

CALCAREOUS ALGAE FROM THE DALRADIAN OF ISLAY

by B. D. HACKMAN and J. L. KNILL

ABSTRACT. Calcareous algae occur at several localities in the Upper Dolomitic Group of the Dalradian of Islay, Scotland; at Bonahaven, these stromatolites occur both within distinct bands and as small bioherms.

THE presence of stromatolitic bodies, of possible algal origin, in the Dalradian of Islay was first appreciated by Wilkinson during the Geological Survey mapping of the island. His discovery is not recorded in the Islay Memoir (1907) but was referred to by Peach (Peach and Horne 1930, p. 214) at a later date and used as supporting evidence for the suggested correlation of the Dolomitic Group of North Islay with the Durness Limestone. Subsequently, Anderson (1950, p. 15) has figured some examples of calcareous algae from Bagh an de Dhoruis, North Islay. During an investigation into the sedimentary history of the Dolomitic Group, the authors found that stromatolites are particularly well developed in the coastal exposures near to Bonahaven (text-fig. 1*a*). As these algal structures have neither been recorded from this locality before nor described in any detail, the authors felt that an account of these undisputed Dalradian fossils would be of interest.

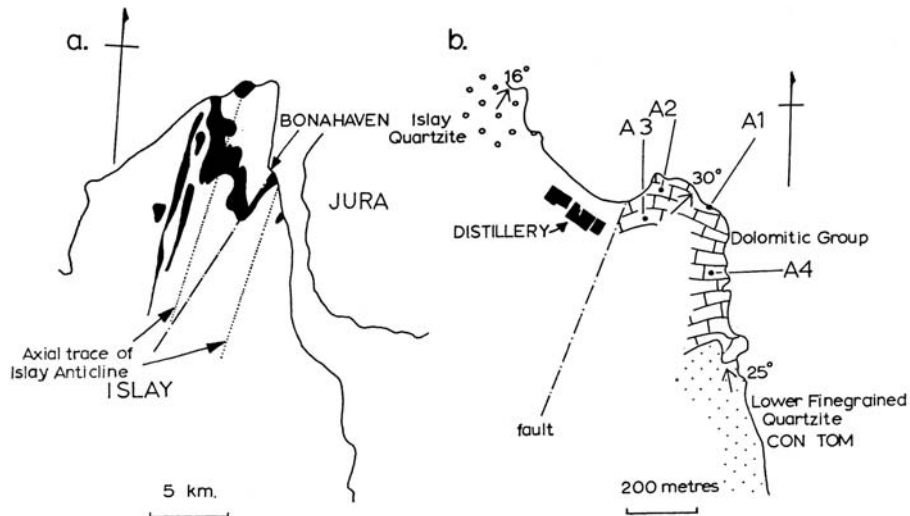
The rocks under consideration outcrop for about 500 metres of coastal exposures south-eastwards from Bonahaven distillery (text-fig. 1*b*); they represent the division termed the Dolomitic Group of North Islay (Allison 1933) which was included by Bailey (1916) in the Islay Quartzite. The succession in the Bonahaven area dips steadily at 20° to 40° north or north-east, occupying a position in, or near to, the core of the north-north-easterly plunging Islay Anticline (text-fig. 1*a*). The dolomitic sequence succeeds the Lower Finegrained Quartzite of North Islay 200 metres north of Con Tom (text-fig. 1*b*). The junction is somewhat complicated by minor faulting, but there is a sharp gradation from brittle white quartzite through some 8 metres of grey and buff flaggy quartzites into the basal dolomitic flags. At least 250 metres of variable, fine-grained dolomitic limestones, with some shales, are exposed in this section; the top of the sequence is not seen. The most frequent rock type is a dolomitic porcellanite, blue when fresh, but weathering to a creamy yellow or orange; these horizons may be laminated, flaggy, or well bedded. Some clastic limestones, associated with sandy dolomites, are present.

Three outcrops containing algal, stromatolitic growths have been identified and these are labelled A1, A2, and A3 in text-fig. 1*b*; an outcrop containing rather more indefinite structures is labelled A4.

At localities A1 and A2 the stromatolites occur in distinct bands; A1, for example, a bed nearly 2 metres thick is exposed for 5 metres across the foreshore. The weathered eastern face of this outcrop displayed excellent sections through algal masses, apparently in position of growth (Pl. 39). Individuals vary from 1 to 10 cm. or more in diameter

[Palaeontology, Vol. 5, Part 2, 1962, pp. 268-71, pl. 39.]

and have developed a semi-dendritic form from a common substratum (text-fig. 2a, Pl. 39); the maximum height for any particular horizon at each level is between 6 and 25 cm. The form of the individual stromatolites varies considerably, ranging from squat, bun-shaped masses to tall, conoidal columns. In general, the substratum is a fine-grained laminated dolomite, the laminations having a maximum thickness of about 1 mm. There may be fifteen or more laminations in 1 cm. Lenticular shreds of coarser, sandy-looking dolomite are interbedded with these laminae. The laminations are always

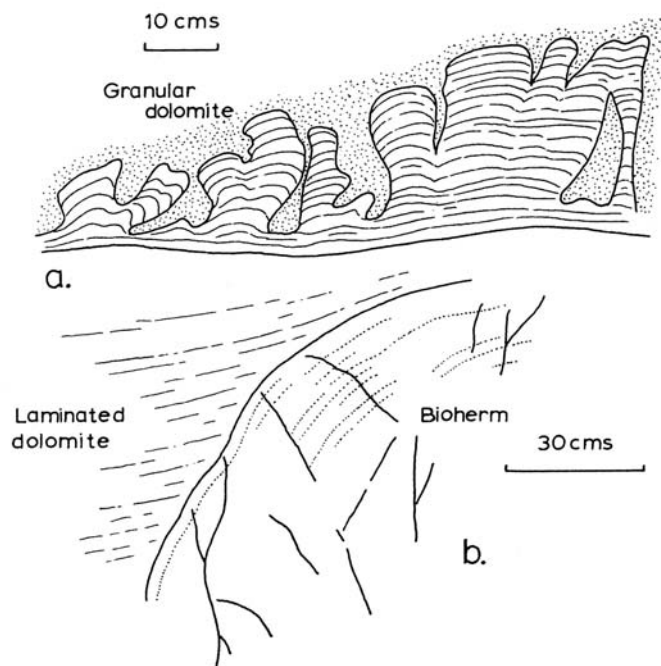


TEXT-FIG. 1. (a) Map of north Islay illustrating the distribution of the Dolomitic Group (in black) in relation to the axis of the Islay Anticline. (b) Map of Bonahaven showing localities of the algal horizons.

slightly irregular in their attitude, so that individual layers crop out as curving lines on joint-faces. There are frequent localized breaks in the succession of laminations, so that minor unconformities are present in the sequence. The individual stromatolites develop from the substratum as a series of upwardly curving humps. It is thus apparent that these laminated dolomites are themselves algal in origin. The most common stromatolites are conoidal in outline and frequently the upper part of these structures is subdivided into two or three further units (text-fig. 2a, Pl. 39). In contrast, other individuals occur as simple mounds with concentrically developed lamination (Pl. 39). Continued development of these examples apparently resulted in the formation of spheroidal masses. Little internal structure of the lamination is seen in thin section, beyond the detailed texture of the dolomite. The structure of this stromatolitic horizon is inconsistent with that typical of slumped or contorted bedding. Where exposed, the tops of the individual stromatolites form a pattern of bun-shaped masses. Coarser, clastic dolomite infills the interstices between the individual stromatolites and forms a layer several centimetres thick burying the complete horizon.

At locality A3, which is at the western extremity of a cliff immediately behind the

distillery houses, there is an interesting section through a composite algal 'reef' or bioherm (text-fig. 2*b*). The lamination of the dolomitic material within the structure is intensely corrugated on a small scale, the attitude of the convolutions being consistent with the radial development of individuals in a colonial habit from a restricted focal



TEXT-FIG. 2. (a) Field drawing of algal horizon at locality A1. (b) Algal bioherm at locality A3.

area on the substratum. The bedding of the overlying dolomite overlaps progressively higher levels of the bioherm. The complete structure is not exposed, but may well have been several metres in diameter. Tracing the upper cliff eastwards several examples of stromatolitic colonies may be observed. The axes of the individuals are often inclined at 35° to 50° to the bedding of the dolomite suggesting that they, also, originated as parts of concentrically developed structures rather than vertically from the substratum as at localities A1 and A2.

The structures developed at locality A4 are uncertain in origin; north-west to south-east sections reveal intense, small-scale folding consistently overturned to the south-east

EXPLANATION OF PLATE 39

Fig. 1. Cross-section of small, bun-shaped stromatolite, showing concentric lamination, $\times 1.2$.

Figs. 2-4. Sections through algal dolomites illustrating the lamination, development of the individual colonies and the covering of coarse, clastic dolomite, $\times 0.8$, $\times 1$, $\times 1.2$ respectively.

The specimens are in the palaeontological collections of Imperial College, London.

affecting the lamination of a 60 cm. thick bed of fine-grained dolomitic mudstone. North-east to south-west faces, however, show that these structures close rapidly along the strike of the beds and individual sections approach an elliptical form. Although there is no other intense folding throughout this coast-section, the attitude of these structures is consistent with deformation within the axial direction of the Islay Anticline. It is feasible that this bed represents an algal horizon which has been disturbed during sedimentation and then later deformed.

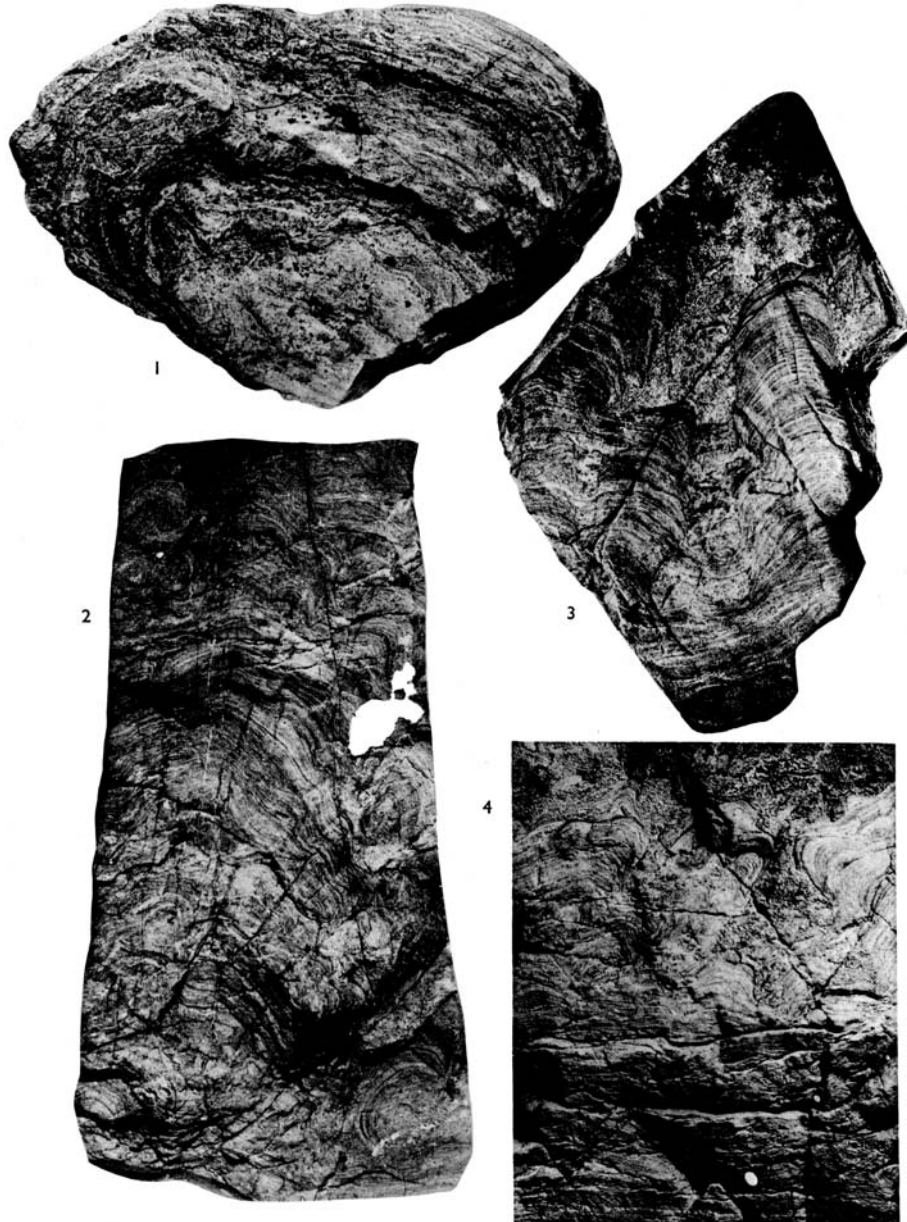
We are indebted to Dr. F. W. Anderson and Mr. G. F. Elliott for confirming our identifications, to Dr. R. N. Sinclair for assistance in the field and Dr. Gwyn Thomas for advice during the preparation of the paper.

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Manuscript received 3 August 1961



HACKMAN and KNILL, Dalradian algae