CORRESPONDENCE

IMPREGNATION OF ROCKS FOR SECTIONING

SIR,—A procedure for impregnating rocks with resin in preparation for sectioning, which gives good results without the need for evacuation, is described below.

The resin used is of the polyester type and has the advantages of low viscosity (100 centistokes at 25° C.) and good wetting power in the initial liquid condition. It is manufactured by Bakelite Limited, of 12–18 Grosvenor Gardens, London, S.W. 1, under the designation DSR 19098. For rock impregnation the catalyst and accelerating agent usually employed to bring about polymerization are dispensed with, hardening being secured by prolonged heating carried out in two stages. The rock samples are first stood or submerged in the resin and heated to about 75° C. This initially lowers the viscosity, enabling the resin to penetrate by capillary action, but after some twelve hours the resin will be found to have become treacly or have gelled, and the temperature is then raised to about 125° C. for a further 12–24 hours. The resin should then have aquired a tough, rubbery consistency, and on cooling to room temperature, should be quite hard and slightly brittle. The samples are then ready for sectioning in the usual way. Times and temperatures quoted are only approximate and are best determined by experience, as the curing time at any temperature depends partly on the age of the resin and the degree to which it has been exposed to light and air.

The treatment is carried out in small metal trays (e.g., tobacco tins) and it is an advantage to cover or close them loosely to cut down evaporation. The polymerised resin does not adhere strongly to metals, so that the impregnated samples can be removed by gentle tapping and chipping. An ordinary laboratory oven is suitable for the hardening process, or if necessary a hot-plate may be used, with slightly inferior results.

Using this resin as described, good thin sections have been obtained from a loess, a chalky solifluction sludge, and a variety of unconsolidated Recent sands, silts, and clays, and exceptionally good sections from sub-greywackes and other rocks which, though on the whole well-cemented or compacted, often contain locally soft material liable to be plucked out during grinding.

The writer is indebted to Bakelite, Ltd., for samples and information, and to Mr. E. J. Hill, who cut the sections.

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FESTOON BEDDING AND "MUD-WITH-LENTICLES" LITHOLOGY

SIR,—Like Professor J. Sutton and Dr. J. V. Watson (*Geol. Mag.*, 1960, xcvii, 106–122), we have been struck by the beautifully preserved sedimentary structures in the Torridonian. On the mainland around Loch Torridon, the Diabaig and Applecross groups abound in exposures displaying small and large scale features quite as well preserved as any in the Weald. Particularly striking are the shore sections at Diabaig and the new exposures by the Alligin–Diabaig road.

Festoon bedding.—Sutton and Watson may be right in attributing, in general terms, their medium-scale festoon bedding (*cf.* Potter and Glass, 1958, *Illinois State Geol. Surv. Rep.* 204, pl. 1A) partly to deposition by " shallow, braided rivers " (p. 113). We infer that the bulk of the erosion and filling processes they envisage might have been carried out by underwater currents

(" streams ") during periods when the irregular (" braided ") bottom topography was completely submerged, whether or not it became exposed betweentimes. Their " channels " may thus represent mazes of shifting hollows or trenches and their " banks " impermanent hummocks between, completely submerged at high stage (or was it high tide ?). Formation of the stacked and interfering Torridonian structures, through the filling and abandonment of long subaerial channels repeatedly cut by neighbouring streams, seems a less likely mechanism. So also is that leading to the development of muddy festoons through the aggradation of intertidal gullies (McKee, 1939, *Journ. Geol.*, xlvii, 78–79 and pl. II).

Can the authors go further ? Have they seen, for instance, any large exposures showing the three-dimensional relations of groups of festoons, suggesting that these are actually worn-down *megaripples* ? It is interesting to know that the " dimensions of the troughs . . . remain fairly consistent in any single outcrop " (p. 110), for this we believe favours a ripple-like regularity. The work of Hülsemann (1955, *Senck. leth.*, xxxvi, 359–388) and others on modern sediments suggests that the march of " societies " of megaripples (accretionary hummocks preceded by erosional hollows) is an important process leading to the formation of festoon bedding. Each megaripple in its forward growth appears to deposit a single lens of festooned sand, and each society a stack of interfering lenses parted by erosional surfaces. The bases of adjacent lenses (floors of original hollows) normally intersect along sharp cusp-like ridges, as described by Sutton and Watson (p. 111). It may be more than mere coincidence that the range of breadths of the festoons (< 1 m. to 6 m.) in the Epidotic Grits is rather close to the range of lengths along the crests of the megaripples figured by Hülsemann (fig. 1, pls. 2, 3). Megaripples form one of the most striking expressions of bed-movement within the braided channels of some swift sand-laden rivers (e.g. Benue and Niger, West Africa), as well as in many tidal inlets where water speeds are high (e.g. Friesian Islands ; German North Sea estuaries). Festoon bedding is thus not necessarily indicative of fluviatile sedimentation, nor does it always denote exposure of the sediments.

The examples in the Hastings Beds (Sussex coast and Mid-Sussex) appear to represent underwater " braided " mazes of either large shifting ripples or less regular hummocks-and-hollows near the mouths of major distributaries (*Phil. Trans. Roy. Soc.*, B, 1959, ccxlii, 320, 329). In particular the festoons in the Lower Tunbridge Wells Sand of Mid-Sussex are related to a channel coming southwards from the London Platform. The latter is even " visible " on Reeves's Lower Tunbridge Wells isopach map as a north–south belt of thinning (*Proc. Geol. Ass.*, 1949, lix, 259, fig. 31). Recent work on the different types of festoon bedding in the Lower Tunbridge Wells Sand shows that in Mid-Sussex the festoons are biggest at the top of the formation, where the sediment was more frequently exposed. Thus certain of the middle and upper sands (e.g. lane banks south-west of Hook Quarry, West Hoathly ; north side of B2110, between parish church and cross-roads, Turner's Hill) consist locally of festoon units a few feet across. Most of them fall within a narrow range of size, and occasionally inverted festoons (concordantly aggraded hummocks) are seen, even more obviously suggesting a megarippled bottom topography. At the very top of the sequence, the festooning consists of enormous " scoops " or " saucers " (" sand-waves ", " underwater dunes," mouth-bars ?) over 40 yds. long (*Proc. Geol. Soc. Lond.*, 1960, no. 1575, 27–28).

Mud-with-lenticles lithology.—This type of lithology (Sutton and Watson, 118, 120) may be seen on the shore section at Lower Diabaig, exposing the lower part of the Geological Survey's " dark shales and mudstones " (Peach *et al.*, *N.W. Highland Memoir*, 1907, 324). To us it suggests rhythmic (e.g. intertidal) conditions. The Diabaig lenticles are largely ripple-ridges, frequently isolated from one another on a muddy floor. In size and character they can be matched around our coast to-day where limited quantities of rippled silt or sand are moving across a muddy foreshore. Like the Skye lithology, that at Diabaig includes numerous beds with rainprints and suncracks, the latter filled with coarser sandy or silty material. Again, fine discontinuous shale laminae, often broken, occur at the bottom of the overlying arkosic sandstones (*cf.* Sutton and Watson, text-fig. 7 (upper diagram)). Orientated particles of shale are also found on the foresets of coarser cross-bedded units having plane bedding and low depositional dips. Interbedded associations of the coarser and finer lithologies are found. Thus some of the finely laminated beds at Diabaig with small scale grading, ripple marking, and concentrations of grit particles in ripple hollows (*cf.* Sutton and Watson, 118) sometimes include coarser grit and sandstone bands.

These observations obviously invite comparison of the Diabaig group in Wester Ross with ordinary shallow water marine sediments, including intertidal deposits. One is not, of course, surprised to find that the older workers had considered this possibility. On page 325 of the N.W. Highland Memoir there occurs the following passage : " These facts point to shallow-water conditions, and the deposition of the sediment on a tidal shore . . ."

Speculation.—What is the significance of the drastic upward change to Applecross lithology and the (apparent) lateral change in facies between Wester Ross and Skye ?

Would it not be valuable to physicists and cosmologists to *know* there were tides in Scotland 1,000 million years ago ? Even, perhaps (shifting the emphasis to our mother star), that the sunspot cycle was operating merrily in Wealden times ?

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THE OLD RED SANDSTONE OF EASTERN EKMANFJORDEN

SIR,—The sandstone members of the Kapp Kjeldsen and Lykta Divisions of the Old Red Sandstone described by Mr. D. L. Dineley (*Geol. Mag.*, xcvii, 18–31), appear to contain several sedimentary features generally regarded as characteristic of turbidity current deposits, and in view of the tendency to regard most " turbidites " as of deep water, marine origin, the present examples are of more than usual interest. Whilst marine turbidites have received much attention in recent years, following the work of Kueuen and others, it is perhaps worth recalling that some of the significant early work of the mechanism of turbidity currents and the resulting deposits arose from the study of sedimentation in lakes and reservoirs (Bell, 1942). The generation of turbidity currents in quiescent bodies of water by a mechanism comparable to " flash floods " may be particularly significant in relation to the environment of the Old Red Sandstone deposits here described, the majority of which appears to be of shallow water origin.

It would, therefore, be of considerable interest if certain of the sedimentary features possibly indicative of turbidity action could be confirmed. For instance, basal conglomeratic layers are stated to occur in some sandstone layers, but it is not entirely clear whether in fact these are true graded beds. The occurrence of intra-clast conglomerates and the concentration of fossils in them suggest the action of powerful currents and concomitant rapid deposition, and again grading (both lateral and vertical) of the beds might be expected.

In the sandstones of the Lykta Division contorted bedding and sole markings are described. The former appears to have many of the features ascribed to *intrastratal flowage* (Rich, 1950, p. 729) but perhaps may be more correctly attributed to *load casting* (Kueuen, 1953, p. 1058). The sole markings described and figured (*vide* page 26 and text-fig. 4) certainly appear to agree closely with