NOTE ON THE GEOLOGY OF RAMSEY ISLAND.

BY J. FREDERICK N. GREEN, B.A., F.G.S.

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Ramsey Island is nearly two miles long from north to south, and is barely a square mile in area. It stands as an outpost guarding the northern horn of St. Bride's Bay, as Skomer guards the south ; and, as the general characteristics of the north and south horns are similar, both consisting of ancient rocks brought up on either side of the Carboniferous Beds, some analogies between the two might be expected. But it has usually been supposed that the structure of Ramsey Island is extremely complicated.

The old Geological Survey Map, revised in 1857, showed the island as a complex of Llandeilo Beds, injected by "greenstone." Llandeilo then included what is now termed Arenig, and the mapping included with the Llandeilo series a mass of conglomerate, half a mile long, south of Aber Mawr, apparently striking about east-south-east. This conglomerate afterwards played a part in the controversy over the age of the St. David's rocks.

Great advances in knowledge were made through the collection and description of the fossils by Hicks, Salter, and Hopkinson, with the resulting discrimination of Lingula Flag, Tremadoc, and Arenig rocks. The rhyolites and "quartz-porphyrries" were correlated with the Pre-Cambrian volcanics and porphyries on the mainland, the relationship being considered proved by the superposition of conglomerate, supposed to be of Cambrian age. This view, however, demanded extreme complexity of structure in the south and centre of the island, the solution of which was given in a map by Hicks (*Quart. Journ. Geol. Soc.*, vol. xl, 1884, p. 560).

In this map the southern half of the island is shown as a mass of Pre-Cambrian with overlying Cambrian conglomerate. The Arenig rocks are dropped into this by a series of trough-faults running south-south-west and north-north-east.

In 1904 Miss Elles published some notes in the *Geological Magazine* on the graptolite zones of the district. She determined the existence of three Arenig zones in the south of the island, and observed that "the rocks may be faulted, as Hicks's map would indicate, yet it is remarkable that the graptolite zones occur precisely where they might be expected were the succession normal."

In August, 1906, I spent a few hours on Ramsey in the expectation of finding a continuation of the Lower Cambrian and Pre-Cambrian, which I was engaged in mapping near St. David's. A hasty traverse convinced me that nothing comparable to these

rocks existed in the more obvious exposures, and that the existence of the trough-faults seemed most improbable. The "conglomerate" and associated rhyolite with large enclosures were puzzling, but at the time I formed no definite conclusions.

In January, 1910, I happened to see some of Mr. H. H. Thomas's lavas from Skomer Island, and recognised a close similarity to the rocks of Carn Llundain, on Ramsey Island. I therefore re-examined my specimens and found that the "conglomerate" was in fact a nodular rhyolite. It became clear at once that these peculiar rocks were simply the product of a volcanic episode of Arenig age, and that they must be, at least approximately, in normal stratigraphical sequence.

The sequence across the southern part of the island, from north-west to south-east, is roughly as follows:

5. Rhyolitic series of Carn Llundain. About 2,000 ft. shown.
4. Shales of Porth Hayog. *D. bifidus*-zone
3. Thick porphyrite cropping out from the farm to Trwyn Mynachdy.
2. Shales of Aber Myharan and Ogof Williams, probably equivalent to those of the Roads with *hirundo* and *extensus* zones.
1. Porphyrite of Foel Fawr.

The narrow centre of the island is composed of Arenigs and porphyrite; but the broader northern portion, which is presumably separated by a fault, contains a much wider representation of the sedimentary rocks. The east coast is formed of Lingula Flags, followed westward by *Neseuretus*-beds and Lower Arenig. The west coast shows Lingula Flag again, repeated by a reversed fault. At the plane of the fault comes a mass of basic rock resembling, so far as I have seen, that of Carn Llidi. My only specimen, however, consists of well-formed feldspars with interstitial micropegmatite and chlorite. It may be one of the leucocratic varieties of the quartz-norite series described from the mainland by Dr. Elsdon.

Thus the northern peninsula resembles closely the usual development on the north-west of Dewisland; but the southern part presents an enormous thickness of acid igneous material, which cannot be paralleled on the mainland.

The lower palæozoic strata of Ramsey are highly fossiliferous, surpassing in this respect any part of the mainland. So far, however, as I am aware, they have been neglected for some thirty years with the exception of the graptolites of the southern half of the island, which have been collected and described by Miss Elles. The following is the succession, as far as known:

Upper Arenig (or Lower Llanvirn. Zone of *D. bifidus*), *Calymene*, *Trinucleus*, *Lingula*, and the following graptolites: *Didymograptus bifidus*, *D. stabilis*, *D. artus*, *D. nicholsoni*, *D. affinis*, *D. acutidens*, *D. patulus*; *Diplograptus dentatus*; *Climacograptus confertus*, *C. scharenbergi*.

Lower Arenig (lower part of *D. hirundo* and upper part of

D. extensus zones, and perhaps lower beds), *Trinucleus*, *Lingula*, *Lingulella*, *Obolella*, *Conularia* and the following graptolites: *Didymograptus extensus*, *D. sparsus*, *D. pennatululus*, *D. gibberulus*; *Phyllograptus stella*; *Trigonograptus ensiformis*, *T. truncatus*; *Ptilograptus hicksi*, *P. cristata*, *Callograptus radiatus*; *Dendrograptus arbuscula*, *D. flexuosus*, *D. diversus*, *D. diffusus*, *D. homfrayi*.

"Tremadoc." *Neseuretus* (the characteristic trilobite of the beds—four species described), *Niobe*, *Ctenodonta*, *Palæarca*, *Glyptarca*, *Davidia*, *Modiolopsis*, *Bellerophon*, *Palæasterina*, *Dendrocrinus*.

Lingula Flag Series. Only the upper part shown. The fossils do not seem to have been described, but *Lingulella davisii* occurs in great abundance.

Above this succession comes the Llundain group of lavas, which seem to have considerable variety. Spherulitic and banded forms have been referred to by J. F. Blake, and Professor Bonney has described specimens collected by Hicks as probably tuffs. I collected a cream-coloured felspathic rock and a dark bluish band with quartz bipyramids. The most conspicuous seemed to be a dark flinty felsite with subangular enclosures, up to six inches in length, which, from a comparison with specimens illustrating Mr. H. H. Thomas's brilliant paper on the Skomer Volcanic Series, I believe to be squeezed spherulites. A slide shows it to be a soda-rhyolite with marked flow and phenocrysts of quartz and albite-oligoclase. A small sub-triangular inclusion consists of a mixture of clear quartz with a cloudy mineral of lower refractive index, probably of a chalcedonic nature.

The nodular rhyolite seems very similar. Most of the spherulites are replaced by a siliceous substance, which, microscopically, is precisely similar to the chalcedonic inclusion mentioned above. Some, however, retain a radiate structure. They are often so closely packed that they have had to accommodate themselves to each other's shape. I noted one over a foot in length.

A dark rock of doleritic appearance which occurs south-west of Trwyn Garlic has a glassy base, densely crowded with phenocrysts of augite and an acid felspar near albite, which tend to aggregate. The specimen has been considerably brecciated. Mr. H. H. Thomas has kindly looked at it and informs me that it is probably allied to his "Skomerite." The presence of this interesting rock, taken with the occurrence of coarsely nodular soda-rhyolite, seems to put beyond doubt the identity of the Llundain lavas with the neighbouring Skomer series. If this is so, the hitherto unsettled question of the horizon of the Skomer rocks can be decided, as the Ramsey Island lavas appear to rest conformably on the *bifidus*-slates and to be in the same position

MAP OF THE COUNTRY NEAR ST. DAVIDS.

Scale: One inch to the mile.

1. Carboniferous.
2. Llandeilo.
3. Arenig (including Bifidus zone).
4. Tremadoc (of Hicks).
5. Menevian and Lingula-flag.
6. Caerfai and Solva Beds.
7. Palaeozoic Volcanics.
8. Precambrian Volcanics.
9. Basic Intrusions.
10. Acid Intrusions.

as the tuffs of the south side of Abereiddy Bay, separating the *bifidus* and *murchisoni* zones. Further research will probably reveal many interesting types in this thick volcanic group.

The porphyrites which cover so much of the southern part of the island are noticeable for a well developed prismatic jointing, which produces long polygonal columns, the axes of which dip slightly west. The rock is usually highly porphyritic, with feldspars, rounded quartzes, and a few chloritic pseudomorphs. I noticed in several places near the margins compact varieties with few phenocrysts, presumably chilled edges. A slide of a specimen near Trwyn Mynachdy, in the extreme south of the island, has very numerous corroded quartz phenocrysts, plentiful andesine, some magnetite, and one pseudomorph, probably after mica. The ground consists of feldspar (mostly near oligoclase) and chlorite with subordinate quartz. It is fairly coarse, a common diameter for the components being about .05 mm. Some of the feldspar phenocrysts show some micrographic growth round their sides.

I have not seen any similar rock on the mainland, but probably it is related to the intrusions described by Dr. Elsdon from the *Ordovician* near Abercastle, which he connects with the porphyrites on the neighbouring coast of Ireland. There is no resemblance to the Pre-Cambrian quartz-porphyrines.

Thus it would appear that Ramsey Island, small as it is, is of exceptional geological interest, including a sedimentary series of great thickness and richness, a remarkable volcanic group, intrusions belonging to two distinct provinces, and many other points worthy of remark.