# Chapter 11 Detailed description of the superficial deposits

# Introduction

In describing the local details of the superficial deposits a similar course will be followed to that adopted for the solid rocks in Chapter 4. The Island will be divided into three belts: (1) Northern, comprising the drift-plain; (2) Central: the hilly ground south of the drift-plain up to and including the Peel and Douglas valley; (3) Southern: the remaining portion of the Island south of that valley, with The Calf. The order of the descriptions within each division will be as before, first the coast-sections and afterwards the interior from west to east, in accordance with the numbering of the six-inch maps, while, at the same time, the physical boundaries will be recognised, as far as possible. The place-names in italics are those which appear on the six-inch, but not on the one-inch Ordnance maps.

# **Northern Division**

(Sheets 1, 2, 3, and parts of 4 and 5 of six-inch map.)

# Point of Ayre

[NX 46656 05087]. The arrangement of the Raised Beach at the Point of Ayre and its relation to the present beach have already been described (p. 402). Cumming. stated that the lighthouse "at first close upon high-water mark, has now a good piece of bank extending between it and the salt water".<ref>"Isle of Man", p. 224.</ref> That he was mistaken in this has been proved by our examination of the plans in the office of the Northern Lights Commissioners at Edinburgh, the old plan of 1815 when compared with the most recent plan of 1893 showing that between these dates the coast-line at the Point has undergone little or no alteration. The question as to the gain or loss of land at this point is of practical consequence in view of the possibility of other buildings being erected in connection with the working of the underlying salt deposits (p.559).

The lighthouse obtains its water-supply from a well 25 feet deep, sunk in the Raised Beach within the enclosure. We were informed by the light house-keeper that the water was rather brackish, but not more so in summer than in winter, and that the supply never failed. The section is said to exhibit 21 feet of shingle (Raised Beach) on 4 feet of clay (Glacial ?). This water-supply taken along with that found in the experimental borings (p. 285) indicates that there is a steady percolation of the surface-rainfall seaward through the shingle, probably augmented by a certain amount of drainage from the northern slopes of the Bride Hills.

There is a rapid tide along the northern side of the Point, with comparatively deep water (up to 11 fathoms) close inshore. Hence the present beach, composed of coarse shingle-ridges arranged in grand curves, is narrow and surprisingly steep considering the material; in one place an angle of slope of over 30° was noticed. The pebbles of the recent shingle are identical with those of the Raised Beach, and include few or no Manx rocks; the following are the chief ingredients of both: dark blue greywacke, grit, and quartzite; red and blue Carboniferous limestone; vein quartz; red and purple sandstone; sandy slate, "haggis-rock" conglomerate; red chalcedonic conglomerate; flint; diabase; basalt; yellowish and reddish porphyritic traps; felsite; mica-trap; mica-schist; gneiss; grey granite both coarse and fine grained; red granite.

The first of the deep borings was sunk, at the edge of the Raised Beach, 200 yards N. of the lighthouse (see p. 289, and Appendix, p. 578). The base of the drift is supposed to have been reached in this (No. 1) section at a depth of 298 feet from the surface, but it is not unlikely from the evidence of the adjacent No. 6 Boring [NX 46712 04835], that the upper part of the underlying Triassic Marl may have been churned up by glacial action, and should be considered as part of the drift. From the samples supplied to us from No. 6 Boring (fully described on pp. 340–4), which lies only 335 yards S.E. of No. 1, reconstructed marl with foreign pebbles appears to extend down to at least 428 feet, and perhaps still lower- and it is scarcely probable that there should be no similar material in the neighbouring section. Further borings are contemplated in the vicinity, which will no doubt elucidate the matter.

Some small travelling dunes of blown sand, one of which has invaded the lighthouse enclosure, are gradually moving eastward across this part of The Ayre and will eventually be intercepted by the sea south of the Point; they are skirmishers in advance of the main body farther westward. Among the shingle of the Raised Beach a few worn shells occur, chiefly oyster, mussel and whelk but are nowhere abundant. On the inner part of The Ayre, where the blown sand forms a tolerably even covering, an irregular strip varying from mile near the east coast to 200 yards or less farther westward has been enclosed and brought under partial cultivation by heavily dressing ('marling') the surface with boulder-clay, which has altered the character of the ground so much that one might doubt the propriety of mapping it as Blown Sand. In one or two places near the east coast, mile north of Portcranstal [NX 46867 04255], the ground contains so much clay that unless it has for some purpose been actually puddled,' glacial clay may lie close to the surface. The ancient cliff of drift which still forms a steep bluff along the southern border of the Raised Beach has been a most convenient place for obtaining the clay, and is therefore broken at intervals along its whole length by old 'marl-pits'. In some of these the chief ingredient is stony red clay, but more often it is laminated 'warp-clay' with few or no stones and sometimes these types occur together, intermixed with sand and gravel; examples of all these varieties may be seen in the pits between Portcranstal [NX 46764 02720] and Ballagarrett, though as scarcely any 'marling' is now done the sections are more or less obscure.

About 1½ miles W.S.W. of the Point of Ayre a small stream, draining the alluvial hollow of Lough Cranstal [NX 45186 02518], flows for some distance across the Raised Beach, but is absorbed before reaching the sea.

## **Ballagenny Boring**

On the seaward margin of The Ayre, 2 miles W.S.W. of the Point, the Ballagenney or No. 5 Boring [NX 43503 03831] (Sheet 3) was sunk in 1896 (p. 286). The following are the details of the drift-section at this place, as recorded in the engineer's journal:

	Feet	Inches
Sand with stoner [Raised Beach]	15	0
Gravel	27	0
Sand	36	0
Clay	34	0
Coarse gravel with sand and clay	26	0
Sand	73	8
Gravel	0	8
St. Bees Sandstone (see p. 583).		
	212	4

As there was a general correspondence between the drifts of this boring and those of No. 4 [NX 40164 03040] which I had previously investigated in detail (see below), it was not thought necessary to wash and sift the samples which had been preserved. A well had been sunk to a depth of 16 feet in shingle, close to the shore, at 3 feet above high-water of spring tides, and yielded fresh water during low tide but slightly brackish water at high spring tides.. The glacial 'sand' recorded in the above section was clayey and pebbly, like that of No. 4 Boring, and yielded a few shell-fragments, including *Astarte sulcata, A. compressa, Mytilus, Turritella,* and *Balanus.* The 'clay' was red, slightly pebbly, and not so sandy as that of No. 4. The pebbles shown to me exhibited the same general character as those of the previous boring; a few were faintly striated, but more were well-rounded, and two, which were said to have come from the base of the 'coarse gravel' at a depth of 138 feet, were encrusted with nullipores.

Half a mile to the west of this boring, on the boundary between the parishes of Bride and Andreas [NX 37769 01527], Mr. J. Todd, the engineer in charge, levelled a line out carefully across the Ayre from an Ordnance bench-mark at 29 feet on the sandy inner part of the beach and kindly allowed me to copy the figures. These show the elevation of the surface of bare shingle to range between 15.7 feet and 17.3 feet above O.D. at 150 to 300 yards from the present shore, while the ridge of blown sand nearer the sea-margin rises to 26.3 feet. The lowest of a series of levels on the Raised Beach farther east, recorded on the six-inch Ordnance map, is 17 feet.

## Drifts below sea-level at Rue Point

[NX 40739 03208]. At Rue Point, where the coast-line takes a more southerly trend, the Knock-e-dooney Boring (No. 4) [NX 40164 03040], gave valuable information regarding the drifts, which were penetrated to their base. I was able to visit this boring from time to time during its progress (in 1895) and secured samples of the glacial deposits, which were afterwards washed and sifted, with the results given below. A well on the foreshore just above high water mark yielded a good supply of perfectly fresh water in spite of the drought which prevailed at that time. The site is about 15 feet above O.D.

Section of the Glacial Deposits below sea-level in the (No. 4) Knock-e-Dooney Boring near Rue Point, Isle of Man.

Journal of the boring. Published by Mr. J. Todd in "Yn Liner Manninagh", vol. iii., pt. ii., April, 1898. [NX 40164 03040]

	Feet
Sand with stones	16
Sand and gravel	20
Soft sandy clay with fragments of coal	40
Sandy clay	25
Sand with small pieces of coal	15
Sand	34
Silt	13
Gravel and clay	10
St. Bees Sandstone (see p. 284).	
	173

#### **Description of samples examined**

The first 16 feet, and perhaps a little more, represent the Raised Beach.

At 50 feet. Clean sharp sand, with very small shell-fragments. On sifting, with sieve of ■ inch mesh, only two or three small pebbles remained, and no shells.

At 93 to 95 feet. Fine warp or clay. No residue of any kind on sifting.

At 107 feet. Fine silt. No residue except two crumbs of coal.

At 117 feet. Clean sand. Only residue a few small quartz and lydite pebbles; no shells.

At 130 feet. Silt. Only one small pebble remained after washing.

At 132 feet, Rather clayey sand, with a few small pebbles of the usual drift type, and a much-worn fragment of Balanus.

At 150 to 160 feet. Purple sandy clay, rather pebbly, with scattered shell-fragments.

A large quantity of this material was washed, and among the shell-fragments; the following species were recognised:

Balanus, sp. (abundant).

Astarte compressa

Astarte sulcata

Nucula, sp.

Pecten, sp.

Mytilus, sp

These fragments had the angular character usual to shell-fragments in boulder-clays. Traces of the epidermis were preserved on some fragments of *Astarte*.

At 165 to 170 feet. Silty sand. Not washed.

At 173 feet. Gravel with worn shell-fragments.

Balanus crenatus?

Pectunculus glycimeris

Mactra, sp.

*Mya,* sp.

Natica clausa.

Fusus, sp.

At 174 feet. Red clayey gravel; mostly subangular fragments of St. Bees Sandstone, but a few erratic pebbles; one or two small bits of shell were found on washing

#### Notes on some pebbles obtained from the above section.

		Diameter in inches	
	(Sub-angular striated fragment of Carboniferous Limestone	31⁄2	
At depth of about165 feet	Somewhat subangular pebble of Allsa Craig riebeckite-rock; encrusted with nullipores	1½	
	Similar pebble of dark porphyry (Southern Uplands Silurian dyke-rock 2): encrusted with pullipores	3	
	Coarse reddish grit }Southern Uplands rocks	21⁄2	
	Two glacially-striated pebbles of hard grit Southern Uplands rocks	about 2	
	Fragments of basic igneous rocks (probably Scotch); porphyrites, etc.; als of Red Sandstone like St. Bees Sandstone.	0	
	Red Sandstone and Carboniferous		
	Limestone fragments more numerous than in above, but associated with		
At and below 170 feet.	porphyritea (Old Red ?) and other non-local rocks. Most were rounded, bu a few showed striations. The whole	ut	
	assemblage was that of a glacial gravel.		

No peaty material or other indication of a land surface was anywhere obtained in the boring,<ref>Mr. T. V. Holmes records the same fact in regard to the low-level drifts of North-west Cumberland, in the following passage: 'Borings,

through the glacial drift into the underlying rocks near the Solway have never yet shown the existence of any interglacial vegetable deposit'. Trans. Cumberland Assoc., part vi. (1881), p, 123 (foot-note). they appeared to be derivative, and were confined to the gravelly bands; and the lowest gravel was largely a rubble of the underlying rock, but contained also many erratic pebbles.</re>/ref> nor was the general character of the deposits different from their character in cliff-sections. There was also no stratum found resembling the marine bed in the deeper part of No. 6 Boring [NX 46712 04835] (see p. 342). The foreign stones throughout were such as might have been gathered from any of the surface-sections; where shell-fragments occurred they appeared to be derivative, and were confined to the gravelly bands; and the lowest gravel was largely a rubble of the underlying rock, but contained many erratic pebbles.

The shells were all of species which occur in the cliff-sections, though the general assemblage was somewhat different, owing to the rarity or absence of *Turritella terebra* and some other gasteropods which are usually the commonest forms. But even in this respect the difference is not greater than is found between one part of the coast-section and another, where, as Mr. Kendall has observed, the species are very unequally distributed; which is the case also in the shelly drifts of East Yorkshire. The pebbles encrusted with nullipores have belonged to the same sea-bottom as the shells; the particularly interesting example from Ailsa Craig has been elsewhere discussed (p. 345).

## Blue Point

The next or Ballawhane (No. 2.) Boring [NX 39284 02429] (see p. 282), is on the Raised Beach, here reduced to a platform only 100 yards wide, under Blue Point, not quite a mile S.W. of the last, and seems to have shown a similar section in the drift but no opportunity occurred to examine the material. The following is a cony of the Engineer's Journal:

Sand and gravel [Raised Beach]	16
Muddy sand	
Sand containing small pieces of coal	41
Sand	20
Clay containing small pieces of coal	15
Silt	50
St. Bees Sandstone (p. 579).	_
	171

With regard to this and the Journal given below, it is probable that much of the material described as sand and silt was of the same character as the unstratified boulder-drift seen in places in the cliff-sections, where the erratics are set in a sandy matrix instead of in clay.

A marl-pit in the old cliff on the west side of Blue Point immediately above the boring showed:

Stratified gravel and sand, in places cemented into	3 to 5 foot	
'hard-pan',	3 10 5 1661.	
Contorted drift; consisting of sandy boulder-loam, stony clay,		
silty sand and clean sand, with gravel-streaks containing	20 to 10 foot	
shell-fragments, chiefly Tellina balthica: a boulder of bluish	ulder of bluish	
flaggy grit, over 3 feet in diameter, occurred in this drift		

The same general arrangement is seen in other sections between this point and the Lhen, the sandy beds being sometimes in part replaced by fine stratified clay or warp.

## The Lhen

The narrow strip of Raised Beach is continued south-westward to the mouth of the Lhen Valley (p. 373), and the most westerly and southerly of the deep borings (No. 3) [NX 38280 01885] was there sunk upon it (see p. 281). The drifts of this section are described as follows in the Journal of the boring. We have no further information regarding them:

Sand and gravel [Raised Beach]	12	
Silt	6	
Grey sand		
Brown sand	26	
Sand and gravel	18	
Gravel	8	
Grey sand	9	
Gravel	40	
Silt	0	6
Carboniferous Limestone, 66 feet 10		
inches.		
	167	6

On the eastern side of the Lhen there are two or more high terraces of gravel, which expand southward and merge into the drift-platform south of the moundy ground (p. 436). Its western side is encumbered with blown-sand that appears to have blocked up an old channel by which the Lhen-water escaped to the shore and forced the stream to find a new outlet 700 yards farther north. On a low mound of shingle, marked Cronk y Bing [NX 38159 01642] on the six-inch map (Sheet 2), round which the stream winds just before reaching the sea, I noticed a few flint chips; the tumulus of sand mentioned on p. 404 occurs on the rising ground half a mile S.W. of this place [NX 37579 00924]. The locality well deserves the attention of Manx archaeologists interested in the study of the physical conditions of the Island in Neolithic times.

## Jurby

For two miles S.W. from the Lhen there is a low persistent strip of blown-sand overgrown with bent-grass, about 100 yards wide, between the cliff and the shore, which appears to rest upon the prolongation of the Raised Beach. The cliff itself is also mantled with blown-sand, so that no section is visible except at one place, due west of Cronkbreck [NX 37044 00934] (at the shore-road marked on the one-inch map), where there is an old marl-pit showing a few feet of contorted stony loam and warp clay, with sand and. silt. No erosion seems to be taking place on this part of the coast at present, until we reach Sartfield [SC 35156 99498], three-quarters of a mile N. of Jurby Church, where the conditions suddenly change. Here the Raised Beach is cut out obliquely, and a freshly eroded cliff of drift is revealed, upon which the sea is making rapid inroads.

The first section traverses a hollow in the moundy drift 40 feet or more below the level of the surrounding ground, in which a little alluvium of some antiquity has accumulated. The section W.N.W. of Sartfield farmstead is as follows:

	Feet
Blown Sand, at cliff top about	8
Grey marly wash, peaty in places (Alluvium)	4
Silty gravel	2 to 4
Red clay and warp (contorted drift)	about 25

To the south-westward of this hollow for 700 yards, the cliff is chiefly composed of red clay, partly stratified, with patches of gravelly wash on the top. A smaller hollow is then traversed, N.W. of Jurby Church, in which again a little alluvium has collected, with peaty layers showing impressions of reeds.

The fine cliff-sections of Jurby Head [SC 34283 98230] are too complicated and variable for ready description. In places they show an upper red pebbly loam or clay, 10 to 20 feet thick; passing down into sand, silt and warp clay with some gravel, 30 to 40 feet thick; which, in turn, passes down into a lower dull red or purple stony till containing large boulders and pebbly layers, and also shell fragments. But these divisions seem to possess no independence, and often become contorted and intermingled into an inseparable mass. There is, however, distinctly more clay and less sand and gravel in these sections than in the sections of the moundy ridges at Orrisdale Head [SC 31646 92647], 2 miles farther south, and this agrees with the arrangement on the east coast (see (Figure 96), p. 355).

The cliff for <sup>3</sup>/<sub>4</sub> mile south of Jurby Head [SC 33795 97000] has recently wasted more rapidly than any other part of the Manx coast, a strip from 30 to 50 yards wide having been lost in the twenty-eight years which had elapsed between the Ordnance Survey and my own examination. Owing to this waste, large boulders accumulate in numbers on the foreshore where not removed for road-metal; among the largest noticed were two of Galloway granite, respectively 6 feet by 6 ft. by 5 ft., and 8 ft. by 4 ft. by 2 ft; and one of brecciated Carboniferous Limestone, 9 ft. by 8 ft. by 7 ft. Mr. Kendall commented on the prevalence of boulders of red sandstone in the lower clay in this locality, which he found in one section to comprise 15 per cent. of the stones; these, as he suggested, had probably been derived from a concealed outcrop of beds of this character in the neighbourhood, an opinion since practically confirmed by the results of the deep borings.<ref>Op. cit., p. 412.</ref>

About ten years ago a piece of the tusk of an elephant, 12 inches in length and 3 inches in diameter, was found in the cliff N.W. of Jurby Church [SC 34583 98973].<ref>The fragment is at present (1898) in the possession of Mr. W. Kneale, of Douglas, whom I have to thank for allowing me to examine it.</ref> It appears to be the only known occurrence of this vertebrate in the Manx drifts. Like the shells and encrusted pebbles, it has probably been transported from an older site.

On the southern side of Jurby Head the ground sinks gradually towards the hollow drained by the Killane River [SC 33864 96800], the high-level or 80-ft. gravel-platform which is so well marked to the east and south-east of Jurby becoming more indefinite in approaching the coast, probably on account of the greater distance from the source of its material (p. 434). Though the upper margin or shore-line of this platform is represented in the cliff-section by a bed of coarse gravel 6 feet thick which thins out northward against the rising slope of clay, the gravel is not so continuous over the platform here as might be thought from its representation on the published map; being worn threadbare, so to speak, so that the underlying clay shows through in several places. The platform terminates southward in a steep bank which is one of the most sharply defined physical features of the drift-plain (p. 434). At the foot of this bank lies the lower terrace, 30 to 40 feet above sea-level, and through it the Killane River, a small brook slightly increased by artificial drainage, has excavated a little valley which breaks the cliff-line [SC 33895 96826]. Near the coast the low ground spreads thence southward for <sup>3</sup>/<sub>4</sub> mile, and is then trenched a second time, at Ballakinnag [SC 33645 96009], by the stream from Glen Dhoo. Beyond the mouth of this stream the moundy drifts rise up with a bold margin and continue into Orrisdale Head.

## Killane and Ballakinnag

[SC 33882 96791], [SC 33595 95975]. This stretch of low ground may have originated in a local modification and thinning of the upper part of drift, but the cliff-section shows that it must have been accentuated by later erosion. The chief constituent of its cliff-section is stratified warp-clay and silt, destitute of organic remains, resting on (the lower ?) boulder clay, sometimes with traces of erosion and sometimes seemingly with a gradual passage. At the northern margin of the flat, near Ballateare, a platform of denudation has been scooped out in the warp, upon which lies an irregular layer of well-rolled current-bedded gravel which probably represents the shore-deposit of the Curragh lake at its second or Late-glacial stage. Before the Lhen channel was opened, it is possible that the lake may have had a westerly outflow in this quarter. The gravel dies out southward, or merges into fine material scarcely distinguishable from the underlying beds. A thin capping of sand, probably wind-drifted, completes the section.

Between the mouth of the Killane stream [SC 33882 96791] and Ballakinnag, [SC 33595 95975] the blown sand at the cliff-top becomes thicker; and in one place, west of Crawyn [SC 33762 96526], it contained indications of a Neolithic settlement at 4 feet below the surface, in the shape of numerous shards of coarse earthenware, flint-chips, and large stones marked by fire.

At the southern end of the low ground near Ballakinnag, a terrace has been scooped out of the warp, in connection with the drainage from Glen Dhoo [SC 33630 96019], perhaps at the Raised Beach period, on which an alluvial deposit has accumulated, seen in the cliff-section to consist of 3 feet to 6 feet of whitish sandy marl, with a thin peaty layer below, and a base of washed gravel. The peat was searched for the arctic remains with negative result.

## **Orrisdale Head**

[SC 31828 92800] The fine cliff-sections south of Ballakinnag [SC 33627 96028], ranging from 70 to about 140 feet in height, extend without a single gap for 2<sup>3</sup>/<sub>4</sub> miles to Glen Trunk [SC 31712 92263] on the S. side of Orrisdale Head. They intersect the western horn of the crescent of drift-mounds, not however by a direct cross-cut like the east coast section, but by an oblique traverse at a low angle. To the student of the shells or boulders of the Manx Extra-Insular drift these cliffs may be recommended as second in interest only to those of Point Cranstal.

The main facts of the section are shown in the accompanying diagram, (Figure 104)

As we enter the chain of mounds the warp, sand and fine gravel which at first occupy the whole section are replaced by coarse strongly current-bedded gravel, interspersed with thick beds of cleanly washed sand, mixed with a little warp and clay towards the top. The base of the cliff is for the most part obscured by talus, but for a mile to the southward of Ballakinnag [SC 33597 96024] seems to contain little or no boulder clay. Farther south a massive boulder-drift, presenting in places a vertical face and appearance like boulder-clay but of which the matrix is chiefly compressed sand, rises up from the shore and occupies the lower half of the section. The slate massif lies within a mile to the south-eastward of the section, and now begins to indicate its proximity by streaks of fine grey mud (somewhat like Fuller's earth, see P. 447), and by small slaty debris among the stratified beds. increasing in quantity ana size as we go southward. Opposite Orrisdale [SC 31939 93069] the stratified beds in the mounds show a tendency to dip in a general way with the surface slope, but the features seem to have been accentuated by subsequent denudation. The section on the southern side of the Head has been given in (Figure 88), p. 339.

The shells are as usual, confined to the coarser stratified beds and boulder clay, and do not occur in the warp or silt; *Tellina balthica, Turritella terebra* and *Mytilus edulis* are the most plentiful, but probably most of the species recorded from the east coast might be found here also (see list, p. 473). Among the boulders and pebbles the following are more or less abundant: Red sandstone, like St. Bees Sandstone, abundant; red calcareous sandstone with Carboniferous fossils (Peel series?); stained and brecciated Carboniferous-Limestone, like that of No. 2 Boring [NX 39284 02429]; shale, probably Carboniferous; Permian brockram, grits, greywackes and conglomerates (from Southern Uplands) abundant; Galloway granites; Ailsa Craig riebeckite-rock; many varieties of porphyrite, diabase, etc. A small collection of the rarer pebbles was examined by Mr. J. J. H. Teall, who noticed among them a granite and a quartz porphyry "probably Arran"; another "not unlike Garabal granite"; a greenish quartzite and a gneiss, "Highland rocks, probably Islay": and a basalt, "Tertiary dyke, Arran, or Southern Uplands". Many of the limestone-pebbles show the borings of *Cliona* and *Saxicava rugosa,* and in one specimen which was collected the shells of the latter still remain in the cavities. Rolled bits of red clay are abundant in the coarser gravels, and denote the active erosion of parts of the series previously deposited.

The encroachment of the sea has not been quite so rapid on this strip of coast as at Jurby. The loss since the Ordnance map was made varies from about 30 yards near Ballakinnag to a few feet only near Orrisdale,

but increases again southward. The Blown Sand which caps the cliff has previously been described (p. 404–5).

At Glen Trunk [SC 31677 92248] the cliff is notched down to shore-level by a narrow ravine through which the water from Bishop's Court and the Orrisdale basin reaches the sea; its sides are slipped and grassy and reveal no sections. The cliff immediately to the south of the gap shows, at the top, 10 feet of well-washed gravel containing much slate, apparently a Late-glacial Hood-gravel from the hills. This thins out southward, but its place is soon taken by the similar but far more extensive gravel of the Kirkmichael platform. The drifts below this gravel resemble those on the northern side of the ravine, the section has been described and figured by Mr. Kendall, who records *Nassa serrata* (*reticosa*) and *Fusus Forbesi*, among the shells he found here.

<ref>Op. cit., fig. 4 of Plate.</ref>

# Kirkmichael Cliffs

Half a mile farther south the cliff is again broken through, by Glen Balleira [SC 31365 91466] (Sheet 7). On the southern margin of this valley the following section *was* revealed in 1897, but as the cliff is wasting rapidly in this quartet, and the drifts are very variable, it may since have been modified. The point of chief interest is the strong unconformability

between the contorted sand and warp series and the upper part of the drift. This structure though local is none the less noteworthy, as it affords another point of resemblance between the upper stony clay (4) and the Hessle Clay of East Yorkshire, which is often similarly placed and seems to have been " the residuum left behind on the melting of a sheet of ice charged with clay and stones".<ref>Drifts of Flamboro' Head. Quart. Journ. Geol. Soc., vol. xlvii., p. 424.</ref> The slaty gravel at the top belongs to the. Kirkmichael platform above mentioned.

In the gravel platform 150 yards S. of Glen Balleira, a shallow depression, intersected by the cliff, shows 4 to 6 feet of grey alluvial marl and sandy loam, with peaty layers, resting on rolled slaty gravel. When traced inland,. this hollow expands, and is broken into by the S. side of the above glen, giving partial sections in which alluvial material is seen in places as far eastward as the railway-crossing. The best exposure is at the top of the cut-road leading southward out of the glen to the farmstead of Loghan ny Maidjey [SC 31611 91120], and is as follows:

Soil: grey earthy loam with a few stones1 to 2Fine gravel of slate and quartz with a few foreign pebbles,<br/>streaked with yellow sand and pale silty sand with peaty7stain: cross-bedded in places7Peat with small pebbles of slate and streaks of sand,<br/>passing into sand and fine gravel both above and below1½Probably more gravel like that above, hidden by grassy<br/>slope on side of road.1½

This alluvial hollow appears to mark the first stage of the excavation of Glen Balliera, and must be of some antiquity as it is 20 to 30 feet above the bottom of the present ravine. As peat with arctic remains was found in sinking a well on the gravel platform only 400 yards farther south (see page 374), some of the peat and silty sand from the above section was sent to Mr. J. Bennie for examination, but yielded nothing by which the climatic conditions could be determined. The following remains were recognised by Mr. Clement Reid in the washings of the peat:

Menyanthes trifoliata.

Viola sp.

Carex, two or three sp.

Umbelliferous fruit (sp. indet.).

Beetles (wing cases).

## Glen Wyllin

[SC 31278 90521]. Immediately to the S. of Kirkmichael, the drift platform, narrowed to little over half a mile by the approach of the hills to the coast, is suddenly trenched on a larger scale than heretofore, by Glen Wyllin which forms a little cañon over 100 feet deep with an alluvial flat in the bottom and the remnants of a series of terraces, marking the progress of erosion, on its sides. These terraces are very clearly exhibited near the mouth of the valley, occurring at four different elevations, the highest being half-way up the slope; they prove the persistence of subaerial conditions since the re-excavation of the valley commenced.

To the southward of this glen, the cliffs for three-quarters of a mile present excellent sections of the glacial deposits and the slaty platform-gravel. of which the following may be taken as a type:

Cliff-section 150 to 200 yards south of Glen Wyllin [SC 30865 90497].<ref>An adjacent and similar section has been figured by Mr. Kendall, op. cit., Fig. 5.</ref>

	Top: Loamy Soil	11⁄2
	Roughish slaty gravel, sandy in places and at base	1½
Late glacial Flood-gravel (thicker and coarser southward).	Pale grey contorted loam with pebbly pockets and streaks, passing into—	3
	Irregularly bedded sand and gravel with	
	some clayey layers ' the gravel smaller	about 10
	and less slaty than top bed	
Upper Boulder Clay?	Band of red sandy clay with rounded stones	3 to 6
	Irregular ripple-marked sand with some pebbles, and streaks of laminated clay	about 12
	Greenish-grey contorted loam and	
Intermediate Stratified Series	unctuous clay with streaks of sand and gravel	3 to 6
	Small dark gravel and sand, with shell fragments	20 to 30
	(Red sandy clay with stones and shell	
	fragments; interstratified with gravel at	6
	Interval concealed by talus	about 10
Lower Boulder Clay	Purple boulder clay with shells: at foot o cliff	<sup>f</sup> about 6
	Height of cliff about	90
	Exposed on the foreshore.	
	Red pebbly clay, and indurated sand	
	(scrablag) crowded with broken shells;	
	contorted and mixed together.	

The greenish grey silty clay about 35 feet from the top of this section seems to be the same material as the "Fuller's earth " of the upper reaches of Glen Wyllin (p. 447). The shelly drift below the foot of the cliff was well exposed on the foreshore in 1895, and proved richer in shells than any other portion of the Manx drift known to me except that passed through in Boring No. 6 [NX 46712 04835] (p. 342); it appeared to be a strip of the old sea bottom, dragged up and only partly incorporated with the boulder clay; the most abundant species was *Turitella terebra*, but there were also many others. Mr. Kendall found a similar strip, containing however an altogether different assemblage of species, at Point Cranstal on the east coast (op. cit., p. 431). With such material in the body of the ice-sheet, the presence of shells in the gravels deposited when it melted is easy to understand.

As the solid hills approach nearer the coast, not only does the slaty gravel at the top of the section become coarser and thicker, but slaty debris is also found abundantly in all the gravels. At Glen Mooar [SC 30184 89395] (Sheet 6), a wide gap in the cliff  $\frac{3}{4}$  mile S. of Glen Wyllin, the top gravel is 15 feet thick; but a few hundred yards inland on the plateau it is at least twice this thickness, and slate fragments, often subangular, constitute over 95 per cent. of the pebbles, the remainder being derived from the drift. The old terraces of erosion are almost as conspicuous at the mouth of this glen as in Glen Wyllin; the principal ones are respectively 6 feet; 10ft.; and 20 ft. above the present stream. Slate crops up in the bottom of the valley 300 yards inland, and rises above the surface of the drift-plateau 50 or 60 yards farther east close to the high-road. Between the slate outcrop and the shore there is an excellent section of the glacial deposits in the south bank of the valley, which has been figured and described both by Mr. Horne<ref>Trans. Edinburgh Geol. Soc., vol. ii., pt. iii., fig. 11, p. 21.</ref> and Mr. Kendall<ref>Op. cit., fig. 7, and p. 413.</ref> as illustrating the relation between the local and foreign drift. It shows, at the base, 15 feet of red stony clay and sand of the usual 'extra insular' character, both clay and sand containing shells; covered by 20 feet of dark grey slaty till, made up almost, but not altogether, of insular material; and about 10 feet of slaty-platform-gravel and sand at the top.

Similar features, though with some difference of detail, are repeated in the cliff-section 300 yards farther south, where the slate first comes out on the coast; and immediately beyond, we reach the section at Gob ny Creggan Glassey [SC 29585 88519] discussed and figured on a previous page (p. 348. (Figure 92), (Figure 93)).

The loss of land between Kirkmichael and Glen Mooar since the Ordnance survey ranges, as a rule, between 20 and 30 yards. From the point where the slate enters the cliff, to the southern extremity of the Island, the rate of erosion-is so slow as to be of no practical consequence.

# Eastern side of the Northern Plain

## Cranstal

[SC 45981 99942]. The coast-sections on the eastern side of the drift-plain are not so extended as those on the west, and owing to the less rapid rate of marine erosion are more frequently obscured by talus; but at Point Cranstal they comprise one of the grandest cliffs of drift in the British Islands. The general character of the deposits has been indicated in the diagram, (Figure 96), to which the additional details given below may serve as explanation.

Starting at Portcranstal [NX 46767 02714], on the southern margin of the Raised Beach, we have at first a comparatively low cliff, composed chiefly of stratifiedwarp, sand and clay, locally contorted. The sections for some distance are grassy and obscure, but become bolder half mile south of Portcranstal, where they are composed from bottom to top (70 to 90 feet) of massive red boulder-loam, with a locally varying proportion of sand to clay; and this material is only obscurely bedded. Stratified drifts then reappear in the lower half of the cliff; and afterwards in the middle portion, dividing the boulder-loam into two parts. As we draw near the Bride Hills the stratified deposits assume increasing importance, and include lenticular masses of coarse current-bedded gravel, probably marking old river channels; as well as much laminated clay, warp and silt, often passing into and confusedly intermingled with stony loam and boulder-clay. The whole series, indeed, bears much resemblance to the 'Contorted Drift' of the Norfolk coast. Shell-fragments are present, but in smaller numbers than in the sections farther south. The gravels are in places full of round washed lumps of clay, and the sands often contain streaks of coaly matter.

Just before rising into the steep slope of Cronk-ny-Irey-Iaa [SC 45826 99965] (267 ft.; the name is now obsolete), the cliff sinks to 50 or 60 feet above O.D. in a broad shallow depression of Late-glacial erosion, which drains away from the coast into Lough Cranstal (p. 418). In the floor of this hollow a few feet of washed gravel overlie the contorted drifts. The ground then rises to over 200 feet, blown sand 4 to 6 feet thick forming the top of the section (p. 405). The rise appears to be due partly to the thickening and partly to the crumpling up of stratified drift, the beds in many places being now at a far steeper angle than the angle of rest of such material during deposition. This great section contains little or no boulder-clay. the chief constituents being red and purple laminated clay, warp and sand, without fossils; and thick irregular masses of current-bedded gravel and sand, containing many worn and fragmentary shells often locally cemented into hard-pan 'scrablag' of the Manx) which where the beds are tilted weathers out into picturesque reefs and spires above the crumbling slopes. Where the beds are horizontal, the cemented material often takes the form of long flattened rods, generally with the long axis approximately N. 30 W.—S. 30 E., indicating the direction of underground percolation of water; in some instances it occurs along joint-faces, and has then a curious dyke-like aspect. Blocks of this material accumulate in such abundance at the foot of the cliff that they have been largely used for dry-walling; the lime which constitutes the cement comes from the solution of shells and limestone pebbles; it is redeposited wherever the underground drainage is checked.<ref>See Henslow, Trans. Geol. Soc., vol. v., p. 495.

On the southern side of the hill another deep hollow occurs [SC 45492 98626]?, its bottom like the last-described, containing a little flood-gravel and falling away inland (see map, (Figure 97)). The long talus slopes of the cliff to the southward of this place constitute the favourite collecting ground for the shells of the drift (see list, p. 473). The deposits here assume a more regular stratification, and contain less coarse material as we pass to the southern side of the chain of mounds. At the edge of the platform, immediately south of the mounds, we find the section as figured on p. 339 (Figure 88). South of Kionlough [SC 45389 98335]?, the cliffs are sloped and grassy, and it is only at intervals that their structure is revealed; but there seems to be a general tendency for the gravels to die out, leaving only the fine stratified silt and

warp; with a band of red stony clay or loam in the upper part, and tougher boulder-clay at the base.

# Seaview (Dog Mills) to Ramsay

[SC 45231 97797] At Sea-view we descend rather sharply from the upper platform, at 90 to 100 feet above O.D., to the second platform at 55 to 65 feet ((Figure 96), p. 355), but this definite terrace-feature fades away within a short distance inland (p. 436). It is noteworthy that the natural drainage of a little alluvial hollow within 200 yards of the coast at this place follows a winding channel inland to the eastern curragh and thence to the Sulby River, flowing 5 miles before it reaches the sea at Ramsey.

Two hundred yards S. of Sea-view [SC 45208 97579] the cliff showed the following section:

	Feet
At the top; irregular gravel, yellow sand and pale silty sand:	2 to 9
= Platform-gravel	
Tough red pebbly clay, semi-stratified; top uneven; contains shell fragments: = Upper Boulder clay	
Base hidden; probably red clay.	

#### Ramsey

[SC 45233 94572]. In the mile intervening between this section and Ramsey the sea is debarred from the foot of the cliff by a low narrow terrace rising only a few feet above high-water mark. It is not clear whether this is a storm-beach of recent times slightly raised by blown-sand, or whether it represents the Raised Beach. It merges at North Ramsey into the shingle-bar of The Mooragh [SC 45121 95139], behind which lay the old course of the Sulby River before its present direct outfall through Ramsey Harbour was opened. By the erection of a sea-wall the bar has been reclaimed and converted into building ground, and the depression behind it into a park. The section in the old cliff behind The Mooragh [SC 44822 95186] has been described and figured by Mr. Kendall<ref>Op. cit, fig. 1 and p. 410.</ref>; it resembles that given above. In an excavation for a sewer at the northern end of the Mooragh, described by Dr. Tellet and Mr. Kermode, numerous shells were found in a bed of boulder-clay 12 to 15 feet thick; and Dr. Tellet notes that two examples of *Tellina balthica*, embedded in hard grey-brown boulder-clay, had their valves united and closed, and full of a white silicious sand in which were some foraminifera.<ref>Kermode, Yn Lioar Manninagh, vol. i., No. 4, p. 96, and Tellet, Trans. Manx. Geol. Soc., 1889–90, p. 6.</ref>

In the foundations for the Swing-bridge across Ramsey Harbour [SC 45169 94499] the following section was obtained, which shows the composition of the drift below sea-level:

	Feet	inches
Sand and beach-shingle	7	0
Stiff red clay (calcareous)	4	0
Soft silty sand	14	0
Stiff red clay	1	9
Soft silty sand	5	9
Stiff red clay	2	6
Hard compact sand and shingle	15	6
Total	50	6

The low part of Ramsey on the southern side of the Harbour stands on a wedge of Raised Beach which has been preserved in the recess at the estuary of the river. The ancient drift-cliff still forms a steep bank behind Waterloo Road [SC 45405 94131], gradually becoming less marked and merging into the valley-slope when traced westward.

Sea-defences conceal the section south of the town until we reach Ballure Glen [SC 45784 93645] though tough red stony clay containing shell-fragments is sometimes visible in the slope above the wall south of the Promenade Pier, and

also on the foreshore when the sand is washed aside. The excellent section between Ballure Glen and the slate-cliffs has already been described and figured ((Figure 91), p. 346).

## Preliminary note on interior of the Northern Plain

The difficulty often found in the conventional separation of glacial deposits into 'boulder-clay', and 'sand and gravel', makes itself keenly felt in mapping this area. On the one hand the material which from a geologist's standpoint is 'boulder-clay' is frequently so sandy or stony as to yield a light loose soil; while on the other hand the laminated clay and warp which form an important constituent of the stratified portion of the series, though necessarily taken as part of the sand and gravel' drift, make stiff clay-land at the surface. A thin superficial coating of sand, either wind-drifted or rain-washed, is also very prevalent on flat ground, even when the subsoil is clay. Under these conditions the representation of the divisions, especially on the small-scale map, must sometimes be misleading as to; the character of the soil and must not be too strictly interpreted. As a general rule, however, the clay-land has been shown on the map by the 'boulder-clay' colour, and the light land by the sand and gravel' colour, irrespective of technical nomenclature, wherever this could be done without violence to the geological interpretation. Some deviation from this rule will be duly noted in subsequent pages.

For information as to the internal structure of the drifts, it is, of course, to the coast-sections that we should chiefly apply ourselves. But as an object-lesson in the development of a drainage system, the interior of the plain is of great interest. The obliteration of all pre-existing topography therein by the glacial deposits; and the ease with which new channels of superimposed drainage have been carved out in the soft materials, to be afterwards partially or completely abandoned under changed conditions; have given rise to phenomena which might serve as an epitome of the history of the physiographic evolution of many a larger and more enduring tract; and with the increased attention now given to these studies, the area may be recommended as an enticing field for any investigator with leisure to follow up the subject in detail.

For our present purpose, the district will be described under the following sub-headings: the Bride Hills and their westerly prolongation up to the Lhen; the Jurby Platform, west of the Lhen and north of Killane river; the Andreas Platform, between the Lhen and the east coast; and the Curragh Basin.

# **Bride Hills**

# Ballamacskelly (Ballathona of new Ordnance map)

A westerly segment of the moundy ridge, separated from the Bride Hills proper by a broad shallow depression, runs E.N.E. from the Lhen [NX 38537 01414] to Knock-e-Dooney [NX 40580 02327], rising 50 or 60 feet above the plateau. Its easterly portion shows principally sand and gravel at the surface; but farther west a more compact drift with pebbles and boulders, occasionally well glaciated, set in a sandy matrix, is seen in the road-cuttings crossing the ridge. One of these, at Ballamacskelly [NX 39065 01372], yielded an unusually large subangular fragment of the Ailsa Craig riebeckite-rock, 8 inches in diameter, being the largest piece observed during our survey. In places this boulder-drift is mingled with more clay, and has then been dug for 'marling', having apparently been preferred for this purpose to the stiffer clays. An old marl-pit [NX 40244 02195] on the north side of the ridge, 350 yards W. of Knock-e-Dooney farmstead, showed (in 1895) a contorted bed of fine gravel full of shells, under or among red stony loam. The following shells were collected, and longer search would no doubt have made additions to the list: Turitella terebra (very common); Murex erinaceus; Trophon clathratus; Purpura lapillus; Pleurotoma turricula; Fusus, sp. Astarte sulcata; Tellina balthica; Mactra solida; Corbula gibba; Mytilus sp.; Pecten sp.; Balanus sp. The strip of lower ground to the northward, between the ridge and the old cliff edging the Raised Beach, is underlain chiefly by boulder-loam, modified in places by a little blown sand on the surface. There are numerous old marl-pits in this tract, and some large boulders of granite, diorite, etc., in the fences. From the S.W. end of the ridge the ground falls away to the Lhen valley in terraces which are more or less gravelly; the lowest is a narrow bank which belongs to a late stage in the excavation of the valley, but the two higher are broad sloping platforms which cannot be assigned to ordinary fluviatile action; the highest probably represents the high-level Jurby platform, and the second the Late-glacial Curragh Lake terrace. They are broken through and destroyed on the east by a little winding

glen which runs parallel to the southern side of the ridge, and drains in part from a small irregular alluvial hollow at Ballacunner [NX 40901 01270], and in part by artificial trenches from a broader depression N. of Andreas [SC 41026 99528]. The walls of an old cottage on the lower terrace at Ballaclucas [NX 38330 00627] (Sheet 2), contained (in 1894) a good collection of large boulders, among which were a mica-trap and a coarse granite with large pink felspars. Chipped flints are rather abundant near the margin of the Lhen, not only in this locality but throughout its course. Where the gravelly terraces fade out, the low slopes bordering the ridge on the south become more loamy, and the difference in composition between the low ground and the neighbouring high ground is scarcely perceptible; they have, however, been differently coloured on the map, for the sake of defining the shape of the ridge.

The depression between the eastern termination of the above ridge at Knock-e-Rooney [NX 40614 02290] and the western termination of the main chain of the Bride Hills near Smeale [NX 41907 02072], has been referred to as a possible outlet from the lake waters at their higher stage (p. 372). It has a breadth of about half a mile, and an elevation of 75 to 80 feet above sea level; it is covered with gravelly loam resting on the usual mixed boulder-drift. Part of its floor is occupied by a chain of curious shallow depressions, which form natural ponds partly dry in the summer. The most southerly of these, Lagagh Mooar [NX 40915 01492] (Sheet 3), is the largest, being 400 yards long by 250 yards broad in its midst there rises an artificial mound, The Buggane [NX 41037 01514], marked sort on the ordnance map. The smaller but deeper hollow of Curragh-y-cowle [NX 41053 01961] lying 200 yards farther north is connected with the former by a narrow strip of alluvium, on which coarsely chipped flints of larger size than those usually found in the island are peculiarly abundant. Another pond, near Ballakinnag [NX 41105 02293] 300 yards farther north, appears to have drained originally to Curragh-y-Cowle [NX 41053 01961], thence to Lagagh, and westward to the Lhen; but afterwards the whole system was tapped by a little valley, indicated by a strip of alluvium on the geological map, falling north-eastward to the Raised Reach opposite Smeale. Like the depressions at about the same elevation on the gravel platform at Ballaugh in which the elk-remains were found (p. 375), these hollows may possibly be due to eddies in the current entering or leaving the old lake. Their mode of occurrence separates them from the 'kettle-holes' often found among morainic drift, as they are confined to the terraces, and do not occur among the mounds. Among the numerous boulders in and around the buildings of this locality is one of unusual character, possibly from the Lower Silurian Volcanic series of the Lake District, measuring 4 feet by 3 feet by 2 feet, at the gateway of the old cottage on the north side of the high road immediately west of the alluvial hollow between Curragh-y-Cowle [NX 41053 01961] and Lagagh Mooar [NX 40915 01492].

## Hills N. of Andreas

The termination of the Bride Hills on the eastern side of the depression above described is more gradual than that of the opposite ridge; and is, indeed, ill-defined. Its indefiniteness is largely due to the complicated effects of ancient flood-erosion, which has trenched the hills first in one direction and afterwards in another nearly at right angles to the first. The oldest system is represented by two broad troughs running almost parallel to the hill-range, or from east to west nearly; the more northerly has a course of about 1½ miles, starting east of Thurot Cottage [NX 43599 01531], passing to the south of Smeale Beg [NX 42797 01851] and opening near Knock-e-nean [NX 41149 01535] into the above-described depression; the more southerly, starting near West Kimmeragh [NX 44015 00791] (see plan, (Figure 97), p. 375), has probably once continued to Johneois [NX 41618 00733], but has had its southern side broken away east of Braust [NX 42126 00333]. These channels were probably abandoned from some change in the glacial lake-level; and a new system, draining southward more or less at right angles to the ridge, was then initiated, which carved out deeper and narrow valleys and soon truncated the older hollows. The western end of the hills is from this cause not only notched and broken but likewise obscured by flood-fans of gravel.

## Bride Hills

As mentioned in a previous description (p. 358), some of the transverse valleys have trenched the ridge from side to side. In these cases their floors have a long gradual slope southward and a shorter sharper gradient northward from a low col lying to the north of the centre of the hill-range, this northward slope apparently marking reversed drainage on a small scale, which asserted itself when the margin of the ice-sheet had shrunk back from the ridge. The high-road crossing the ridge north-eastward from Andreas [SC 41289 99577] past Thurot Cottage [NX 43599 01531] is carried through one of these valleys; the Ordnance levels along it show a rise of from 90 feet above O.D. on the gravel platform near Braust [NX

42127 00335] to 238 feet at the col a mile farther north, and a fall thence northward to 130 feet in the next 600 yards, the valley-slopes rising steeply 50 to 60 feet above the road in the pass.

#### North of Kirk Bride

A mile farther east another similar valley, which may be taken as the typical example, has been utilised for a branch from the Bride highroad leading past Lambhill [NX 45377 00818] to Cranstal [NX 46017 02297] (see plan (Figure 97), p. 357); the broad inclined floor of this valley spreads out into the sand and gravel delta south of East Kimmeragh [NX 44512 00464], and the steep, well-preserved slopes on both sides rise 60 to 80 feet above it,—eloquent tokens of the former flow of a considerable stream, and in striking disparity with the present aridity of the loose gravelly soil of the valley. Another example, not so deeply notched on the crest, leads across from Ballavarkish [NX 46027 00764] to Ballacottier [NX 45668 00718], less than ¼ mile farther east; this is tributary to a broad depression of the older type, 150 to 250 yards wide, which has its down-slope inland and runs east and west, between Ballavarkish [NX 46027 00764] and Ballavair [SC 44888 99246], until beheaded by the coast-line S. of Point Cranstal, as mentioned on p. 429.

The ramifying system of minor valleys, running in every direction among the hills and falling southward, needs no description beyond that already given (p. 356 and (Figure 95), (Figure 97)). Not only are all these valleys without present drainage, but they have also been in this state since the time when the high-level gravel-platform was spread out at their mouths, as this platform is in no case trenched where they emerge upon it.

In composition, the Bride Hills are evidently much the same throughout as in the coast-section at Point Cranstal [SC 46041 99901] (p. 355). Sand and gravel, the latter sometimes coarse and bouldery, predominate between the summit and the southern margin, but are interspersed with patches of boulder-loam and stratified clay, into which marl-pits have been opened; and on the northern slopes boulder-loam and clay is the prevalent constituent. The general arrangement confirms the evidence of the coast-section in showing that though the hills have been modified by denudation, they are essentially a feature of original accumulation. Large boulders are plentiful in both the stratified and unstratified portions; and are being constantly dug out to prevent them impeding the plough (all except the steepest slopes being under cultivation), and because of their general utility for road-mending and building in this otherwise stoneless country. Those of Galloway granite are the most abundant, and may be seen in profusion in the fences and buildings, as for instance in Bride Church; the larger blocks of this rock were formerly often shaped into agricultural rollers. A fine granite boulder measuring 9 feet by 4 feet by 5 feet was noticed in an old marl-pit mile N.E. of Braust [NX 43308 01455]?. Lower Silurian grit from the Southern Uplands is also abundant, of which a good example, 8 feet by 6 feet by 8 feet, which had been split by blasting but not removed, lay near the eastern fence of a field 400 yards S. by E. of Ballakilley.<ref>For details of some of these boulders, see Rev. S. N. Harrison's lists in Reports of Erratic Blocks Committee, British Assoc. Reps., for 1891–2–3 and Yn Lioar Manninagh, vol. 1., no. 11, p. 375.

The altitude of the highest point of the Bride Hills is not given on the Ordnance map, but the Admiralty chart gives 310 feet as the height of the summit of Ballacash Hill, one mile W. of Bride Church [NX 43707 01032].

The lower drift-ground to the N. of the Bride Hills abruptly truncated northward by the old cliff overlooking the Raised Beach, is 1½ miles in width near the E. coast, but narrows to ¼ mile westward. It forms a gentle slope falling northward, but is broken by the long irregular hollow of Lough Cranstal [NX 45131 02511], which has once held a small lake but is now drained to the condition of a waterlogged flat. Into this hollow from the northern side of the hills run little shallow valleys, some of which are now dry, while others still retain rivulets in artificial gutters. The alluvium of the hollow is merely a thin sandy wash derived from the drifts, with a peaty surface in places; but there are indications that the depression was originally excavated by a stream strong enough to transport gravel and form terraces. There is a predominance of rather stiff soil on the slope, varying from clay-land to sandy stony loam, and the greater part has therefore been coloured on the map as 'boulder clay'; but the numerous old marl-pits show that while in some places the subsoil is true boulder-drift, in others it is stratified clay or warp without stones, and in both cases often mixed confusedly with patches of sand and gravel. One or two localities in which sand and gravel attain ascendency have been indicated on the map. The absence of the gravel delta-platforms on this side of the hills, which are so conspicuous on the opposite side, shows that the drainage conditions have been very different; and the whole evidence sustains the view already put forward (p. 358) that the hills have accumulated as a moraine along the margin of the ice-sheet during a pause in its

retreat, and have been deeply trenched by heavy floods pouring across them from the ice into Lake Andreas.

# The Jurby Platform

## Jurby

[SC 35415 98420]. The shape and character of the tract bordering the coast in the parish of Jurby suggest that higher land, forminga link between the Orrisdale mounds and those near Ballamacskelly [SC 35415 98420], has been destroyed by the sea. The ground still for the most part rises towards the cliff; and high-lying moundy gravel north of Sartfield [SC 35531 99489] probably marks the inner slope of a vanished ridge; while the elevated clayey strip to the southward, in which are several old marl-pits, may indicate a further segment of the ridge. To the eastward lies the great gravel platform, stretching N. and S. for two miles from the Ballaghaie [NX 37162 00288] to Ballateare [SC 34240 97110], and E. and W. for 2½ miles from Jurby to the Lhen valley. The average altitude of this platform is about 80 feet above O.D.; it rises to 90 feet in the vicinity of Sartfield, where the gravel is probably thickest; and falls to 70 feet towards its southern boundary and towards the Lhen, where the material scantily covers the underlying beds. The distribution of the gravel with a generally even surface over a tract of this extent precludes ordinary stream action; and the trend of the whole evidence, as previously stated, is against the possibility of marine agency; while the hypothesis of the former presence of a lake appears to explain satisfactorily all the facts. From the steady thickening and increasing coarseness of the gravel towards the north-west, we may be tolerably certain that the material was brought down into the lake from that quarter; and of this we have confirmatory evidence inasmuch as the surface of the platform becomes undulating, and rises near Jurby Schoolhouse into low ridges of bouldery gravel striking W.N.W. to E.S.E and then merges insensibly into the gravelly mounds near Sartfield [SC 35503 99412].

In the Manx agricultural districts the houses are generally scattered broadcast over the land; but on this platform, as the map shows, they are rare, on account of the lack of water near the surface, a condition to which Manx farmers are not accustomed (see p. 570). The farmsteads are therefore ranked along its southern edge where water is given out at an under-lying clay-bed, and in its eastern part where the gravel is thin. A well at the N.E. corner of a field 650 yards S. of Loughan [SC 37261 98777] is said to have passed through 20 feet of sand and gravel, to clay.

The north-eastern part of the plateau is not so regular in composition and simple in structure as the south-western, being broken by little valleys sloping eastward or south-eastward towards the Lhen, and by tracts in which there is Scarcely sufficient covering of silty sand and fine gravel to conceal the underlying clay. Though on the published map the only part of this ground coloured as clay is a lenticular strip between Ballachrink [SC 38554 98606] and Ballachonley [NX 38743 00121], there are other tracts in which, while the soil itself is sandy or gravelly, it is underlain by clay within a foot or two of the surface; one such area occurs N.W. of Rhendhoo [SC 38554 98606] and another round Loughan [SC 37240 99404]; and even farther in the interior of the plateau, about half mile S.E. of Jurby Church, red clayey soil unexpectedly reveals itself. The gravels have probably been deposited on an uneven surface of clay; and their thinning away towards the east and north-east, where the ground sinks to 70 feet, denotes the position of the outskirts of the delta.

The longest of the above-mentioned channels cutting the platform starts from a little boggy basin at Loughcroute, which has a margin of sandy alluvial wash with some peat in the middle, and seems to be of the same character as those around Lagagh Mooar [NX 40915 01492] previously described. The trench, a mile in length, with the present drainage trickling in an artificial gutter in its midst, runs south-eastward to the Curragh end of the Lhen Valley, passing through another small basin on the way. Several shorter valleys, also draining to the Lhen, trench the platform to the north of this; while to the westward are others, of which those of Ballachurry (Sheet 4) and Berrag (the latter with a small peat bog in its floor) are the largest, falling southward to the lower terrace bordering the Curragh. From the manner in which the last-mentioned valleys terminate upon this terrace we may judge that they were excavated at the period when the lake had subsided to its lower or 40 ft. level.

The sharp feature which marks the descent from the upper platform to the lower platform has been noticed in describing the western coast-section (p. 423). For three miles eastward from the coast it continues to form a regular bank 30 or 40 feet high, broken here and there by the above mentioned little valleys, and diversified by the trees and gardens

surrounding the chain of substantial farmsteads which are placed upon it. Swinging northward, the feature then makes the western bank of the Lhen Valley, and in this guise sweeps round the platform to the coast again. That it is throughout its course a denudation-feature there can be no doubt. In the Lhen Valley it has been carved out by fluviatile action, but elsewhere apparently by lacustrine agency. Almost everywhere this bank is in part composed of clay, sometimes stony, but oftener of the stratified warpy kind. Usually the clay is overlain, and sometimes also underlain, by sand and gravel; so persistent is this arrangement that the different beds might almost have been shown on the map, if the scale would have permitted, with regular outcrops, just as one might shoe an equivalent thickness of horizontal 'solid' strata. Such regularity is very unusual in the drift-sections of the Island.

The Lhen valley [SC 39471 98938], of which the general characters have previously been described (p. 373), forms the boundary between the parishes of Andreas and Jurby. The drain cut about 250 years ago<ref>See Moore's "History of the Isle of Man" vol. ii., p. 921.</ref> along the middle of the broad flat valley-floor now carries a steady flow of water from the northern edge of the Curragh [SC 36467 95640], but previous to its excavation there does not appear to have been any distinct water-course in the glen; and it is probably because of the former absence of a definite channel that the parish-boundary runs along the foot of the western bank instead of dividing the valley between the two parishes. In many places there is a thin superficial layer of peat in the bottom, which here and there has been cut for fuel; but the flatness of the floor, even where widest (over 300 yards), appears to have been due to the broad shallow character of the stream by which the valley was excavated and not to a later infilling by boggy growth, as within three or four feet of the surface the artificial trench seems to possess a firm bottom of washed sand (sometimes rather peaty) and fine gravel throughout its length. At the great bend near Ballachrink [NX 39594 00070] where the course changes from northerly to westerly, the valley-slopes exhibit a steep bluff on one side with a more broken and gradual descent on the other, such as is usual in stream-banks where erosion has recently been in active progress. Where it leaves the Curragh, the valley-bottom is 30 feet above O.D., and is not more than a foot or two lower opposite Ballachristory [SC 38631 99247] 11/2 miles farther north. Low discontinuous terraces of sand and gravel occur here and there within the Lhen, chiefly as small deltas near the confluence of subsidiary valleys i but on the whole these marks of progressive erosion are surprisingly inconspicuous. The presence of chipped flints on these banks, and of a so-called 'fort' [NX 39627 00095] or crannog-mound in the bottom opposite Ballachrink (Sheet 2), indicate a pre-Neolithic age for the excavation of the valley. As previously explained (p. 373), the glen probably began in Late-glacial times as a channel for water flowing southward from the melting ice, but afterwards acted as the principal northward outlet of Lake Andreas; under the latter condition it would be likely to carry floods filling the valley from side to side at certain seasons, and at other seasons to be almost dry. The absence of slaty debris shows that the streams flowing northward from the mountains into the lake left their load of detritus in the basin before passing out through the Lhen.

# The Andreas Platform

# Andreas

The ground between the Lhen valley [NX 39518 00172] and the E. coast [NX 46227 00361] constitutes an uneven platform falling away southward from an altitude of 100 feet above O.D. near the Bride Hills [NX 43719 01028] to about 30 feet along the Curragh margin [SC 36390 95038]. A terraced arrangement is exhibited to a slight extent near the E. coast, but is scarcely recognisable over the greater part of this tract; and as there is much variability and indefiniteness in the character of the drift at the surface, the rendering of the area on the geological map is necessarily patchy, and somewhat confused.

In the west, along the eastern margin of the Lhen, there seem to be traces of the prolongation of the Jurby gravel-platform between Ballamegagh [SC 37264 97822] and Gylcaugh [SC 39600 98093]; but the gravel rapidly fades out eastward into rather uneven clayey ground. In the N.E. a broad flat gravel-delta spreads out around the mouths of the dry valleys of the Bride Hills (p. 357, (Figure 97)), extending from Braust [NX 42136 00376] to Ballavair, but becomes attenuated and disappears southward. A fringe of similar or more sandy material, probably the edge of a delta which has been swept away by marine encroachment, occurs along the E. coast S. of Ballavair [SC 45499 98583]. Over the rest of the area these superficial gravels have either not been deposited in sufficient quantity to cover up the irregularity of the underlying surface of clayey drift, or have been carried off by later denudation. Hence we find a larger proportion of

clay-land in Andreas than in the other northern parishes.

## Andreas

[SC 41362 99563]. In the parts where clay lies near the surface there are several small tracts lying a little below the general level which appear to have been liable to occasional or seasonal floods until artificial drainage was instituted. In these shallow basins, the clay, though found at a foot or two beneath the surface, is usually covered thinly by dark silty sand or loam, rarely sufficiently thick to map as alluvium; as, for example, in the depression between Andreas and Lowdas [NX 40158 00763]. Where, however, a basin of this kind is continued into a definite strip of valley-alluvium as in the instance south of Ballaseyr [SC 42139 98976]; or where it still contains bog, as in the hollow at Seaview [SC 44994 97861]; it has been shown on the map. These little basins generally give rise to small winding valleys, which like those of the Jurby platform have been excavated into the drifts down to the level of the Lhen or upper Curragh terrace, and now contain only a runnel of water in an artificial ditch. The four principal of these channels have been shown on the one-inch map by slightly exaggerating their strip of alluvial wash; of which two drain south-westward to the Lhen, and two southward to the eastern Curragh. An antler of an elk was found in draining one of these depressions, in a field 200 yards west of Ballalheaney [SC 42520 98446], in a bed of peat covered with sandy wash at 4 feet from the surface.

The Curragh [SC 36527 95651] margin is not so well defined in this area as farther west, the drift-slopes as a rule disappearing gradually beneath the alluvium, with only faint indications of the beach-like lower platform; while spurs and islands of sand and gravel or clay, rising slightly above the Curragh, denote original inequalities of the glacial deposits which have not been completely buried by post-glacial accumulations.

Old marl-pits, often of large size, are very numerous in the tracts of clay many of them now form ponds, but some in which sand has been reached beneath a clay-bed are dry and still partly show a section; they are usually sunk in a deep-red clay, generally containing only a few small pebbles, but now and again a large far-travelled boulder. These pits are not confined to the area mapped as boulder-clay, having often been opened where the clay has been covered with sand and gravel of mappable thickness, as around Ardonan [SC 42628 96886] and Regaby [SC 43172 97517]. At a small brickyard at Regaby Beg [SC 42294 97535] the following section was exposed, all the beds being very irregular:

	Feet
Soil	1
Sand and gravel, with shell fragments	0 to 3
Red loamy clay with small round stones, and a thin band of	
pebbly clay with crumbs of shells; in places mixed and	6 to 8
contorted with patches of sand and gravel	
Sand (in bottom of pit)	0 to 2

Another brickyard at West Craig [SC 39299 96770], 700 yards W. of St. Jude's Church, had been worked in a similar but rather more stony clay. A small pit, 7 feet deep, in the corner of a field 200 yards N.W. of Ballabeg [SC 40074 98236], on the east side of the high-road from St. Jude's to Andreas revealed a confused admixture of pebbly boulder-loam with sand, silt and clayey gravel —in fact, such material as could not be defined either as boulder-clay or as sand and gravel, being just half-way between; the pit is at the edge of a mound which rises above the general level of the platform and appears to be an outlier of the Bride Hills.

In the vicinity of Ramsey the drifts rise more sharply out of the alluvial flat, and the ground becomes undulating, apparently indicating original inequalities of accumulation unmodified by delta-gravels. The Sulby River has cut a steep bluff in its north bank between Riversdale [SC 43872 95087] and Ramsey [SC 45022 94581], in which the following section is exhibited:

	Feet
At the top: Sand and rounded gravel	6
Red pebbly clay	6 (or more)
Stratified sand, with red loamy bands	30

Shell-fragments abundant on the talus.

Mr. Kendall mentions that at Riversdale the sands met with in a well yielded several specimens of *Nassa serrata*, Broc. (*N. reticosa*, Sow.) (op. cit., p. 410).

# The Curragh Basin

## Ballaugh

The Curragh Basin, using the term in the broader sense to include the lower Late-glacial flood-platforms as well as the alluvial tracts, is sharply bounded on the west by the western horn of the drift hills, which rise to 150 feet above O.D. between Ballaugh [SC 34685 93630] and the coast. This high ground has been eroded into a steep sandy bank, which runs north and south for 1<sup>3</sup>/<sub>4</sub> miles from Broughjairg [SC 33931 93516] near Ballaugh to Ballakinnag [NX 41059 02275]. In several places along the summit of this bank neolithic chipped flints are abundant. At its foot is spread out the broad delta of slaty gravel from Glen Dhoo (p. 448), which falls from a level of 130 feet just inside the Gleu to 50 feet or under near Ballakinnag, where it is merged into the low platform of the northern margin of the depression. Through this delta the present stream from Glen Dhoo has carved a little valley, extending to the coast at Ballakinnag (p. 104), which contains narrow strips of alluvium of some antiquity. In the east bank of this stream, near Ballacorage, 200 yards S. of St. Mary's Old Church [SC 34427 95282], a small section was exposed in 1894, showing 2 feet of grey marl resting on 6 inches of peat, with slaty gravel and sand below. Specimens of the marl and peat were washed and sifted by Mr. J. Bennie, and the material examined by Mr. C. Reid, but proved poor in results, the only determinable plant being *Isoetes*. Peat is reported to have been dug beneath 6 feet sand, on the platform near the farmstead of Corvalley [SC 33911 95255] 300 yards farther south, but is not now visible. The low land to the west of the stream, south of Ballacooiley [SC 33761 94038] (Sheet 4) is stiffish, as if the gravel were mixed with clay in this quarter.

The larger of the curious hollows in the gravel delta east of Ballaugh, in which the Irish elk-remains occur, have been described in a previous chapter (p. 375). Smaller hollows, of similar character except that they are dry and sandy in the bottom, occur around Ballacrosha [SC 35457 94190] (Sheet 4), and Squeen [SC 35785 94452] 200 to 300 yards east of those described; and the extremely irregular and deeply indented boundary between the boggy Curragh and the dry ground at the edge of the gravel platform immediately to the eastward, between Ballavolley [SC 36242 94210] and Ballaterson Beg [SC 35538 94645], probably indicates that more of these depressions are hidden beneath the Curragh peat. It is not unlikely that in early Post-glacial times the flood-waters from Glen Dhoo have occasionally taken this course into the old lake. Northward along the platform the slaty debris dwindles in size, and the ground becomes more sandy as we reach the outer fringe of the delta; and north of Ballacorage, where shown by the dotted line engraved on the map, the slaty gravel loses its identity. Between this line and the Killane River the surface-geology is difficult to render. The tract appears to represent that portion of the bottom of the Late-glacial lake upon which very little sediment was deposited. Judging from the coast-section (p. 423) and from the sharp truncation of the Jurby platform, the upper part of the glacial deposits have been denuded off, down to the level of about 40 feet above O.D., and a thin irregular covering of sandy wash spread out over the denuded surface. On the map the tract has been shown by the same colour as the Late-glacial Flood-gravels, since no practicable alternative suggested itself; but this must only be taken as representing the age of the terrace, and not the character of the deposits upon it; the soil is generally a dampish sandy loam with few stones. There are large old clay-pits at Ballamona Mooar [SC 34700 96215] and Ballamona Beg [SC 34770 95858] which show from 2 to 5 feet of discoloured sandy wash with a little gravel and yellow sand, resting on thick warpy clay which is probably that of the middle portion of the drifts in the cliff-section; no stones were seen in this clay, but two or three far-travelled boulders lying on the floor of one of the pits had probably been dug from it. Several smaller pits, mostly without present exposures but apparently in similar deposits to the above, are scattered over the area farther east, between Ballamona and Close Taggart [SC 36435 95931], and also along the northern margin of the Curragh north of Killane river, between Ballacain [SC 35665 97242] and Sandygate [SC 37505 97316]. I was at first of opinion that this warpy clay might represent the deposit in the stiller waters of the lake at the 40 foot level; but after re-examining the coast-sections between Jurby and Ballaugh, I concluded that it was of older date, and, though probably of fresh-water origin, was derived direct from the ice-sheet.

This sandy flat sinks gradually and irregularly eastward until covered with more modern alluvium, which at first occurs in detached patches occupying little basins, or in broken strips; but afterwards expands into the broad level sheet of the Curragh. The different divisions of the Curragh, with their respective levels, have been explained in the general chapter (pp. 406–9). The south-western basin extends up to the foot of the steep bluff of slate known as Gob y Volley, having apparently been screened by this headland from the mountain-detritus which has been swept down the valleys and usually occupies a platform between the hill-slopes and the alluvium. The middle of this basin is still a peat-bog, but along its ill-defined western boundary a thin irregular bed of blue silty mud overlies the peat.

## Sulby

[SC 38653 94350]. The embayment in the hills at the mouth of Sulby Glen is occupied by a broad delta of slaty gravel, 60 to 70 feet above O. D., which runs up to the foot of a steep bank eroded into slaty till. East of Cronk Sumark [SC 39206 94067] this old flood-gravel forms a well marked terrace 10 to 20 feet above the present alluvium of the Sulby; and on the north side of the hill overlies yellow sand belonging to the Extra-insular drift, which is dug for building purposes. This delta, furrowed by an ancient flood-channel (p. 407), stretches out northward in long low spurs into the Curragh [SC 37228 94639], with level tracts of blue alluvial mud lying between and partly overlapping them. There is a tradition in the neighbourhood that the Sulby River once escaped in this direction to the Lhen; but the story, like that regarding the growth of The Ayre beach (p. 402), has probably been suggested by the shape of the ground rather than by ancestral recollections as claimed, as this condition is not likely to have obtained during historic times. The above-mentioned spurs occur at intervals from The Rule on the west to Closechyrrim on the east, dying down gradually to the Curragh-level northward. The main road leading across the Curragh from Sulby Glen Station [SC 38960 94821] to Sandygate [SC 37467 97343] takes advantage of one of these gravelly rises, while another, 34 mile farther east, is traversed by the road from Sulby Bridge Station to St. Jude's. The alluvium on the northern margin of this part of the depression is more or less sandy from the washing in of the drifts. It contains in many places beds of peat with large trees, generally covered with sandy wash or blue manly clay; but the only sections are in the banks of shallow drains, so that the full thickness and sequence of the post-glacial deposits cannot be ascertained. The bog-wood is best exposed in the drain to the east of the Sandygate road, S.E. of where the road level '36' is marked on the one-inch map; it may also be seen in the same drain west of the road, ■ mile farther south.

## Lezayre

There are traces of sandy terraces at the northern margin of the Curragh between Closeakewin [SC 38491 96887] and Cronkglass [SC 40911 96278], and again S. and S.E. of Ardonan [SC 42890 96650], probably representing the 40 ft. terrace of the country farther west; but they are too indefinite to be mapped separately, and have therefore not been distinguished from the glacial sand and gravel. The islands of dry sandy ground in the Curragh E. and N.E. of Closechyrrim [SC 39436 95405], referred to in the previous chapter (p. 409), probably constituted the islands of Lake Mirescogh mentioned in the old "Chronicon Mannae".<ref>See Cumming, "Isle of Man", p. 217, where an account is given of "a notable miracle wrought [in 1249] by the intercession of St. Mary of Rushen " in the escape of a prisoner from one of the islands, as recorded by the old monks.</ref> The best defined of these is that on which the farm of Close-an-Allan [SC 40127 95563] stands; it is about 100 yards long by 100 to 200 yards broad, and is composed of yellow sand and drift-gravel, apparently resting in places on red clay, and overlain around the margin by a wash of peaty sand. Another tract of similar composition, but lower and lass definite, lies 1/4 mile to the southward, around Ballamona [SC 34776 96060]; while the third forms a low narrow strip on the north side of the Sulby River west of Lezavre Station. The last two seem to be portions of a sandy bank which may once have run continuously under the slate bluffs between Sulby Glen and Glen Auldyn [SC 40940 94213], but has now been cut up by the Sulby River and partially overspread by slaty debris from the little ravines at Glenduff [SC 41158 94038], Glentramman [SC 41639 93961], and Glionne Killey [SC 42332 93999] (Sheet 5). The river-alluvium is bounded by a sharp bluff of this drift between Sulby Bridge [SC 39272 94725] and Ellanbane [SC 40906 94601], in which yellow sand is frequently revealed; and the same is again the case at Ballakillingan [SC 42511 94413]; the sand is obscurely associated with slaty drift where it approaches the solid rock, probably in the same manner as in the coast-sections at Ramsey [SC 44830 94526] and Gob ny Creggan Glassey [SC 29585 88519] (Figure 91), (Figure 92) and (Figure 93); thus, 10 ft. of slaty till is visible in a little gully near Kerroo Mooar, 150 yards west of Bellevue, (Sheet 4).

The character of the alluvium in the Lezayre Curragh has been modified by the presence of this sandy border on all sides, its soil being for the most part a lightish loam. In peaty earth thrown out from a trench 550 yards N. of Ellanbane [SC 40910 95109] were many hazel nuts, some gnawed by a rodent, together with a horse-chestnut and cherry-stones. The little valleys which drain from the drift-platform into the embayment of alluvium north of Riversdale have already been noticed (p. 436); they must have brought down much material into the hollow, and can scarcely have transported it thence through the old lake into the sea, so that this part of the basin may originally have been of considerable depth.

## Milntown

[SC 43745 94253]. The conditions at the mouth of Glen Auldyn are precisely similar to those at the mouth of Sulby Glen. A broad flat delta of slaty gravel and wash, furrowed by old channels, is spread out around its entrance, and sends processes (shorter than those of the Sulby), into the alluvial flat. When traced up into the valley, the delta contracts into a terrace lying at the foot of an eroded bluff of slaty till. This terrace at first ends off against the alluvial flat of the stream in a steep bank, which gradually loses its distinctness as the bottom of the valley rises, and finally disappears. To the east of the delta a bank of the Extra-insular drift is again found at the foot of the slate-bluff, between Crossags [SC 44091 93712] and Claghbane [SC 44589 93693] (Sheet 5), and extends thence up to the coast. It consists at first of yellow sand with streaks of red clay, but N.E. of Claghbane stony red clay of the usual Extra-insular type occupies the surface. At the foot of the bluff this drift is overlain by slaty rubble, as in the adjacent cliff-section (Figure 91).

## Ramsey

[SC 44617 94708]. The alluvium bordering the Sulby River between its confluence with the Glen Auldyn stream and Ramsey is so little above present high-water mark that the tract can scarcely have escaped estuarine conditions during the Raised Beach period; but so far as the insufficient exposures in the ditches show, the material maintains its tluviatile character close up to the town. The Harbour and its vicinity have already been described (p. 430)

# **Central Division**

(Sheets 6, 7, 8, 10, 11 and 14, and parts of 4, 5, 9 and 13 of 6-inch map.)

# Western coast between Gob ny Creggan Glassey and Peel

[SC 29585 88519] to [SC 24485 84277]. South of the point where the slate makes its appearance in the cliff (p. 121) the drifts are banked (irregularly against the flanks of the massif, lying thicker or thinner according to the slope of the surface upon which they rest, in some places dwindling to a mere film, and in others, where they fill bays in the ancient coast line, forming the greater part of the cliff-section. In composition the deposits show the same irregular intercalation of Insular with Extra-insular drift as already described at Glen Mooar and Gob ny Creggan Glassey, the one material or the other predominating according to the local conditions.

For half a mile to the southward of the Glion Shellan exposure [SC 28961 87940] ((Figure 93), p. 348) the cliffs here and there present nearly similar sections; but at Lady Port [SC 28859 87874] the slaty till and rubble increase, in the old valley of Glion Cam [SC 29044 87700], at the expense of the red drifts, and almost monopolize the section.

## Gob y Deigan

[SC 28389 87481] At Gob y Deigan the foreign drift regains prominence, consisting, at the base, of 15 feet of partly indurated shelly gravel; which passes up into slaty till; overlain by red clay containing shells, and sand. South of this point, at Lhiannag [SC 28323 87279] (Sheet 6), the drift increases greatly in thickness, having obtained lodgment in the broad hollow around Ballabooye [SC 28052 86937], through which the ravine of Glion Broigh has been excavated since glacial times. Down this hollow a great amount of partly re-arranged grey slaty drift has been swept from the hills; this material overlies contorted red clay and sand, both in the cliff-sections and in the steep sides of the glen. The railway-cutting at the top of the slipping cliff above Lhiannag [SC 28400 87240] also shows good exposures of drift, the general succession being the same as at Glion Shellan. At the southern end of Lhiannag [SC 28202 87115] the cliff

reveals the following section:

	Feet	
At the top: Slaty gravel interbedded with and passing into	about 70	
Red clay, sand and gravel with shell fragments on	about 70	
Blue slaty till and gravel on Slate.	about 20	

A section 400 yards inland, in the S. bank of Glion Broigh 40 yards E. of the highroad [SC 27881 86608], shows:

	Feet
At the top — Grey and blue slaty clay, partly stratified	6
Blue slaty gravelly till, partly stratified	10
Contorted red clay and sand, with a few shells	30 +

#### Ballanayre Strand

[SC 27613 86762]. The surface of slate beneath the drift in the little headland north of the glen exhibits faint indications of striation running W. 10° S.–E. 10° N. South of Ballabooye the slate hills begin to fall back from the coast line, and the shelf below them is then invaded by the red drift, which forma a moundy surface of sand, gravel and red clay.; while in the cliff-section these deposits are seen to overlie dark slaty till in which there are a few foreign boulders. At Wills Strand the Peel Sandstones set in, the slate hills gradually receding farther from the coast, and the red drift still follow ing them inland and usurping the surface at the expense of the slaty drift. These phenomena mark the commencement of the pressing in of the lower layers of the ice-sheet upon the Peel embayment which has been described in a previous chapter (p. 351).

#### White Strand

[SC 26678 85433]. Opposite White Strand the grassy sloping cliff over 100 feet high, is wholly composed of drift, but probably in part slipped, though the base of the glacial deposits at one point apparently descends slightly below high water mark as if occupying an obliterated valley. Many large erratic blocks lie on the shore here between tide-marks' including one of grey Galloway granite measuring 8 feet by 5 ft. by 4 ft.; another, apparently Shap granite. , 4 ft. by 3 ft. by 1 foot; others are of pebbly grit, Ailsa Craig, etc. At Cain's Strand [SC 26257 85344] (Sheet 9), where sandstone forms the lower part of the cliff, the drift-section is clearer, showing: at the top, sand and indurated gravel; resting on sand and coarse gravel with irregular curved kame-like bedding, and brown slaty till containing shell fragments, at the base. Two little glens open out upon the shore at this place within 100 yards of each other; the more northerly is excavated nearly down to sea-level entirely in drift, the following being the section 200 yards from the coast [SC 26350 85286] :

	Feet
At the top: Rolled gravel and sand	20
Slaty till with a few shell-crumbs and some foreign stones	10
Sand and gravel, with many shell fragments	20
Clay? concealed by talus	

In the neighbouring glen [SC 26262 85213] the red sandstone lies at a comparatively high level, and the ravine has therefore not been excavated nearly so deeply another instance is thus afforded of sharp irregularity of the Pre-glacial surface masked by the glacial deposits. Among the boulders in the more southerly of these glens is one of coarse granite of unrecognised origin, measuring 5 ft. by 4 ft. by 3 ft., lying in the valley-bottom 150 yards from the cliff.

Where the coast takes a more westerly trend, S. of Cass Strooan [SC 26201 85276] (Sheet 9), the drifts thin away rapidly, until only a few feet of sand or red clay is found above the sandstone. At Lhoob y Reeast [SC 25712 85081] this thickens to 15 or 20 feet, but dwindles to a mere sprinkle between this place and Creg Malin [SC 25049 84510] where the sandstone cliffs end. We then reach the Pre-glacial depression of Peel Bay, into which the Extra-insular drifts are banked to a great thickness, both above and below sea-level. The Raised Beach is represented in this bay by a narrow terrace

extending from Creg Malin to the Harbour, behind which rises the steep slope of the old cliff, to a height of over 100 feet at the eastern side of the bay hut sinking gradually westward. This old cliff is composed entirely of drift, perhaps at the eastern end banked against a concealed Preglacial cliff or valley-bluff of sandstone. The greater part of its slope and the Raised Beach at its foot are covered by the town of Peel, and there is no natural section; but artificial openings in various places reveal sand, gravel and red stony boulder-clay, all of the Extra-insular type.

The foundations for the sea-wall built in front of the Raised Beach were excavated in sand and shingle. Clear proof that the red drifts underlie the bay was obtained from the works in connection with the extension of the breakwater which runs out from St. Patrick's Isle. The foundations of this extension were in purple boulder-clay containing a few shell-fragments. In 1893 I was able to examine the material from some borings into the sea bottom below low-water mark, made with a view to further additions to the breakwater, which gave the following results:

#### Borings beneath the Sea in Peel Bay

(The first column gives the engineer's journal; the second, my notes on the material preserved.) In the region of [SC 24344 84690].

No. 1 Boring 250 feet from end of old breakwater, or 50 feet from end of extension, on the S. side.

	Feet	
Shingle	6	Pagant
Sand	2	Recent
Clay	41⁄2	Purple boulder-clay
	12½	

No. 2 Boring Same distance from old breakwater as No. 1, but on the N. side.

Sand	3	Descet
Shingle	3	Recent
Mixture of sand and clay	1/2	
Sand	1	Darkish sand
Sand and clay	1	
Clay	21/2	Purple boulder-clay
	21/	Clean sharp sand (like recent
Sand	272	sand)
	12	

No. 3 Boring 350 feet from end of old breakwater on the S. side.

	Feet	
Sand	2	Decent
Shingle	2	Recent
Clay and sand	3	Sandy purple boulder-clay
Fine shingle	21/2	Sharp sand and small stones (like
Sand	21/2	recent beach)
	12	

No. 4 Boring Same position as No. 3 (on N. side ?).

	Feet	
Sand	2	Recent
Sand and clay	8	Purple clay mixed with sand
Sand	21⁄2	Sharp sand
	121⁄2	

#### No. 5 400 feet from end of old breakwater, on the S. side.

	Feet
Sand	4
Sand and clay	6
Sand	2
	12

#### Peel Castle

[SC 24156 84568] On St. Patrick's Isle only a trace of drift is found outside the castle walls, but inside there is a little patch of gravelly and red clayey material which has been much disturbed for making earthworks (see (Figure 39), p. 147). An ancient well at the edge of this patch is commonly reputed to yield an inexhaustible supply of excellent water, but I found on close inquiry that as might be expected, its capacity is very modest; and as the place is frequented by crowds of visitors in the summer, the quality of the supply may also reasonably be doubted. It is worth noting in regard to the antiquities of the Castle that all the smaller and several of the larger of the stone cannon-shot which are preserved in the little Museum and are described as having been fired into the enclosure by invading Scots, are made of Foxdale granite, carefully dressed into shape. Of the remainder, one or two are of a granite like the Galloway granite boulders; but there are several stones, more rudely shaped, of a pale softish rock, which do not seem to be of Insular origin. There are traces of a glaciated surface on the slate-rocks just outside the castle wall east of the **Prison** (see List, p. 477).

The description of the coast-section south of Peel is resumed on p. 460.

## Eastern coast between Ramsey and Douglas

[SC 45367 94449] to [SC 38154 75563]. East of the section shown in (Figure 91), p. 346, the slate slope is too steep for much drift to lodge; and as the upper part of the cliff is grassy, there are few exposures in the little that does occur, which appears to consist of slaty rubble with interbedded streaks of red clay. The slipping of masses of this material down the dip-slopes of slate produces striations on the rock-face at the summit of the cliff, which resemble those due to glacial agency and have been assigned to that cause (p. 359, footnote). Although a Pre-glacial cliff no doubt existed in this locality such striations may be found on rock-faces which cannot have been in existence in Glacial times. They occur here and there all along the east coast wherever the conditions are favourable for their production. That they should resemble glacial markings is to be expected, since both are alike due to the sliding of stony rubble under pressure in a definite direction over the rock-surfaces, the difference being that in the one case the slope is essential and always determines the direction of the striie while in the other it is non-essential and the striae only accidentally coincide with it.

## Port Lewaigue

[SC 46500 93086] The presence of red boulder-clay on the foreshore outside the narrow rock-shelf between Ballure and Lewaigue has previously been mentioned (p. 347). In Port Lewaigue (Sheet 5) this rises along the cliff into a prelacial hollow and is exposed in the disused brickyard on Tableland Point Gob ny Rona of revised Ordnance map) in a section exhibiting up to 15 feet of red stony clay with streaks of stoneless clay and of sand and gravel. Mr. Kendall, who figures this section (in (fig. 9) of his plate), notes the occurrence of a few shell-fragments in the lower part, and states the order of prevalence of the stones to be as follows: "Red Sandstone, Granite (all Scottish), Silurian Grit (probably from Wigtonshire), Clay Slate, Vein Quartz, Flint". (Op. cit. p. 415.) Similar material lines the cliff-top up to Port e Myllin (Mwyllin of 6 inch map) and probably also again underlies the lower part of the foreshore there.

#### Maughold

[SC 49778 91385]. Having once obtained entry at this low point, the red clay runs south-eastward up the depression between Maughold Head [SC 49852 91345] and Slieau Lewaigue [SC 45734 92099] (p. 347), occupying the whole breadth of the valley, but fading off into slaty drift on the western slopes, along the dotted line drawn on the map. On the eastern slope it is covered by or passes into a moundy sloping bench of gravelly drift, consisting of slate-fragments with a

fair sprinkling of foreign pebbles. In the valley-bottom (in which are a few old clay-pits) the present drainage, artificially assisted, goes in part north-west to Port e Myllin [SC 47429 92740], and in part south-east to Port Mooar [SC 48840 90956]; and in two places level patches of peaty alluvial wash indicate old flood-basins. The incurving coast-line south of Maughold Head intercepts the valley again at Port Mooar; and in the cliffs around this place and in patches on the foreshore the red stony clay, with interbedded sand and tratified stoneless clay, is here and there well exposed.

On the outer or northern side of the headland the slope is too steep to retain more than a little rearranged slaty rubble mixed with foreign stones. Glacial striae occur at two or three places on the crest of the ridge, and afford remarkable proof of the swerving of the ice-flow in rounding this corner of the Island (see List, p. 476). Numerous large erratics are scattered upon the headland and its shores, regarding which Mr. Kendall notices the remarkable abundance of slaty quartzose grit, which he identifies with the Queensberry Grit of Wigtonshire (op. cit. p. 415). These boulders have been studied and catalogued by Rev. S. N. Harrison of Ramsey, who discovered, among other rare and interesting rocks, a rounded block of Arran Pitchstone (identified by Professor Zirkel), 4 feet in diameter, on the shore at Port e Myllin, and one of gneiss at Ballure.<ref>"Boulders around the Maughold Coast", Yn Lioar Manninagh vol. i.; pt. 8, p. 208; see also Mr. Harrison's "Report of the Geological Section,' ibid., vol. i., pt. 11, p. 375; and Reports of Erratic Blocks Committee, British Assoc. Reps. for 1891, p. 297–9; 1892, p. 286–9; 1893, p. 521.</ref>

## Gob ny Garvain

[SC 48873 89838] A narrow strip of Raised Beach lines both sides of Port Mooar [SC 48816 90835]; and a broad rock-platform, slightly above high-water mark, indicates tie old shore whore the beach stuff is absent. As we pass southward from this inlet the solid rock rises in the cliff, and the red clayey drift becomes thinner and in places disappears. On the south side of Gob ny Garvain, where a little gravelly and red clayey drift rests in a slight hollow in the rock, the surface of the flags shows glacial striae in two directions, the older, N. 10° W.—S. 10° E., and the newer, E. 10° N. — W. 10° S.; this is the more noteworthy as striated surfaces are of rare occurrence directly beneath the red drift. From this point to Port Cornah [SC 47412 87845] (Sheet 8) the drift, where present at all, is confined to mere traces of red clay mixed with local rubble and foreign pebbles, too impersistent to map. At the last-mentioned place a valley-terrace of gravelly drift, probably deposited by late-glacial floods, reaches the coast on the western side of the deep glen: and half a mile inland there are some fine sections in boulder clay in the glen (p. 450). For the next 1½ mile southward there is no drift in the vicinity of the coast.

## **Bulgram Bay**

[SC 45677 85615]. We then reach Bulgham Bay, where the profile of the cliff is unusual, an undercliff of slate, 30 to 50 feet high, forming the sea margin, with a great precipice rising. to over 600 feet behind it, the two being separated by a gently sloping cirque-like platform which tapers out crescent-wise northward and southward. On this interspace some clayey slaty rubble containing a few blocks of Dhoon granite and a sprinkling of foreign pebbles has lodged this resembles drift, and if really in place and not simply material dislodged from the cliffs, it would indicate that the inner cliff is pre-glacial The platform is not easy of access, and is so cumbered with fallen blocks and overgrown with tall bracken in the summer that its exploration is difficult; the remains of a carefully constructed ancient pathway may be traced in the upper precipice.

#### Laxey Bay

[SC 43992 83453]. South of Bulgham, the inaccessible cliffs are composed wholly of slate, until we round Laxey Head, where the coastline is broken by the preglacial valley of the Laxey River [SC 44333 83683], which is lined on both sides by banks of drift (p. 451). A triangular strip of Raised Beach is preserved at the mouth of this glen. From the abrupt cessation of the solid rocks on the foreshore, it is probable that the preglacial valley is excavated below sea-level, and. that its drift-filled channel underlies the beach, but no exposure was visible on the shore during my examination of the area. This matter may be of practical consequence if new harbour-works be constructed at Laxey. It is also not unlikely

that drift may exist beneath the beach exposed outside the rocky shelf at low spring tides for some distance south of Laxey, the conditions bearing much resemblance to those between Ramsey and Lewaigue.

Between Laxey [SC 44333 83683] and Garwick [SC 43418 81469] the slate cliffs frequently have a capping of rubbly drift, but being dip-slopes, rarely show sections at the top. The cuttings of the electric tram-line to Douglas, which hugs the coast, have however made good this deficiency. At Ballybeg [SC 43392 82291] the cutting which crosses an old burial ground with stone cists reveals 6 feet of slaty gravel-drift, becoming rather clayey in places towards the top. South of this locality the excavations show a more clayey material of variable thickness, containing a few blocks of Dhoon Granite.

#### Clay Head

[SC 44345 80466]. In Garwick the drift is again deeply banked in a preglacial hollow, which has been partly re-excavated to form Glen Gawne [SC 43109 81374] (Sheet 10). There is a good section at the mouth of this glen in a cut-road descending the cliff on the northern side, showing 20 feet of grey till in which the majority of the stones are slate, but with a few foreigners. In the stream-bed a curious unidentified boulder of richly micaceous garnetiferous pegmatite was found by one of the cottagers at Ballig [SC 42953 81209], from whom we obtained specimens.. Between Gob ny Stowell [SC 43674 81304] and Braggan Point [SC 44087 81062], ■ of a mile south-east of the glen? an irregular strip of red pebbly clay 200 or 300 yards in length, containing a few foreign pebbles, is lodged in an unusual position upon the steep slope just above the actual cliff. This has furnished the Laxey miners with material in which to stick their candles, and appears to have given rise to the name of the headland, which is not very appropriate considering the small extent of the patch and the bold rocky character of the whole promontory. Glacial strum at three places on the headland in the vicinity of the cliff, along with other examples farther north and farther south, indicate a general ice-movement parallel to the coast (see List of Striae, p. 477).

On the southern side of Clay Head there is little or no drift until we reach the depression at Port Groudle [SC 42055 78209] (Sheet 14), where on the north side of the inlet a little platform of rubbly local drift, containing a few red sandstones and other foreign pebbles, with a depth varying from 8 to 20 feet, is exposed in the cliff section.

#### **Banks Howe**

[SC 41686 77973]. On Banks Howe (Sheet 14), as is so often the case throughout the Island, the steep northern side of the hill is practically free from drift, and is scored in many places by glacial strie, sometimes in more than one direction (see List), while the less steep southern side possesses an irregular capping of till and glacial rubble, as may be seen in the cliffs to the east of Onchan Harbour [SC 40504 77673]. Fragments of the Groudle mica-diorite (p. 152) occur in this drift. Similar drift is exposed in the tram-line cuttings between Onchan Harbour and Port Jack [SC 39981 77297], and at the cliff-top west of Port Jack. All along the east coast the foreshore is sprinkled here and there with extra-insular boulders; a notable example occurs on the western side of Port Jack, where one of the blocks is a rounded mass of grey (Galloway ?) granite 6 feet in diameter. At the same place are smaller blocks of Dhoon Granite.

#### **Douglas Bay**

As we enter Douglas Bay [SC 39550 77408] (Sheet 13) the drifts thicken, but are for the most part concealed by buildings. At Derby Castle [SC 39626 77385] a strip of Raised Beach is preserved at the foot of the slate cliff, and continues thence around the bold crescent of the Bay up to the Harbour [SC 38370 75187]. It is protected throughout by a sea-wall, and in the middle of the bay has a little blown sand upon it. This low terrace with its open front, backed by large houses and the steep bluffs of the old cliff behind, combine to give that imposing aspect which characterizes Douglas as viewed from the sea. At Strathallan Park [SC 39500 77450] the top of the cliff shows a gravelly rubble of slate with a few foreign pebbles, becoming more clayey towards the surface. This is broken by Glen Crutchery [SC 39334 77476], but is continued again on the south side, and near Athol House begins to show streaks of red clay. At Falcon Cliff [SC 38706 77000] as the drifts thicken the presence of the Extra-insular material becomes more marked, beds of stratified sand, gravel and warp associated with tenacious red clay making their appearance. South of the last-mentioned place the preglacial cliff of slate recedes inland, and the glacial deposits which are banked against it occupy the whole of

the high bluff south of the ravine behind Castle Mona Hotel [SC 38615 76818]. At the mouth of this ravine there are sand pits showing 10 to 12 feet of fine stratified sand, with bands of loam and lenticles of gravel; and near the base, a bed of stiff red and purple clay with a few stones; below which is clayey gravel; the whole mass resting against, and perhaps partly slipped upon, a steep rock-slope. This section, like those in similar positions m localities previously described (Figure 91), (Figure 92), (Figure 93), represents the wedging out of the Extra-insular drift against the higher ground occupied by the slaty drift. There seems to have been a pre-glacial valley in this vicinity, perhaps a former outlet of the River Glass, into which the lower layers of the ice-sheet have entered. A gap a little over 100 yards wide in the rock-reefs at low water on the shore nearly opposite, which is indicated in the ornamentation of the ordnance map, probably represents the prolongation of this channel below sea-level. Some patches of indurated slaty gravel resting on a surface of decomposed slate were exposed in 1896 on the beach to the westward of this gap; but recent beach-stuff hid the part of the shore which is most likely to be underlain by drift alone.

South of the section above described the slope of the old cliff becomes less steep and more encumbered with buildings, and there are no more open exposures. The character of the drifts in the upper part of the town was, however, revealed in drainage and other works carried on during our survey; and the evidence thus obtained supplements that of the cliffs.

There is a small section in brown weathered rather gravelly boulder-clay in a cutting on the Peel Road at the south-western outskirts of the town, half a mile from the shore; and similar material appears to occupy the surface over the whole of the rounded hill between the valley of the Glass south of Cronkbourne [SC 37224 77362] (p. 456), and Douglas Bay. The majority of the stones in this clay are of slate, but with a fair sprinkling of foreigners. Boulder-clay of this kind was exposed in Bucks Road [SC 37874 75851] and its prolongation up to Woodside Terrace [SC 37784 76251], and also in Upper Derby Road [SC 37866 76323], and in several places farther west. In the slight depression farther north, which perhaps marks the filled-in preglacial valley previously mentioned, the drift becomes more sandy, and on both sides of Ballaquale Road [SC 38024 76782] sand is the prevalent constituent and has been dug in several places. It appears to be continuous with that seen in the cliff near Castle Mona [SC 38679 76840]. It was well exposed in the tramway excavations and in the foundations for the tramway engine-house. In a sand-pit opposite Ballaquale Cottage [SC 38183 76790] the section showed 3 to 5 ft. of stony loam (perhaps partly wash), on 12 feet or more of sand with contorted warpy streaks; gravel was said to occur below the sand. On the rising ground north of the sandy hollow the drift gradually resumes its previous stony-clay character.

In the lower part of the town bordering the harbour the Raised Beach fades off indefinitely in the alluvial river-fiat. At the brewery on the north side of the harbour, 40 yards east of the Douglas Bridge road, [SC 37867 75140] I was informed that a pipe-well starting at about 17 feet above O.D. passed through 14 feet of made ground and loose shingle, and 26 feet of compact clay, to slaty rubble yielding fresh water of good quality. Another well, 9 yards north of the last, reached the water-bearing stratum at 30 feet, the compact clay being only 16 feet thick. Nuts are said to have come up the pipe from the bottom of the well; but as the "compact clay" is likely to be boulder-clay and not alluvium, the evidence seems scarcely sufficient to establish the presence of vegetable remains at this depth.

# Interior of the Central Division

## **Bishopscourt**

At the north-west corner of this area, between Ballaugh [SC 34769 93453] and Kirk Michael [SC 31684 90651] (Sheets 4 and 7) we find the sandy drift-mounds sweeping up to the foot of the solid hills, and south of Bishopscourt [SC 32731 92374] mounting a little way on their slopes. The basins among these mounds bordering the massif appear' to have held temporary lakelets, of similar character to the Curragh Lake, but of much smaller dimensions. The largest of these minor basins lies between Orrisdale [SC 32569 93034] and Bishopscourt [SC 32767 92402]; it has been distinguished on the map by the 'Late-glacial Flood-gravel' colour and sign, but its level floor is for the most part composed of sandy or silty wash, with a little patch of newer peaty alluvium at the southern end. It probably persisted as a lake in flood-times until drained by the excavation of Glen Trunk [SC 31984 92275] (p. 425). A small pond still existing on the north side of the highroad half a mile N.E. of Bishopscourt appears to occupy a natural depression. South of Bishops court the railway passes through the mounds in a deep cutting, which as, however, now obscured; it has consisted mainly if not wholly of

sand and gravel containing shell-fragments.

#### Kirk Michael district

[SC 31767 90760]. To the east of this place the slate hills have a more gradual descent than usual; and here, east of Whitehouse [SC 32374 90912], the gravel mounds, composed chiefly of slaty detritus, are found up to an elevation of 400 to 500 feet, resting in part on the solid rock and in part onclayey rubble-drift. They extend southward in a broken chain at about the same level up to Glen Wyllin [SC 31500 90091]. Cronk Urleigh [SC 32129 89368], on the east side of this glen, is one of the most prominent of these mounds, while on the opposite side they line the crest of the valley and rise up on both margins of the dry rock-gully near Ballalheigh [SC 31379 89291], as shown in the ground plan (Figure 102), p. 365. The railway intersects these mounds again near East Berks, in a cutting showing 30 to 50 feet of sand and gravel, possibly resting on slaty till almost concealed by talus. They also extend inland along the upper slopes of Glen Mooar for more than a mile, entering well within the slate hills; as may be seen on both sides of the valley around Chester, where small pits and road cuttings reveal sand and fine slaty gravel containing many foreign pebbles (porphyry, flint, etc.), with some streaks of warp and red clay. In the lower part of Glen Mooar, just below the waterfall known as Spooyt Vane [SC 30863 88727] (Sheet 7), and extending thence for 250 yards on the east bank of the stream [SC 30864 88829], there is a grand cliff of slaty till, 40 to 60 feet high, containing, like that at the mouth of the Glen (p. 428), a few foreign pebbles and shell-crumbs. Similar walls of local till are found in Glen Wyllin west of Cronk Urleigh [SC 32023] 89357], where the stream has cut a deep inner ravine in the glacial, infilling of its old valley, the remnants of high-level fluviatile terraces here and there recording the progress of its re-excavation. Three large boulders of Galloway granite and one of coarse grit were noticed in this ravine. As previously mentioned, the 'Fullers Earth' which has been dug in this glen at a place to the southward of Erinville, marked Summer Ho. on the six-inch map (Sheet 7) [SC 31581 90159], forms part of this drift. In the upper part of the glen, near Cammall [SC 31989 88879], the till is overlain by a gently sloping sheet of slaty gravel, which was probably formed at the same time as the great terrace of similar material at the mouth of the glen around Kirkmichael (p. 374), and dates back to the closing stages of the ice-invasion. There are good exposures of drift of strictly local derivation at several places in Glion Kiark [SC 33353 87945], between Sartfell and Sheau Freoaghane, up to its head at over 1,000 feet above sea-level; and again in the north branch of the other feeder of Glen Wyllin, east of Ballalionney [SC 33027 89677]. The mountain-ridge itself is peculiarly free from drift right up to its northern extremity in Slieau Curn; nor, so far as could be discovered, does it possess any straited surfaces. This condition is probably due to the floods which have swept across the corner of the Island during the melting of the ice-sheet, as shown by the dry gullies on the lower slopes described in a previous chapter (p. 364, (Figure 101), (Figure 102)), and by similar indications which may be traced up to the very summit of the ridge. Thus, 200 yards N. of the boundary fence between Slieau Curn and Slieau Freoaghane [SC 34292 90168], a channel (briefly referred to on p. 363) has been excavated in the slate, with a floor 10 to 20 yards wide and walls 20 to 40 feet high, starting on the crest at an elevation of 1,058 feet and descending the slope for a short distance in a south-westerly direction.

#### Glen Dhoo

Where Glen Dhoo opens out upon the gravel platform at Ballaugh [SC 34781 93412] it contains on both sides well-marked terraces conterminous with the platform; and these rise with the valley from an altitude of 120 feet above O.D. at the mouth to about 200 feet at Ravensdale, a mile farther south [SC 34995 91927]. Above this place the valley-bottom contracts and the terraces can scarcely be separately distinguished.

The occurrence of foreign drift in this glen has already been discussed (p. 352); it consists mainly of yellow sand, with some gravel and red clay containing foreign pebbles. Found on both sides of the valley above the gravel-flat, it is best developed on the eastern side, where it extends up to the mouth of Ravensdale [SC 34995 91927]. Its relation to the local drift is shown in the following diagram (Figure 106).

The slaty rubble (3) of this section is a form of the local drift which is plentiful among the hills both on the gentler slopes and on level ground. It appears to represent the material left loose on the surface at the melting of the ice sheet, and has no doubt since been in part redistributed by subaerial agencies. When swept into the valleys, it probably furnished the principal portion of their terraces and deltas. It is generally, as in the present instance, sharply distinct from the till when this is present, but often merges into the stratified drifts. Towards the head of Glen Dhoo, the drift is limited to a narrow strip entirely of local origin; and the same is the case in its tributary, Ravensdale [SC 34995 91927] (Glen Shoggle of 6-inch map, (Sheet 7)), at the head of which there are good exposures near Nascoin [SC 36366 91499]. In a high-lying combe near the head of the main glen, on the northern side of Slieau Dhoo [SC 34551 89836], there is a small crescentic mound, apparently of coarse local rubble, which has been shown on the map by 'boulder-clay' colour. It has somewhat the aspect of a valley-moraine, but the hollow seems too small ever to have held a moving glacier. On the rock-surface below the entrance to this comb: some doubtfully-glacial striae were observed, the only examples found in this part of the island (see List, p. 476).

The high moorland ridge between Glen Dhoo and Sulby Glen [SC 36664 90846] is for the most part free from mappable drift, though loose rubble with a peaty covering lies rather thickly upon it S.W. of Killabgah [SC 37509 90846] (Sheet 7). The short deep glen, tributary to the Sulby, to the west of Mount Karrin, has a thickish bank of local till in the bottom, which is well exposed on the east of the stream, opposite Earybedn [SC 37277 92615] (Sheet 4).

## Sulby Glen

In passing up Sulby Glen from the mouth [SC 38409 94019] (p. 438), we find a narrow strip of local drift on the east bank, forming a definite feature, but not often seen in section. The river-alluvium is broader than usual, and probably somewhat ancient; and the stream has not reached its pre-glacial floor until we are two miles up from the entrance of the glen. Above this point there is very little drift in the valley, or in that of its tributaries, until we reach the head-waters. On the west bank opposite Druidale farmstead [SC 37162 88773] we have an excellent example of those effects of temporary post-glacial stream-deviation described on p. 372, in the form of a deep rock-gully which gashes the valley-wall high above the present river. Other deviations are indicated ½ mile higher up the valley, where the river does not seem yet to have found its buried pre-glacial bed. In this locality high banks and cliffs of slaty till, rising in places up to 70 feet in height, form the southern side of the valley and continue up to the head-waters, at over 1,000 feet above sea-level [SC 34709 86919]. In two places in these excellent sections I noticed dragged-out streaks of red clay and sand of Extra-insular aspect among the local till, but failed to find any foreign pebbles.

A narrow tongue of this drift sweeps across the col, at 1,100 feet, between Sartfell and Slieau Maggle [SC 34384 86714] (Sheet 7), into the basin of the Neb River [SC 33933 86195] (p. 453), while the main mass spreads out in an irregular sheet eastward up to the slopes of Beinn-y-Phott [SC 38097 86086] and Snaefell [SC 39785 88128]; it is well exposed in places in the upper part of Glen Crammag [SC 37263 86455]; and less clearly in the glen west of Snaefell, where it runs up to 1,350 feet and crosses the col to the headwaters of the Laxey River (p. 451). It is frequently covered by boggy hill-peat, which attains a depth of 6 feet or more on the northern slopes of Beinn-y-Phott, and here has been extensively dug. At the higher elevations the clayey till becomes more rubbly, and on the steeper slopes fades off into moundy slaty debris containing many scratched stones.

Similar material sweeps round the northern shoulder of Snaefell [SC 40539 88361], and again crosses into the Laxey basin at an elevation of 1,380 feet; while northward and north-eastward it extends to the head of Glen Auldyn [SC 41442 90126] and of the eastern tributaries of the Sulby, where however it is thinner, less continuous and without conspicuous sections. The northern side of Slieau Monagh [SC 39643 90951]. on which occurs the glaciated quartz-vein of Creg Bedn [SC 39466 91332] previously described (p. 361 and (Figure 99)), (Figure 100), is almost free from drift; as is also the greater part of the high moorlands between Sulby Glen and Glen Auldyn [SC 40710 90876]. The northern end of the ridge, above Ballamanaugh [SC 38995 93863], differs from the rest of the northern bluffs in being apparently swarthed in drift to more than half its height, perhaps due to its sheltered position within the mouth of Sulby Glen. In the Narradale depression [SC 39883 93448] the drift is thinly spread, except in one portion of the lower part of the glen, half a mile E. of Cronk Sumark (Sheet 4), where the stream appears to have broken into an old ravine filled with till.

## Glen Auldyn

In Glen Auldyn the phenomena of Sulby Glen are repeated, the local drift occurring as a narrow sloping platform chiefly on the eastern side of the stream, with good sections, showing 20 to 40 feet of slaty till, near the head-waters. Its smaller tributaries descend over steep slopes of bare slate, but intersect this platform in the trunk-valley, while their gathering ground on the upland is generally more or less drift-covered.

#### North Barrule and Snaefell Hill-chain

On the high moorland to the eastward which culminates in the long steep ridge of North Barrule and Clagh Ouyre (p. 139), rubbly drift, based in places on slaty till, forms a fairly continuous sheet covering the smooth slopes below the broken craggy crest, as may be seen in the cuttings of the mountain-road; but this sheet splits northward into lobes at the head of the little glens which gash the plateau above Ramsey, leaving the intervening ground for the most part free from drift. On the ridge itself scattered blocks of local dyke-rocks and quartz, with occasional glaciated fragments of slate in the thin surface-rubble, would suffice to prove that ice had swept over the crest, were other evidence wanting. But still more convincing proof is afforded by the glacial striae winch are found at intervals along its whole length, from Slieau Lewaigue close upon the east coast; across North Barrule [SC 44284 90992] and Clagh Ouyre [SC 41447 88952] to Snaefell [SC 39767 88090]; and thence across Mullagh Ouyr [SC 39789 86153], Carn Gerjoil [SC 39316 84107], Slieau Ree [SC 37976 82331] and the more westerly spurs, up to the central valley. As the position and character of these striae are indicated in the List (p. 476), they require no further description. In many other places where no striae could be detected, the rock-surface is distinctly *moutonnée*.

There is a little rubbly and clayey local drift around the northern end of North Barrule near Dreem e Lhergy [SC 45563 92047], and this spreads in a thin covering southward and eastward around the flanks of Slieau Lewaigue, descending into the Cornah valley [SC 46744 89659] in the one direction, and in the other to the western side of the Port e Myllin depression [SC 47443 92750]. In the last-mentioned locality, as it reaches the lower part of the slope a few foreign stones make their appearance, at about 250 feet above sea level; this is best seen in a weep gutter which descends the slope from a house by the roadside near Ballasaig [SC 47051 91280], 600 yards S.S.E. of Lewaigue, where there is a section showing about 10 feet of slaty-rubble drift with some extra-insular pebbles; and a 4-ft. boulder of grey Galloway granite, and another of coarse granite not unlike that of Shap, 3 feet in diameter, lie in the bottom. At the foot of the slope red clay is seen, as previously described (p. 444). Similiar conditions prevail all along the eastern flank of the massif; but south of Laxey the intermingling of the foreign with the local material becomes more intimate and extends farther inland.

## **Cornah Valley**

Between the hamlet of Cornah [SC 46702 89671] (Sheet 8) and the coast [SC 47297 87881] the valley-floor is flat and fringed with gravel terraces, except at one place just above the confluence of the Rhenab tributary, where the stream seems to have missed its preglacial channel. This part of the valley is thinly lined on both sides with local drift, in which a streak of red clay was noticed about ¼ mile from the coast. The rocky glen above Cornah [SC 45767 89689] is clear of drift until we approach Corrany, where there is a little river-flat in which some recent changes have been made in the water-course. West of Corrany [SC 45341 89646] we enter a broad glen running back into the heart of the hills, which appears to be an older feature than the lower valley. Local drift of the usual hill-type is thinly overspread on the northern side of this glen up to 1,000 feet or more above the sea-level, but on the steeper southern side is more restricted. As is generally the case in upland valleys of this character, the present stream has almost everywhere reached the rock-floor, and the drift forms grassy banks somewhat above the valley-bottom which constantly tend to slip. On the high-lying slope near Park Lewellyn [SC 43881 90017] (Sheet 8) there is a group of large blocks of slate and greenstone which, if in their natural position, are rather suggestive of a small valley-moraine; they may, however, have been artificially brought together for some purpose in prehistoric times. If morainic, their occurrence is exceptional, as indications of valley-glaciers, so common in Scotland and Wales, are conspicuously wanting in the. Island.

Returning to the mouth of the Renab tributary [SC 46725 88539], we find for 200 or 300 yards on the northern side of that stream a high cliff of slaty till, while the opposite side is a bare rock-slope. Although the Dhoon Granite crops out on the crest of the hill, <sup>3</sup>/<sub>4</sub> mile to the southward, no fragment of it was found in this drift. Toward the head of one of the branches of the stream, which descends directly from the granite near Ballig, one or two boulders of this rock were, however, noticed. Another of its branches, 150 yards south of Trinity Church [SC 45300 88776], exposes slaty till 16 feet thick, resting on decomposed red and yellow slate-rubble. This material continues in a broadish strip northward to Corrany, being proved to a depth of 12 feet in a well at Ballacorteen [SC 45705 88866]?400 yards E. of the church; and also extends southward, along a shallow depression, across the granite outcrop, to the head of Dhoon Glen; leaving Barony Hill [SC 46171 87384] to the eastward and Slieau Ouyr [SC 43671 87931] and Slieau Ruy [SC 44099 87259] to the westward practically free from drift.

#### Dhoon Glen

To the southward of the granite, while slate still constitutes the main ingredient of the glacial deposits, the igneous rock has contributed freely, especially to the upper or more rubbly portion. There is no drift in the deeper part of Dhoon Glen [SC 45344 86454], but a thick mass fills its higher valley and is exposed in sections 30 to 40 feet deep on both sides above the upper highroad. A mining adit 70 yards long, driven northward from the valley a few yards west of this road, is said to be entirely in till. On the slopes above Rhenny [SC 44908 86576] the drift becomes thin and rubbly, and in this form extends over the western part of The Dreem [SC 44643 86312] at an elevation of 900 feet, descending thence into the Laxey basin. The eastern portion of The Dreem is without mappable drift, but boulders of Dhoon Granite are plentiful there. South of The Dreem thin drift covers the upland, but fades out on the brow of the Laxey valley.

#### Laxey Basin

Near the mouth of Laxey Glen, on the northern slope east of Minorca [SC 44052 83942] (Sheet 11), there is a well-defined terrace of slaty gravel with streaks of red clay, 50 to 60 feet above the present stream; and portions of a similar terrace are traceable on the opposite side, just above the confluence of Glen Roy [SC 43418 84401]. These are no doubt equivalent to the 'Late-glacial Flood-gravels' of the northern glens, and have probably at one time been connected with a delta outside the valley-mouth, which has been removed by the sea. Up to its junction with Glen Agneash the river possesses a terraced alluvial flat, and has not reached its pre-glacial floor; but above that point its alluvium contracts, and solid rock is constantly seen in the stream-bed. Irregular strips of rubbly drift, in places covering hard slaty till, line the valley on both sides, generally a little above the bottom, up to its head, filling the high cols north and south of Snaefell [SC 39798 88119] to a considerable depth. A large boulder of Dhoon Granite lies at the edge of the alluvium 500 yards above the Agneash confluence but none was seen higher up the valley, and the fragments of 'contact-rock' observed by Mr. Kendall on the flanks of Snaefell

At the mouth of Glen Agneash there is a bank of coarse flood-gravel; and the drift has been almost denuded from the lower part of this valley, but lies deeply in places on its upper slopes, as for example in the banks of the Glen Drink feeder [SC 43171 85982], when there is slaty till 20 feet or more thick. It is to the eastward of this place that the Dhoon Granite blocks begin to be numerous. The patch of drift on the high moorland south-west of Slieau Lhean [SC 42589 87697] is chiefly of the rubbly type. Glacial striae on this moorland and on the high ground on the southern side of Laxey Glen are recorded in the List (p. 476).

In Glen Roy the drift is mostly confined to the northern bank where the side-ravines frequently expose deep sections in hard slaty till; this is 40 feet or more in thickness near the head of Glen Roy itself at 800 feet above sea-level, and in the more northerly branch rises to 1,220 feet in the pass between Carn Gerjoil [SC 39316 84107] and Mullagh Ouyr, and descends the opposite slope along the Creg-y-cowin feeder of the Baldwin River (Sheet 10). No boulders of Dhoon Granite were observed in Glen Roy or its tributaries, though there are some derived from the elvan-dykes associated with this granite, which cross the heads of the northern feeders of the glen (p. 367).

South of Glen Roy, the little undulating plateau west of Christ (Lonan) Church [SC 43341 84438] is thinly overspread with drift, which apparently contains a few foreign blocks as well as Dhoon Granite, judging from the stones collected from the fields, and from the presence of a few boulders, including one of grey (Scotch ?) granite 2 ft. in diameter in a field 300 yards east of Hoanes [SC 42070 82012] (Sheet 11).

#### Dry valleys east of Slieau Meayl

At Poolvilla, 700 yards W.S.W. of Christ Church, at 500 feet above sea-level, there is a little dry gully, excavated partly in slate, for which the present drainage can scarcely be held responsible. The narrow moorland- Spur running eastward from Slieau Meayl [SC 39915 82594] to Barroose [SC 42112 81374], a mile inland from Garwick Bay [SC 43413 81489], is notched across by several dry gullies of similar character to those which have been described on the north-western

flank of the massif. These are slightly developed in two or three places between The Skoryn [SC 40281 82772] and Crank Garroo, at 800 to 900 feet above sea-level; a better example is seen at Caunrhenny [SC 41150 81702], east of Crank Garroo [SC 41151 82153] (Sheet 11), at a little over 700 feet; and another, smaller but in some ways more remarkable, half a mile farther east, are between 500 and 600 feet, near the farmstead of Barroose [SC 42112 81374]. The last-mentioned, in which the slate has been quarried, does not cross the ridge, but runs more or less parallel with it, and ends off abruptly on the slope. A little below its mouth there is a lenticular mound of slaty gravel which may possibly be connected with its erosion. The ridge, from its position athwart the general axis of the Island and from the presence of wide tracts of lower ground on both sides, would be likely to emerge at the margin of the waning ice-sheet in the path of streams flowing southward over the ice; and, as already stated, it is difficult to understand how otherwise valleys of this character could have-been excavated.

#### Groudle River

On the gentle southern slopes of the ridge the head-waters of the Groudle River are collected. The most westerly branch, known as the Ballacottier River, rises directly under Slieau Meayl and flows southward in a broad hollow thinly covered with clayey local drift. In the lower part of its course, 700 yards above its confluence with the main stream it reveals red stony clay, unlike the grey till in its upper reaches; the included stones, however, seem to be all local. At Low Ballacottier [SC 39434 80152] (misengraved Ballacollie on the old one-inch map) at 400 ft. above O.D. there is an ill-defined patch of yellow loamy sand; and in a little gully 100 yards farther south rather pebbly boulder clay is exposed, in which besides the usual local stones a few small foreign pebbles were noticed, including one, an inch in diameter, of the Ailsa Craig rock. At about the same elevation a mile farther west, in the drainage basin of the Baldwin River, the extra-insular material is still better represented, as will subsequently be described (p. 455). It indicates the invasion of the area by an ice-lobe laden with foreign material, which probably passed up the broad shallow depression westward of Clay Head. The electric tramway follows this depression and on the S. slope of Glen Gawne (Garwick), near Ballig [SC 40130 79571], reveals slaty gravel and sand, with ti sprinkling of foreign pebbles; similar material, mixed with slaty till, is alao exposed between Ballameanagh Beg [SC 42484 80470] and Baldroma Beg [SC 42246 79871] ?(Sheet 11); and again on the north side of Groudle Glen, where it rests on a glaciated surface of slate. The undulating ground east of the tramway is drift-covered up to Ballacreggan [SC 43279 80199], Ballakilley [SC 43019 79639] and Ballavarane [SC 42531 79053]; and is trenched by a broadish drainage hollow in which some alluvium has accumulated. Scattered over this track, along with numerous Dhoon Granite boulders, are many of extra-insular origin, including Galloway granite, coarse Silurian grit, porphyrite, diorite, etc. These are especially, noticeable in the fences around Baldroma Beg [SC 42271 79912], where one of the blocks, 2 feet in diameter, in a fence 370 yards S.W. of the house, resembles the altered tuff of the Lake-district Borrowdale series.

To the westward of the train-line, north of Groudle, extra-insular ingredients are rare or absent, the ground being overspread by a sheet of hard slaty till, which is exposed in a bank 30 to 40 feet high on the north side of the stream 150 yards east of the Laxey highroad-crossing at White Bridge [SC 40486 78763]. North-west of the road, between Ballakilmartin [SC 40468 79315] and Begoade [SC 40784 80132] [2025 note: there are 3 Begoade close toeach other], we find in the fields and fences scattered blocks of the peculiar igneous rock to which reference has been made in another chapter (Chapter 4., p. 160); these increase in abundance towards Ennamona [SC 40658 81206] and Cawnrhenny [SC 41139 81692]where, as previously stated, it is probable that an outcrop of the rock may occur, thinly covered by rubbly drift. These boulders were at first thought to bey of extra-insular origin.

On the southern side of Groudle Glen, a little eastward of the highroad, a shallow depression leads into an alluvial hollow which curves round at Onchan [SC 40165 78300] (Conchan of new Ordnance map) and drains into the sea at Port Jack [SC 39603 77014] (Sheet 14). The alluvium consists principally of clayey wash, but is said to contain peat with wood east of the dam at Onchan [SC 40166 78303]. The depression probably marks a Late-glacial flood-channel. It is bounded on both sides by thin slaty drift, through which the rock protrudes in the bank north of Onchan Church.

#### Western hill-slopes north of Peel

We will now return to the western side of the Island, and work eastward across the drainage basins which discharge into the central valley.

The rivulets which descend to the western coast at Glion Shellan [SC 29513 88479], Glion Cam [SC 28891 87839] and Glion Broigh [SC 27682 86771]. (Sheet 6) have each their source in a little basin of slaty drift. In the second of these, the flatter part of the basin has a floor of alluvial wash thinly, covered with peat. Small areas of this character are common on the uplands, and have probably at one time been occupied by shallow tarns, though none now exists in this condition. The subsoil in these tracts is usually a cold wet clay full of bits of vein-quartz, the relics of the decomposition of local slaty wash; and Manx farmers reckon such land, which they recognise by the abundance of the "white stone" (quartz) as the worst in the Island (p. 569).

## "Colby Wash"

On my field-maps I applied the term "Colby Wash" to ground of this description, from the district in which I first encountered it. Its origin may be assigned to the washing of bare drift-slopes by heavy rains immediately after the recession of the ice-sheet, and before the growth of vegetation (p. 413). The absence of tarns among the hills at the present day is somewhat unusual for a glaciated district, but may be explained by the short course and steep fall of the streams, by which they have been enabled to break through the drift-barriers and to re-excavate their filled-in preglacial channels with rabidity.

In the sprinkling of drift-rubble which covers the slopes of slate in this neighbourhood, a few foreign pebbles may be observed among which a fragment from Ailsa Craig was noticed at about 500 feet above sea-level east of Knocksharry [SC 28371 85697]. To the east of this hill there lies another upland drift-basin with a flat of "Colby Wash", which drains to the valley of the Neb below Laurel Bank [SC 28430 83419]. Glacial striae occur at Staarvey [SC 28243 84273], Lambfell Mooar [SC 29634 84830], Beary Pairk [SC 29916 83418] ? and other places in the vicinity of the Neb, as recorded in the List (p. 477). The next depression eastward, through which runs the main-road from St. John's to Kirkmichael, has been mentioned before in connection with peculiarities in its drainage (p. 8). Its northern portion, draining to Glen Mooar, is occupied by slaty till, while the water-parting between the north- and south-flowing streams lies in a strip of alluvial wash underlain by rubbly drift, like the basins above described.

#### **Basin of the Neb**

The main head-waters of the Neb are in drift-filled hollows on the southern slopes of Sartfell [SC 33511 86783]. In the east branch or Rhenas River (Sheet 7), there are good sections showing 40 to 50 feet of slaty till capped with slaty rubble, at about 1,000 feet above sea-level [SC 34189 86553], just below the col east of Cronkdoo, as well as at several points lower down the stream. The feeder north of Cronkdoo starts high up on Sartfell in a bare coombe-like hollow with cliffs of slate, but has banks of drift a little lower down the slope. South of Little London [SC 32083 86150] the river runs for the most part on bare rock, bordered here and there by strips of alluvium, down to the mouth of Glen Helen. The steep western slope of the valley is also free from drift, but on the opposite side the bank has a capping of local till and rubble which extends eastward over most of the enclosed ground and moorland up to the spurs of Colden [SC 33369 84596] and Lhargee Ruy [SC 32712 83912], except where eroded through by the side-streams. A small quarry near the edge of the moorland, 1,000 yards E.S.E. of Ballashimmin [SC 32318 85188] ?, reveals 5 feet of till resting on a glaciated surface of slate, with striae in two directions, both somewhat unusual, viz., W. 30° N. to E. 30° S., and E. 20° N. to W. 20° S., the ice having evidently suffered local deviation in this confined basin. The drift, covered with 2 or 3 feet of hill-peat on the watershed, sweeps over the ridge into the basin of the Glass river between Slieau Maggle and Colden [SC 34185 85391], and again between Colden and Lhargee Ruy [SC 33713 84022], at elevations of 1,200 to 1,300 feet.

Below Glen Helen the deep valley is free from drift on the western side, but has hard slaty till and rubble banked thickly against its eastern slope. A brickyard on a rather extensive scale was started in this bank 600 yards above the bend at Ballig [SC 28580 82909], but the material seems to have proved unsuitable; the section here shows 20 feet or more of bluish slaty till. To the north and south of this place the valley-spurs are capped with flood-gravel, 12 to 15 feet thick, probably the relics of a high terrace of Late-glacial age connected with the great terraces which line the central valley around the mouth of the glen (p. 410). No trace of foreign material was found in any part of the basin above the termination of the glen at Ballig; below this point the river occupies an alluvial flat, but erodes the northern bank just before issuing into the central valley, revealing 8 feet of stratified stony rubble resting on 15 feet of slaty gravel belonging to the higher flood-terrace. In the bed of the river below this section red pebbly clay containing masses of crushed slate,

foreign stones and many fragmentary marine shells is revealed, while slate in place is seen a few yards farther eastward. The shelly clay is like that in the riverbed near Peel (p. 457).

#### Greeba

Leaving for the present the consideration of the central valley itself, we pass eastward on its northern slopes into the little drainage basin of the Greeba River. This is covered with a thin but persistent sheet of slaty drift, up to the slopes of Beary Mountain [SC 31347 83305] on the north and Greeba Mountain [SC 32120 81948] on the east. The latter hill shows glacial striae a little to the east of the summit, at 1,268 feet above O D; and others along with the characteristic rounded surfaces, indicating movement from the west and north-west, on the top of the crags overlooking the central valley. Greeba Glen is for the most part clear of drift; but in the bed of the stream, 300 yds. above the mill [SC 30229 81466], a 3-ft. boulder of grey (Galloway 7) granite was noticed, and a little lower down another of pebbly grit which did not seem to be insular. These have no doubt been transported eastward along the central valley by the ice-lobe previously described (p. 351). The singular effect of the old delta of flood-gravel at the mouth of Greeba River in diverting the present drainage has already been noted.

## North of Crosby

Bordering the central valley east of Greeba Mountain, there is again a. broad drift-covered incline, out of which rise islands of bare slate in Croak Breac [SC 33598 81197] and Crank ny Mucaillyn [SC 33785 80286] (Sheet 10), while in several other places the sheet of slaty till and rubble is so thin that the rock peeps through. Indeed in all tracts of this kind in the Island, while on first impression it may appear that the solid rocks are buried deeply, one finds on closer investigation that the smoothing down of the surface has been effected with great economy of material, and that only exceptionally, in the deeper hollows, have the glacial deposits accumulated thickly. Hence 'live-rock' crops out, in little patches too small to map, in all sorts of unexpected places. The drift-mantle is therefore far more ragged than appears on the published map. Sometimes, as in this tract, the positions of a few of the rock-exposures are indicated on the map by dip-arrows or other rock-symbols.

On the slope north of Eyreton Castle [SC 32971 79505] an unusual number of large boulders of actinolitic greenstone (p. 311) have been ploughed out, and now line all the fences up to Braid [SC 33770 80965]; and are equally plentiful on the opposite slope leading into the West Baldwin (Glass River) valley, around Ballalough [SC 34673 81114] and again near Ballaquine [SC 34807 81695].

The principal known exposures of dykes of this character are near the heads of the Glass and Baldwin valleys, 4 miles to the northward (pp. 157 and 159), but there may of course be nearer ontcrops concealed by drift. In any case, the blocks form a well-marked train crossing the ridge in a N.N.E. to S.S.W. direction, in agreement with the trend of the glacial strife of the neighbourhood. On the same slopes ½ mile farther east, near Nab [SC 34279 80004] and Ballakelly [SC 34207 79666], while the greenstones diminish, boulders of pale micro granite of the Foxdale elvan-type 158) become plentiful; and though somewhat intermingled, a parallel train of the latter may be traced down to the central valley near Ballabeg [SC 33306 78825] and Ballahutchin [SC 34068 78085]. These have no doubt been derived from the dyke which is exposed at Ballachrink [SC 35167 80417] in the West Baldwin valley, though not necessarily from this particular part of its outcrop. Still farther east the boulders are principally of quartz-veined grit, like that seen in place north of Mount Rule [SC 35459 79325] and on the moorlands east of the Baldwin River. The drift with which all these boulders are associated is hard slaty till; and this material lines the northern side of the valley down to Union Mills.

#### West Baldwin Valley

In the lower part of the valley drained by Awin Darragh (Sheet 10) which joins the River Glass at Baldwin, we find an unusual quantity of local till, scarcely any rock being exposed below Cregwine. Above this place there is only a narrow strip of drift in the glen until we reach its head at Braid ny Scarrag, at about 1,100 feet above O.D., where it is again banked deeply and sweeps over into the Neb basin as already described. Similar conditions occur at the head of the Injebreck River on the northern side of Golden Mountain, but this stream flows over bare rock for some distance above its junction with the Glass.

The upward margin of the drift around the head of the main branch of the Glass, between Injebreck Hill and Beinn-y-Phott, is ill-defined, fading off on the higher ground, as usual, into a sprinkling of slaty rubble containing a few scratched stones. In the valley there is much slaty till; above Injebreck the stream has cut through this to its old floor, but below that place the glacial material occupies parts of the valley bottom, and is exposed in high banks on the eastern aide, both on the main stream and in transverse gullies. One of the best of these sections is the river-cliff 300 yards S. of Ulican (Sheet 10), which exhibits from 40 to 50 feet of till interbedded with rough slaty gravel. This drift extends westward up to the foot of the Awhallan crags, on which there are excellent glacial striae (see List, p. 477); and eastward, though not quite continuously, across the dividing ridge into the East Baldwin depression. Below Injebreck traces of fluviatile gravel-terraces are visible here and there in the bottom of the valley, the higher of which probably correspond to the more conspicuous platform below the confluence of the Baldwin River which attracted the attention of Macculloch<ref>"Western Isles", vol. ii., p. 525.</ref>

#### East Baldwin Valley

The conditions in the East Baldwin valley resemble in all respects those of West Baldwin, except that the drift is not so thick in the bottom of the glen; wherefore the stream runs for longer on a rocky floor, and its alluvial. flats and terraces are confined to lower reaches than in the sister-valley.

Its eastern feeders, the Creg-y-cowin River [SC 38063 83790] and a nameless stream 703 yards farther south [SC 37562 83216], rise in basins deeply filled with glacial material, and afford interesting illustrations of the post-glacial erosion of these deposits. On the moorland-ridge of Slieau Ree [SC 37994 82316] to the east of the valley, glacial striae were observed in several places (see List, p. 477). The eastern slopes of this ridge are thinly overspread with drift, apparently all of local origin, in which small sections are revealed in places in the gullies that occur at the head of a little stream (Selby River) tributary to the Glass.

#### Glenville

The rising ground east of this stream is also more or less drift-covered; and on the southern part of this tract, between Abbeylands [SC 36902 79973] and Glenville [SC 38191 79575], at 300 feet above sea-level, a section occurs which deserves especial notice, since it shows an admixture of extra-insular material with the local detritus. This is revealed in a shallow clay-pit 500 yards west of Glenville, from which material was dug for use in the construction of the Douglas waterworks reservoir on the Groudle River; the section visible in 1896 showed 2 feet of slaty gravelly clay of 'Colby wash' character (p. 453), resting on 6 feet or more of dull red clay with stones of which the majority and the larger were local, but with a fair sprinkling of foreigners.

Among the local boulders was one of greywacke, 6 feet in diameter; the extra-insular stones included fragments of grey (Galloway?) granite; red sandstone and grit (rather plentiful); Carboniferous Limestone, etc. Specimens of the Liassic fossil *Gryphaea incurva* were said to have been obtained in this pit by the workmen, but their authenticity seemed very doubtful.

The little glen to the S.E. of this exposure revealed no clear section; but a brickyard by the side of the highroad at Highton, 300 yards S. of the glen, showed 10 feet of mixed slaty clay; in this a few red sandstone pebbles were noticed, and possibly other foreigners might have been obtained by longer search. This drift was rather gravelly at the top, and thinned off southward upon a bank of slate. A slate quarry 400 yards east of Willaston [SC 38055 77852] (Sheet 13), <sup>3</sup>/<sub>4</sub> mile S.E. of the section last described, is capped by gravelly drift, 2 to 3 feet thick, containing numerous foreign pebbles; and the same admixture probably prevails in most of the material which covers the slope between Cronk-ny-Mona [SC 38852 79234] (Sheet 10), where the bare rock is seen, and the valley of the Glass [SC 36875 79243]. Where thin, such drift weathers into a reddish or yellowish stony loam, differing from the soil of the unmixed slaty boulder-clay. It is frequently difficult to decide whether it is least misleading to map such material as gravel, or as boulder-clay,—a difficulty often still more acute in the case of the mixed drift south of the ventral valley.

#### Lower part of the Valley of the Glass

In the valley of the Glass below its junction with the Baldwin [SC 35353 80409], high banks or cliffs of till and partly-stratified drift extend along the eastern side of the river-flat down to Tromode [SC 37188 77708]. A section in the upper part of this bank 300 yards N. of the dam of Tromode Mills [SC 37183 78181] showed 30 to 40 feet of stratified coarse slaty gravel and loamy sand, with bouldery loam towards the top. In some of the gravel beds in this section the pebbles were arranged with their longer axes vertical. One hundred yards farther south, firm slaty till is seen at the foot of the bank, with gravelly drift above. A little below this place the river has missed its old channel and excavated a trench in slate, as described in a previous chapter (p. 161). The section where the present bank cuts across the abandoned eastern loop opposite Ballanard [SC 37528 78243] shows slaty flood-gravel resting on warp and silt, with boulder clay probably concealed under the talus slope. Slaty till is seen again under the gravel terrace in the little side-ravine 500 yards S.E. of Tromode.

On the western side, the river-flat south of the confluence of the Baldwin and Glass [SC 36164 80067] is fringed by a high-level terrace, which, like its equivalents in theBaldwin valleys, borders a more or less drift-covered slope. This terrace is interrupted by a bluff of slate at Sir George's Bridge [SC 36732 79301], near Oatlands (Sheet 10), but sets in again a little below, and continues up to the ravine at Tromode. It is represented on the opposite side of the valley by the gravel which covers the southern spur at the confluence of the Selby stream. Opposite Castleward [SC 37116 78695] the terrace is composed of thin clayey rubble resting on slate, with little or no clean gravel. It falls southward from 200 feet above O.D. where first seen, to 100 feet at Tromode, but does not quite keep pace with the present fall of the river, and is therefore highest above the stream in the lower part of its course.

Below Tromode [SC 37179 77697] the valley bottom expands suddenly into an alluvial flat 200 to 300 yards wide, and 40 to 50 feet above sea-level. The opinion is generally held in the neighbourhood that this alluvial flat marks a silted-up cstr anne inlet, an idea recorded by Cumming,<ref>"Isle of Man", p. 18.</ref> repeated in the guide-books, and fostered by the name, Purt-ny-shee [SC 37194 76942], by which the place is known. The flat is however evidently of fluviatile origin, and is too high to have been entered by the sea even during the Raised Beach period. On its western side the continuation of the high terrace above-described may be traced down to its junction with the central valley, where the edge of the terrace is 40 feet above the river-flat. Sections of this terrace in the steep bank S.W. of Purt-ny-shee farmstead exhibit in places 20 feet of slaty gravel, with loamy bands in some of which most of the flatter pebbles are vertical even when underlain and overlain by beds in which such pebbles re horizontal, as shown in (Figure 107) Traces of the gravel terrace are also seen, resting on a high bank of till, on the eastern side of the valley between Tromode [SC 37179 77696] and Purt-ny-shee [SC 37284 76949]; but south of the latter place they disappear, and the stream impinges upon a bank of slate. From the form of the ground and the position of the gravel, it seems not improbable that the drainage of the valley may at one time have found more direct access to the sea in Douglas Bay, in the direction marked by the shallow depression due east of Purt uy-shee, to which reference has been made in describing the Douglas area (p. 446).

## **Balla-Fletcher**

The spur of rising ground between the valley of the Glass and that of the Dhoo below Union Mills [SC 36742 77411] is almost wholly drift covered, and sometimes. apparently to a considerable depth, but there are few sections. West of the road between Oatlands and Union Mills, slaty boulder-clay is the chief constituent, and no foreign ingredients whatever were found. East of the road, gravelly and sandy material predominates, with a sprinkling of extra insular pebbles among the slaty debris, and the surface is more uneven and moundy. A small sand-pit in this tract 350 yards W. of Cronkbourne House [SC 36880 77505] showed (in 1896) 12 to 15 feet of cross-bedded fine gravel and loamy sand. Former pits of larger size adjoining the main road 400 yards W.S.W. of this place are now disused and obliterated. Towards the southern end of the spur the ground becomes stiffer, and has been mapped as boulder-clay.

## **Central Valley—Peel to Douglas**

The general description of the drift and alluvia of the central valley given in preceding chapters (Ch. 1., p. 8, Ch. 9., p. 349, and Ch. 10., p. 409), will be supplemented by a few additional details, without repeating the facts already recorded.
Between Peel Harbour [SC 24213 84357] and the rock-gorge at Glenfaba the Neb is fringed on the east by a low alluvial flat, Close Chiarn of the six-inch map (Sheet 9), which is conterminous with the strip of Raised Beach at Peel, and may be in part estuarine. This is bordered on the east by a high bank of drift of the extra-insular type, best exposed in the road-cutting leading to Glenfaba Bridge [SC 24198 83073], consisting of red sandy boulder-clay, associated both above and below with sand, loam, and gravel. The bed of the river 300 to 400 yards S. of Peel Station reveals patches of contorted red pebbly clay and loam with foreign stones and many fragmentary marine shells, including *Leda pernula, Tellina balthica, Trophon clathratus*, etc., which appears to rest directly on crushed slate, and must have been deposited against the cliff-like rock-slope which forms the western bank of the river beneath Peel Hill [SC 24024 83865]. A large excavation into this bank at the brickyard 150 yards farther south, where some of the drift still adheres to the slope, showed (in 1897) 10 to 20 feet of slipping slaty rubble, mixed with red clay and drift-gravel containing pebbles of flint, Ailsa Craig riebeckite rock, granite, etc., and some scratched stones. This drift rested on the crushed and decomposed shaly blue slate, which is ground up and made into bricks.

It has previously been suggested (p. 410) that at Glenfaba the buried pre-glacial valley probably lies to the eastward of the present gorge; and evidence in favour of this view is furnished by the report (see p. 279) that 90 feet or more of "soft clay, gravel and clay mixed, and then boulder-clay", were passed through in a boring for coal made in 1873 a little to the eastward of Glenfaba Mills [SC 24265 83070]. This boring does not appear to have struck solid rock until below present sea-level, although in the adjacent river-bank the rock is seen at 50 to 60 feet above O.D.

The undulating platform of Extra-insular drift extending inland from Peel to the foot of the slate hills at Lhergydho [SC 27423 84844] and Poortown [SC 26815 83140] is composed for the most part of low sandy and gravelly mounds, but red stony clay comes to the surface on the rise between Ballaquane [SC 25492 83593] and Ballagyr [SC 26126 84721], and slaty clay covers the lower slope of the solid hills. The platform is trenched by several drainage channels, now almost dry, falling southward to the Neb. The occurrence of little basins in this tract has been previously noticed in describing the elk-remains found at Close-y-Garey [SC 26890 82585], but the most conspicuous example, at Ballalough [SC 26329 83437], deserves further mention. This is a pit-like hollow about 200 yards in diameter, surrounded to a height of 40 or 50 feet with steep banks of sand, gravel and a little clay, except on the south-west where one of the drainage channels just referred to leads out from it towards the Neb. The bottom of the basin is still boggy, but contains a dry mound which is not unlikely to be artificial, like the so-called "Fort" at Lagagh Mooar [NX 40961 01525] (p. 432). Immediately to the south-east of this hollow rises Cronk Lheannag [SC 26327 82926], a little isolated hill of bare slate (p. 155); and we may suspect that the deposition of the drift may have been so modified in some way by the vicinity of the rocky hillock as to produce the depression. A smaller basin lies 200 yards farther north, with another, still smaller, beyond it, the three forming a broken chain in the direction of the drainage-slope.

The upper gravel terrace on the northern side of the Neb east of Ballawyllin [SC 25810 82396] is in places only thinly overspread with slaty gravel, with an eroded surface of glacial clay. This clay has been dug for brickmaking both on the terrace and in the upper bank of drift which bounds it, but the works were not in operation during the survey of the area.

## Kirk Patrick

On the south side of the valley around Kirk Patrick [SC 24378 82174] ?, above the terraces elsewhere described (p. 410), clayey drift containing an admixture of local and foreign detritus sweeps through the low col leading to Glen Meay [SC 23334 79821]; at Gordon [SC 23824 80628] and Rheabymooar [SC 23607 80180] this is overlain by terrace-like strips of gravelly material, and in the valley bottom by alluvial wash, indicating former drainage through the gap. The manner in which the lower layers of the ice-sheet laden with foreign material were pushed forward into the embayment of the hills in this neighbourhood has previously been discussed. While the greater portion of this ice escaped through the opening at St. Johns [SC 27761 81726] and up the Archallagan slope [SC 29003 79910] (p. 351), or passed out at Glen Meay by the above-mentioned col, some part seems to have been pushed up the western slope of Slieau Whuallian [SC 25910 80536], where the gradient is comparatively gentle, as foreign material is associated with slaty drift in the patches preserved around the heads of the little glens high up on the ridge, and passes at Eairy [SC 24994 79811] over the watershed into a galley descending to Glen Mooar [SC 24106 79285].

## Slieau Whuallian

[SC 26478 80458]. A boulder of grey (Galloway?) granite, measuring 5 feet by 3 feet by 2 feet, lies in the ravine above Ballacosnahan (Sheet 9), 400 yards S. of the Peel reservoir; another, of purple grit, 5 feet in diameter, at the head of the glen due south of Ballaspet [SC 26285 81534], with others lower down; and Mr. Kendall records a 3-ft. block of Galloway granite on the ridge of Slieau Whuallian itself.<ref>Yn Lioar Manninagh, vol. i., p. 409.</ref> The boulders are most numerous and largest, however, below Eairy [SC 24993 79810], in the above-mentioned rocky gully descending southward into Glen Mooar [SC 24818 79658], at 500 to 600 feet or more above sea-level, where among others noticed were one of o arey granite, 6 feet by 5 feet by 4 feet, and one of pebbly grit, 6 feet by 4 feet by 3 feet. This gully is one of those which cannot be explained by the present drainage and must date back to Late-glacial times. Glacial strive in several places on Slieau Whuallian show that the summit of the ridge has been crossed by an ice-flow from N.N.W. (see List, p. 477).

## Foxdale

The character of the drift in Foxdale has previously been outlined (p. 350 and p. 370). The best sections are in the lower part of the glen [SC 27950 81109] and at the head of its western feeders south of Slieau Whuallian, the upper part of the main valley containing, only a thin rubbly covering on the slopes, with bare rock in the stream-bed: A 4-ft. boulder of Galloway granite was observed near the east bank of the river 400 yards below the road-crossing at the mines, and two or three others of smaller size lower down the glen, north of Ballanas [SC 27199 79532], where the slaty drift is intermingled with foreign material (see (Figure 94), p. 350). To the eastward similar boulders are scattered plentifully on the upland around the head of Glion Darragh [SC 29243 79629], but blocks of the local granite alone were seen on the moorlands west of Foxdale.

The slopes above the fans of flood-gravel lining the central valley east of Foxdale have a thin covering of yellowish sandy drift, containing both local and foreign pebbles. This is sparingly exposed in the occupation roads south-east and east of Kennaa [SC 28734 80632] (Sheet 9); it has been coloured as 'boulder-clay' on the map, but scarcely falls under that designation; and the rather more sandy material occurring in the same position farther east, around Rhenny (Sheet 10), is r far removed from boulder-clay that it has been coloured as 'sand and gravel'. In cases of this kind, where the litho-logical characters hang upon the border-line, it must be understood that the strong contrast in the conventional colouring of the map may represent only a slight difference in the actual composition of the deposits. A few boulders of Galloway granite and other extra-insular rocks accompany this sandy drift and mark the path of the ice-lobe previously discussed (p. 350). The crest of the slope is for the most part bare of drift, but on the plateau beyond we again find a covering of yellow loam with an admixture of local and foreign stones, best seen in the road leading from Ballacurry [SC 29940 80403] to the Old Cornelly Mines [SC 29738 79522], and in the drainage-trenches of Archallagan plantation [SC 29890 79111]. No drift now remains in Glion Darragh [SC 29649 80066] (otherwise known as Ballacurry Glen), but numerous large foreign boulders strew its channel, of which a rounded block of grey (Galloway?) granite 8 feet by 6 feet, at the fork below the mines is perhaps the finest example.

On the northern side of the central valley, a little tract of mouldy gravel at Ballacraine [SC 28639 81746], at the mouth of the low col leading into the ravine of the Neb, deserves mention. Like the adjacent gravel-platform of slightly newer date, it probably denotes the passage of flood-waters from the upper glen through this now dry gap during the melting of the ice.

## East of Greeba

The drift on both sides of the valley contracts eastward towards Greeba [SC 31146 80325], and disappears altogether in the narrowest part of the pass opposite Cregacable [SC 31325 80270], where the rocky bluffs come down to the alluvium for a space of 40 or 50 yds. To the E. of this, sloping banks of drift once more border the depression, that on the southern side, which continues up to the mouth of Cooillingill [SC 31986 79328] (Sheet 10), being again in part composed of yellow sandy loam. A 4-ft. boulder of grey Galloway granite was noticed at the lower margin of this bank 480 yards S.W. of Cregbeg [SC 31621 79949]. The head of Cooillingill [SC 30419 79075] reaches back to Archallagan, and contains loamy drift with foreign stones at 600 feet above sea-level. Similar material extends southward into the little basin which gives rise to the stream flowing to the central valley at Ellerslie [SC 32918 78328]; and occasional extra-insular boulders, along with many from the local micro-granite dykes, may be seen in the fences around and to the east of Eairyjora [SC

30952 78041] and Eairykellag [SC 31027 78232] (Sheet 13) at elevations up to 500 feet.

## Ellerslie

[SC 32920 78330]. At Garth [SC 31680 77433] in the lower part of the basin this drift becomes assorted into stratified sand, gravel and stoneless warp; and an irregular strip of similar material stretches down the depression N.E. of Slieau Chiarn [SC 31629 76668] to the mouth of Ellerslie Glen. A small sand-pit in this strip 350 yards west of Ballingan [SC 32362 77237] showed 6 feet of yellow sand with small local and foreign pebbles scattered as in a boulder-clay. A rock surface exposed at the new buildings 60 yards E. of the pit bore glacial striae in two directions (p. 479); the one set corresponds with striae on Slieau Chiarn [SC 31629 76668], and represents the local flow on the leeside of the hills; the other agrees with those on Archallagan and Slieau Whuallian, and indicates the main flow. Below Ellerslie [SC 32910 78382] the drift on both sides of the central valley seems all to be of local origin, until we pass Union Mills; it is, as usual, deeply banked on the northern slopes, and thin or absent on the opposite side. Below Union Mills [SC 35350 77841] the south-western slopes, above the flood-terrace (p. 411) and below the outcrop of the slate, are sparingly covered with indefinite rubbly loam; this has been coloured as boulder-clay', except where it forms distinctly gravelly mounds as in the patch between Kirby [SC 36217 76805] and Farmhill [SC 35301 76114] and again at Pulrose [SC 35697 75357] (Sheet 13). The drift of the opposite side of the valley has already been described (p. 457).

## **Middle River**

The remnants of a flood-gravel terrace, probably equivalent to those of the Glass and the Dhoo, are seen in the lower part of the valley of their confluent, the Middle River, up to its sharp bend above Kewaigue [SC 36089 74794]. Its western slope south of Middle is capped by a moundy belt of rubbly and sandy slate-gravel with some foreign pebbles, which follows the trend of the valley up to the above-mentioned bend, but then crosses it and runs up into a depression leading to the coast at Keristal [SC 35276 73080], north of Port Soderick [SC 34681 72650] (p. 463), no doubt indicating a glacial drainage-course. To the east of the valley, the patches of drift running up into the depressions at Nunnery Howe [SC 36657 74662] and Ballaslig [SC 35920 73834] though still rubbly are of a more clayey character. Both varieties are exposed in railway-cuttings between Douglas and Port Soderick. In the upper part of the Middle River basin, north of Richmond-hill [SC 34315 75031], there are several small exposures of slaty till, while an ill-defined patch of local gravel occurs south of Ballabunt [SC 33877 76193].

The drifts of the eastern extremity of the central valley required no further description than that already given (pp. 456–7).

# **Southern Division**

(Parts of sheets 9 and 13, and sheets 12,15, 16, 17, 18 and 19, of 6-inch map.)

## Western Coast south of Peel

[SC 24425 84159] to [SC 22752 82857]. Between Peel and Contrary Head a mere sprinkling of drift-pebbles on the steep hill-slope above the cliff and some strile on the top of the ridge (p. 477) are the only indications of glaciation, On Contrary Head [SC 22752 82857] itself, a little red boulder-clay and gravelly drift with local and foreign stones has lodged; and is associated with striae parallel to the cliff-line, which show that the general contour of the coast has not altered much since Glacial times. Narrow strips of similar drift hug the crest of the cliffs southward to Glen Meay, running a little way inland in a gap in the ridge S.W. of Knockaloe Mooar [SC 23703 82219] (Sheet 9), and on the inward slope forming a moundy delta-like patch of sand.

## Glen Meay to the Niarbyl

[SC 22546 79952] to [SC 20843 77516]. At the mouth of Glen Meay the slate-rocks sink to a comparatively low level, constituting between this place and Niarbyl Bay a sloping platform at the foot of steeper ground. Upon this platform the glacial deposits attain considerable thickness, levelling the irregularities of the old surface and rising above it north of Ballaquane into gravelly mounds. Excellent sections are revealed at the mouth of Glen Meay [SC 22546 79952]; and to

the southward, at Lag ny Traagh [SC 22313 79581] where the drifts are 70 feet thick; and again opposite the Niarbyl [SC 21170 77627]. They show much variation in details, but where most fully developed the sequence is as follows—

	Red sandy boulder-clay or loam; stones chiefly rounded and
1 Upper Boulder clay	small, and many extra-insular, but with a few large scratched
1.—Opper Boulder-Clay	blocks; often absent, especially where the drift rises into
	mounds, and never more than a few feet thick.
	Rudely stratified coarse bouldery gravel, with seams of fine
2 Middle Stratified Drift	gravel, sand and red clay; containing slate-fragments more
	or less waterworn and lyingflat, along with many foreign
	stones; thickness very irregular, up to 40 feet.
	Dark grey boulder-clay; local rocks the most abundant
	constituent, sometimes in large blocks, but a few foreigners
3 — Lower Boulder-clay	also; some small shell fragments thickness in depressions
	may reach 30 to 50 feet, but, thins out under the Stratified
	Drift against slopes of rock.

Drift of the above character, sometimes clayey at the surface and some times gravelly, extends inland up to the highroad between Glen Meay [SC 23607 79704] and Dalby [SC 21946 78295], but is frequently overlain by clayey slaty rubble on approaching the steeper hill-slope. The middle division becomes thinner, finer in composition? and less moundy as we leave the vicinity of Glen Meay; which is suggestive of its material having been swept through the previously-described gap in the hills S. of Kirkpatrick.

## Lagg River

South of Dalby the drift thins out at Barrane [SC 21997 77167] (Sheet 12), where the high ground again joins the coast-line. At this point a little delta of slaty gravel, at the mouth of the Lagg River [SC 21583 77159], is intersected by the cliff; inland, in the bottom of the short coombe-like recess drained by this stream, blue slaty till has accumulated in places to a considerable depth, especially around the head of its southern branch, the Kylley River [SC 22447 76966]. In the similar but smaller hollow of Glion Mooar [SC 21550 75653], a mile farther south, from which a stream leaps in a waterfall over the cliff at Gob yn Ushtey, only a little rubbly drift has been preserved; but in the bed of its stream, at 400 or 500 feet above sea-level, are several large extra-insular boulders, including one of red granite, 6 feet in diameter.

## Vicinity of Cronk ny Arrey Lhaa

[SC 22439 74669]. The great precipitous slopes bordering the sea between this place and Fleshwick [SC 20174 71392] seem at first sight to offer no lodgment for drift; but this is not quite the case, since both north and south of The Stacks [SC 21126 73462] (Y' Slogh, (Sheet 12)) a narrow strip of clayey drift with scratched stones has adhered to the seaward side of the mountain, and forms here and there a slight terrace between the higher crags and the true cliff. As we approach the Fleshwick depression, this material thickens; and fills the old valley with a mixture of slaty till, laminated clay, sand, and gravel with some foreign pebbles. Striated rock-surfaces of peculiar interest occur on both slopes, and show that a tongue of ice has been forced through the constriction; these should be studied in connection with the examples on the crest of he ridges to the northward and to the southward (consult List, pp. 478–79).

## Bradda and Port Erin

[SC 19491 71228] [SC 19634 69237]. and Bradda Hill though glaciated is bare of drift; but patches of till have lodged under its shelter on Bradda Head, as may be seen at the top of the. cliff 359 yards S. of North Bradda Mines, where it is 12 feet thick. On this part of the headland occur numerous fine boulders of Galloway granite and other foreign rocks, one being 9 feet in diameter, another 5 feet, etc.; and associated with them are a few of Foxdale granite. Several of the former lie near the path leading from the above-mentioned mines to Bradda West. Mr. Kendall thinks that an Irish granite (Mourne Mountains) may be represented among the boulders which he observed in Port Erin Bay.<ref>Op. cit., p. 406.</ref>

present sea-level, as patches of till were visible on the foreshore at the northern margin of the recess in 1893 where the beach-stuff was washed aside. In the middle of the bay, where the drift is thickest, the sections are obscured; but probably consist largely of sand, gravel and laminated clay, 20 feet of such material being exposed in 1892 in an excavation at the south corner of the recess, under Ballafurt [SC 19495 68857]. On the opposite side, near the old Biological Station, the upper part of the cliff, above the slate, shows sandy pebbly clay and loam, partly stratified and gravelly in places, containing many shell-fragments and some foreign pebbles. Boulders of Foxdale granite were noticed in two places in this part of the bay. South of Port Erin the drift of the coast-section is confined to small patches of clayey rubble lying thinly in sheltered places on the slate. Glacial striae are, however, more numerous along the crest of this cliff and southward to Spanish Head than in any other part of the Island, and are frequently super-imposed in more than one direction (List, pp. 478–79).

## South-eastern Coast; Douglas to Langness

[SC 38120 75317] to [SC 28752 66333]. Small patches of till and gravel adhere to the northern face of Douglas Head [SC 39081 74755], sometimes resting on striated surfaces of slate. The largest patch lies around Fort Anne Hotel [SC 38546 75024] and is exposed in a gully in the hotel grounds and in the adjacent road-cutting. To the southward of the Head, where the road-cuttings for the Marine Drive afford an almost continuous section in the slope above the cliff, the drift is in negligable quantity until Little Ness [SC 36608 72891] is passed, though glacial strim are numerous (p. 478).

## Port Soderick

[SC 34690 72656]. At Rebog [SC 35626 73118] (Sheet 13), ½ mile west of Little Ness, clayey drift with gravelly intercalations is banked deeply upon a sheltered slope at the cliff-top, being 25 feet thick in one part of the cutting. This gives place to gravel in the depression between Coolebegad [SC 35378 72952] and Port Soderick [SC 34685 72671], which, as mentioned above, is probably the continuation of the gravel-belt of the Middle valley.

A fine section has been opened up to a depth of over 20 feet in these gravels by the Marine Drive, showing arched-bedding, false-bedding and contortions, the pebbles being mostly of local sandy slate and greywacke, but with a sprinkling of foreigners including flint, red sandstone, porphyry, etc. The figure on next page represents a portion of this section as seen in 1892.

Among the boulders on the Port Soderick beach [SC 34702 72641], the Foxdale Granite and Oatland Granitite are represented, this being the most northerly point at which these rocks were observed on the east coast; blocks of extra-insular origin also occur. That the glen opening to the shore at this place has been in existence in Pre-glacial times is proved by the presence of slaty till in the bottom; this is exposed to a depth of 25 feet in south bank of the stream, 400 yards above its mouth. In the railway-cutting at Port Soderick Station [SC 34254 73041], slaty till is banked against one side of a boss of rock, and slaty gravel against the other side, the gravel partly overlying and partly intermingling with the till above the boss.

## St. Ann's Head

[SC 33260 70270]. Southward from Port Soderick there is little or no drift in the cliffs until we round Santon (St. Ann's) Head, where some slaty till has accumulated in the recesses south and east of Mary Voar [SC 32363 70336] (Sheet 17). A boulder of Foxdale Granite lies in a gully in the drift of the more easterly recess, 50 yards from the shore. A remnant of the Raised Beach is preserved in this recess and in one or two others farther west. In approaching Port Grenaugh the drift forms a more continuous capping to the cliffs, and in the middle of that inlet descends below high-water mark and occupies portions of a pre-glacial channel on the foreshore. From this locality south-westward, blocks of Foxdale Granite though rarely seen in place are of frequent occurrence on the beach.

South-west of Port Grenaugh [SC 31629 70427] the cliffs are lower and the adjacent ground less hilly, thus affording better opportunity for drift to lodge; and we find in consequence a more regular development of the glacial deposits, though their thickness still varies greatly with the form of the surface on which they rest; they are, on the whole, of a clayey type, but with gravelly intercalations.

#### Port Soldrick

[SC 30327 69679]. At Port Soldrick we have once more an example of the infilling of a pre-glacial recess, the drift being banked against cliff-like slopes of slate on both sides to a depth of 100 feet in the middle of the inlet, consisting, so far as can be seen, of till and gravelly bands containing shell-fragments. The Santon River, at present discharging through a rocky gorge at Cass-ny-Hawin [SC 30299 69399] 600 yards farther south, may have had its pre-glacial outlet at this place. A glaciated rock-surface is visible at the base of the drift at the southern entrance to Port Soldrick.

The clayey drift extends up to Cass-ny-Hawin [SC 30299 69399], and also covers the rising ground inland to the south of that ravine; but where the Carboniferous Limestone sets in, the ground in the neighbourhood of the coast forms a lower undulating platform which is for the most part thinly covered with stratified gravel (pp. 470–2). This gravel is exposed here and there in the low cliff between Cass-ny-Hawin and Ronaldsway [SC 29001 68166]; at the latter locality traces of the Raised Beach are also present.

#### Derby Haven

[SC 28860 67690]. It is probable that in the inner part of Derby Haven, which is concealed by beach-stuff, the limestone may be overlain in places by boulder-clay, as this material is seen in the low bank at Ronaldsway [SC 29036 68117], and masses of cemented drift-rubble cap the solid rock on the foreshore east of the farm-buildings. The Haven is surrounded by a rim of blown sand, resting for the most part on Raised Beach; and sand covers the isthmus running out to Langness [SC 27764 65268].

#### Langness

[SC 28685 66197]. Cumming states<ref>"Isle of Man", p. 78.</ref> that a cutting made for a drain in this isthmus showed "alternating layers of pebbles, sand and loam". The pebbles which occur throughout the blown sand on the Racecourse have probably been driven up in part by storm-waves and in part by the wind, entangled in rolling balls of sea-weed, both methods having been noticed in operation above high water mark in Castletown Bay. The blown sand rests on drift-gravel in the bank south of the causeway leading to St. Michael's Island [SC 29340 67303]; and pockets of similar gravel, occupying little hollows of the slate-rocks, are of common occurrence along the outer shores of Langness, but are all too small to map. On the western side of the promontory, however, where the Carboniferous rocks afford a less rugged surface, the gravel, partly of local and partly of foreign material, is sufficiently persistent to require mapping; a little boulder clay is also seen on this side, in the bank above the Raised Beach at Langness farmstead [SC 28631 66445]; and some large boulders, including Foxdale Granite, greenstone, coarse grit, etc. are conspicuous on the broad tidal-shelf of limestone. On this shelf the Raised Beach merges insensibly into the present shore.

## Southern Coast; Castletown Bay to Calf Sound

On the eastern shore of Castletown Bay the limestone-scars [SC 28239 67283] give place rather suddenly at Sandwick to a beach of sand and shingle [SC 28081 67368] which extends westward to the vicinity of the harbour. This beach is for the most part underlain by drift, as was proved by the exposure of patches of till in several places between high and low water during our survey of the coast.

The most easterly of these exposures was seen near low water within 20 or 30 yards of the disappearance of the limestone; another occupied a good breadth of foreshore opposite King William's College; and others occurred between half tide and low water at many points farther west up to within a few yards of the reappearance of the limestone. They were all of similar character, showing a hard stony till full of glaciated limestone-blocks, with a sprinkling of foreign pebbles and fragments of shells, among which a single perfect valve of *Leda pernula* was obtained.

#### Hango Hill

The only cliff-section of this drift is at Hango Hill [SC 27599 67803], opposite King William's College, where the till rises for a short space to 30 feet above O.D., while the surrounding ground forms part of the gravel-platform (p. 471). This section was carefully studied and figured by Cumming,<ref>Quart. Journ. Geol. Soc., vol. ii. (1846), p. 338, and fig. in

text; also "Isle of Man", pl. viii.</ref> whose description deserves quoting as an illustration of the remarkable insight of this observer at a time (1845–1848) when the phenomena of the glacial deposits were still imperfectly understood. It is as follows: "We have a consolidated mass of black or dirty blue mud, such as we can easily imagine to be formed by the grinding down of the dark limestones and shales of this district, such a debris in fact as is formed in the yards of the stone-masons of this neighbourhood where this same limestone is cut and polished. In it we find mixed up confusedly gravel and sand, and pebbles (not large) of foreign rocks, granites, syenites and porphyries, fragments of the Coal-measures of Cumberland, and ore or two chalk flints. We have some boulders of the insular granite and larger masses of insular rock, such as greenstone and old red conglomerate, but above all masses of limestone in rhomboidal blocks, some weighing upwards of a ton and having the appearance of transport from Coshnahawin, a mile and a half to the north eastward These limestone blocks seem pushed over one upon the other, and piled up amongst the gravel, sand and clay in wondrous confusion".<ref>"Isle of Man" (1848), p. 69.</ref> In another part of his book, Cumming shows that the changes in the appearance and colour of the boulder-clay depend upon the composition of the subjacent rock to the eastward, and adds: "The analysis of Dr. Kemp (of St. Peter's College, Cambridge) for the purpose of determining the percentage of lime in the marls of the north and south of the island, gave for a sample taken from Kirk Bride parish, near Point Cranstal, only 5.145 per cent. of lime, whilst a sample from Hango Hill yielded about 24.5 per cent. A sample taken at Ronaldsway, a little to the westward of the basset edge of the old red sandstone, gave 61.5 per cent.. and the same was very nearly the proportion of a mass from Strandhall".<ref>Op. cit., pp. 113 and 365.</ref> He also discusses the erosion of the cliff at this point, and gives evidence to show that "in 1662 when William Dhone was here shot to death, the cliff was probably removed from 30 to 40 feet from the building "<ref>Op. cit., p. 80.</ref> (an old tower now nearly all carried away by the sea). Mr. Kendall has likewise described the section, and records, besides limestone, the following rocks in order of abundance: "Vein-quartz, dark-red recrystallised sandstone, yellow sandstone, flints, diabase, Ailsa Craig eurite, clay slate.... The rarity of clay-slate is very remarkable".<ref>Yn Lioar Manninagh, vol. i., p. 415.</ref>

#### Scarlet

Between Hango Hill [SC 27599 67803] and Castletown Harbour [SC 26649 67425] a narrow strip of Raised Beach borders the shore, behind which rises a gravelly bank more or less covered with blown sand. South of the town there is no exposure of drift until we reach the quarry at Scarlet [SC 25835 66501], where, under a covering of from 2 to 4 feet of clayey rubble-drift and till full of the local rock, occurs an excellently striated surface of limestone (p. 479). This was first described by Cumming, who distinguished three kinds of markings, "the deeper polished groovings, the striations or finer scratches upon the groovings, and the indentations"<ref>Op. cit., p. 115.</ref>; later descriptions have been given by several observers.<ref>J. Horne; J. Clifton Ward; W. Hewitt; P. F. Kendall. (See Bibliography for references.)</ref> A boulder of porphyritic greenstone, measuring 6 feet by 5 feet by 2½ feet, perhaps derived from the mass bordering the Oatland granitite (p. 321), was uncovered in 1892 in the drift in this place. The entrance to the quarry has been cut through a patch of Raised Beach full of recent shells.

#### Poolvash

West of Scarlet Point, where the Carboniferous Volcanic rocks occupy the coast, drift is represented only by pockets of gravel in the hollows, until we reach the limestone at Poyll Vaaish [SC 24406 67381], where it again thickens. The section in the "black-marble" quarry (p. 220) on the eastern side of this inlet has been described almost as frequently as that of the Scarlet quarry. It shows 6 to 10 feet of bouldery gravel-drift, clayey at the base, resting on a striated surface of limestone. The gravel contains many boulders of the local tuff and porphyrite, along with a few foreign stones. Patches of more clayey drift are seen beneath Raised Beach at a few points farther north, though gravelly material predominates at the surface a little way inland. In the low cliff west of Balladoole [SC 24256 68072] (Sheet 16) the drift, 8 to 10 feet thick, gravelly above and clayey below, is cemented into hard masses by calcareous percolation, as fully described by Cumming. (Op. cit.: p. 137).

#### Strand Hall

[SC 23896 68567]. In the bend of the bay at this place, a gap 200 to 300 yards wide, in the limestone-scars on the foreshore opposite the mouth of the Strandhall brook, indicates the place where, when the sand and shingle of the beach is washed aside, peat with trunks of trees is revealed, as described in the preceding chapter (p. 413). The low cliff

between Strandhall [SC 23819 68704] and Kentraugh is composed of till which descends in places to the foreshore and there covers striated surfaces of limestone (p. 479). It seems quite possible that the present tidal-flat of limestone in this bay, and in parts of Castletown Bay and Derby Haven, may nearly correspond to the tidal-flat of Preglacial times.

Where the slate-rocks are faulted in at Kentraugh [SC 22616 68881], they rise in a hummock nearly through the drift but sink again before reaching the mouth of the Colby River, opposite which, in 1892, stony till was visible in places on the foreshore. A little blown sand caps drift-gravel and till on the eastern side of the stream. Westward to Rhenwyllan [SC 21464 68553] the coast is fringed with a strip of Raised Beach, backed by a gravelly plateau. The foundations for a protecting wall for the high-road along this strip, E. of Mount Gawne, exhibited 12 feet of shingle stained and cemented in places, resting on sandy clay without stones. Cumming was informed that in 1827 the sand which covers the broad tidal-flat opposite Mount Gawne [SC 21662 68760] was swept aside by a storm and revealed the remains of an old forest, with traces of a primitive hut (pp. 413–1). During the present survey the only exposure in this tract west of the mouth of the Colby was at half-tide about 200 yards east of the mill at Rhenwyllan, where patches of till and greenish glacial silt were seen.

#### Port St. Mary

In Chapel Bay [SC 21046 68185], the northern recess of Port St. Mary Bay, the glacial deposits occupy the whole cliff about 60 feet in height, the, lower part composed of loamy till with small stones and crumbs of shells, passing upinto stratified clay and loamy sand, with clean sand and gravel at the top. South of this there are no sections until we pass the harbour and reach the faulted outlier of Carboniferous Limestone forming Port St. Mary Point [SC 21459 67351], which is overlain by a sheet of drift and beautifully glaciated, furnishing another of the localities repeatedly described in Manx glacial literature.<ref>See Cumming, Horne, Kendall, Hewitt, op. cit. Cumming also discussed and figured the section in his paper "On the Superior limits of the Glacial Deposits of the Isle of Man". Quart. Journ. Geol. Soc., vol. a. (1854) p. 213.</ref> Mr. Hewitt has called attention to the manner in which the vertical as well as the horizontal surfaces of the limestone have been striated. He remarks, "...at the limekilns at Port St. Mary, the upper limestone beds end inland in a succession of six steps, against which abuts a mass of unstratified stony till. Each step is well polished and striated on both its horizontal and exposed vertical sides; the horizontal edges are well rounded off and the striae may be seen running obliquely from the horizontal to the vertical faces. These steps have a total difference of height of from 5 to 6 feet".<ref>Proc. Liverpool Geol. Soc., vol. v. (1888) p. 366.</ref>

The section in the cliff 400 yards S.W. of the new breakwater is shown in the figure on next page [SC 21163 67241]?.

Among the boulders on the foreshore at the time of my examination, derived from this drift, were one or two blocks of Foxdale granite; these were being hewn into shape preparatory to removal, and I was informed that similar blocks were at one time very abundant. Examples of this granite may be seen here and there all round the shores of Bay ny Carrickey; and a rounded boulder, measuring 3 feet by 2 feet by 1½ feet, which seems to be of Shap granite was seen near low-water mark in the middle of Perwick Bay [SC 20308 67268] (p. 338).

#### Calf Sound

West of the limestone-outlier the drift spreads more thinly over the rising slope of slate, but thickens again in an old hollow in Perwick Bay [SC 20308 67268], and then fades to a mere sprinkling on the rugged coast beyond. Between Kioney Ghoggan [SC 19953 66420] and Calf Sound [SC 16868 66454] the only places where there is drift thick enough to map are in the recesses of Bay Stacka [SC 18914 66323] and Baih ny Breechyn [SC 17819 66467], the first, E. and the second, W. of Spanish Head. A little gravel has lodged on the lower part of the slope at the extreme south-western corner of the Island; and a tiny patch of similar material, partly cemented, caps the islet of Kitterland [SC 17089 66642] in Calf Sound. If this tract had ever been submerged since Glacial times, these gravel patches must have been swept away by the tide-race through the Sound. Glacial striae were observed abundantly on all the higher ground W. of Perwick, and by their direction mark the confluence in this quarter of the-south-westerly flow of the leeside of the Island with the main south-south-easterly current of the ice sheet, some surfaces showing one direction and some the other, while a few have been successively scored by both streams.

#### Glen Meay and Glen Rushen

In entering Glen Meay [SC 22920 79918] from the west coast we pass at first through a deep post-glacial ravine with craggy walls of slate (p. 148), but in the wider valley above the bridge carrying the Dalby high road we find banks of slaty till on both sides and a small alluvial flat in the bottom. Similar drift extends up the little tributary glen on the south but dwindles and disappears from the main valley until we reach its sharp southerly bend and enter the part known as Glen Rushen [SC 24810 78003]. In the gully of Glen Doo [SC 24942 78285] (Sheet 12), a small tributary which falls into the main valley at the bend, there are several boulders of Foxdale Granite, and several more are seen in the bed of the main stream in this vicinity, whither they may have been carried by floods. The wet moorland sloping up east of Glen Rushen to South Barrule [SC 25776 75929] and northward to the rim of Foxdale [SC 27462 77766] is overspread by a fairly continuous sheet of rubbly local drift, with a base of hard slaty till in the hollows. This has been denuded away from the bottom of the main valley except around the head-waters W. of the mountain-road to Dalby but is exposed in the gullies of the numerous small feeders. In one of these, on the S.W. side of the old Beckwith Mines [SC 24923 77770], there is an interesting section showing grey till, 30 feet thick, banked against a little cliff of slate, probably the wall of a buried preglacial ravine. In a lower part of the same gully we find 20 feet of grey clayey till with blocks of slate and guartz, overlain by 15 feet of gravelly till of similar derivation; and this may be taken as a typical section of the local hill-drift. As described in a previous chapter, boulders of Foxdale Granite are thinly sprinkled over the surface of the moorland as far north as the head of the streams descending into Foxdale from Kerroodhoo [SC 26759 78994], and southward and south-westward to the summits of South Barrule [SC 25810 75946] and Cronk ny Arrey Lhaa [SC 22435 74670]. None were noticed on Dalby Mountain [SC 24071 77953], west of Glen Rushen; the rounded summit of this hill carries a little slaty rubble with occasional foreign pebbles, too thin to map as drift; while its steep slopes, both east and west, are of bare slate.

## Valley of Santon River

Crossing the well-glaciated ridge of South Barrule (See List of Striae, p. 477), and passing around the head of Foxdale north of Granite Mountain, to the watershed of the Island, we reach the source of Santon River in a peaty hollow at 470 feet above O.D. [SC 29482 78171]. Of this hollow, advantage has been taken for the construction of dams for the Foxdale Mines. To the north eastward of it there lies the previously-described rising ground of Archallagan, with its train of foreign boulders. For nearly the whole of its length the Santon River flows southward in the middle of a broad drift-mantled depression with gentle slopes [SC 30776 74968], differing greatly from the deep glens and ravines which characterize most of the Manx streams; and it is only at its mouth at Cass-ny-Hawin [SC 29750 69420], where, as already mentioned (p. 462), the river seems to have lost its preglacial course, that it is bordered by craggy rock-walls. The drift which covers the depression is for the most part a clayey till, best seen in the eastern bank above and below Mullenaragher [SC 30844 73375] (Sheet 13) and in the railway-cutting west of Santon Station [SC 30944 72347]; and is mainly composed of local detritus, but to the southward of Ballacorris [SC 30817 73962] contains a few foreign stones, probably brought over the watershed in the Archallagan train of extra-insular material. South of the Foxdale Granite outcrcp, boulders of that rock are very numerous on the western slope of the valley; but on the eastern slope are of rare occurrence until we pass Ballanicholas [SC 30261 76087], south of which they are spread in limited numbers over the drift-covered ground eastward into the drainage basin of Glen Grenaugh [SC 32060 73361]. A single boulder of this granite was noticed still farther east, in the valley of a feeder of the Crogga River 600 yards due west of Southampton [SC 33284 73614], under circumstances that did not suggest artificial transit though not actually disproving it. That the transport of this block may have been natural is rendered the less unlikely by the presence of boulders of the granite on the beach at Port Soderick at the mouth of the Crogga River [SC 34727 72603], which like those in Port Grenaugh [SC 31700 70345] have probably been swept down from the upper reaches of the valley by flood waters at the melting of the ice.

The drift of the upper basins of the Grenaugh [SC 32142 73522] and Crogga River [SC 32923 74627] esembles that of the Santon valley, and needs no special description. The deep dry glen curiously excavated through a spur of slate-rock at Crogga, through which the railway passes, has already been mentioned (p. 170) as perhaps indicating a late-glacial flood-outlet from the upper part of the Santon basin when the mouth of that basin was still blocked by drift or by ice. The

probable position of the pre-glacial channel of the Santon has also been pointed out in the coast-section (p. 462). The undulating plateau between Crogga Glen and Port Grenaugh, forming the interior of Santon Head, is more or less drift-mantled nearly up to the coast, as is well shown in the railway-cuttings. In the cutting 250 yards S.W. of Ballaquiggin [SC 29165 70171] (Sheet 17), a 5-ft. boulder of Foxdale Granite is seen embedded in till; but the most plentiful boulders in this tract are those derived from the adjacent outcrop of the Oatland Granitite (p. 185), a well-marked train streaming off from this small boss southward and south-westward towards Seafield and Ballavar.

#### St. Mares and Awin Ruy Valley

The Awin Ruy, a stream joining the Silverburn at Ballasalla [SC 27957 70623], has its source on the western side of Granite Mountain in a boggy col [SC 27920 76288], corresponding to that of the Santon River on the eastern side; and maintains a course strictly parallel to that river even in its easterly curve.

The ground intervening between them, about a mile in width, is comparatively low, and is for the most part drift-covered, though occasionally too thinly so to be shown on the map. The same drift-sheet, everywhere characterised by the abundance of Foxdale Granite boulders, extends westward under the above conditions into the drainage area of Awin ny Reash, and thence into the main basin of the Silverburn, reaching northward to the slopes of South Barrule and southward to the gravels and alluvium of the low ground near the coast. Cumming mentions<ref>"Isle of Man", p. 171,</ref> that close by the **Black Fort** at St. Marks there formerly stood a famous granite boulder, broken up however before he wrote, weighing between 20 and 30 tons, known by the name of Goddard-Crovan's stone [SC 28884 74128], which was thrown, according to an old Manx legend, by the hero of that name from the top of South Barrule at his termagant wife who was rating him loudly at what she considered the safe distance of over two miles. A fine block of Foxdale Granite, broken by blasting, but originally measuring 10 feet by 7 feet by 6 feet, lies at the fork of Awin ny Reash at Moaney Mooar [SC 27043 73654].

At Gibdale [SC 28275 74549] near the head of Awin Ruy there is a small patch of sand and slaty gravel with a few foreign pebbles, including flint, red sandstone, etc.; and similar patches, though apparently with local pebbles only, occur on both sides of the Silverburn valley near Ballagilbert [SC 25434 73987]. Elsewhere the prevalent drift is firm slaty till where thick, and clayey rubble where thin, or the two in combination. In many places, on the flatter portions of the slopes of the broader parts of the valleys, the drift has a superficial covering of 'Colby Wash' (see p. 453), which in some cases apparently marks the site of small seasonal water-pools at the final stages of the glacial period. Among other localities, strips of this 'wash' occur towards the head of the Santon valley; to the W. of it between Shenvalley [SC 29914 75535] and Ballavarvane [SC 29995 74678];<ref>Spelt Ballavarane, on one-inch map.</ref> in the Awin Ruy basin, N.W. of St. Marks [SC 29582 74057]; farther S., around Cly-na-mona (Sheet 12), ■ mile S. of Ballamodha Mooar [SC 27980 73368]; towards the head of Awin ny Reash [SC 27183 74968]; and W. of the Silverburn, ■ mile N. of Ballavarkish. The presence of a larger tract of similar material in the hollow at the foot of the hills, S.W. of Arbory, has been discussed in the preceding chapter (p. 413).

Half a mile below St. Marks the Awin Ruy [SC 28999 73536] is bordered on both sides for several hundred yards by curious hillocks and ridges of slate 20 to 30 feet high, due to accidents of erosion, the stream having lost its preglacial channel here and from time to time shifted its position in seeking the readiest passage across the flat barrier of rock. Such alterations of the stream-courses, of which we have previously noticed many instances in the Manx valleys, are characteristic of drainage-waters subject to great seasonal fluctuations. In the Isle of Man they may be assigned to the period when the surface-flow was stopped by frost during the winter, but became very copious during the melting of the snow in the spring and early summer.

#### Silverburn Basin

Another peculiar effect of post-glacial erosion is exemplified at the head of the Silverburn basin, where pre-glacial ravines filled in with drift have been re-excavated with double channels, either by twin streams or by a single stream alternately attacking the slopes on the opposite sides of the valley and sinking down into the drift on both sides of the buried rock-channel, leaving a narrow interrupted ridge of drift to separate the twin gullet's. These conditions are found near the head of the main stream in the drift-filled col between South Barrule and Cronk Fedjag; and slightly differently at the head

of Glion Cam, a mile farther east. In both places erosion is now at a standstill and the banks and bottoms of the valleys overgrown with vegetation. This peculiarity is repeated in various stages of development in other parts of the Island. It exists on a more extensive scale in the re-excavated drift-filled valleys of north-east Yorkshire, as described some years ago by my colleague Mr. G. Barrow.<ref>Mem. Geol. Survey; North Cleveland, p. 69.</ref>

Around the head of the Silverburn [SC 24831 75423] and its tributaries the upward limit of the drift deposits is ill-defined, the boulder-clay fading off on the higher slopes into thin sheets and hillocks of sub-angular bouldery rubble, with only a few scratched stones. Striated rock-surfaces are fairly numerous on the surrounding watershed. In the lower part of the valley there are several good exposures of slaty till in the river-banks, especially between Ballacannell [SC 25506 73283] and Grenaby [SC 26545 72410]. One of these, south of Grenaby Farm, has been described and figured by. Mr. Home;<ref>Op. cit., pp. 19–20.</ref> it shows, at the base, 30 ft. of hard grey till with insular stones, including Foxdale Granite; overlain by 1 to 2 ft. of stratified silt and fine gravel, with a capping of stony clay. Farther south, where it extends over the Carboniferous rocks, the drift becomes redder from the intermingled detritus of the Basement Conglomerate, changing afterwards to dark bluish-grey as the debris of the dark shaly limestone attains prominence. These local changes in the colour of the boulder-clay were admirably described and interpreted by Cumming in 1845.<ref>Quart. Journ. Geol. Soc., vol. ii., p. 339.</ref>

## **Colby River**

The drift around the sources of the Colby [SC 22963 74023] and its branches resembles in all points that of the Silverburn valley and needs no special description. One exposure however deserves passing notice, as showing how a deceptive appearance of subaerial weathering-may be produced on a surface between two masses of till. The section in question occurs in a side-gully which joins the Colby River on the E. just below the waterworks reservoir near its source. It reveals 20 feet of slaty till, blue above and below, but with a narrow band of red decomposed earthy material in the middle of the section. When traced up the gully, this red band is found to spring from a decomposed ochreous seam in the solid slates, possibly one of the crushed schistose diabase-dykes so numerous in these rocks (p. 306). Hence the decomposition is pre-glacial, although the weathered material has been streaked out into the mass of unweathered till. Weathered surfaces between two boulder-clays are sometimes adduced as sufficient evidence for an inter-glacial period, and it is therefore advisable to point out a case of this kind in which such a conclusion would be erroneous.

## Low-level Drifts of the Southern Basin

The strip of ground between the coast and the main-road from Ballasalla [SC 28038 70165] to Port St. Mary [SC 20900 67981] forms a low-lying tract in which many of the features of the drift-plain of the North are reproduced on a smaller scale.

As in the latter tract, we find gently sloping platforms of gravel spreading out around the mouths of the principal streams, and enclosing alluvial hollows which have formed shallow lakelets or flood basins until drained by artificial means. It seems probable that, like the Northern Curragh, the whole of this area has been occupied by a fresh-water lake during the closing stages of the Glacial period, held in on the south either by the receding ice-sheet or by higher drift-ground since removed by the sea. It differs however from the northern tract by including a few small islands of solid rock which rise above the superficial deposits, and by the more gentle slope of the drift-covered hills bounding it to the northward.

## Low ground around Castletown

[SC 26553 67513] The most easterly portion of the gravel-platform extends from the coast north of Derbyhaven [SC 28486 67836] up to the Silverburn S. of Ballasalla [SC 27857 70080], falling gently southward, from 70 to 80 feet above O.D. between Creggans [SC 27751 68892] and Ballahick [SC 28848 69798] to 30 to 40 feet near the coast. It is interrupted by the shallow stream channel descending from a small flood-basin near Ballahick, and by theclayey mound of Creggans Hill [SC 27671 69209]. Cumming believed this hill and the similar rise known as Skybright Hill [SC 26679 69464] (Sheet 16) near St. Lupus (Malew) Church to be composed entirely of drift,<ref>"Isle of Man", pp. 52–54.</ref> in which case they might be described as 'drumlins'; but in both places there is evidence tending to show that the knolls have a solid core of limestone, upon which boulder-clay is moulded. In a small excavation adjoining the railway, on the

western side of Creggans Hill, a striated floor of limestone is revealed, underlying till. The Silverburn flows through a shallow depression in the gravel-flat, which is margined in places by slight terraces probably dating back to early Post-glacial times. Cumming notices the discovery of elk remains in one of these, as previously mentioned (p. 386).

West of the Silverburn the platform extends up to an alluvial hollow S. of Billown Mooar [SC 26105 69490] (p. 412), but in places there seems scarcely sufficient gravel upon it to cover the subjacent boulder-clay. An excellent section is exposed in it by the railway-cutting W. of Castletown, which reveals at the western end strongly current-bedded gravel 10 to 20 feet thick, resting farther E. on contorted clayey sand with a few pebbles and blocks of limestone, some scratched, up to 1 foot in diameter. This sand rises higher in the section eastward, and appears to pass into tough till with large glaciated boulders of limestone; but, in 1892, this part of the cutting was grassy and obscure. The gravel consists largely of limestone, both rounded and subangular; with some grit, greenstone, quartz, etc. from the Manx slates; and flint, porphyrite, etc. foreign to the Island. It also contains a few small shell-fragments, and some of the limestone-blocks show *Pholas* and *Cliona*-borings. From its composition and relation to the boulder-clay, this portion of the gravel is clearly of glacial origin, and not merely a delta of flood-gravel washed down by the Silverburn.

We were informed that a well at the hotel at Castletown Station [SC 26840 68020] was sunk through the drifts for 45 feet, and obtained an artesian flow at that depth, below boulder-clay, from a shingly bed resting on the top of the limestone. West of the above-mentioned alluvial hollow the limestone, enwrapped by till, rises into the hummocky ridge of Cronkdarragh [SC 25166 68579] and Balladoole [SC 24883 68585]. A lenticular mound of limestone-gravel, known as Cross Welkin Hill [SC 24685 68640], probably resting for the most part on bare limestone, forms the summit of the ridge at about 90 feet above O.D.

## Arbory and Colby

The difficulty in respect to the composition of the low-lying and partly alluvial tract south of Arbory (otherwise known as Ballabeg [SC 24893 70556]) and Colby [SC 23190 70097] has been discussed in the preceding chapter (p. 413). That the northern slopes of this low ground are deeply mantled with boulder-clay is shown by the railway-Cuttings west of Ballabeg Station; and that similar material probably covers most of the rising ground on its southern margin is Indicated by the character of the cliff-sections between Strandhall [SC 23796 68720] and Kentraugh [SC 22660 68720]. A well at the school at Arbory, 44 feet deep, is reported to have passed through boulder-clay into slate-rubble ("rotten callis"). Moundy patches of coarse slaty gravel border both sides of the tongue of alluvium at Arbory [SC 24940 70427]; and a similar patch occurs a little to the east of Colby [SC 23082 70310], where it forms definite banks at the margin of the hollow; while at the mouth of Colby Glen there is a spread of gravel which is probably a late-glacial flood-delta.

West of the Colby depression we again find a nearly level tract of drift-gravel between the bills and the south coast, usually at an elevation of from 60 to 80 feet above sea-level. This platform extends from Colby [SC 23082 70310] to Port St. Mary [SC 20910 67552], and thence through the broad depression between the slate hills to Port Erin [SC 19650 68952], while an arm runs up northward past Trinity Church towards the head of the Fleshwick gap [SC 20139 71203] (p. 461). It has previously been mentioned that the gravel may possibly represent a 'kame-delta' spread out by waters draining from the ice through this gap (p. 371). The patches of alluvium which break its surface need no further description than that already given (pp. 412–5). The slopes rising from the platform are for the most part thinly overspread with boulder-clay, with bare slate-rock cropping out on their upper portion.

#### Mull Hill

[SC 19000 67606]. The little detached tract of hilly ground lying to the south of the gravel flat, and forming the south-western extremity of the island, has a few limited patches of slaty drift in its hollows and glacial striae in places on its summits (p. 479), but with no features calling for further remark.

#### The Calf of Man

[SC 15777 65696]. The drift-deposits of The Calf are practically limited to a few patches of clayey and gravely rubble in hollows of the slate, with a single gravel-mound in an exposed position at about 300 feet above O.D. on its northeastern

slope. The presence elsewhere of a sprinkling of drift-stones, including Foxdale Granite and a few extra-insular rocks; and of smoothed rock-surfaces occasionally showing scratches directed towards S.S.E.; complete the proof of its glaciation. The drift touches the coast only in the recess of Rarick [SC 15657 64792] (Sheet 18) at The Puddle, where 10 to 20 feet of clayey gravel and till are exposed, and at the heads of gullies at Ghaw Lang [SC 15115 65112] and Gibbdale Bay [SC 15955 66232] where there is a little till. The largest patch of drift underlies the enclosed and cultivated land in the depression south of the farmstead. The isolated gravel-mound mentioned above, into which a small pit has been opened, hes 650 yards E.N.E. of the farm buildings. In his paper "On the Geology of the Calf of Man", <ref>Quart. Journ. Geol. Soc., vol. i (1847), pp. 179–185.</ref> Cumming made especial reference to this gravel and figured a section across it. As it was much better exposed at that time than now, the following passages are quoted from his description: "The mass itself (which is about 13 feet thick and 50 feet across in each direction) consists of boulders, gravel and sand. The sand is chiefly at the base of the formation, and in it occur a few pebbles and laminae of fine gravel. As we ascend, the size of the fragments of rock increases; we have a bed of fine, then of coarse gravel, and the uppermost portion consists generally of large rounded pebbles with good-sized boulders which are scratched and grooved. Most if not all the rocks are foreign. There are not any which the author can certainly claim as belonging to this locality<ref>This passage probably refers to the lower portion of the gravel; at any rate, in the uppermost part to a depth of 4 to 6 feet, which was all that was exposed at the time of the present survey in 1892, subangular fragments of slate constituted the larger proportion of the deposit.</ref> There are red and grey syenites, porphyries, granites, grit and sandstone, either from Cumberland or the south of Scotland. And though there is no doubt that the drifting currents of this period pissed over the limestone area of the south of the island in this direction, the author has not met with a single pebble of limestone in this mass of boulders and gravel.... It will be observed that the stratification or quasi-stratification is not horizontal; it seems, in fact, to follow in general the outline of the surface of the hillock itself, and to consist of concentric layers forming a semi-ellipsoidal mass".

## List of shells from the glacial deposits of the Isle of Man.

Reproduced with some additions and alterations from Mr. P. F. Kendall's list in "Yn Lioar Manninagh", vol. i., No. 12 (Oct. 1894), pp. 416–418.

*Note* — Mr. Kendall's specimens were obtained chiefly from the cliffs of the east coast north of Ramsey and of the west coast north of Peel; his tables state the local distribution under the following headings: Boulder Clay, Lower Mooragh (North Ramsey); Mooragh Sand; Boulder Clay, Upper Mooragh; Shellag (Point Cranstal) Sand; Shellag Clay; Glen Wyllin; and Cliffs north of Peel. The relationship to the existing fauna is also shown in columns marked "Northern", "Recent British", "Southern", and "Extinct". It has not been thought necessary to reproduce these particulars in the present list, but the locality is stated where an addition is made to Mr. Kendall's list. The following species given by Mr. Kendall on the authority of Cumming and Forbes, and apparently not since verified have been omitted, as most may be only synonyms: *Cardium laevigatum*, L., *Astarte danmoniensis*, Lamk.; *A. pisiformis*, S. V. Wood; *Venus gallina*, L.; *Buccinum, ciliatum*, Fabr.; *Fusus Sabini*, Gray; *Balanus communis*, *B. uddevallensis*, L.

The species in italics are our additions to the list. The prefixed asterisk indicates that the determination has been verified in the palaeontological department of the Survey, either from specimens obtained during the survey, or from the large collection placed at our service by Rev. S. N. Harrison, of Ramsey to whom our best thanks are due for the loan and gift of specimens. The species from Mr. Harrison's collection are denoted by the letters S. N. H.

[Postscript.—While this memoir was in the press, a list of the Foraminifera of the glacial clay at Shellag (Cranstal) has been published by Mr. Joseph Wright, in which 72 species are recorded. See *In Lioar Manninagh, vol. iii.* (1902) pp. 627–629]

## CIRRIPEDIA

\*Balanus crenatus, Brug. From shelly drift at depth of 228 to 240 feet in No. 6 boring, Point of Ayre, see p. 342.

\*Balanus Hameri, Ascan. From shelly drift at depth of 228 to 240 feet in No. 6 boring, Point of Ayre, see p. 342.

Balanus porcatus, Da Costa

## POLYZOA

Eschara, sp.

Lepralia, sp.

#### BRACHIOPODA

\* Rhynchonella psittacea, Chemn. From shelly drift at depth of 228 to 240 feet in No. 6 boring, Point of Ayre, see p. 342.

#### LAMELLIBRANCHIATA

\*Anomia ephippium, L.

Area lactea, L.

Artemis exoleta, L.

\*Astarte borealis, Chemn. ((Figure 80), p. 336).

\*Astarte compressa, Mont.

\* Astarte sulcata var. elliptica, Brown

Astarte sp. ("a small species with concentric grooves and a rounded form, very like the sub-genus Woodia, but not agreeing with W. digitaria". P. F. K.).

Cardium echinatum, L.

Cardium edule, L.

Cardium groenlandicum, Chemn. Point Cranstal, S. N. H.

Cardium norvegicum, Speng.

\*Corbula gibba, Olivi

\*Cyprina islandica, L.

Donax, sp.

Glycimeris (Panopaea) norvegica, Speng.

Lutraria, sp.

\*Mactra solida, L.

Mactra subtruncata, DaCosta

\*Modiola modiolus? L. Point Cranstal. S. N. H.

Mya arenaria, L.

Mya truncata, L.

Mya truncata var. uddevallensis, Smith

\*Mytilus edulis, L.

Nucula nucleus, L.

Nuculana (Yoldia) pygmaea, Münst. ("in Forbes's list as Nuculana Leda pygmaea, Goldf." P.F.K.).

Nuculana (Arca) minuta var tumida, H. P. C. Maier ("in Forbes's list as Leda minuta". P.F.K.).

Nuculana (Arca) pernula, O. F. Müller ("in Forbes's list as Leda rostrata, Lamk". P.F.K.).

\*Ostrea, edulis, L.

\*Pecten maximus, L.

Pecten opercularis, L.

\*Pectunculus (Axinea) glycimeris, L.

Pholas crispata, L.

\*Psammobia ferröensis. Chemn. Point Cranstal, S. N. H.

Saxicava arctica, L.

\*Saxicava rugosa, L.

\*Tapes, sp. Point Cranstal, S. N. H. (Kendall records Tapes decussatus, L., but on authority of Cumming).

\*Tellina balthica, L.

Tellina calcarea, Chemn. Venus casing, L.

#### SCAPHOPODA

Dentalium abyssorum, Sars

Dentalium entalis, L.

#### GASTEROPODA

Acmaea (Patella) virginea, L.

\*Admete viridula, Fabr.

Aporrhais (Chenopus) pes-pelicani, L.

\*Buccinum undatum, L.

\*Buccinum undatum var. tenerum, Sow. Point Cranstal, S. N. H.

Bulla? ("fragmentary shell belonging to the Bullidae". P.F.K.).

\*Columbella sulcata, Sow.

Columbella (Mitrella) sp.

*Cypraea (Trivia) europaea, <i>Mont.</i>
*Fusus Forbesi, Strickl. ((Figure 84), p. 336).
Fusus cf. longiroster, Brocchi ((Figure 85), p. 336). Point Cranstal, S. N. H.
*Lacuna divaricata, <i>Fabr.</i>
Littorina litorea, <i>L</i> .
Littorina obtusata, L.
*Murex erinaceus, <i>L.</i>
*Murex tortuosus, Sow. Point Cranstal, S. N. H.
*Nassa incrassata, <i>Mull.</i>
Nassa Kermodei, P. F. Kendall ((Figure 83), p. 336).
Nassa monensis, <i>Forbes</i> ((Figure 82), p. 336).
Nassa reticulata, <i>L</i> .
Nassa serrata, Brocchi (" = N. reticosa, Sow = N. pliocena, Strickl". P. F. K.). ((Figure 81), p. 336).
*Natica Alderi, Forbes
Natica clausa, Brod. and Sow.
Natica groenlandica, Beck
Natica monilifera, <i>Lamk.</i>
*Patella vulgata, <i>L.</i>
Pleurotoma laevigata, Phil.
Pleurotoma pyramidalis, Strom.
Pleurotoma turricula, Brocchi
Puncturella (Cemoria) noachina, L.
*Purpura lapillus, <i>L.</i>
Rissoa, sp.
*Trichotropis borealis, Brod. and Sow.
Trochus, sp.
*Trophon antiquus, <i>L</i> .
Trophon antiquus var. contrarius, Gmel.

Trophon bamffius, *Don.* From No. 6 boring at Point of Ayre, at depth of 228 to 240 feet; and in S. N. H.'s coll., from Point Cranstal.

Trophon clathratus, L. ((Figure 86), p. 336).

Trophon clathratus var. Gunners, Lovell. Point Cranstal, S. N. H.

Trophon (Fusus) Fabrici, Beck (= T. craticulatus, Fabr.). ((Figure 87), p. 336). Point Cranstal, S. N. H.

Trophon gracilis, DaCosta

Trophon muricatus, Montagu Point Cranstal, S. N. H.

Trophon propinquus, Ald. Point Cranstal, S. N. H.

Trophon sp. nov. Point Cranstal, S. N. H.

\*Turritella terebra, L.

\*Voluto-mitra groenlandica, Beck (= Mitra, sp. P.F.K.). Point Cranstal, S. N. H.

# List of glacially-striated rock-surfaces observed in the Isle of Man

The place-names in italics are those appearing only on the six-inch and not on the one-inch map of the Ordnance Survey. The list is arranged in the order of the six-inch maps, except in two or three cases where a group of striae would be dispersed by strict adherence to this rule.

\* The distances have been measured on the 6 inch field maps.

Number of six inch Ordnance Map	Locality	Rock-surface	Direction of Principal Strive	Remarks
<u>(Sheet 5)</u>	550yds.* E. of Park Mooar near Ramsey	quartz-vein	S. 20° E	faint.
(Sheet 5)	Slieau Lewaigue 400yds. W. of Lewaigue Cottage	esheared grit	E. 30° S.	
(Sheet 5)	Road 200yds. S.W. of Ballacreggan	slate	S. 30° W.	perhaps on displaced block
(Sheet 5)	Maughold Head, 480yds. N. of Church	sandy slate	S. 10° E.	
<u>(Sheet 5)</u>	Maughold Head 350yds E.N.E. of Church	sandy slate	S.	
<u>(Sheet 6)</u>	Cliff at small headland N. of Ballanayre Strand	slaty flags	E. 10° N.	? glacial.
(Sheet 7)	Glen N. of Slieau Dhoo, 450yds. S.S.E. of Glendhoo Farm	striped slate	E. 30° S.	? glacial.
(Sheet 7)	Creg Bedn on N. elope of Slieau Monagh	quartz-vein	S. 20° E.	see p. 361 and (Figure 99), (Figure 100).
(Sheet 7)	40yds. from Summit Station	slate	S. 10° E.	the highest ground in the Island; see p. 361.

<u>(Sheet 7)</u>	Snaefell N. slope; tramline, N. 10° E. of summit	slate	S. 25° E.	altitudes between 1,400ft. and 1,800ft
(Sheet 7)	Snaefell; N. slope; tramline, N. 35° E. of summit	slate	S. 45° E.	altitudes between 1,400ft. and 1,800ft
(Sheet 7)	Snaefell; W slope; tranilinr. S.W. of summit	slate	E. 25° S.	altitudes between 1,400ft. and 1,800ft
(Sheet 7)	Snaefell W. slope; tramline, S.S.W. of summit	slate	S. 15° E.	altitudes between 1,400ft. and 1,800ft
<u>(Sheet 7)</u>	Snaefell; N.E. spur; 350yds. E. of Ramsey road	quartz-vein	S. 10° E.	altitudes between 1,400ft. and 1,800ft, faint.
<u>(Sheet 7)</u>	summit, 70yds. S.W. of wall across mountain	quartz-vein	S. 15°W.	altitudes about 1,500ft.
(Sheet 7)	Mullagh Ouyr; near summit, 150yds. S.W. of wall across mountain	quartz-vein	S. 5° W.	altitudes about 1,500ft.
(Sheet 7)	Mullagh Ouyr; near summit, 170yds. S.W. of wall across mountain	quartz-vein	S. 15° W.	altitudes about 1,500ft.
<u>(Sheet 8)</u>	Col N. of Clagh Ouyr, 20yds. S.W. of wall across mountain	quartz-vein	S. 30° E.	
<u>(Sheet 8)</u>	Same ridge; 550yds. N.E. of wall across mountain	quartz-vein	S. 35° E.	obscure.
<u>(Sheet 8)</u>	S.E. side of ridge, 550yds. N.W. of Park Lewellyn	slate	E. 30°–35° S., crossing others S. 30° E.	also on vertical rock face, see p. 363.
(Sheet 8)	S.E. side of ridge, 150yds. N.E. of last	slate	S. 35° E.	
<u>(Sheet 8)</u>	Ballasaig, in road leading to School Ballasaig 500vds	slate	S. 30° E.	also faint S.W. markings (glacial 1),
<u>(Sheet 8)</u>	E.N.E. of Magher-e-breck	slate	S. 30° E.	good.
<u>(Sheet 8)</u>	Ballagorra; roadside 400yds. N.N.W. of hamlet	gritty flags	S. 30° E.	others obscurely seen 300yds. further to S.S.E.
<u>(Sheet 8)</u>	Cliff, S. side of Gob ny Garvain	gritty flags	W.10° S.,crossing others S. 10° E.	below red stony clay, see p. 944.
<u>(Sheet 8)</u>	350yds, S.E. of Trinity Church	flaggy slate	S., also S.E.	? glacial.
<u>(Sheet 8)</u>	Laxey Valley; N. slope 450yds. N.E. of Laggan Agneash	quartz-veined grit	S. 40° E.	

<u>(Sheet 8)</u>	Laxey Valley; S. slope; tramline S.S.W. of Laggan Agneash	quartz-veined grit	E. 35° S.	
(Sheet 8)	tramline half mile E.S.E.	gritty flags	S.E.	faint.
(Sheet 8)	Croak y Vaare; summit	quartz-vein	S. 40° E.	
<u>(Sheet 8)</u>	Croak y Vaare; 130yds. E. of last	quartz-vein	E. 85° S.	good example of glaciated quartz-vein.
<u>(Sheet 8)</u>	Croak y Vaare; 140yds. E.S.E. of last	quartz-vein	E. 80° S.	faint.
<u>(Sheet 8)</u>	S. corner of coppice 800yds. N.W. of Baljear	quartz-vein	S. 25° E. and S. 40° E.	two directions.
<u>(Sheet 11)</u>	Crag in field 700yds. W. of Baljean	quartz-eined grit	S. 10° E.	
<u>(Sheet 8)</u>	Slieau Ruy; 450yds. N.B. of summit	quartz vein in granite	S.E.	obscure; ? glacial; antitude about 1,100ft.
<u>(Sheet 9)</u>	shore, outside castle	flags	S. 10°-20° W.	
<u>(Sheet 9)</u>	St. Patrick's Isle; N. shore, east side of	flags	S. 30° W.	?glacial.
<u>(Sheet 9)</u>	Peel Hill,170yds. S.S. W. of Corrine Tower	flags	S. 15° W.	
<u>(Sheet 9)</u>	S.S.W. of Corrine Tower	flags	S.W.	
<u>(Sheet 9)</u>	Contrary Head; cliff-top on N. side	flags	S. 40° W.	also more faintly in other directions.
<u>(Sheet 9)</u>	inland, 300yds S. of Trale Cabbage	flags	W. 35°-40° S.	
<u>(Sheet 9)</u>	Small quarry east side of stream 150yds. N.E. of Staarvey	grit	E 10° N.	also on vertical side of boss.
<u>(Sheet 9)</u>	Field, 230yds. 9 E. of Lambfell Mooar	slate	S. 20° E.	faint; ? glacial.
<u>(Sheet 9)</u>	Valley; old quarry N.H. of ruined brick-kilns	slate	E. 15° E.	faint.
<u>(Sheet 9)</u>	Low crag 230yds. E. of last	slate	S. 10° E also S.E. and others	intercrossing striae.
<u>(Sheet 9)</u>	Low crag 40yds. E. of last	slate	S. 10° E.	also on vertical side of crag.
<u>(Sheet 9)</u>	Slieau Whuallian; near crest, 170yds. S.W. of wall across mountain	slate	S. 45° E. and others crossing	altitudes about 1,000ft.; good.
<u>(Sheet 9)</u>	crest, 180yds. S.W. of last	slate	S. 30° E.	altitudes about 1,000ft.

	Slieau Whuallian,			altitudes about 1 000ft
<u>(Sheet 9)</u>	280yds. S.W. of The	quartz-vein	E. 25° S.	faint
	Cairn			ianit.
	Prolongation of Slieau			
(Chaot 0)	Whuallian ridge; 1	quartz vain		acad
(Sheet 9)	50yds. N.W. of	quartz-vein	E. 20 S.	good.
	Carnagray			
	Prolongation of Slieau			
(Sheet 9)	Whuallian ridge;	slate	E. 35' S.	good.
	300yds. S.W. of last			
	Arehallagan plantation;			
(Sheet 9)	gutter 200yds. 9.E. of	slate	S. 85. E.	see p. 361.
	Cornelly Mines			·
	Small guarry near edge			
(Sheet 10)	of moor 100yds. E. of	flaggy slate	E. 30° S., crossing	
<u>.                                    </u>	Ballashimmin enclosure		E.20° N.	
	Crags S. of Colden			
(Sheet 10) (Sheet 10) (Sheet 10) (Sheet 10) (Sheet 10) (Sheet 10) (Sheet 10)	River, 300vds, W. of			
<u>(Sheet 10)</u>	confluence with R.	slate	S. 15° E.	
	Glass			
	Crads S of Colden			
<u>(Sheet 10)</u>	River 50vds E of last		S. 25° E.	
	Crads S of Colden			
<u>(Sheet 10)</u>	River 450vds S of last	quartz-vein	S. 10° E.	
	Old slate quarry at The			
<u>(Sheet 10)</u>	Crea S of Colden mtn	slate	S.	
	Carn Gerioil 500vds			
<u>(Sheet 10)</u>	S W W of Cairn	quartz-veined grit	S. 10° W.	altitude about 1,360ft.
	Sliean Ree 500vds.			
<u>(Sheet 10)</u>	N.E. of ordnance station	quartz-veined grit	S. 20°–30° E.	altitude above 1,000ft
	Sliean Ree 350vds. E.		S. 30° E. and fainter S.	
<u>(Sheet 10)</u>	of ordnance station	quartz-vein	6° E.	altitude 990ft.
	Sliean Ree 30vds, S.W.			
<u>(Sheet 10)</u>	of last	quartz-veined grit	8. 35° E.	
	Sliean Ree 200vds, S.			
(Sheet 10)	10° E. of ordnance	quartz-veined grit	S. 20°–30° E.	
<u>()))))</u>	station			
	Greeba Mtn · 450vds		S 30° E and fainter S	
(Sheet 10)	E, of sun suit	Slate	25° W.	altitude 1,268ft.
	Gob ny Creg wa Creg		20 111	
<u>(Sheet 10)</u>	nv Greeb	Slate	E. 5°–15° N.	altitude 400ft.
	Slope F of Baldwin			
(Sheet 10)	Riv $650v Is N 10^{\circ} F$	flaggy slate	S 5° F	altitude 600ft
	of Balliargev	huggy blate	0.0 2.	
	300vds S of Gretchver	1		
<u>(Sheet 11)</u>	near Lavey	flags	S. 10° E.	? glacial
	Rough ground QOvde			
(Sheet 11)	W of highroad W of	flags	F 40° S	faint
	l avev Dier	nago	L. TO . O.	
	Tramline 350vde N of			
(Sheet 11)	Seaview near Lavey	flags	S.	
	ocaview, riear Laney			

<u>(Sheet 11)</u>	Tramline W.S.W. of Baldroma Mooar Clay Head: cliff	gritty flags	S. 25° W.	faint.
<u>(Sheet 11)</u>	300yds. S. of Braggan Point	flags	S. 5° E.	
	Clay Head; cliff,			
<u>(Sheet 11)</u>	600yds. S. of Braggan Point	flags	S. 20° W.	good; ascending slope.
(Sheet 11)	Clay Head; cliff, opposite "The Clytt"	flags	S. 15° W.	faint.
<u>(Sheet 12)</u>	Barrule Beg (N. spur of South Barrule), 500yds. N.E. of Slate Quarry	quartz-vein	E. 40° S.	also W. 5° S. on east side of rock. all above 1,000 ft in altitude
(Sheet 12)	Barrule Beg 300yds. N.E. of Slate Quarry	slate	E. 30°. N.	above 1,000 ft in altitude
<u>(Sheet 12)</u>	Barrule Beg, west slope, at small slate trial, 250yds. N. W. of Quarries	slate	E. 25° S.	all above 1,000 ft in altitude
(Sheet 12)	North-west slope of South Barr.ile. 610vds.	quartz-vein	W. 35° S.	faint. all above 1,000 ft
(	N. of summit	4		in altitude
	North-west slope of			
(Sheet 12)	South Barrule; W. of Geavlin ny Cregyn	а	W. 35° S.	faint. all above 1,000 ft in altitude
	West slope of South			fide Mr. P. F. Kendall.*
<u>(Sheet 12)</u>	Barrule; 30yds. W. of Creg ny Vaare	slate	S. 5° E.	all above 1,000 ft in altitude
	North slope of Granite			on or noar main
(Sheet 12)	Mtn., Foxdale; 880yds. E. of Castletown	quartz-vein in granite	S. 20° E.	watershed of Island; altitude about 650ft.
	highroad			
(Sheet 12)	Granite Mtn., Foxdale; 750yds. W. of Renshent	quartz-vein in granite	S. 20°–30° E	on or near main watershed of Island; altitude about 650ft.
	South-east slope of		<b>0</b> 000 000 <b>F</b>	on or near main
(Sheet 12)	Granite Mtn., Foxdale:	quartz-vein in granite	S. 20°–30° E.	watershed of Island;
	Moor S E of Croak			
(Sheet 12)	Fedjag; 600yds. S. of	striped slate	S. 30° E.	good; altitude about 1,100ft.
	mtn. road * Yn Lioar Ma ninagh, vol. 1., No. 12 (1894), p 406. Moor S.E. of Cronk			
(Sheet 12)	Fedjag; small quarry 750yds. S. of mtn. road	striped slate	S.	
(Shoot 12)	Near St. Mark's; small	floggy alots	S 10º E	acad
	S.E. of church	naggy siate	3. IU E.	yuuu.

<u>(Sheet 13)</u>	Slieau Chiarn; 600yds. E. of Ballacallan Mooar	qaartz-vein	S. 15° W.	rock? in place.
<u>(Sheet 13)</u>	of new house, 300yds. S.W. of Ballingan	flags	S.E.; also S. 40° W.	faint.
<u>(Sheet 13)</u>	Small quarry at N.W. side of Santon granitite, N. of road	baked flags	S. 30°–50° W.	good.
(Sheet 13)	Douglas; slope S. of Harbour, on roadside be hind St. Anna's Hote	flags I	S. 30° W.	
(Sheet 13)	Douglas Head; slope S. of outer pier	flags	S. 15°–30° W. and others	
(Sheet 13)	Douglas Head; near top of slope, above road	flags	S.W.	
(Sheet 13)	opposite Fiddler's Green	flags	S. 20° W.	
(Sheet 13)	Douglas Head; tramline 100yds. W.S.W. of last Douglas Head; tramline	flags	S. 20° W. S. 25° W.	
(Sheet 13)	100yds. E. of Pigeon Stream	flags		
<u>(Sheet 13)</u>	Tramline 250yds. E. of Port Wallberry	flags	S. 25°–35° E.	
<u>(Sheet 13)</u>	Cliff-top at Wellberry Hil	Iflags	W. 35° S.	altitude 408ft.
(Sheet 13)	yds. S.E. of Nunnery Howe	quartz-vein	W. 40° S.	faint; ? glacial.
<u>(Sheet 14)</u>	Cliff 250yds, N.E. of Port Groudle West side of Banks	flags	S. 30° W.; also S. 30° E.	
<u>(Sheet 14)</u>	Howe, S. of Groudle	flags	S. 20° W.	
(Sheet 14)	Station	flags		
<u>(Sheet 14)</u>	Howe, E.S.E. of Groudle Tram Station	flags	S. 5° W.	
<u>(Sheet 14)</u>	Howe, 150yds. S.E. of last	flags	S 30° W.	
<u>(Sheet 14)</u>	North-east slope of Banks Howe, by side of tramline	flags	S. 30° W ; also W. 20° S.	
<u>(Sheet 14)</u>	Banks Howe, by side of tramline, 50yds. S. of last	flags	S.W.	
<u>(Sheet 14)</u>	North-east slope of Banks Howe, by side of tramline, 70yds. S. of last	flags	E.; also E.S.E.	

<u>(Sheet 14)</u>	North-east slope of Banks Rowe, crag below tramline	flags	S.S.W.	also on vertical face inclined 25° towards north.
<u>(Sheet 14)</u>	South slope of Banks Howe, by side of tramline	flags	S. 40° W.	
<u>(Sheet 14)</u>	South slope of Banks Howe, by side of tramline, 80yds. W. of	flags	S. 5° E. and others	
<u>(Sheet 14)</u>	New road at Howorake, 160yds. N. of Onchan Harbour	flags	S. 5° W.	
(Sheet 15)	Cliff at deep gully, east side of Fleshwick	slate	E. 15° S.	
<u>(Sheet 15)</u>	Bradda Hill, east side; 300yds. W. of Ballalonney	slate	S 10° E.	also on vertical face inclined N. at 10° (see p. 363).
<u>(Sheet 15)</u>	Bradda Hill, 350yds. inland, E. of North Bradda Mines	slate	S. 30° E.	
<u>(Sheet 15)</u>	Bradda Head, north side; cliff opposite Caren Vreid	grit	S. 15° E.	
<u>(Sheet 15)</u>	Bradda Head, south side; above cliff; 100yds. E.N.E. of South Bradda Mines	slate	E. 20° S., crossing S. 20° E.	
(Sheet 15)	Bradda Head, south side; above cliff; 400yds. E.N.E. of last	slate	S. 20° E.	
<u>(Sheet 15)</u>	South of Port Erin; cliff 450yds. S. of Kione-ny-Garee	slate	W.10° S.	
(Sheet 15)	Crest of slope above cliff, 500yds. S.S.W. of Bay Fine	slate	S. 15° E.	
(Sheet 15)	Crest of slope above cliff, 70yds. S.E. of last	slate	S. 15° E.	
(Sheet 15)	Top of cliff, 200yds. S.W. of last	slate	S.	
<u>(Sheet 15)</u>	Top of cliff, in recess at Aldrick, and again 50yds. inland	slate	N. 40°W.(chief), also W.10° S.; S. 30° E. and others.	several directions intercrossing.
<u>(Sheet 15)</u>	In recess at Aldrick, 150yds. inland, S.E. of	slate	S. 15° E. and others.	
<u>(Sheet 15)</u>	Top of small headland S. of Aldrick	slate	S. 2° W.	
<u>(Sheet 15)</u>	Mull Hill, N. side, 30yds E. of road at Howe	grit	S. 10° W.	obscure.

<u>(Sheet 15)</u>	Mull Hill, top, 20yds. N.W. of stone circle	quartz vein in grit	S. 10° E.	
(Sheet 15)	Cregneish, at N. side of road in hamlet	slate	S. 10° E. S. 20° E.	
<u>(Sheet 15)</u>	Cregneish. 200yds. S. of hamlet, on road to Chasms	slate		
<u>(Sheet 16)</u>	ground 500yds. E, of hamlet	slate	S.	obscure; ? glacial.
<u>(Sheet 16)</u>	Lhiattee-ny-Beinee, N. of Fleshwick, 200yds. S.E. of Gob Beinn	quartz vein	S. 30° E.	
(Sheet 16)	Lhiattee-ny-Beinee, N. of Fleshwick, 250yds. S.S.W. of Gob Beinn	quartz vein	S. 20° W.	obscure.
<u>(Sheet 16)</u>	Lhiattee-ny-Beinnee, N. of Fleshwick, 380yds. W. of Kirkill	quartz-vein in microgranite dyke	S. 20° E.	
<u>(Sheet 16)</u>	Rough ground E. of parnanes, 430yds. S.S.E. of Kirkill	grit	S. 30° E.	
<u>(Sheet 16)</u>	Rough ground E. of Cartutnes, 300yds., S.S.W. of Ballarock	grit	S. 40° E.	
(Sheet 16)	Rough ground Rof Carnanes, 400yds. S.W. of last	grit	W. 40° S.	
<u>(Sheet 16)</u>	Small quarry 400yds. W. of Scholaby	striped slate	S. 5° E. and fainter S. 50° E.	good.
(Sheet 16)	Small quarry 360yds 8. of Ballacorkish South Mine	striped slate	S. 25° E., crossing S. 10° W.	
<u>(Sheet 16)</u>	Roadside 250yds. S.S.E. of Bellagawne, Arbory	striped slate	W. 15° S.	
<u>(Sheet 16)</u>	Small quarry 130yds. S.W. of Ballavarkish, Arbory	striped slate	S. 25°E., crossing stronger set, S.W.	good.
<u>(Sheet 16)</u>	Port St. Mary Point. low cliff at S. side of breakwater	Carb. Limestone	W. 26° S.	see p. 466.
(Sheet 16)	Port St. Mary Point. Iow cliff opposite Carrick Philip	Carb. Limestone	W. 20° S.	see p. 466.
(Sheet 16)	Port St. Mary Point, low cliff 70yds. W. of last Foreshore F. of	Carb. Limestone	S. 30° W.	
<u>(Sheet 16)</u>	Kentraugh, 25yds. from sea-wall, close to boundary fault	Carb. Limestone	W. 20° S.	see p. 465.

(Sheet 16)	"Black marble" quarry, S. side of Poyll Vaaish	Carb. Limestone (upper)	S. 60° W.	
(Sheet 16)	cliff at Scarlet, W. side of Castletown Bay	Carb. Limestone	W. 20° S.	see p. 465.
<u>(Sheet 16)</u>	Small quarry adjoining railway opposite Cregans, 1 mile N.N.E. of Castletown Station	Carb. Limestone	S. 5° E., crossing other S. 40° W.	S
(Sheet 17)	Small quarry, 270yds. E.N.E. of Santon Church	slaty flags	S. 20° W.	
(Sheet 17)	Cliff at S. edge of Port Soldrick, Santon	flags	W. 5° S. and others	under red clay.
(Sheet 17)	Cliff, 400yds. N.N.E. of Staiden	flags	E. 25° S.	? glacial.
<u>(Sheet 18)</u>	Top of Barroo Ned, Call Sound, 110yds. E. of Carrick Nay	striped slate	S. 15° E.,crossing, S. 40° E.	
<u>(Sheet 18)</u>	Mooar, W. side of Spanish Head	striped slate	S. 80° W. and others	
<u>(Sheet 18)</u>	Cliff-top at Spanish Head above Slea ny Bery	striped slate	S.30°W.,crossing S. 20 E.	0
<u>(Sheet 18)</u>	East edge of moor N. of Spanish Head, 300yds. E. of Cronk Mooar	f striped slate	S. 30°W.	
<u>(Sheet 18)</u>	North edge of moor, 350yds. N. of Cronk Mooar	striped slate	S.15° E. crossing S. 20 W.	° good.
<u>(Sheet 18)</u>	North edge of moor, 100yds. N.B. of last Cliff-top west of The	striped slate	S. 30° E	good.
(Sheet 18)	Chasms, above stone circle	grit	W. 40° S	
<u>(Sheet 18)</u>	At edge of one of Chasms	grit	W. 40° S.	
(Sheet 18)	100yds. inland N.B. of The Chasms	grit	S. 20° W.	
<u>(Sheet 18)</u>	Calf Island; roadside 350yds. W. of Grant's Harbour	striped slate	S. 20° E.	
<u>(Sheet 18)</u>	380 yds. E.N.E. of upper lighthouse	striped slate	S. 20° E.	altitude about 400 ft.
<u>(Sheet 18)</u>	320yds. E.N.E. of upper lighthouse	r striped slate	S.	altitude about 400 ft.



(Figure 96) Diagram from Ramsey to Point of Ayre, showing profile of the northern plain and mode of arrangement of Drifts. Scale: Horizontal, 1 inch = 1 mile; vertical,  $\blacksquare$  inch = 100 feet. Explanation. a. Manx slates. b. See enlarged section, (Figure 91) c. Alluvial flat, expanding inland into the Curragh. d. Yellow sand and gravel, with some red clay; surface rather moundy e. Thin sand and gravel on red boulder-clay and stratified drift. f. Thin sand and gravel on red stony clay: stratified material below. g. Chiefly stratified material, with a little boulder-clay h. Chiefly red boulder-clay. i. Stratified red clay, sand and boulder-loam k. Shingle and blown-sand.

16. 88. Cliff-section in 2 miles north	glacial drift at Kionlough of Ramsey.
Scale : 1 inc	h = 40 feet.
5 Blown sand and gravelly rainwash	Thickness 3 to 5 feet
A Stratified gravel and sand = Upper Platform Gravel a	about 15 "
Reddish warp and clay, more or less stratified; rather stony in the upper part; passing down- wards into—	" 20 "
2 Well-stratified sand with gravelly layers and streaks of red clay; calcareous concretions in places. Shell-fragments abundant in the finer gravel but absent from the sand and clay -	50 to 60 "
Red warp or clay with a few stones, at foot of cliff	about 5 ".

(Figure 88) Cliff section in glacial drift at Kionlough 2 miles north of Ramsey. Scale:1 inch = 40 feet. 5. Blown sand and gravelly rainwash — Thickness 3 to 5 feet 4. Stratified gravel and sand = Upper Platform Gravel — about 15 feet 3. Reddish warp and clay, more or less stratified rather stony in the upper part; passing downwards into —Thickness 20 feet 2. Well-stratified sand with gravelly layers and streaks of red clay; calcareous concretions in places. Shell-fragments abundant in the finer gravel but absent from the sand and clay Thickness 50 to 60 feet 1. Red warp or clay with a few stones, at foot of cliff Thickness about 5 feet.



(Figure 92) Diagram showing replacement of stratified shelly drift by local boulder-clay in the cliff-section near Gob ny Creggan Glassey, Kirk Michael. Scale, for both Figs.: 1 inch = 100 feet, hor. and vert. Explanation (for both sections). 5. Stratified slaty platform-gravel, probably passing into (4) at foot of slope. 4. Upper local rubble-drift. 3. Stratified extra-insular drift; cross-bedded and confused in places; composed of sand, silt, gravel, with a few shell fragments, and thin patches of red clay, 3a, towards the top; the gravel, a mixture of local and foreign material. 2. Dark grey or blue local till, with a few foreign stones. 1. Slaty rubble passing in places into dark slaty till (2). x Manx Slates.



(Figure 93) Diagram at right angles to the above, showing general arrangement of the drift deposits on the lower slopes of the hills; based on sections in Glion Thoar and Glion Shellan. Explanation (for both sections). 5. Stratified slaty platform-gravel, probably passing into (4) at foot of slope. 4. Upper local rubble-drift. 3 Stratified extra-insular drift; cross-bedded and confused in places; composed of sand, silt, gravel, with a few shell fragments, and thin patches of red clay, 3a, towards the top; the gravel, a mixture of local and foreign material. 2. Dark grey or blue local till, with a few foreign stones. 1. Slaty rubble passing in places into dark slaty till (2). x Manx Slates.



(Figure 97) Plan of dry valleys near Kirk Bride. The figures denote height above sea-level.



(Figure 91) Cliff-section south of Ballure Glen, Ramsey, showing interbedding of local and foreign drift-material. Scale, horiz. and vert., 1 inch = 100 feet. 11. Rough semi-stratified clayey slate-rubble and gravel: =, Local rubble-drift: capped in places by thin silty wash. 10. Irregular band of red clay with a few pebbles:= Extra-insular drift: appears to thin southward into underlying gravels. 9. Fine slaty gravel and silt, with a few foreign pebbles; thin streaks of red clay in upper part at N.W. part of section. 8. Streaks of red clay among slaty gravel and silt, probably represented by red boulder clay farther north. 7. Cross-bedded sand, loam and fine gravel; pebbles partly of local slate and partly of foreign material thins rapidly southward. 6. Irregular band of stony red clay, fading out in places:= Extra-insular drift. Probably continued southward (6 ?) among local till (4). 5. Dark slaty gravel and sand with a few foreign pebbles. 4. Bluish slaty till:= Local drift. 3. Stratified cross-bedded yellow sand and gravel, contorted in places; pebbles chiefly local but foreigners abundant, including Ailsa Craig riebeckite-rock. 2. Grey slaty till, with an occasional extra-insular stone:= Local drift, with foreign admixture., 1. Coarse rubble of slate-fragments, banked against old cliff and in small hollow on top. x. Manx Slate forming pm-glacial cliff. NOTE. — Unshaded portions of section not seen; dotted boundaries obscure.

FIG. 95. The Bride Hills, as viewed from a spot 14 miles north-east of Kirk Andreas. HLOL FRANC **用的新教室**的 and a state

(Figure 95) The Bride Hills, as viewed from a spot 1¼ miles north-east of Kirk Andreas.



(Figure 39) — Plan of St. Patrick's Isle, Peel, showing position of dykes traversing contorted Niarbyl Flags.



(Figure 99) Sketch-view of Creg Bedn, on the northern side of Slieau Monagh (Meanagh), near Sulby; looking west: a glaciated crag of vein-quartz, with striae pointing S. 15–25 E.; height of crag about 15 feet; width (N–S) 20 feet; length (E–W) 60 feet.

<i>Fiver, opposite Ballahig, sho</i> red (extra-insular) and grey (i	owing interlamination of insular) boulder-clay.
Scale : $1 \text{ inch} = 20$	) feet.
2 Manual Manual Ma Manual Manual Man	Top not exposed. 2 Slaty clay (local drift) traversed by several nar- row contorted strips of red pebbly clay (ex- tra - ins ul a r), from 1 inch to 4 inches thick, containing for- eign pebbles as wellasslatefrag- ments : about - 10 ft. 1 Slaty rubble in grey clayeymat- rix (local drift)- 6 ft.

(Figure 94) Drift-section in the west bank of the Foxdale River, opposite Ballahig, showing interlamination of red (extra-insular) and grey (insular) boulder-clay. Scale: 1 inch = 20 feet. Top not exposed. 2. Slaty clay (local drift) traversed by several narrow contorted strips of red pebbly clay (extra insular), from 1 inch to 4 inches thick, containing foreign pebbles as well as slate fragments: about 10 ft. 1. Slaty rubble in grey clayey matrix (local drift) — 6 ft.



(Figure 80) Astarte borealis. Shells of the Manx Extra-Insular Drift (nat. size). Figure 80 represents a shell from the Post-Pliocene beds of the Clyde, as there was no suitable Manx specimen of this species in our collection; the others are from specimens from the Isle of Man. Drawn by Mr. Gilbert Williams from specimens in the Geological Survey Museum.



(Figure 84) Fusus Forbesi. Shells of the Manx Extra-Insular Drift (nat. size). Drawn by Mr. Gilbert Williams from specimens in the Geological Survey Museum.



(Figure 85) Fusus cf. longiroster. Shells of the Manx Extra-Insular Drift (nat. size). Drawn by Mr. Gilbert Williams from specimens in the Geological Survey Museum.



(Figure 83) Nassa Kermodei. Shells of the Manx Extra-Insular Drift (nat. size). Drawn by Mr. Gilbert Williams from specimens in the Geological Survey Museum.



(Figure 82) Nassa monensis. Shells of the Manx Extra-Insular Drift (nat. size). Drawn by Mr. Gilbert Williams from specimens in the Geological Survey Museum.



(Figure 81) Nassa serrata. Shells of the Manx Extra-Insular Drift (nat. size). Drawn by Mr. Gilbert Williams from specimens in the Geological Survey Museum.



(Figure 86) Traphon clathratus. Shells of the Manx Extra-Insular Drift (nat. size). Drawn by Mr. Gilbert Williams from specimens in the Geological Survey Museum.



(Figure 87) Trophon (Fusus) Fabrici, Beck (from E. Forbes, Mem. Geol. Surv., vol. 1., p. 424.)