Chapter 9 New Red Sandstone (continued)

Upper Division (Triassic)

The Upper Division of the New Red Sandstone is the sedimentary formation which builds the greater part of the southernmost quarter of Arran. Fine sections are exposed in the old sea-cliffs around the southern and south-western coasts, and in the lower courses of the streams debouching on these coasts. Up the western coastal region the Triassic marls and shales are found as far north as Ballymichael. A small detached area of Triassic rocks is preserved in an area possibly between two converging faults at the head of the Birch Burn (Lag a' Bheith) to the south of Brodick; and a few small masses of Triassic marls have been involved in the Central Ring Complex. The latter, however, are reserved for description in the succeeding chapter, in which all the Mesozoic fragments preserved in this way will be dealt with.

The rocks are chiefly variegated shales and marls of red, green, and grey tints, with some bands of sharp-grained and micaceous sandstones, calcareous sandstones, and impure nodular limestone. Thus the group is lithologically contrasted with the rocks of the Lower Division. They present the characters of aqueous deposits rather than those of deserts, and may be regarded as the varied accumulations of a river system. Some of the marls are crowded with minute calcite rhombs, and were probably laid down under lagoon conditions.

The stratigraphical classification of these rocks is stated on p. 76. It differs from that proposed by Prof. J. W. Gregory<ref>*Trans. Geol. Soc. Glasgow*, vol. xv., part ii., 1915, p. 186.</ref> in the recognition of a lower series of marls and cornstones, typically exposed in the upper part of the Lag a' Bheith, which rests directly on the Glen Dubh Sandstones, and must therefore be on a lower horizon than the Levencorroch Marls and Cornstones. The order of description will be clock-wise around the coast, starting on the east side with the faulted outlier of the Lag a' Bheith. G.W.T.

In the Birch Burn (Lag a’ Bheith) the rocks may be seen in both main headwaters of the burn, but the longer branch yields the better section. Overlying the red sandstones rather more than half a mile north of Cnoc Dubh, we find beds of red and mottled clays or argillaceous shales with occasional thin bands of nodular limestone. The dip is first to the south at a low angle, but higher up the stream the dip is eastward or undulating, and the strata are traversed by dykes or sills of felsite, pitchstone, and basalt. Traces of the mottled shales or marls, variegated red and green, are found occasionally up to near the head of the stream where it issues from a peat moss. The size of this patch of the upper beds appears to have been limited by faults on either side, which bring up the lower sandstones.

In the region immediately west of Whiting Bay, the red and green marls and accompanying sandstones are well seen in the upper parts of practically all the small burns which drain into Glen Ashdale. They come on above the main Glen Ashdale dolerite sill (the one at the great waterfall); and to the north and west of Glen Ashdale they appear at the horizon of the widespreading felsite mass of Loch na Leirg.

The Allt Garbh, which flows by the west side of Borrach, on the north of Glen Ashdale, offers a typical section of these rocks, and shows the way in which they are involved with the Cainozoic igneous rocks. The gorge of Creag Bhan in this burn, immediately south of Borrach, exposes a rather complicated mass of igneous rocks, including spherulitic felsite, a 'felsite-basalt' composite sill, and several basalt dykes, with at least two demonstrable faults (Figure 14). The true Triassic marls and shales, brick-red, tea-green, and ash-grey, are seen interbedded with soft manly sandstones and some thick posts of whitish and chocolate-coloured sandstone. Up to the igneous rocks of Creag Bhan the dip does not depart sensibly from the horizontal. The intrusions and the faulting, however, result in various inclinations, different on opposite sides of the gorge. There is nothing to indicate discordance between the marls and the underlying red sandstones.

One-eighth of a mile above Creag Bhan the spherulitic felsite of that locality passes under horizontal red sandstone and shale, and the sedimentary rock upstream of this point is a thin-bedded chocolate-coloured shale. Thence the stream passes into the extensive felsite mass of Loch na Leirg.

The Dippin section has already been described (p. 89). G.W.T.

The Kildonan section eastward from Little Mill, is in soft marls with thin sandstones. The best sections are, however, inland, in the two burns of Allt na Ceardaich and Allt Mòr. The latter issues from Loch Garbad, and, where it passes through the wood above the road, runs in a deep gorge cut through the marls. This gorge is terminated by a waterfall forming the centre of a fine amphitheatre of rock, capped by a sill, which is divided into two parts by an intercalation of marls and sandstone. At the fall there are some small faults, and two thin dykes, each about 2 feet in width, running perpendicularly up the cliffs. The more easterly dyke appears to coincide with a fault, and apparently does not reach the sill, while the more westerly dyke seems to pierce it. The beds in both burns are nearly flat, but the general inclination seems to be towards the south-east. The Allt na Ceardaich, or the Smithy Burn, has a bed of sandstone above the wood, which is somewhat flaggy, red or white in colour, and in places has a carious weathering. Some of it is ripple-marked and alternates with shale, and the whole dips gently to S.S.W. Hard grey calcareous shale occurs higher up, which was carefully searched for organic remains, with a negative result. W. G. (Ms.)

Prof. J. W. Gregory<ref>The Permian and Triassic Rocks of Arran, *Trans. Geol. Soc. Glasgow,* xv., part ii., 1915, p. 178.</ref> gives the following detailed section from a road cutting above the Kildonan shore, by the side of the Allt Mòr:

	feet	inches
Red shale with green spot	6	—
Green shale	—	6
Light brown to buff soft sandstone	1	2
Bar of hard buff sandstone	—	5
Green sandy shale	—	4
Buff to white soft sandstone, with layers of green shale	2	—
The green layers increase in proportion till they form a basal layer of green shale	1	—
Red nodular shale, ending below in a line of green patches	3	—
Red nodular shale	5	—
Green shale	—	8
Buff coarse sandstone	—	2
Buff sandstone decomposed to sand	—	3
Green shale	—	6
Red shale	—	6
Green shale	—	3
White to buff sand with brown spots; in part false-bedded	1	3
Green shale	—	—
Bar of white to brown or buff sandstone	—	4
Red nodular shale	4	—
Total	27	4

The corresponding section in the Levencorroch Burn is also described by Prof. J. W. Gregory.<ref>*The Permian and Triassic Rocks of Arran, Trans. Geol. Soc. Glasgow*, xv., part ii., 1915, p. 177.</ref> In the upper part of the stream the beds are almost horizontal. The sequence from the base of the Auchenhew dolerite sill at 620 feet is as follows:

Immediately below the sill are chocolate and reddish shales, followed by alternate layers of red shale and white sandstone. Some of the shales are green-spotted. Below the upper waterfall, at a level of 570 feet, are some light-blue calcareous sandstones rich in white mica. Some of this rock is well bedded and some is false-bedded. The rock weathers into cavities, and effervesces freely with acid. The surfaces of some of the sandstone layers are marked by a network of raised bands, due to the sands having been pressed into shrinkage cracks in the adjacent beds of clay. The red shales in this part of the section are accompanied by red marls, which have the typical irregular fracture of the English Keuper

marl. At the level of 525 feet are two layers of calcareous nodules or potato stones, which are secondary calcareous segregations. At 495 feet is another waterfall due to a basic sill, and below it occur further red marls and green shales. At 450 feet is a lenticular bed of quartzite. Thirty feet below it, at the end of the main section, are thicker bands of bluish-white sandstone, with some of the markings usually described as fucoidal; they are about a quarter of an inch wide and branch repeatedly. These sandstones have layers which owe their light colour to the abundance of white mica. Some of the bands are brecciated by settlement of the rocks during consolidation.

The dip at the lower end of the section is about 7° north. A grass-covered slope extends down to the road, broken by one exposure of red and green shales. South of the road a gully shows occasional exposures of red shales on the floor of the hanging valley above the waterfall at the mouth of the Levencorroch Burn. Beneath the fall are red and green shales, which have been cut through to the underlying white calcareous sandstones and chocolate-brown sandstones; and these are succeeded, at the lowest point exposed, by more red and green shales.

According to Gunn, a fault which has a westward hade of 45° is clearly visible at the Levencorroch waterfall. It runs down on the west side of the burn, and must have a downthrow to the west of 100 feet, and perhaps much more. The sandstone itself is cut off by the Levencorroch dolerite sill. This fault also affects the rocks which appear in the cliff east of the lower part of this burn. On the west of the fault there occur marls overlying a set of flagstones while east of the fault the flagstones (or a lower set) are raised to the top of the cliff, and continue in this position, associated with marls, nearly to Little Mill. G. W. T.

The section from the mouth of the Sliddery Water eastward to Bennan Head is described by Mr. Gunn as follows:—East of Sliddery Water, on the shore, a great breadth of rock is exposed in places at low water. The dip is here usually to west of south at 5° to 10°, and the rocks consist of red marls and thin sandstones. On either side of Torrylin Waterfoot the foreshore is covered with sand and shingle, and not much rock appears. Up the stream, however, there are fine sections in the banks about Lagg, in the lower part of the Cloined Burn, and the small streams near Laigh Clauchog. The dip is generally to the south-west, and in the Cloined Burn amounts sometimes to 30° or 40°. This high dip, however, does not appear in the Kilmory Water near the church, where the rocks form a low, anticlinal arch. Probably a large fault ranging north-east intervenes between the two outcrops. W.G. (MS.)

Prof. J. W. Gregory<ref>The Permian and Triassic Rocks of Arran, *Trans. Geol. Soc. Glasgow*, vol. xv., part ii., 1915, p. 179</ref> has described sections in the Allt Mòr Cloined and its tributary from High Clauchog. At the confluence of the tributary and the main burn the following section occurs:-

Red and green shales, with four or more ribs of sandstone	from 2 to 6 in. thick.
Red shaly sandstone or mudstone breaking into small irregular fragments	3 ft.
Sandstone rib, bordered above and below by green shales	6 in.
Red shale, with green spots, and red or chocolate argillaceous massive sandstone,	8 to 10 ft.

The section in the tributary begins with red shales, which contain layers of red sandstone from 1 to 10 inches thick, and dip 15° to the south. The sandstones are sometimes white, with green spots and lines; and some of the red shales are much jointed with flat surfaces instead of the curved fractures of the typical red marls. The burn level rises more quickly than the beds, and younger members of the series are therefore exposed higher up. A cliff on the right bank consists of massive sandstone, which is buff-coloured, with green lines; and below this is a section as follows:

	feet	inches
Red shale	5	—
Alternation of sandstones and red and green shales	6	—
Rib of earthy limestone	—	6
Red shale with some horizontal green streaks	—	8

Clayey limestone	—	1–4
Red shale	2	—
Potato stones	—	4
Red shale	2	6
Layer of larger potato stones	—	5
Red shale passing down into red sandstone	6	—

This part of the section may be correlated with the calcareous horizon of the upper part of the Levencorroch Burn. G.W.T.

Returning now to the shore-section, the old sea-cliffs along the Torrylin shore, north of Eilean Main, afford in one place a section of 60 or 70 feet of red marl with bands of nodular limestone, and one sandstone band a few feet in thickness. Above these, to the east, come alternations of marls and thin sandstones; and near the thick felsite dyke is the base of a thick mass of yellow sandstone which stretches a long way to the eastward. It may have been this mass which was encountered in a boring at Kilmory Manse, where, beneath 45 feet of till, and 33 feet of marls, etc., a thickness of 85 feet of sandstone was proved. In the cliffs the sandstone appears to clip gently to the east, and there are no high dips except close to the felsite dyke, which has much altered and disturbed the strata. Close to high-water mark the sandstone contains calcareous concretions. At Eilean Main the rock dips to the south, at a low angle. Between the cliff and the shore a fault passes with a southward downthrow. About 350 yards to the east of the large felsite dyke there may be seen near high-water mark a few feet of fine calcareous-looking yellow sandstone full of nodules like marbles. Above, and to the east of this, is a thick mass of coarse and pebbly, red, false-bedded sandstone. In one place the false-bedding may be observed to dip south at 20°, while the true dip is eastward at a low angle. The marls which overlie the sandstone are well exposed in the small stream west of Shannochie; and from the burn east of Torr nan Uain, for half a mile to the eastward, the cliffs, 200 feet in height, are composed mainly of red, with some grey, mans. There are several thin bands of yellow-white sandstone, and near the top of the cliff are several layers of nodular, light-coloured limestone. The highest beds that appear are of sandstone, close up to the Bennan Head quartz-porphyry. The rocks have a gentle easterly dip all the way. On the shore farther east, however, but still west of Bennan Head, the dip changes to the south-west. At the Head itself, igneous rock occupies the cliffs for some distance. The marls ,appear again at Port a' Ghille Ghlais with a south-westerly dip, and are visible also in the cliffs. Opposite Levencorroch an anticline occurs, and the beds dip easterly again for a long distance. W.G. (MS.)

According to Prof. J. W: Gregory,<ref>The Permian and Triassic Rocks of Arran, *Trans. Geol. Soc. Glasgow* vol. xv., part ii., 1915, p. 178.</ref> north of Bennan Head the Keuper beds include a layer of sandstone which is almost as compact as a quartzite. West of Bennan Head, on the cart road from the shore to the top of the cliff of Torr nan Uain, is an excellent exposure, which, in descending order, gives the following section:

	inches
Nodular red marl, with curved irregular fractures	3
Red shale	10
Red nodular marl	3
Red shale	15
Potato stones	2
Red shale	14
Band with occasional large potato stones	2½
Red shale	3
Potato stones	2
Red shale	6

The lowest part of the section consists of red mudstones, shales, and marls, some of which have the aspect of typical Keuper marls. G.W.T.

East and south-east of the great mass of quartz-porphyry at Brown Head, good sections of the marls are obtained in the Corriecravie Burn, and at Port na Feannaiche. Along the shore to the eastward rapid alternations of marls with thin

sandstones, which dip south at 12° to 15°, are encountered. As the mouth of the Sliddery Water is approached, there is an occasional ripple-marked grey sandy bed; and several small faults are visible crossing the outcrop on the foreshore. West of the Sliddery Water one of the sandstone- bands may be traced for 500 yards at low water parallel to the shore.

Inland the best section occurs in the lower part of Allt na Pairce for about a mile above its junction with the Sliddery Water. The banks, more particularly that on the west side, reveal frequent alternations of thick beds of red marl with thin bands of soft yellowish sandstone. The dip is pretty regularly to S.S.W. at angles of from 12° to 15°. Sections in the Sliddery Water and the Allt Burican have already been noted (p. 91).

Among the complicated igneous masses of the southern interior of Arran the marls and sandstones crop out for short distances in various places, as, for example, in the upper part of the Allt Dhepin, the Allt nan Clach on the south-east of Tighvein, and in the neighbourhood of Smuraig. The Allt nan Clach section shows red marls with subordinate green and red sandstones. There is a good section in the Allt an t-Stuie (one of the headwaters of the Kilmory Burn, 12 miles S.S.W. of Tighvein), where the general dip in the higher part is W.S.W., or in the same direction as the sandstones of the lower division of the New Red Sandstone, which are found on the high ground on the other side of the big intrusive masses. The position of the two subdivisions is here inexplicable unless the igneous rocks conceal a large fault with a downthrow to the southwest. A fault in a north-east direction is probable, as was suggested. to explain the relations west of Kilmory Manse; and this, if prolonged through the ground now occupied by the igneous rocks, would account for the relations of the marls to the lower sandstones in this obscure and difficult ground.

Lower down Allt an t-Stuie, and about half a mile north of Auchareoch, are some red and green marls and mudstones with cubical shapes which are probably pseudomorphs after salt. Some disturbed thin grey beds north-west of Auchareoch, in the same burn, seemed likely to yield fossils, but none were obtained. The only locality where these rocks contained traces of organic remains is Allt na Pairce, to the west of the Sliddery valley. Here obscure traces of plants were obtained by Mr. Tait, as well as pseudomorphs after salt.

The western sections begin near the King's Cave, to the north of Blackwaterfoot, where the boundary between the upper marls and the lower sandstones is sharper than usual. The sandstones, massive red or yellow, are found at the caves. The colour is not of much importance. North of the caves carious yellow sandstone overlies red sandstone. Farther south, rock of the one colour passes laterally into the other, and south of the caves some 30 feet of red sandstone overlies yellow. The basalt dykes hereabouts have come up along lines of faulting, and the sandstone is bounded by the most northerly of these, which throws down the marls on to the foreshore, on the east side. The dip is here easterly at a low angle, and the shore is occupied by a strip of marls overlying another strip of sandstone on the west. The next dyke to the south throws down the marls a few feet in the same direction as before; but the third dyke, which throws in a contrary direction, shifts the boundary eastward. A short distance farther is a fault trending north-west on the shore, which cuts off the sandstones entirely; and beyond this, both on the shore and in the old sea-cliff, there are red marls, sometimes of a grey colour, with bands of thin sandstone, as far as the cliffs of Drumadoon. The dip is usually south-east at a low angle, generally not more than 4° or 5°. After passing the Drumadoon quartz-porphyry sill there occur various outcrops of sediments opposite the golf course on the shore. Yellow sandstone dipping south-east occurs near the point, but towards the east end of the links marls and sandstones occur dipping westward. Among these rocks appear several thin nodular calcareous bands accompanied by hard grey sandstone. Near the intrusive felsite mass of Blackwaterfoot the rocks dip at an angle of 45° to 60°. In the cliff north of this locality is a kind of cave above which appears a patch of purple shale alternating with bands of yellowish sandstone. These rocks, which are about 20 feet in thickness, dip gently to the west, and are bounded on either side by felsite. Another small area of sedimentary rock apparently surrounded by intrusive igneous masses occurs at a farmhouse in Torbeg, on the east side of the road, and 1100 yards north of Blackwaterfoot. It consists of a strip of red shaly sandstone some 40 yards in breadth, which dips north at 25°. On the foreshore near low-water mark, some 200 yards south of Blackwaterfoot, is another sedimentary mass caught up in a felsite intrusion. It is a band of yellow sandstone 25 feet broad, which has a dip to north-west of 40°.

Alternating red marls and sandstones may be observed in most of the small streams that enter Drumadoon Bay from the east. The beds usually dip to the north-east at 5° to 10°. Perhaps the best of the sections is afforded by the stream called Allt Cul na h'Eilde, to the south of Cnoc Ballygown. The highest beds seen are yellow and red sandstones, which overlie red sandy marls, and then sandstone well exposed lower down the burn. Beyond the bend where the burn turns

westward is a wooded gorge in the red marls, which are separated by partings of yellowish-white, and grey, soft sandstones. A band of thick, white, quartzose sandstone has been quarried in places to the west of Cnoc Ballygown. It dips to the south-west.

There are some good sections of the rocks in the lower part of the Clauchan Glen, particularly on the south bank of the stream. The dip is here south, as it is in the lower part of Allt na Glaic, the branch stream that issues from Loch Cnoc an Loch. Higher up this burn the dip changes to north, near the fork, and the highest sediments in this section, which are thin-bedded red and white sandstones of considerable thickness, are nearly horizontal. W.G. (MS.)

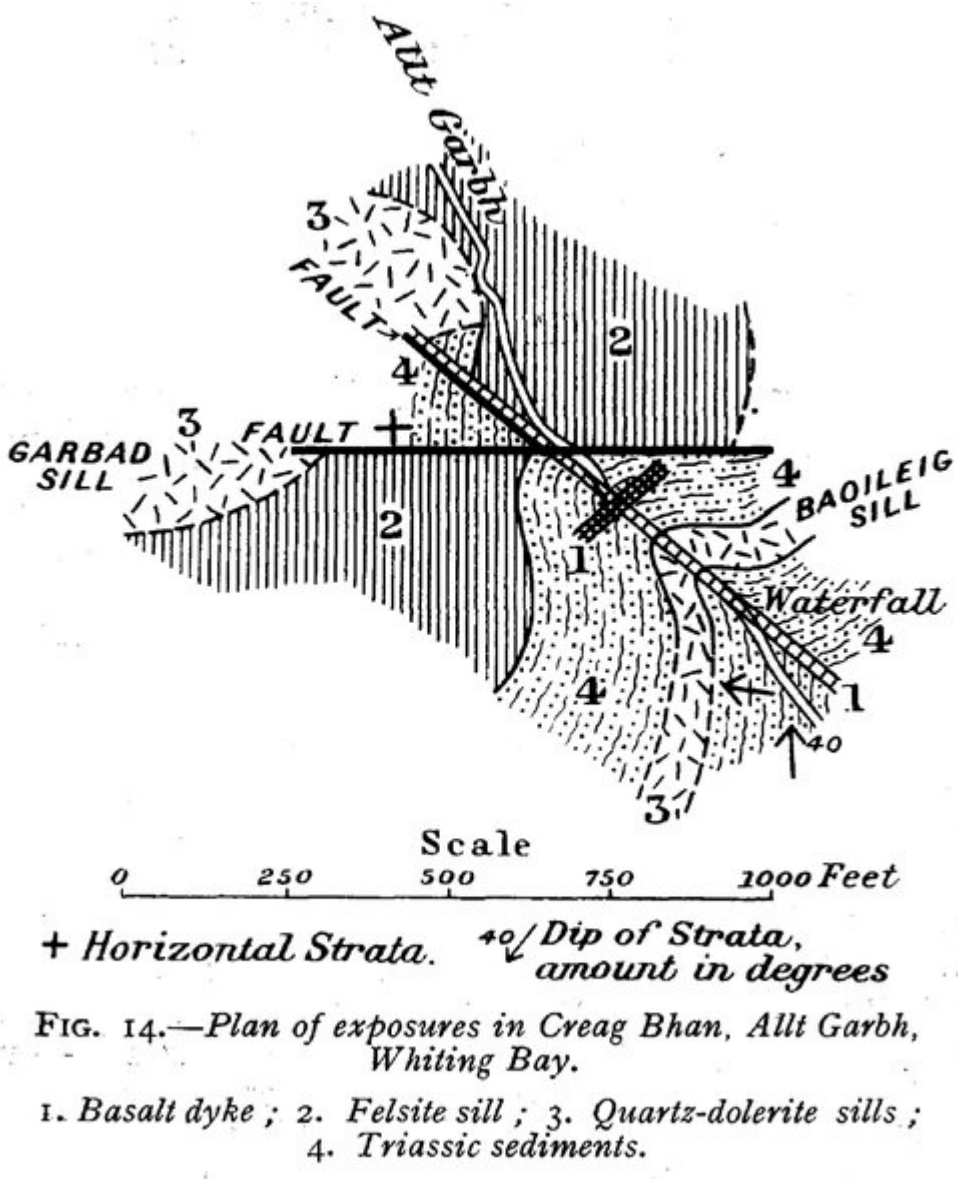

FIG. 14.—*Plan of exposures in Creag Bhan, Allt Garbh, Whiting Bay.*

1. *Basalt dyke ;* 2. *Felsite sill ;* 3. *Quartz-dolerite sills ;* 4. *Triassic sediments.*

(Figure 14) Plan of exposures in Creag Bhan, Allt Garbh, Whiting Bay 1. Basalt dyke 2. Felsite sill 3. Quartz-dolerite sills 4. Triassic sediments.