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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 memorandum 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. Plate 1, a copy of p. 8 of his manuscript, is reproduced by permission of the Syndics of Cambridge University Library.

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 (1

In the neighbourhood of Hobart town, two[i] *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*[ii] *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 white 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)* A *of a decomposing Greenstone; on one side the strata dip away at an angle of 60° or 70° and fragments*[iii] *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* B
ii. *Examine flints in 'Flo' formation for Infusoria*
iii. *Dr Scot's paper on Van Diemen's Land* C *Annals of Philosophy. June 1834.*

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 so 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 Greenstones abutting against each other in straight lines. In all parts of the hill, on D
which the town stands dykes of Trappean rock and those of aqueous origin alternately appear; and I am doubtful which E
467 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 Sand- F
stone 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 Febru. 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 Huepilacuy at Chiloe. These are capped by a stratum of basalt, a few feet thick, compact with scarcely even a minute vesicle and abounding with very
467 small crystals of red Olivine 3(?) 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
3469 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).

1836 Hobart town 840 (4
of subaqueous Lava. The whole of this mass has been tilted at an angle of 30° to the South.—Following the Basaltic beach for a few hundred yards, there is a cliff, composed of a very compact mass of highly vesicular stone mingled with some compact kinds.—parts have been broken and apparently reunited by heat, others clearly by the agency of water, as shown by containing two or three rounded
3468 pebbles. The cells of the Vesicular Lava, are generally linear, the lines being not infrequently parts of curves and the internal surfaces are lined with sulphur (?).—I can feel no doubt that this little projecting cliff although at present showing(i) no trace of a Crater, was the point, from which the Basalt flowed. In close proximity we have the older greenstone bearing almost the appearance of a
3445 syenite and through this rock the former Volcano must have burst its way.—This is the only spot where I examined any Basalt but in all the South part of both sides of the

Footnote:

(i) *'yellow substance or stains'* in margin at this point.

soft chalk; it is not a little remarkable that such a substance should be included between the state of hard Crystalline Limestone. —

On the shore, a few miles South of Hobart Town I found the following varieties blending into each other & alternating. 1st a white Cherty
3457 rock with grains of quartz; a blue, slightly
3458 calcareous, siliceous compact Clay-Slate & a
3459 greenish brown rather soft, coarser Clay-Slate.
3460... The white abounds with impressions; in it
3465 are scattered a very few rounded pebbles of pure Quartz, Quartz rock & 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 & following cases. — On the beach of Pt. Wellington I noticed amongst similar
3473 kinds, 1st a pale blue coarse speckled Clay Slate (which perhaps would be called Greywacke) 2d
3474 White compact coarse fracture Alumi-nous
3475 stone & another similar one with blue & yellow. On the opposite shore to Hobart-

Plate 1.—reproduction of p. 8 of Darwin's memorandum on the geology of Hobart Town.

1836 Hobart town 841 (5
estuary, the rock is found in platforms, which present to the sea cliffs, composed of magnificent columns.—In one spot I J
saw white horizontal strata, joining by a great vertical fault to such a mass and at no great distance apparently capped by a K
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

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 'basaltes', 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 842 (6
formation of rocks, from the degradation of which the first series, have been formed. The upper strata, to the thickness of several hundred feet consist of Sandstone; this rock is subject to some L
variation, but generally is of a yellowish
3466 or red colour, hard, siliceous, and contains rounded grains of Quartz; I have seen some white and some quite red and not siliceous, but these are rather exceptions than common occurrences.—Close to Hobart town, there is such confusion in the strata, that I am very doubtful, whether some of the Quarrys, especially those at some height, are not worked in this rock.—Beneath this older Sandstone we have a very singular assemblage of rocks; they may be described as graduating in character between compact hard blue Clay-Slates, white Cherty or Flinty rocks, white aluminous fine Sandstones (or Claystones) and Limestones; each kind is occasionally met distinct and tolerably perfect; but the greater part is of an intermediate nature.

L. 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 around the Springs is the Triassic sandstone described as *'The Upper strata'*.

1836 Hobart town 843 (7
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 Quarrys. M

3476-80 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 N
curious figures, representing Corallines, are chiefly found in the flinty beds.—The Limestone in parts becomes slaty and impure; it is very remarkable by con-
3481 taining 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).

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 in one of the quarries south of the upper part of Tolosa Street (512.2 E. 724.25 N) (fig. 1 C). The only

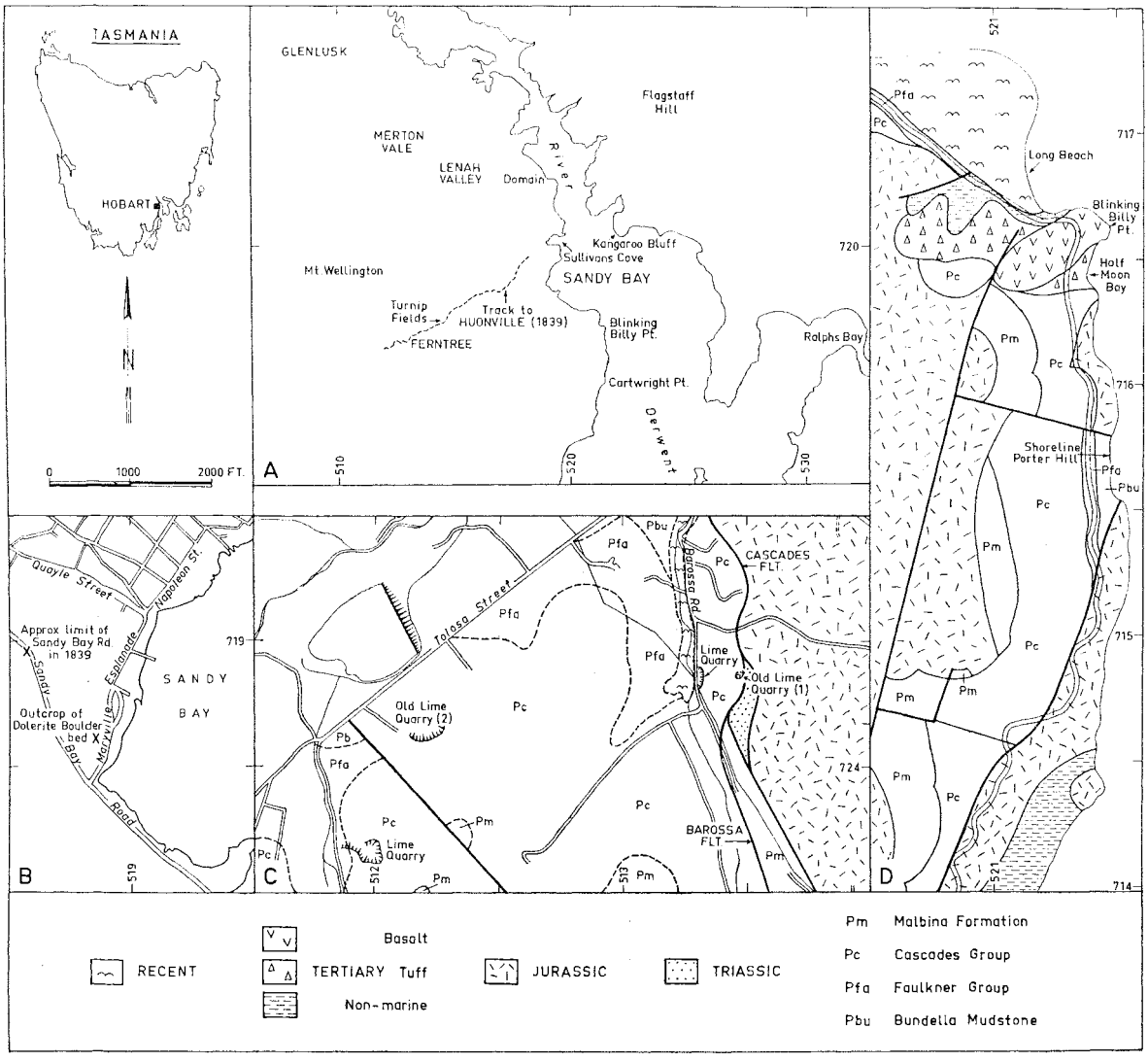

Fig. 1.—Maps illustrating some of the areas visited by Charles Darwin, February 6-16, 1836. Numbers in margins of maps refer to co-ordinates in State Grid System.

A. General map of the Hobart area showing some of the areas visited and the course of the track to Huonville.

B. Sandy Bay area showing some of the localities mentioned in the text.

C. Geological sketch map of the Barossa Road—Tolosa Street area; no geology is shown north of Tolosa Street; the quarry visited by Darwin is that marked (1) or one close to it.

D. Geological sketch map of the Lower Sandy Bay—Taroona area showing localities mentioned in the text.

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* O
> *varieties blending into each other and*
> *3457-58 alternating. (i) a white Cherty rock with*
> *3459 grains of quartz; a blue slightly cal-*
> *3460-65 careous, 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*
> *3473 speckled clay Slate which perhaps would be called Greywacke), a white compact-*
> *3474 uneven fracture aluminous stone and*
> *3475 another similar one mottled blue and yellow. On the opposite shore to Hobart* P

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 Bellerive to the western end of Bellerive Beach (522.5 E. 720.9 N) are shore platforms and low cliffs of Ferntree 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 ex-*
> *3447 cessively fine grained aluminous Sandstone (?) with an uneven fracture, which in parts becomes more sandy in other passes*
> *3448 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* Q
> *brittle s . ous one with straight frac-*
> *3482 ture—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,*
> *3496-99 the Surveyor-General, gave me specimens of the white Aluminous stone, abounding with impressions of Shells from the Huon* R
> *River and likewise, a blackish Limestone almost composed of parts of Bivalves*
> *3500 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 gards 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 *Eurydesma* (see also comment HH).

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 avicula* in Darwin's *'Geological Observations . . .'* and probably also of *Spirifera vespertilio* in the same publication.

1836 Hobart town 846 *(10 I was not fortunate enough to find an actual junction; but as in this latter, pebbles from the second and older series are found, the two formations must be quite distinct. In a like manner neither did I see the inferior junction; the white flinty Slates, being the lowest stratified rocks which are visible. The pebbles however of Quartz rock and Micaceous Slate, show that a third and older formation must be not very far distant.—*

Yet in this immediate neighbourhood I believe the lower strata of the second series generally rest on a coarse greenstone which x(i) *has burst through them when in a fluid state. I think this, from the entire absence of pebbles of Greendistant from this rock; and from its close juxtaposition on either hand of masses of the stratified stones, which would appear to be the effect of violence.—I confess however, I saw no cases, where the Stratifications pointed out this relation, in a satisfactory manner. The strata are seldom horizontal but are gently inclined and as far as I can ascertain in* U

(i) this is the manner in which Darwin presumably indicated the insertion at the point shown of the phrase *'when in a fluid state.'*

U. This correct ordering of the dolerite with respect to the Permian rocks represents the earliest correct attempt to do this. It was unfortunately not published.

1936 Hobart town 847 *(11 no particular direction. Almost all the hills, even those of quite secondary height, consist of Greenstones. Fringed with these strata.—On the opposite side of the water*
3451 *to Hobart town a hill composed of* V
3453 *ordinary, granular, and fine grained*
3454 *ferruginous Greenstones was skirted in the upper parts of its sides by gently inclined strata, which appeared (but I do not feel at all sure) to have undergone some*
3449 *alteration; there were bluish siliceous - Aluminous stones with minute grains of Quartz and white ones of a similar nature,*
3450 *which are indurated and fractured.— Mount Wellington, the most conspicuous feature in this neighbourhood rising close behind the town to the height of*(i) *3,100 ft is similarly constituted.—Passing over the low ground at its foot composed of the* W *first series, we first reach in the ascent the anomalous flinty and slaty rocks, then come to the Sandstones; these strata extend to a height perhaps of 1200 ft, above which there is nothing but Greenstone.—As the Strata on the sides are not very much disturbed,*

(i) *'Anguln. M. Beagle'* is written in the margin at this point.

V. This locality is a little difficult to identify with certainty but 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*
3472 *coarse and contains*(i) *crystals of Hornblende; it strongly affects the Magnetic needle; one side of the summit shows*(ii) *a large columnar structure; generally there s a grand accumulation of immense loose fragments.—I have as yet only mentioned the Trappean rocks incidentally, some as 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*
3451 *Trappean rocks of two ages.—Indiscrim-*
3453 *inately over the country, we find ordinary*
3454 *Greenstone graduating into a granular*
3456 *kind which assumes a Syenitic appearance. These probably belong to the older set, and are generally found in the higher* X *hills ; there are however numberless exceptions; on the coast some miles South of the town, there is a continued mass* Y
3455 *of a Greenstone composed of a*

(i) *'& 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 granophyric 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 Trappean formations (including in that name 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; these in parts are said almost Z *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
2470) *impressions of the Corallines and Tere-*
2471) *bratulate, so frequently mentioned.—Hence there can be little doubt concerning the age of the clay. Slate; and when we consider the variable nature 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* AA BB

AA. The *'great formation of white Quartz'* must refer to the ranges of Precambrian quartzites and quartz schists which characterise south-western Tasmania. This passage is an almost direct transcription from Flinders' (1801) description in his report on the first circumnavigation of V.D.L.

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

1836 Hobart town 851 (15
3483- *are remarkable by the large quantities of*
3488 *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* CC *cavities, which resemble those found in some Freshwater Limestones, to which stones this bears much resemblance.—*
3495 *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 *'Travertin 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 Combes, 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
3489- *the lower strata, abound with distinct im-*
3494 *pressions 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 a singular nature. Fragments of some Trappean 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 Calcareo-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 lime in solution, was covered, by some subterranean 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(i) *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 older 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
(a) 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
(b) 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 EE

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.

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 or more island; as likewise perhaps did the Granite of the NE(a)*.—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 subterranean forces propelled upwards large masses of Greenstones; 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 Trappean 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

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 Darwin 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 conchoidal 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 pegmatitic 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 Wellingon; 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)

3468 *vesicular lava;* locality as 3467

3469 *scoria;* locality as 3467

2470-71 *Clay Slate with impressions of . . . Corallines and Terebratulae* (Permian fossiliferous mudstone, probably Golden Valley Group); *Quamby Bluff* (several richly fossiliferous localities occur in this area); (*'2470'* and *'2471'* may be a slip of the pen and may have been intended to be 3470 and 3471 as all of Darwin's other numbers for Tasmanian material commence with '3'; and there are no numbers 3470 and 3471 in the margins)

3472 *greenstone* (dolerite); *top of Mt Wellington*

3473 *pale blue coarse speckled clay slate* (? Ferntree Mudstone); *flanks of Mt Wellington*

3474 *white compact uneven fracture aluminous stone* (?Ferntree Mudstone or siltstone in Malbina Formation); *flanks of Mt Wellington*

3475 *Mottled blue and yellow aluminous stone* (probably Ferntree Mudstone); *flanks of Mt Wellington*

3476-80 *compact crystalline blackish brown stone containing Terebratulae etc.* (Berriedale Limestone); *beyond New Town* (probably quarry at Barossa Road, 513.3 E. 724.3 N; possibly quarry near Tolosa Street, 512.2 E. 724.3 N)

3481 *snow white, soft . . . pure calcareous substance* (travertine); *beyond New Town* (locality as 3476-80)

3482 *white stone . . . quartz . . . in a siliceous paste* (Ferntree Mudstone); *near New Norfolk;* probably near Black Snake Inn.

3483-88 *silicified wood; the level district at the source of the Derwent and Tamar* (Campbell Town-Tunbridge region)

3489-94 *impressions of leaves* (fossil dicotyledons); *quarry of limestone . . . within Hobart Town* (top of Burnett Street; approx. 517.4 E. 721.4 N) (see Johnston 1888, p. 286)

3495 *nodules of ordinary flint in fresh-water limestone;* locality as 3489-94

3496-99 *white aluminous stone abounding with the impressions of shells; Huon River; donated by G. Frankland, Surveyor-General*

3500 *blackish limestone . . . parts of Bivalves* (Darlington Limestone with *Eurydesma); Maria Island* ('Fossil Cliffs', Maria Island); *donated by G. Frankland,* Surveyor-General

3630, 31, 32 *Terebratula* (brachiopods); *the neck of the Peninsula* (Eaglehawk Neck)

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 Town in 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 tame 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 Cartwrights 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 (Mount Wellington 2 days; Hobart streets ½ day; Bellerive 1 day; Ralphs Bay 1 day; Barossa Road 1 day; New Norfolk 1 day; Sandy Bay at least 1 day; Burnett

Street quarry ½ 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 home-sickness—*'. . . 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 PALAEONTOLOGISTS

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' *(Stenopora),* 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 Bellerive but did not collect any and included donated specimens of *'Terebratula'* from Quamby Bluff and Eaglehawk Neck and corallines *(Stenopora)* 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 'Spirifera' and Lonsdale (*ibid,* pp. 161, 169) named the 'corallines' *Stenopora,* and the 'Retepora' *Fenestella.* Three specimens of *Producta brachythaerus* are quoted by Sowerby; one, the only one of which he was certain, in grey limestone (presumably Berriedale Limestone from Barossa Road where *T. brachythaera* (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 recognisable 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 *Neospirifer 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. jukesi* 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 (?) chlorite schist and moulds

of fossils, mainly polyzoa, coated with limonitic encrustation. Comparison with specimens of Rayner Sandstone from Porter Hill suggest that the provenance was elsewhere. The rubber casts show the presence of a ramose *Stenopora* and *Peruvispira allandalensis* Fletcher.

The specimen on which the diagnosis of *Spirifera subradiata* Sowerby is based was apparently the original shell of a brachial 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 *Spirifera trapezoidalis* Sowerby is not clear although the description of the matrix a 'dark, rusty, grey limestone' suggests some of the limestone within the Bundella Mudstone on the shoreline at Porter Hill. No light is cast on the provenance of *Spirifera paucicostata* Sowerby but the internal moulds on which *Spirifera vespertilio* 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 vespertilio*. . . . 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 *Sulciplica transversa* by Waterhouse (1968, p. 27), the latter as *?Licharewia phalaena* (*ibid,* p. 24) associated with *Ingelarella 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. xv. f. 4). Morris further stated *(ibid,* p. 280) that he had seen Darwin's specimens assigned *to Spirifera rotundata* and *Spirifera trapezoidalis* var. by Sowerby and he grouped them as *Spirifer tasmaniensis.*

Of the species based on Darwin's collections, specimens of only two are now available (*Productus brachythaera,* B.M.N.H. B 19298, which is a *Strophalosia,* and *Spirifera 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 *Producta brachythaera* Sowerby (G.B.) 1844 in favour of *P. brachythaerus* 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 brachythaera* (Morris) occurs in the likely type area for *P. brachythaera* Sowerby.

Establishment of neotypes, where necessary, should be based on specimens from the Barossa Road area for *Spirifera 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 polyzoa.

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 Lamarck 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 zerox 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 Fuego'.* 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 ice-berg 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', 'syenitic' 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 as 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 Haüy) 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.* 1965) 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 overruled 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 French and English exploratory maritime surveys, with a limited number of observations inland by early surveyors such as Humphrey, Laycock 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 Wernerian 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 be 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 Cascades Group near Barossa Road, Glenorchy, and from siltstones 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 nieck (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 Wernerians.

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