is itself partly decom­posed and resembles Wacke.—By tracing its graduations I found this new com­paratively compact substance once to have been Scoria which without doubt divided two distinct streams

Comments:
H. This can refer only to the Tertiary sands and clays overlain by basalt forming parts of a volcanic centre at and just south of the southern end of Long Beach and extending to the point south of Blinking Billy Point (i.e. from 521.25 E. 716.7 N to 521.4 E. 716.4 N) (fig. 1 D); this section was subsequently described and figured by Johnston (1888, pp. 279-81) and intensively studied by Spry (1955).

Footnote:
(i) ‘yellow substance or stains’ in margin at this point.
soft chalk, it is at a little remarkable
that much a substance should be included
between their Pytolic Linie.

On the shore, a few miles south of Hobart
town I found the following varieties. Blackening into
each other or alternating in a white.

3457 rock with grains of quartz; a thin, slight
3458 calcareous, siliceous, compact Clay Slate or a
3459 granitic horn rather often, common Clay Slate.
3460... The white above with impurities; in it
are scattered a very few branded half, fowl
pale yellow, quartz rich thin of a mixture
Clay Slate. — The occurrence of a very few
pebbles in the slate is this formation is
generally common. — Such happen in the
limestone and similar cases. — In the bank
of the Wellington, I noticed except similar
3473 kind of a pale blue coarse harder Clay Slate
(which judge must be called Gneisschale). —
3474 White compact, more lustrous, Alumina;
3475 slate or other similar me white close
grey. On the opposite shore it appears
3466. The section described here and to the end of p. 6 of the manuscript is probably based on the section seen (and not recognised as faulted) during the ascent of Mount Wellington from the south, presumably from the coach road or track to Huonville. On Frankland's map (1839) this road is shown leaving the town near what is now Fitzroy Gardens (517.75 E. 719 N) where it crossed Sandy Bay Rivulet, and passing south of this rivulet to about the junction of Huon Road and Ridgeway Road (513.25 E. 716.25 N) beyond which it skirted the headwaters of Dunns Creek and Browns River (fig. 1 A). Limestone is exposed on the north bank of the rivulet near Turnip Field Road (514 E. 716.8 N) where old, small quarries may still be seen. On the bench north of the rivulet there and above the limestone are scattered blocks of Grange Mudstone which might well be described as 'white Cherty or Flinty rocks'. Further along the old track, near Fern Tree, 'compact hard blue Clay-Slates' may be recognised as the Fern Tree Mudstone and above this the Springs is the Triassic sandstone described as 'The Upper strata'.

J. Darwin, like Flinders (1801) and many other early navigators and naturalists, regarded the great cliffs of columnar dolerite around the Derwent Estuary as volcanic in origin. By many the cliffs were stated as composed of 'basaltics', probably because of the superficial similarity of the columns to basaltic columns as in Auvergne. It is a little surprising that Darwin who must have climbed over the columns of the Organ Pipes to the top of Mt Wellington did not realise that the columns and the greenstone on top of the mountain were one and the same.

K. This is probably close to Cape Raoul which the 'Beagle' would have had to pass in coming up Storm Bay.

1836 Hobart town 841 estuary, the rock is found in platforms, which present to the sea cliffs, composed of magnificent columns.—In one spot I saw white horizontal strata, joining by a great vertical fault to such a mass and at no great distance apparently capped by a larger pile of the same substance. This was near Port Arthur, where a considerable mine of Coal (not of very good quality) is worked in Sandstone. I suppose of course these Carboniferous strata are of the same age, with those at Hobart Town and if so the great Basaltic Platforms and the 2 little streams of lava which I have described, belong likewise to one class of events. This whole formation occurs as a fringe, at the base of older series, around the estuary; it likewise extends inland and partly comprises the lower grounds of the fertile valley of the Derwent. I do not think its elevation exceeds a few hundred ft.—We now come to the older rocks, white aluminous fine grained Sandstone; this rock is subject to weathering and often comprises a considerable thickness of the same Lime- stone strata have been exposed by Quarries.

1836 Hobart town 843 Perhaps the most abundant varieties might be named whitish flinty Slates.—These rocks abound with impressions of Organic remains—the most abundant are those of the smaller stony Corals and of forms like Retepora; I saw a few of these beautifully silicified; there are likewise the casts of numerous Terebratula, and of one imperfect univalve.—At three or four points, several miles distant from each other, a considerable thickness of the same Limestone strata have been exposed by Quarries.

Beyond New Town I found a compact crystalline, blackish brown stone, containing some Terebratula, and a few parts almost composed of a small Oyster; there were the impressions of a Pecten; the curious figures, representing Corallines, are chiefly found in the flinty beds.—The Limestone in parts becomes slaty and impure; it is very remarkable by containing an irregular stratum of unequal thickness of Snow white, soft (so as to be excavated with spade and pick) pure Calcareous substance; it is a

M. The Berriedale Limestone, quarried at Barossa Road, Tolosa Street, Collinsvale, Granton and elsewhere (see also comment on N).

This locality 'Beyond New Town,' combined with the occurrence of travertine ('Snow white, soft ... pure Calcareous substance') between 'strata of hard crystalline Limestone' makes it likely that the area was that at Barossa Road (513.3 E. 724.4 N) where even as late as the 1940s the quarries had just that appearance. The 'flinty beds' occur abundantly in this neighbourhood as Grange Mudstone. A less likely locality is one in the quarries south of the upper part of Tolosa Street (512.2 E. 724.25 N) (fig. 1 C). The only
puzzling feature is the presence of 'a few parts almost composed of a small Oyster' and might refer to a small outcrop of *Eurydesma*—rich limestone on the Glenlusk Road (508.25 E, 728.1 N) which was certainly worked as a source of lime in the early days of the colony as shown by the presence, size and style of the remains of a small kiln nearby. However, this last possibility is not considered very likely as (a) Darwin would probably have referred to this locality as beyond Humphrey’s Rivulet which was already named (Frankland’s map 1839), (b) ‘flinty beds’ are not at all close (see Sutherland 1964 maps), (c) there is no present evidence of travertine there, (d) the *Eurydesma* would hardly be referred to as small, (e) in his published description Darwin referred to this being ‘near New Town’ (1884, p. 155), and (f) on a chart (Dept of Lands, Buckingham Plan 17 A,
dated Nov. 1832) a lime kiln is shown at the Barossa Road locality but nowhere else north of New Town to the limits of the map near Granton.

1836 Hobart town 844 (8 soft chalk; it is not a little remarkable that such a substance should be included between strata of hard crystalline Limestone.—

On the shore, a few miles South of Hobart town I found the following varieties blending into each other and alternating. (i) a white Cherty rock with grains of quartz; a blue slightly calcareous, siliceous compact Clay-Slate and a greenish brown rather softer, coarser Clay-Slate. The whole abounds with impressions; in it are scattered a very few rounded pebbles of pure Quartz, Quartz rock and some of a Micaceous Clay-Slate.—

The occurrence of a very few pebbles in the strata of this formation is generally common.—Such happens in the Limestone and following cases. On the flank of Mount Wellington I noticed amongst similar kinds, first a pale blue coarse speckled clay Slate which perhaps would be called Greywacke), a white compact uneven fracture aluminous stone and another similar one mottled blue and yellow. On the opposite shore to Hobart.

O. There are two possibilities for this locality (i) Porter Hill (521.45 E. 715.7 N) or (ii) south of Blackmans Bay (518 E. 703 N).

At Porter Hill siltstones and thin impure limestones (perhaps 'greenish-brown rather softer, coarser Clay-Slate' and 'blue slightly calcareous, siliceous compact Clay-Slate' . . . 'with impressions') are overlain by relatively unfossiliferous sandstones and siltstones and then by Grange Mudstone (perhaps 'white Cherty rock with grains of Quartz' which occurs as float near the top of the cliffs just behind the shoreline (fig. 1 D).

South of Blackmans Bay the Grange Mudstone outcrops in shore platforms and cliffs and includes 'white cherty rocks' as well as 'blue . . . Clay-Slate.' However the greenish brown rocks in the Grange Mudstone there are very hard and very fine-grained not 'softer' or 'coarser' as stated by Darwin. In addition, the dolerite sills and dykes are so beautifully shown in the cliff sections in this area that an astute observer such as Darwin could hardly have failed to see and comment on them had he visited the locality.

Thus on balance the Porter Hill locality is considered the more likely.

P. From near the Ferry Wharf (522.E. 721.55 N) at Bellereive to the western end of Bellereive Beach (522.5 E. 720.9 N) are shore platforms and low cliffs of Fern-tree Mudstone with the characters of the rocks described from the 'opposite shore to Hobart town:' Spiriferids (all brachiopods seem to have been referred to by Darwin as 'Terebratula') and pebbles are present but rare. The joints project upwards as noted by Darwin (footnote on p. 9).

1836 Hobart town 845 (9 town, there are white strata and an excessively fine-grained aluminous Sandstone (?) with an uneven fracture, which in parts becomes more sandy in other passes into a Porcelain rock with conchoidal fracture; the whole series graduates into an underlying blue stone partaking of the characters of Clay Slate.—In both are found rarely casts of Terebratula and pebbles.—(a) Near New Norfolk a similar white stone, passes into a very hard brittle s . . . ons one with straight fracture—whose grains of quartz are blended and almost dissolved in a siliceous paste.

Here pebbles of pure quartz were more frequent than elsewhere. Mr. Frankland, the Surveyor-General, gave me specimens of the white Alumina stone, abounding with impressions of Shells from the Huon River and likewise, a blackish Limestone almost composed of parts of Bivalves from the island of Maria.—(B) We thus see this formation extends over the whole SE extremity of Van Diemen's land.—

With respect to its connection with the first formation.

Footnote:
(a) and (B) appear in the margin at the places indicated and refer to the following notes which appear on the back of page 9.

(a) also all the strata are crossed by fissures the sides of which are penetrated with ferruginous matter, so as, from being harder, to project upwards.—

(B) I have also Terebratula from the neck of the Peninsula (where the gords is kept) of the penal Settlement (3630:31:32). T Q. There are too many outcrops meeting this description near New Norfolk to allow specification of a locality. However it is likely that the coach on which Darwin travelled to and from New Norfolk (Barlow 1933, p. 389) stopped at the Black Snake Inn near the present western end of the Bridgewater Causeway.

At this locality Ferntree Mudstone occurs which meets the description.

R. There is insufficient detail given to allow recognition of a locality or formation.

S. This reference is certainly to the Darlington Limestone from the cliffs and shore platforms north of Darlington, Maria Island. This limestone has long been known for its richness in Eurydema (see also comments H1). T

T. 'The neck of the Peninsula' is Eaglehawk Neck and 'Terebratula' again refers to spiriferids which are fairly common in the cliffs and shore platforms from Clydes Island (incorrectly called Nuroo Island by Banks and Williams 1965) to the Blowhole. These specimens almost certainly formed the basis of Sowerby's description of Spirifera australis in Darwin's 'Geological Observations . . .' and probably also of Spirifera australis in the same publication.'
This locality is a little difficult to identify with certainty. A hill is probably Flagstaff Hill (523.7 E. 726.1 N) on which Ferntree Mudstone ('bluish siliceous-Aluminous stones . . .') outcrops almost to the top on the eastern side. The top is occupied by dolerite ('Greenstone'), part of a wide dyke forming most of the western face of the hill.

W. See comment L. Darwin did not see the faults which greatly disturb the section between Hobart and the summit of Mt Wellington (see Banks et al. 1965).

1836 Hobart town 849 (12) perhaps this height nearly expresses the thickness of this formation.—All the Greenstone which crowns this mountain is of a very uniform character; it is rather coarse and contains (i) crystals of Hornblende; one side of the summit shows (ii) a large columnar structure; generally there is a large accumulation of immense loose fragments.—I have as yet only mentioned the Trappean rocks incidentally, sometimes belonging to the first and more modern, others to the second series of strata. From my limited observations I have not been able to ascertain any difference in these Trappean rocks of two ages.—Indiscriminately over the country, we find ordinary Greenstone graduating into a granular kind which assumes a Syenitic appearance. These probably belong to the older set, and are generally found in the higher hills; there are however numberless exceptions; on the coast some miles South of the town, there is a continued mass of a Greenstone composed of . . .

(i) 'A yellow cryst.' is written in the margin at this point.

(ii) 'Heavy' is written in the margin at this point.

X. It is interesting to see that Darwin recognised that most of the higher hills were capped by dolerite. His 'granular kind which assumes a Syenitic appearance' refers to the coarser grained varieties (and perhaps pegmatitic or granophytic differentiates) which are widespread. Professor Carey points out (pers. comm.) that in places (on sea shores) weathering causes the dolerite to become paler and this may be the origin of the 'syenitic appearance.' I have examined the pale weathered dolerite and the colour is due to the fact that within the zone of wave washing or splash the feldspar weathers to clay, thus changing from transparent or translucent to white and chalky looking, before the ferromagnesian minerals oxidise and hydrolyse to red iron hydroxides. Where the feldspar is translucent, the rock is dark but where the feldspar is chalky, the rock is mottled and looks syenitic.

Y. This is most likely to refer to the dolerite between Porter Hill and Cartwright Point (521.4 E. 714.4 N) where schlieren and masses of pegmatitic feldspar-rich dolerite occur. Somewhat similar rocks occur at Crayfish Point (520.9 E. 712.2 N) and at the western end of Taroona Beach (520.3 E. 711.9 N) but it is unlikely that Darwin travelled down the coast as far as Crayfish
Point or he would have seen and commented on the unusual boulder beds between Cartwright and Crayfish Points.

1836 Hobart Town 849 (13) numerous Crystals of Feldspar and Hornblende (and Mica?) mingled in patches with a compact Feldspar. This rock in mass, had the aspect of a Granite. These Trappian formations (including in that same ancient Lava streams) prevail most extensively over the whole Island.—I hear everywhere of cascades of Columns and detached conical hills—The summit of Mount Wellington is broad, level and of considerable extent; looking to the W. and N.W. numberless mountains of the same form and height are seen; some in almost to unite into an elevated central plateau.

I may here mention some facts obligingly communicated to me by Mr Frankland, which will give a general outline of the Geology of the Island.—The central mountains which occupy a large space; and of which Mount Wellington may be considered as the termination in one direction entirely consists of Greenstone.—On their Northern

Z. This comment is an interesting, unpublished fore­runner of Davies’ recognition of the ‘Higher Plateau Surface’ (Davies 1959), hinted at also in Darwin’s diary (Barlow 1933, p. 389).

1836 Hobart town 850 (14) boundary (20 to 30 miles SW of Launceston) there is an extensive formation of Limestone, Conglomerate, and Clay. Slate.—From Quamby Bluff I have specimens of this latter rock marked with impressions of the Corallines and Terebratulate, so frequently mentioned.—Hence there can be little doubt concerning the age of the clay. Slate: and when we consider the height of the Flinty Slate and Limestone beds, containing pebbles near Hobart town; it is highly probable that the whole formation of the North belongs to the same one of which the SE extremity is composed. We shall thus see one continuous series sweeping around the central nucleus of Greenstone.—On the NE coast Granite is extensively found; and on the opposite extremity, the SW, there is a great formation of white Quartz; so conspicuous is this from its brilliant appearance, that Navigators noticing it from a distance, have thought it to be Snow.—The level district at the sources of the Derwent and Tamar

BB. The conjunction of ‘level district,’ ‘silicified wood,’ ‘beds of agate pebbles’ and ‘salt’ indicate that this area is between Antill Ponds and about Conara, perhaps especially between Tunbridge and Ross.

1836 Hobart town 851 (15) are remarkable by the large quantities of silicified wood found there; in the same district are found beds of Agate pebbles. Salt likewise is procured from some ponds which periodically in the dry season leave an incrustation of this substance. Perhaps these latter circumstances indicate another and distinct formation.—Within the outskirts of Hobart town, there is a Quarry in Limestone, which I have delayed mentioning because I am entirely ignorant in which class it ought to be arranged. The limestone is of a pale yellow colour, not very compact, of a minute Crystalline structure; its strata are inclined at an angle of 45°. It is everywhere traversed by a very small linear cavities, which resemble those found in some Freshwater Limestones, to which stones this bears much resemblance.—Contains occasional layers and nodules of ordinary flint and still more occasionally a few small pebbles.—Those which I saw were about twice as large as beans, and consisted of pure Quartz and Quartz rock.—Some of

CC This fuller description of the ‘Travertine with extinct plants’ referred to by Darwin in ‘Geological Observations’, shows that this could not be the Geilston Travertine as thought by Johnston (1888, p. 286) on the basis of the shorter published description. The locality, topography, lithology and structure are all wrong if the Geilston Travertine is being considered but the locality and topography and to some extent the lithology suggest that it was the quarry in upper Burnett Street which supplied lime to Shoobridge’s limekiln (Johnston 1888, pp. 248, 286). This quarry appears in a painting of Hobart Town by Surveyor-General G. W. Evans dated 1828 and published as a print by R. Ackerman of London (copy of print in collection of Dr C. Craig, Launceston, ‘The Aquatint of Hobart Town 1828’, Craig 1964, p. 34). The painting shows the quarry in about the position of the western end of Burnett Street with a building nearby to the north-west. The quarry site is shown on a chart in the archives of the Department of Lands (Plan of Lime Kiln Reserve, James Combis, 1863) and was in the area bounded by Arthur, Browne, Lochner and Hamilton Streets and is now partly occupied by a reserve. The kiln is shown in the trapezoidal block bounded by Mary, Burnett, Arthur and Murray Streets.

1836 Hobart town 852 (16) the lower strata, abound with distinct impressions of various leaves, which are said to differ from those now existing.—Very many Shells have been found.—The Limestone is covered by a mass of Alluvium, several feet thick, of rather singular nature. Fragments of some Trappian rock, by their decomposition, now appear
as balls imbedded in a Wacke; the interstices however and in parts, masses, consist of a quite white soft Calcareous-Aluminous powder. — This resembles a substance which was found under very similar circumstances at St Jago in Chili. This singular mixture of rubbish has also filled up a vertical fissure after the manner of a dyke in the Limestone, DD and until I found in it a rounded pebble, I was uncertain of its nature. — I suppose, the Limestone, after the displacement of its strata, but yet whilst beneath the Water, bearing line in solution, was covered, by some subterraneean violence with the fragments of Volcanic rocks. — This kind of Limestone has only been found on the side of a small hill; as from the purity

DD. Probably the first record of a Neptunian dyke from Australia.

1836 Hobart town 853 (17 of the Lime, which is produced\(^1\)) from it it is an object of value, it has been searched for with some care. — It is probable that this very limited formation was deposited either in a lake or small creek; the nature of the pebbles would lead me to class it with the other formation; but on the other hand its unconsolidated nature and the impressions of leaves connect it with the more modern series. I now come to a subject which I have so frequently discussed in my Geological Memoranda; viz recent movements in the level of the land. On both sides of the Bay and along nearly the whole line of coast broken shells are found on the land to the height of 30 to 40 ft in quantities which render it rather difficult to believe they have all been carried there by the Aborigines. Amongst these shells are found many rounded pebbles and individuals too small to be brought for purpose of eating; the coast moreover in a few places, by its outline, obscurely shows a small

(i) 'Examine for bones' is written obliquely across the top of the line here

1836 Hobart town 854 (18 vertical retreat; on the other hand, much of the shells appear collected in heaps, in which instruments of the Natives have been found and hence clearly bespeak their origin. — In Ralph Bay, Mr Frankland, who accompanied me in these excursions, and myself, found a beach from 12 to 15 ft above present high water mark, and covered with vegetation, many of the pebbles in which were coated with Serpulae. This instance is of no value, because the creek is only separated from a larger expanse of water by a low strip of land, which the tides might have heaped up, and before this had happened, a higher surf might have thrown up the beach. — Again on the banks of the Derwent River where the water is fresh or so brackish that marine shells will not live even for some miles lower down, the same layers of shells, intermingled with masses of shingle are found on the banks, elevated from 6 to 10 ft above the present highest tides. When the bay was less filled with the

Footnote:
The following notes appear on the reverse of p. 18.
(a) N.B.: That changes are still in progress in this little cove is certain from the fact that oysters which two years previously were abundant, have entirely ceased to exist.
(b) I may mention also that some of the little side valleys have that peculiar flat-bottomed structure which indicate that they formerly were occupied by the water as small coves

EE. There appears to be a page missing here.

1836 Hobart town 855 (20 Australian caves. — Mr Frankland has determined to investigate this subject and likewise the recent rise of the land; there can be little doubt he will make some interesting discoveries. Before concluding I will give a summary of the history of the formations; but, when it is considered that this Island nearly equals Ireland in extent it will be manifest what a shadowy outline such must be. At a very early period the great Quartz formation in the SW extremity probably existed as one or more islands; as likewise concluding the Granite of the NE\(^2\). — In the surrounding or intervening ocean, thick mass of strata were accumulated, which compose the second series; Hence we have the pebbles of pure quartz and Quartz rock. —

In this sea Corallines abounded, and amongst them numerous Terebratula and beds of oysters. — During this epoch, the subterraneean forces propelled upwards large masses of Greensenstone; this propulsion appears to have taken place

Footnote:
The following appears on the reverse of p. 20.
(a) for some other rocks v. Lesson's Zoologie FF
FF. R. P. Lesson was naturalist on the French survey ship La Coquille which visited Australia in the period 1822-1825. The ship did not visit Hobart but while in Sydney (Jan. 17-Mar. 22, 1824) the naturalist procured about 30 specimens of rocks from Van Diemen's Land: pegmatites, rocks of a tertiary terrain, spirifers, serpentines, asbestos, an intermediate (?transition) 'limestone' (Duperrey 1830, Zool. II, p. 144).

1836 Hobart town 856 (21 in mass, and as the superincumbent strata are not much displaced, without much partial violence. — In this state we either
have an Archipelago crowded with Islands or a land deeply indented by arms of the Sea; in such spaces our first or most modern formation was deposited from the wear and tear of the older(a).—During this period igneous rocks were both poured out as Lava streams and injected masses violently ruptured the strata. We believe lastly the land attained its present position after some considerable oscillations of level.—

In attempting to compare the Geology of this country with that of the Colony of New South Wales, a considerable resemblance may be observed in the Carboniferous series, which in both places forms the upper formation. At the distance of 600 (Geograph.) miles it appears very doubtful how much confidence may be given to such resemblances in ascertaining their coeval origin. I think

Footnote:

On the reverse of p. 21.

(a) I should observe in such newer patches of strata, many probably belong to rather distant periods of time but its first rough classification they come into the formation.—

and also

'Macc. Class of Rocks p. 471 on Hypersthene appearing at passage (?) from greenstone to syenite. GG GG. Probably a reference to a publication by John Macculloch, the Scottish mineralogist and geologist, 'A Geological Classification of Rocks, with Descriptive Synopses, comprising the Elements of Practical Geology, London 1821.

1836 Hobart town 857 (22 however it is not improbable, that on an extended examination, a considerable degree of parallelism in the formations of the two countries would be discovered. The Limestones of Argyle with Organic remains, might correspond with the second series of this place, and the Quartziferous Granites of Australia, with the Quartz rock of Van Diemen's land.—On first examining the country, from the preponderance of Trappian and ancient Volcanic rock I was struck with the resemblance of it to New Zealand. There also I believed there were two distinct formations; the older containing Limestones and Cherty beds, and the more modern Lignites and Sandstones.—

With respect to the absolute age of the second series of this place, I fear the fossils are far too scanty even to offer a conjecture. The subject remains a field open to the examination of the rising Geologists of Tasmania.—

Footnote:

On the reverse of p. 22.

May 25, 1836, Memoir of Van Diemen's Land, of Mr Frankland

HH. This refers to a paper by Frankland on Maria Island (Proc. Geol. Soc. 1836, ii, p. 415), read on May 25, 1836.

The microfilm on which this transcription is based was supplied by The Librarian, Cambridge University and was marked Darwins Ms, 38 (1) ff 837-857; original pages of ms. about 8.1" × 10". Pages are numbered 1 to 22 (19 is missing) in Darwin's script; numbers 837-857 are not in Darwin's script.

A Catalogue of Darwin's Specimens from Tasmania compiled from his manuscript.

For this purpose it is assumed that the numbers in the margins of the manuscript refer to specimen numbers collected at the sites mentioned or of the rocks etc. mentioned in the immediately subjacent text. The numbers are in Darwin's script. Quotes from Darwin's text are in italics.

3445 greenstone (dolerite); coast south of Hobart town (Half Moon Bay, Lower Sandy Bay 521.4 E. 716.3 N) (see Spry 1955)

3447 fine grained aluminous sandstone (Ferntree Mudstone); opposite shore to Hobart town (Bellerive-Kangaroo Bluff foreshore)

3448 Porcelain rock with conchooidal fracture (Ferntree Mudstone); locality as 3447

3449 bluish siliceous-Aluminous stones (probably Ferntree Mudstone); opposite side of the water to Hobart town (near Bellerive, possibly Flagstaff Hill, Gordons Hill or Grasstree Hill)

3450 white ones (stones) of a similar nature (to 3449) (probably Ferntree Mudstone); locality as 3449

3451, 53, 54 ferruginous greenstone (p. 11 of manuscript) (dolerite or weathered dolerite); locality as 3449

3455 greenstone (dolerite, perhaps pegmatic or granophyric); on the coast some miles south of the town (possibly Porter Hill (521.52 E. 715.55 N) to Cartwright Point or Crayfish Point, Taroona)

3456 greenstone (dolerite); locality uncertain

3457 white cherty rock . . . with impressions (? Grange Mudstone or top of Bundella Mudstone); shore a few miles south of Hobart (Porter Hill or cliffs south of Blackmans Bay)

3458 blue slightly calcareous siliceous compact Clay-Slate . . . with impressions (Bundella Mudstone); locality as 3457 (must be Porter Hill)

3459 greenish brown rather softer, coarser Clay-Slate with impressions (Bundella Mudstone); locality as 3457, 8

3460-65 impressions from area of 3457-59 (fossils as moulds); locality as 3458

3466 sandstone (Springs Sandstone); (Locality not certain, could be Mt Wellington; see p. 6 of ms.)

3467 basalt with red olivine (?) (basalt with olivine altered to iddingsite); coast south of the town (Long Beach, Sandy Bay; see Spry 1955)
Darwin’s rock collection from Tasmania is now housed in the Department of Mineralogy and Petrology, University of Cambridge (T. G. Vallance, pers. comm., July 5, 1970).

**DARWIN'S ACTIVITIES IN HOBART**

An exasperated and rather homesick young man of almost 27 wrote to his sister, Susan Darwin, from Sydney, on 28th January 1836, ‘From Hobart town being superadded to the list of places...’ (Barlow 1945, p. 133). It may be deduced that Darwin was not aware that the ‘Beagle’ had been originally scheduled to visit Tasmania depending on the season (Narrative, 2, p. 33; instructions to FitzRoy) and one may suspect that this part of the itinerary became known to him only in Sydney. Thus, during the evening of Friday, 5th February 1836, a blustery wet day (Narrative, 2, p. 624), Charles Darwin reached Hobart, where he wrote to the ‘Beagle’ (Narrative of the Surveying Voyages of H.M.S. Adventure and Beagle, vol. III, p. 532). Darwin records in his narrative that he walked around the streets of Hobart during the morning of the sixth (ibid, vol. III, p. 532) and subsequently made ‘several pleasant little excursions.’ From the Narrative and his diary (Barlow 1933, pp. 388-9) it is clear that one of these was to what is now Bellerive which he reached by steam boat. During the interval Feb. 7 to Feb. 10 he not only visited Bellerive but also made two attempts to climb Mt Wellington. The first attempt was foiled by ‘... the thickness of the wood,’ and the second, though successful, was rather strenuous as the guide ‘was a stupid fellow, and conducted us to the damp southern side of the mountain.’ From the summit he noticed ‘to northward... wooded mountains of about the same elevation and tamer outline as the one on which we stood.’ (Barlow 1933). Between the 12th and the 15th he went riding (‘several pleasant rides’) with Mr Frankland, the Surveyor-General, one of these being to Ralph’s Bay (Geological Observations...,’ p. 141). From ‘Geological Observations...’ it may be further deduced that he visited limestone quarries ‘near New Town,’ revealed by this new memorandum to be most probably the quarries at the northern end of Barossa Road. It is also confidently deducible (‘Geological Observations...’ p. 139) that he examined the volcanic centre just south of Long Beach, Sandy Bay. The new memorandum casts further light on his ‘pleasant little excursions.’ His ‘long walk on the side of the bay opposite the town’ almost certainly included an ascent of Flagstaff Hill. He seems likely to have seen the dolerite dyke now cut by Augusta Road near Waverley Ave (memorandum, p. 1), Note A). His ‘excursion’ along the shore of the town took in the Tertiary sediments behind what is now Maryville Esplanade, at that time probably a sandy beach backed by cliffs of Tertiary, and extended to Long Beach, to Porter Hill where he collected Permian fossils, and probably beyond this to Cartwright’s Point, near which he saw the dolerite which ‘had the aspect of a granite.’ (memo, p. 13). He also visited the lime quarry in Burnett Street (see comment CC). In his diary he noted that on 16th February ‘the weather was cloudy and prolonged the stay beyond what was expected.’ The cloudiness prevented observations of the sun and calculation of the latitude and longitude therefrom involving the use of the many chronometers carried by the ‘Beagle’. As such observations were a critical part of the ship’s task in circumnavigating the globe, the ship stayed in port until such observations could be made. On 16th February, Darwin went by stage coach to New Norfolk, probably taking the opportunity to collect a specimen when the coach stopped at the inn at Black Snake Gully. Taking all these statements and deductions about his activities together, about eight of the 11 complete days spent in Hobart Town can be accounted for: Bellerive 1 day; Ralphs Bay 1 day; Hobart 3 days; Bellerive 1 day; Ralphs Bay 1 day; Barossa Road 1 day; New Norfolk 1 day; Sandy Bay at least 1 day; Burnett...
Street quarry 1 day). As at least two of the 11 days were sabbaths, and likely to be observed as days of rest and letter writing (see below re letter to Katherine) almost all his time in Hobart can be accounted for. The 'Beagle' sailed from Hobart on 17th February, having been 11 days in port (Darwin in the Narrative, p. 534, apparently erroneously gave the figure as 10 days).

Darwin wrote in his journal (pp. 532, 533, 536), first aspect of the place (Hobart) ... very inferior to that of Sydney ... latter a city this only a town . . . streets fine and broad . . . shops appeared good . . . Mount Wellington of little picturesque beauty . . . if I emigrate choose this rather than Sydney . . . climate and aspect of country . . . society on a pleasanter footing . . . free from contamination of rich convicts . . . colony appeared well-governed . . . streets at night more orderly than those of an English town.' It is also clear from a letter Darwin wrote to his sister Katherine 14.2.1836) (Barlow 1945, p. 135) that he preferred Hobart to Sydney—'all on board like this place better than Sydney.' The reasons given suggest some homesickness—' . . . the Gardens . . . delightfully resemble England . . . and a liking for the society—the pleasant society there is here.' Some of that society Darwin met when he dined at the Attorneys-General (Mr Alfred Stephen, later Chief Justice of New South Wales) on the 13th February, the day after his twenty-seventh birthday (Barlow 1945, p. 135). Between the 12th and 15th February Darwin, having been introduced to George Frankland, 'was much in his society' and 'passed at his house the most agreeable evenings since leaving England.' (Barlow 1933, p. 389). His impressions seem to have been, on the whole, favourable.

The visit of the 'Beagle' received scant attention in the local press, the main interest being to try to get the ship to send a party to survey the Actaeon Rocks on which a vessel, not the first to do so, had recently run aground.

**DATING THE MEMORANDUM**

It is likely that the memorandum was written before the preparation of the journal of researches published in 1839 as no geological ages based on the fossils collected are given in the memo but some ages are given in the journal. It is probable that it was written at sea (i.e. before Oct. 2, 1836) before Darwin was able to refer to any of the more recently published works on fossils. The reference on the back of p. 22 to the memo by Frankland on Maria Island would have had to be added after Darwin reached England.

**THE SIGNIFICANCE OF THE MEMORANDUM TO TAXONOMIC PALAEOENTHOLOGISTS**

Although not stated in the memorandum, it is very likely that the numbers in the margins refer to specimens he collected, and this gains further credence from the existence in the British Museum of Natural History of a specimen with '498' on it in Darwin's script and from Tasmania. He tested some material from the volcanic rocks at Sandy Bay with a blowpipe but this could have been done in situ or on the ship rather than in England as he had a blowpipe with him (de Beer 1963, p. 34). As shown in the catalogue herewith, compiled from his numbers, he collected Permian fossils from the Porter Hill area and the area near the quarries at the northern end of Barossa Road, and was given Permian fossils from Quamby Bluff, Eaglehawk Neck and the Huon. He collected Tertiary plants at Burnett Street and was given pieces of silicified wood from the Ross-Tunbridge area.

In the memo, Darwin refers infrequently to fossils by name. Smaller stony corals (Stenoporá) forms like _Retepora_ (fenestellids) and _Terebratula_ (this term was used for all brachiopods) abound in 'whitish flinty Slates' (probably Grange Mudstone) (memo. p. 7) but no specimen numbers are given and if the inference made (comment L) that he saw these near the Turnip Fields during ascent of or descent from Mount Wellington is correct, it is perhaps not surprising that he did not collect any, being wise about not carrying extra weight up the mountain and being too exhausted or too late on the way down to worry about collecting specimens. They did not reach the ship till 8 o'clock 'after a severe day's work' (J. Res. 1839, p. 536). Near Barossa Road quarry he reported (memo. p. 7) _Terebratula_, a small oyster, _Pecten_ and corallines and apparently collected five specimens. He also apparently collected six specimens of 'impressions' from the Porter Hill area (memo p. 8). He noted _Terebratula_, from Bell rivere but did not collect any and included donated specimens of _Terebratula_ from Quamby Bluff and Eaglehawk Neck and corallines (Stenoporá) from Quamby Bluff in his collections.

Subsequent work by Sowerby reported in 'Geological Observations' (pp. 158-160) led to replacement of the term _Terebratula_ by the terms 'Producta' and 'Spirifer' and Lonsdale (ibid, pp. 161, 169) named the 'corallines' Stenoporá, and the _Retepora_ Fenestella. Three specimens of _Producta brachythae arus_ are quoted by Sowerby; one, the only one of which he was certain, in grey limestone (presumably Berriedale Limestone from Barossa Road where _T. brachythae arus_ (Morris) is common); another, an internal mould of the brachial valve, in a 'light rusty-brown' stone; and a third, an internal mould of the pedicle valve, in a 'nearly similar stone.' Of these only the second is extant and recognizable in the _B.M.N.H_. (B.M. 19298) and is _Strophalosia_ (Hill 1950, p. 19). Hill (1950, p. 19) noted that it bears the printed number '498' in the type of script used by Darwin. In this case, assuming that the label has not been displaced, the specimen is one of those given to Darwin by Frankland from the Huon. I have seen the specimen in the British Museum and it is an internal mould with a ferruginous coating and the block also contains a _Neo spir?rer sp._, _Stenopora_, ostracodes and productid spines. My diagnosis of its locale at the time (1956) was that it most probably came from the Rayner Sandstone which outcrops above the Channel Highway at Porter Hill, but similar rocks occur in the Huon area, e.g. near Cygnet. The brachial valve most resembles that of _S. jukesii_ which occurs in the Cascades Group near Hobart, and its correlates elsewhere. By the courtesy of the _B.M.N.H_. I have been able to obtain pieces of the matrix and rubber casts of the _Strophalosia_ and associated fossils. These show that the matrix consists of finely mottled pink and white siltstone with angular sand-grade clasts of quartz and larger clasts of (?) chalcedonic schist and moulds.
of fossils, mainly polyclava, coated with limonitic encrustation. Comparison with specimens of Rayner Sandstone from Porter Hill suggest that the provenance was elsewhere. The larger casts show the presence of a ramose Stenopora and Peurispira allandiensis Fletcher.

The specimen on which the diagnosis of Spirifer subradiata Sowery is based was apparently the original shell of a brachiopod valve. This is most likely to have come from the Barossa Road area, based on the range of this species in Tasmania and mode of preservation, but an origin from Eaglehawk Neck is not impossible. The provenance of the specimens of Spirifer trapezoidalis Sowery is not clear although the description of the matrix a 'dark, rusty, grey limestone' suggests some of the limestone within or the Bundella Mudstone on the shoreline at Porter Hill. No light is cast on the provenance of Spirifer pau­ cicoostata Sowery but the internal moulds on which Spirifer vesperilio and S. avicula were based almost certainly came from Eaglehawk Neck where such moulds are common in the Malbina Formation. A specimen, B10858, in the B.M.N.H. is recorded as 'said to be Spirifer vesperilio. . . . Charles Darwin collection.' The specimen, a medium-grey siltstone, contains external moulds of both the normal (Strzelecki 1845, pl. XVII, f. 1) and short variety (ibid, pl. XVII, f. 3), the former referred to as Suleipica transversa by Waterhouse (1968, p. 27), the latter as Licharewa phalaena (ibid, p. 24) associated with Angelarella angulata Campbell and crinoid columnals in a matrix characteristic of the Malbina Formation. The lithology and associated fossils taken in conjunction with Darwin's memo strongly suggest an origin from Eaglehawk Neck. No extant internal moulds assignable to Darwin's collection are known.

The origin of the polyzoa described by Lonsdale from Darwin's collection can also be ascertained with some confidence as a result of access to this memo. Stenopora tasmaniensis is embedded in a 'coarse calcareous shale, or a grey limestone' (Geological Observations . . . , p. 162), and is associated with Fenestella internata which also occurs in a 'coarse grey calcareous shale, . . . splintery limestone . . . hard-ferruginous or light-coloured claystone' (ibid, p. 166). This association of fossils and rock types is best met in the limestones and siltstones of the Bundella Mudstone at Porter Hill, and, before the existence of Darwin's memo was known, the late Edith Smith had chosen this area on the basis of the associations as the locality from which neotypes should be set up. Not only are these fossils abundant at Porter Hill, but so also is Fenestella ampla; Fenestella fossula also occurs there. The matrix of F. ampla as noted by Lonsdale ('Geological Observations', p. 165) can also be matched at Porter Hill. This leaves only S. ovata and Hemitrypa sexangula of those species described by Lonsdale unlocated, but Lonsdale's description of the matrix leaves no doubt that Porter Hill was the site. Stenopora ovata occurs there but is less common than S. tasmaniensis at that locality. H. sexangula has not been recognised subsequently. Strzelecki also collected Permian fossils from Tasmania, which were described and illustrated by Lonsdale (polyzoa) and Morris (molluscs and brachiopods). These included a Stenopora ovata from Norfolk Plains (B.M.N.H. PD 4604), and Stenopora informis (B.M.N.H. PD 4605). Lonsdale took this opportunity to figure some of Darwin's specimens as, Hemitrypa sexangula, F. fossula and F. ampla (Strzelecki, pl. ix. f. 4a, 1a, 3) were stated to be from Darwin's collection (Strzelecki 1844, p. xvii). Morris also figured some Darwin material, e.g. Spirifer tasmaniensis Morris var. (Strzelecki, pl. xiv. f. 4). Morris further stated (ibid, p. 280) that he had seen Darwin's specimens assigned to Spirifer rotundatus and Spirifer trapezoidalis var. by Sowery and he grouped them as Spirifer tasmaniensis.

Of the species based on Darwin's collections, specimens of only two are now available (Productus brachythaea, B.M.N.H. B 19298, which is a Strophulosis, and Spirifer vespertilio, B.M.N.H. B 10858). A neotype has been established by Crockford (1941) for F. fossula from near the top of the Cascades Group on Huon Road not far from the Turnip Fields and a specimen (B.M.N.H. PD 4603-5) exists of Stenopora ovata which was used and figured by Lonsdale in his work of Strzelecki's collection. It does not, however, come from the type area as deducible from Darwin's published and unpublished work.

Maxwell (1956) successfully suggested suppression of Haplochitoninae Sowery (G.B.) 1844 in favour of P. brachythaeus Morris 1845 which then becomes the type of Terrakea Booker 1930, the type specimen of which was designated as B.M.N.H. BB 9466 from Illawarra. We thus now have the interesting situation that Terrakea brachythaeus (Morris) occurs in the likely type area for P. brachythaeus Sowery.

Establishment of neotypes, where necessary, should be based on specimens from the Barossa Road area for Spirifer subradiata, at Eaglehawk Neck for S. avicula and from Porter Hill for the polyzoans, as suggested by the late Edith Smith in her manuscript on fossil polyclava.

DARWIN'S CONTRIBUTION

Darwin recognised 'two distinct formations' near Hobart and a third further afield. The younger of the two 'formations' near Hobart contained rocks now known to be Triassic (memo p. 1 and top of p. 2) as well as Tertiary rocks (memo bottom of p. 2 and p. 3). He correctly (memo p. 5) correlated the coal-bearing Upper Triassic rocks of the Saltwater River area near Port Arthur with those of New Town. Some of the 'disturbances' in the Triassic on the Domain were correctly identified as cross-bedding.

The older 'formation' had 'hard sandstone' at the top (memo p. 6) which is now known to be Triassic and correlatable with the sandstones of Knocklofty and the Domain. Darwin himself almost made this correlation (central part of memo p. 6). The rock types beneath this sandstone, now regarded as Permian, were recognisably described by Darwin who also placed them in approximately correct superpositional order. He did not display any extraordinary virtuosity in noticing the great variety of fossils in the Permian rocks but perhaps this is not unexpected as he had only a hand lens and a simple microscope (up to about × 30; made by Bancks & Son, 119 New Bond Street; J. Dobson pers. comm.) with him and the state of palaeontology at the time was such that discrimination of the great variety of fossil forms was just beginning (the name 'palaeontology')
was used for the first time only in 1834 (Zittel 1901, p. 363) and it is doubtful if Darwin saw it before he reached England late in 1836. One might be amazed that a biologist and palaeontologist as good as Darwin could not provide better names than 'corallines,' 'Retepora,' 'Terebratula,' 'Pecten,' 'oysters' for the abundant Permian invertebrates he must have seen. However, it was only two years before Darwin left England in the 'Beagle' that the Polyzoa were recognised as fundamentally different from corals. As late as 1818 Lamark recognised only three brachiopod genera, Orbicula, Terebratula and Lingula, and it was only in 1834, two years after Darwin left England, that von Buch published the first significant treatise on brachiopods (Zittel 1901, pp. 397, 399). Darwin did use the fossils and rock types to correlate correctly Permian rocks at Quamby Bluff with those at Hobart and elsewhere in south-eastern Tasmania.

He used the pebbles of Permian fossiliferous mudstone and Jurassic dolerite in the Tertiary beds at Sandy Bay to infer the correct order of deposition of his 'modern' and 'older' formations. The pebbles in the Permian he also used correctly to suggest the presence of older formations including the Precambrian quartzites with quartz veins in south-western Tasmania (memo p. 10, p. 20). Darwin noted (in his notebook marked 'R.N.', on p. 21; a zero of which was kindly made available by Miss Dobson, Curator of the Darwin Collection) 'There is a resemblance at Hobart-Town between the older strata and the bottom of the sea near T. del Fiego.' In 'Observations on South America' Darwin commented (Darwin 1846) on the occurrence of pebbles on the sea-floor off the coast of southernmost South America and explained them as due to ice transport. Thus he seems to have visualised the possibility that the pebbles in the Permian (older strata) were iceberg rafted. His reconstruction of the Permian (second series) palaeogeography (middle part of p. 20 of memo) is remarkably close to much more recent attempts (e.g. Banks 1962).

Darwin's comments on the igneous rocks he saw were astute. He had an eye for unusual minerals and remarked on the red (?) olivine at Sandy Bay, subsequently recognised as iddingsite. He was probably the first observer to notice the pegmatitic or granophyric differentiates of the dolerite which he referred to as ' syenite', 'spilitic', and having 'aspects of a Granite' (memo p. 4, p. 12, p. 13), and to notice the syenitic appearance of dolerite weathered in some conditions. His identifications of minerals in the dolerite would not gain him a pass in a modern examination but must again be taken in the context of contemporary knowledge. Thus his identification as hornblende (instead of augite) of the dark component in the greenstone (memo pp. 12, 13) reflects the common idea of the time that augite occurred only in volcanic rocks (after Hally) and that hornblende occurred in 'compound and aggregated rocks' (Bakewell 1819, pp. 292, 301, 302).

On one important point Darwin's memo and his report on Van Diemen's Land published in 'Geological Observations' differ. In his memo Darwin correctly deduced that the 'greenstone' (dolerite) was younger than the 'second series' (Permian and basal Triassic) on the basis of lack of dolerite pebbles in sediments immediately adjacent to the dolerite and the disturbance of the stratification close to the dolerite (memo, p. 10). Had he elaborated this argument in the published work, the debate which developed later on the age of the dolerite might well have been avoided.

Darwin saw or understood few of the many faults which affect the Hobart area (see map, Banks et al. 1963) but this perhaps is not surprising in view of the shortness of his stay and the probable lack of outcrop at the time.

On matters of geomorphology, Darwin noticed incidentally but did not interpret the accordance of summit heights (memo, p. 13) and gave much of his attention to recent changes in sea-levels (memo pp. 17-20). His observations on this matter were accurate but his argument confused and weak and one almost gets the impression that his interest in the subject developed so strongly and well in South America had overlapped his discretion.

From his own observations and from discussions with Frankland and perhaps by judicious reading of the available literature on the geology of Tasmania, Darwin deduced a reasonably accurate geological history (memo pp. 20, 21) and some accurate palaeogeographic reconstructions. His suggestion of parallelism in history with New South Wales was perspicacious, that with New Zealand poorly founded.

When the statement on Van Diemen's Land in 'Geological Observations' is compared with the memo, it is seen to be much less detailed and in places, e.g. where dealing with the 'modern formation', the condensation leads to confusion. Localities cannot be established with confidence. The locality for the leaves seen by Robert Brown had not been given in as much detail and led Johnston to infer incorrectly that they came from Geilston. Much of the material on the dolerite was reduced or eliminated although a new mineral identification, that of Hypersthene was added, presumably as a result of testing before the blowpipe, as fusibility is one of the tests given by Bakewell (1819) for distinguishing hypersthene from hornblende. Identification of the fossils he collected allowed Lonsdale and Sowerby to suggest affinities with the Mountain Limestone (Carboniferous) of Great Britain, a remarkably good correlation at that time. The published treatment of movements in sea-level was better organised and gives less impression of special pleading than does the memo. Thus, on the whole, the published work is less informative than the memo and it is regrettable that the latter was not published.

There remains the question of what Darwin, by his publication on Van Diemen's Land, added to knowledge of the geology. Before his visit scattered observations, especially about the coastline, had been made by early English and French exploratory maritime surveys, with a limited number of observations inland by early surveyors such as Humphrey, Lacyco and Hellyer. Granite, basalt, sandstone, shale, coal and limestone, quartzite and slate had been recognised and minerals such as jasper, cornelian, quartz, hematite, silver lead, asbestos and feldspar recorded. Some comments on rock and mineral distribution were given by Bischoff (1832), a work certainly sighted by Darwin as he cited it in the Journal (p. 533). With minor exceptions, no relation-
ships had been established and no ages were known. A geological map of Van Diemen's Land drawn in 1836 would have been a mineral and rock-type distribution map. All earlier observations seem to have been made through Werneriarian eyes; Darwin was the first Huttonian to do any geology here.

Darwin provided a more detailed description of the rocks within a small area in Tasmania than had earlier authors. He described for the first time variations within the dolerite. He also described, probably for the first time in Australia a structure of the type later called a 'Neptunian dyke.' His analytical techniques, though primitive, were better than those generally used earlier on Tasmanian rocks. But his work went beyond description and analysis. He concerned himself with relationships, a thing few if any earlier workers had done. He tried to establish a sequence as can be gathered from his published statement and even better from his unpublished memo. He collected fossils, not as curios but as means of correlating strata with those in Europe. His initial age determinations (see Journal and Narrative) were fair first approximations improved by more detailed work on the fossils by Lonsdale and Sowerby. Darwin inferred on relationships near Half Moon Bay that it had been the site of a volcanic crater, thus going beyond Péron who may earlier (1907, p. 247) have seen the basalt and scoria there. He would appear to have been the earliest author to note accord­ance of levels in Van Diemen's Land.

Thus Darwin's published work marked a considerable advance on any earlier work here and was a distinct contribution, but was overshadowed, unjustly, almost as soon as it was published by Strzelecki's monumental 'Physical Description.' Publication of Darwin's manuscript on Hobart would have been an even greater step forward than that provided by published material.

The reason or reasons for lack of publication of the manuscript is unknown. The published version is much abridged when compared to the manuscript and pressure of space may have surmised as one reason.

**SUMMARY AND CONCLUSIONS**

As a result of the location of the unpublished manuscript by Charles Darwin on the geology near Hobart, it has been possible to account for much of his stay of 13 days at Hobart in February 1836. The manuscript with associated specimen numbers allows localisation of his collection with considerable confidence. Polyzoa collected by Darwin and described by Lonsdale almost certainly came from the mudstone and limestone of the Bundella Mudstone on the shoreline at Porter Hill, Lower Sandy Bay, and the brachiopods described by Sowerby from the Darwin collection probably came from limestones of the Barossa Group near Barossa Road, Glengarry, and from silstones of the Malbina Formation at Eaglehawk Neck. Darwin's observations were acute enough to allow recognition of the rocks and localities he described, but he, perhaps naturally enough, did not see or deduce any of the many faults which affect the Hobart area. His identifications of minerals, rocks and fossils were good in terms of the very limited instruments available at the time and considering the state of the science. He was the first to recognise the relative ages of the dolerite and associated sediments and to describe a volcanic neck (and recognise it as such) from Tasmania. His correct deduction of the geological history of the island, at least in broad outline, indicates his own acuteness and some fund of geological knowledge of Tasmania prior to his visit. He seems to have been the first Huttonian to publish on Tasmanian geology; all earlier writers appear to have been Werneriarians.

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