The photographs claim no rapport to the text, but are representatives of some of the birds of our Island.

Nomenclature throughout is taken from Hartert Jourdain, Ticehurst & Whitherby's "Handlist of British Birds."

As I finish I have to hand the report from the Chambers Street Museum on the Snipe mentioned earlier in this article. It proved to be an interesting and very unusual variation of the Common Snipe, but was, unfortunately, too flyblown to set up for exhibition or even to preserve as a skin.

A GUIDE TO THE ROCKS OF BUTE.

By Archibald Lamont, M.A.

(Read 3rd February, 1931.)

1.—Metamorphic Rocks.

The earliest formation represented in Bute is the Dalradian. This system originally comprised clays, sandstones, and pebbly rocks. These rocks were caught in the earth-storm in which, before Old Red Sandstone times, mountains were piled up high above the present peaks of the Highlands. In this folding of the crust of the earth, clays were compressd into the *slates* which we see at Port-Bannatyne; ancient sandstones gave rise to *schists*, while pebbles in the pebbly rocks were crushed and the matrix surrounding them hardened to give the *sheared grits* found in various parts of the North End.

New minerals were produced in the rocks thus altered. A well-marked succession in the occurrence of these minerals can be followed in Bute. Grey mica produced by metamorphism is seen everywhere from the Loch Fad boulder bed northward; north of Ardmaleish Point tiny white crystals of Albite appear which require an increasing degree of heat and pressure for their crystallisation; finally, in the extreme north of the island, at Black Farland, brown mica appears in the schists, indicating the intensest degree of metamorphism suffered in the island. In this way, if the most altered rocks are the oldest, the Dalradian rocks of Bute increase in age as we go towards the North.

At Ardscalpsie, south of the Loch Fad boulder bed, and at Rothesay Pier, the metamorphic formations are cut off along the Highland boundary fault. North of that tantalisingly obscured fault, there occurs on the north

side of Scalpsie Bay a thick sheet of dark foliated rock, intruded in a molten state and later altered, in the mountain-building movements, to a *Hornblende-Schist*. Kindred igneous intrusions, entirely changed to *Serpentine*, make their appearance under the beach materials on the west side of Loch Fad. These intrusions cannot be dated from local evidence, but are probably Ordovician, of the same age as the Ballantrae lavas which were extruded on the floor of a deep sea.

2.—Old Red Sandstone.

Canada Hill is a typical mass of *Old Red Sandstone*. This system was laid down by rivers which eroded the mountains built up in the earth-movements. Screes and basal conglomerates of huge boulders were covered with beds of *sandstone* thousands of feet thick, while floods brought alternate layers of river-worn pebbles.

At Ascog and south of Kilchattan, the Old Red Sandstone shades up into *cornstones* and white limy sandstones. This gradual passage to the Carboniferous System shows that in Bute we are dealing with the Upper series of the Old Red Sandstone. The Middle series, during the deposition of which the principal movements along the Highland boundary fault took place, is absent from the Midland Valley of Scotland. The Lower series is present, however, and is probably represented in Bute by the Haystack at Scalpsie, a mass of boulders perched on the schists against which the white and red rocks of the Upper Old Red Sandstone lean just a hundred yards to the South.

The Haystack is not a scree deposit from the cliff to north of it, since the downward inclination of its roughly distinguished strata is towards, not away from, the cliff. In the Haystack, therefore, we may have part of the very foundation of the entire Old Red Sandstone System. It is composed of the huge blocks deposited by the first headlong torrents from the newly upreared mountains of schist and sheared grit.

3.—The Carboniferous System.

The transition between Old Red Sandstone and Carboniferous is well seen in the increase of calcareous material as we go from Craigmore to Ascog. We reach successively higher strata, until at Millhole the cornstones disappear under the dark lavas of Ascog Hill. We have here come to the lowest compartment of the Carboniferous System. At the south end of Loch Ascog, the white sandstones reappear from under the lavas, and are seen to contain flakes of red mud dried and blown by the wind. The Calciferous Sandstone Series is still better developed in the extreme South End of Bute, where in addition to the *white sandstones* of quartz grains knit together with carbonate of lime, there are beds of *white conglomerate* and a *limestone* at Creag a Mhara, telling of an ancient sea with varying sandy shore.

Above the white sandstone, the lava flows, so well seen in the terraces of Ascog Hill, of Ambrisbeg, and of the Kilchattan peninsula, were poured out from innumerable small volcanic vents. These are yet marked where necks of brecciated and exploded *tuff* protrude through the older rocks. Creag a Mhara and Suidhe Chatain, though of a much smaller size because they were on the outskirts of volcanic activity, are the Bute contemporaries of Dumbarton Rock and Dumgoyne.

The lavas from these volcanoes, interbedded occasionally with fine purple *ash*, are dark basalts, rich in ferromagnesian minerals. They are remarkably uniform in composition, but different conditions of cooling have given rise to differences of crystallisation. In this way *Jedburgh Basalts* are entirely fine-grained, while *Markle Basalts* show many large crystals of plagioclase. Associated with those basalts in South Bute we find fine-grained, light-coloured igneous rocks composed of minute orthoclase laths aligned as if flowing like logs in a stream. These are *Bostonite* lavas.

Underground intrusions of Markle Basalt, occurring in thick sheets, or sills, in South Bute, are distinguished from the lavas proper, by the absence from their upper surfaces of vesicular cavities. Lavas are invariably marked by such cavities formed on the escape of volatile constituents. Such cavities in the Bute lavas, yield calcite crystals, various forms of quartz, and, occasionally, yellow garnets and reniform hematite.

Coal in Bute is restricted to the Carboniferous islands of Ascog Hill and Ambrisbeg.

4.—Later Formations in Arran.

After the Clyde Plateau lavas there is a great gap in the Bute succession. From Arran, however, we can fill in the *Carboniferous Limestone Series* with its corals, crinoids, and brachiopods. In Arran also we have the *New Red Sandstone*, distinguished from the Old Red by its quartz grains which are spherical, smooth, and often greasy looking from being subjected to the desert sand-blast. The New Red is later replaced by *white*, and *yellow sandstones* of the Triassic System, well seen at the King's Caves, followed by the micaceous and highly coloured South Arran series.

5.—Kainozoic Rocks.

The beginning of the Kainozoic era saw an outburst of igneous activity around the gradually foundering basin of the North Atlantic. The deep-seated intrusion of the North Arran *Granite* belongs to this period. Activity in the island of Bute focuses south of Kilchattan, where there are two notable sill-intrusions. One is of *Crinanite*, an alkalic rough-textured rock, which weathers readily to a crumbling yellow-brown material. The other, which has cut through the first, consists of five distinct sheets; three of these are of *Basalt*, and two of *Quartz-Orthoclase Porphyry*, a rock with large crystals of clear quartz and dull white orthoclase in a fine, quickly cooled groundmass. At one point the groundmass has cooled so suddenly as to give a glass, so that we have the *Pitchstone Porphyry*, south of Glencallum Bay.

The majority of the dykes of Bute belong to the concluding phase of Kainozoic igneous activity. They are mostly *Tholeites*, basaltic rocks with glass in the interstices between their minute crystals. They cut like knives through the other rocks of the island. Occasionally, as in the small quarry at Milton, clay slates in their vicinity are baked to the consistency of *Porcellanite*. Two other notable dykes are the *Quartz-Dolerites*, which cross the island from east to west. One of these is quarried behind Rothesay Academy. Their age is uncertain.

6.—Quaternary Deposits.

Most of the rocks of Bute are concealed under a deep covering of fine red clay. This clay was produced by glacial denudation as a "rock-flour." It is usually crowded with boulders, the closer-textured of which may show ice-scratching. At Balnakeilly this *Boulder Clay* is covered by fine grey micaceous clays deposited in the quiet waters of ice-locked seas. Similar *clays with Arctic shells*, belonging to a time when the land stood 100ft. lower than now, have also been excavated at Rothesay gas-works and Kilchattan tileries. These clays furnish curiously shaped *concretionary nodules*.

Raised beaches with water-worn stones and shore sand are well developed in Bute, and very clearly seen at Ettrick Bay. Upper Ettrick and the other farms stand on the *100 feet beach* which extends some distance into Glen More. The beach is continuous with the ancient floor of the valley. The *25 feet beach* includes the fields stretching to the coast, while an intermediate beach level can also be traced, especially at the confluence of the Ettrick and the Glen More burns. These beaches are as yet unconsolidated, except in sooty layers where manganese dioxide concentrated by peat has provided a tenacious matrix which already cements the pebbles of the former beach into an authentic *conglomerate:* a process which demonstrates how sedimentary rocks are formed.