The first Jurassic mammal from Scotland

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Introduction

RECORDS of mammals in Mesozoic strata are rare: the earliest are of late Triassic age in Wales, S. Africa and China: two primitive mammal families (Eozostrodontidae and Kuehneotheridae) are represented in these faunas. There then follows a long time gap until Late Jurassic, when mammals are known from the U.S.A., U.K., Portugal and Tanzania: these faunas include pantotheres, the stock from which almost all the later mammals arose. Between the Late Trias and Late Jurassic, the only known fauna is that of the Middle Jurassic of Stonesfield in Oxfordshire. Thus the discovery of a second site is of great importance: it occurs in the Estuarine Series of Skye in Scotland, and contains a fauna of tritylodonts and docodont mammals. The discovery of this fauna was made in August 1971 by Dr. M. Waldman and Mr. J. B. Dobinson during the course of a search for terrestrial vertebrates in the non-marine strata of Skye.

Stratigraphy

Since Hugh Miller (1858) described the occurrence of Jurassic vertebrate fossils on the Isle of Eigg, further vertebrates of similar age have been found in the Hebridean region. The richest material so far recovered has been from the Bathonian (Middle Jurassic) of Eigg (Hudson 1966), and the most recent find is that of plesiosaur remains from the Bearreraig Sandstone (Bajocian) near Rigg, Isle of Skye (Hudson & Morton 1969). All the Jurassic vertebrate remains known from this area are those of fish and reptiles and occur in a variety of localities. (Miller 1858, Peach 1910, Arkell 1933, Hudson 1966 & Hudson & Morton 1969).

The mammal and therapsid remains now described occur in the marlstone bands of the Ostracod Limestones, the latter forming a unit of the upper part of the Great Estuarine Series. The marlstones are dark blue-grey in colour, but weather to a very much paler hue. The Great Estuarine Series (G.E.S.) extends from the Basal Oil Shale up to the Mottled Clays, this sequence ranging from the *Parkinsonia parkinsoni* Zone up to that of *Clydoniceras hollandi* and including both zones. Thus it includes the uppermost part of the Bajocian and most of the Bathonian, with the exception of the top *Clydoniceras discus* Zone (Hudson 1962, Hudson & Morton 1969).

The Ostracod Limestones are placed well up in the G.E.S. and are undoubtedly Mid-Upper Bathonian in age. They are succeeded by the Mottled Clays which Hudson considers to be the last beds of the Series. There is some argument as to whether the beds above the Mottled Clays should be considered as part of the

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G.E.S. These are the Upper Ostrea Beds and the Belemnite Sands, which Hudson refers to as the Staffin Bay Beds, but which Anderson & Dunham (1966) refer to the G.E.S., thereby extending the range of the latter into the Callovian. In Strathaird the Carn Mor Sandstone directly overlies the Mottled Clays (the Upper Ostrea Beds are missing) and on the ammonite evidence Hudson notes that this bed belongs to the *calloviense* Zone (Kellaways Rock). However, in Trotternish the Upper Ostrea Beds are present and are separated from the Mottled Clays by a non-sequence.

The sediments of the G.E.S. were probably laid down in large, quiet, shallow, warm lagoons, not open directly to the sea, with the sandy beds of the succession indicating river deltas. According to Hudson (1964) most of the sediment was derived from the mainland of Scotland to the east and north-east, the Scottish-Pennine Island of Wills (1951). Some sediment may also have come from islands to the north–west (Hudson 1964).

We have, therefore, a picture of small mammals and therapsids inhabiting the large Scottish-Pennine Island (the nearest land mass to this deposit), and being carried out by rivers into the shallow lagoons of the Minch Basin. The skeletons would not have remained intact for very long in such an environment and only isolated bones and teeth would have been preserved, in a similar way to the preservation of vertebrates in the Stonesfield Slate of southern England (cf. Phillips 1871). The likelihood of preservation would have been enhanced by the muddiness of the lagoons (Hudson 1963) and the continual influx of deltaic sediment.

The Reptile Bed on Eigg noted by Miller (1858) has been redescribed by Hudson (1966). This bed falls within the *Mytilus* Shales of the G.E.S. and is correlated with the White Sandstone of Strathaird, a bed low down in the G.E.S., which is probably of Lower Bathonian age.

Although both mammal jaws and some of the *Stereognathus* teeth were collected from fallen blocks of the Ostracod Limestone, there is absolutely no doubt at all of their provenance, as the beds may be accurately placed by examination of the arrangement of hard and soft bands in the Ostracod Limestones of the cliff and beach. As confirmation of this, a good deal of bone material was collected *in situ* and this includes teeth of *Stereognathus*.

Palaeontology

Class REPTILIA
Subclass SYNAPSIDA
Order THERAPSIDA
Infraorder TRITYLODONTOIDEA
Family Tritylodontidae Cope 1884

Diagnosis. Therapsids having quadrate upper molars, with three rows of two to four cusps each. Cheek teeth little differentiated, at least five molariform teeth of identical pattern, no trenchant premolars (after Simpson 1928).

Remarks. The family comprises ten genera; details of the species, stratigraphic and geographic distribution are to be found in Savage (1971). *Oligokyphus* is the only genus to have been monographed (Kühne 1956).

Genus *Stereognathus* Charlesworth 1855

Diagnosis. Tritylodontid having upper molars with two outer, two median and two inner cusps. External and internal cusps not crescentic, with but one crest from apex (after Simpson 1928).

Type species. Stereognathus ooliticus Charlesworth 1855. Stonesfield Slate (Zone of *Gracilisphinctes progracilis*), Middle Bathonian stage, Great Oolite Series, Middle Jurassic. Stonesfield Slate Quarry, Stonesfield, Oxfordshire, England.

Remarks. Only one species known. Material comprises holotype and one additional specimen from the same quarry. The holotype, preserved in the museum of the Institute of Geological Sciences, London, is a right maxilla with three broken molars and the alveoli of three others; it has been figured by Owen (1857, 1871). The second specimen, in the Oxford University Museum, is a left maxilla with the roots of four molars; a detailed account of the specimen is to be found in Simpson (1928).

Stereognathus hebridicus sp. nov.

Diagnosis. Species much larger than type species. Lower molars with two outer and two inner cusps, all crescentic. Trivial name is derived from the Hebrides, group name for islands off west coast of Scotland.

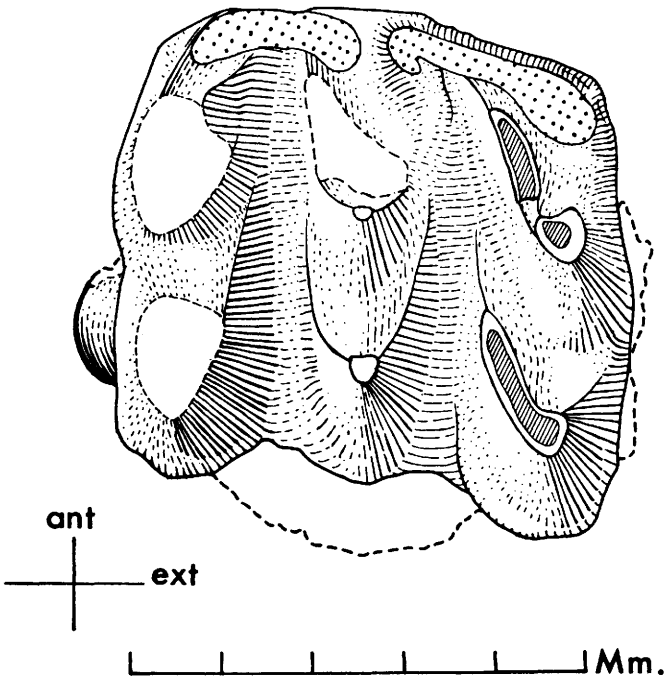

FIG. 1. Upper Left molar of *Stereognathus hebridicus* sp. nov. Holotype, UBGM 20572.

Holotype. UBGM 20572. Isolated upper left molar. Middle Bathonian, Great Estuarine Series, Middle Jurassic. Locality UB 7111, Isle of Skye, Scotland.

Hypodigm. In addition to the holotype, the following paratypes are included, all from the same locality as the holotype: UBGM 20573, isolated upper left molar; UBGM 20574, isolated lower left molar; UBGM 20575, isolated lower left molar.

Description and remarks. Detailed description must await full preparation of the material. Measurements given below show the new species to be 1.6 times larger than *S. ooliticus*. The median crests of the upper molars are selenodont, but the outer and inner cusps carry a single ridge. The upper molars have five roots each; two outer, two inner and an anterior median root. The lower molars have two outer and two inner cusps, all selenodont; the roots are not preserved. With the exception of the size difference, the new species shows close similarity to the Stonesfield species.

mms.	*S. ooliticus* Holotype			*S. hebridicus*			
				Holotype	UBGM	UBGM	UBGM
	ant	med	post	20572	20573	20574	20575
	Upper molars			Upper molars		Lower molars	
Length	3.1	3.3	3.2	5.3	5.3	5.2	5.8
Width		3.6		5.4	5.4	3.1	3.7

Class MAMMALIA
Subclass PROTOTHERIA
Order DOCODONTA
Family Docodontidae Simpson 1929

Diagnosis and remarks. Patterson (1956) gave a detailed diagnosis of the order Docodonta, which he considered to possess a single family, Docodontidae. In Patterson's usage the family composed the genera *Docodon* Marsh 1881, Morrison Formation, Wyoming and Colorado; *Peraiocynodon Simpson* 1928, Purbeck Formation, England and *Morganucodon* Kühne 1949, Rhaeto-Liassic, Wales. The present authors follow Hopson (1970) in excluding *Morganucodon* (a junior synonym of *Eozostrodon* Parrington 1941). *Peraiocynodon* is considered by Patterson to be a juvenile *Docodon*. *Docodon* has five named species, all known from the Morrison Formation of Wyoming and Colorado; four species are based on mandibular dentitions and the fifth on upper dentitions. Jenkins (1969) pointed out that almost certainly fewer species are represented by the material when variation is taken into account.

Genus *Borealestes* g. nov.

Diagnosis. Docodont in which the molar teeth have large primary cusp, prominent main internal cingulum cusp, well differentiated antero-internal and antero-external cingulum cusps, and weakly differentiated postero-internal cingulum cusp. Name derived from Greek *βορεωσ* northern and *λησττησ* brigand.

Type species. Borealestes serendipitus. Only known species. Middle Jurassic, Isle of Skye, Scotland.

Borealestes serendipitus sp. nov.

Diagnosis. As for genus. Trivial name from noun serendipity, defined as the faculty of making happy and unexpected discoveries by accident.

Holotype. UBGM 20570. Left mandible with two premolars and part of a third, four molars fully erupted, one unerupted and alveolus of a sixth. Middle Bathonian,

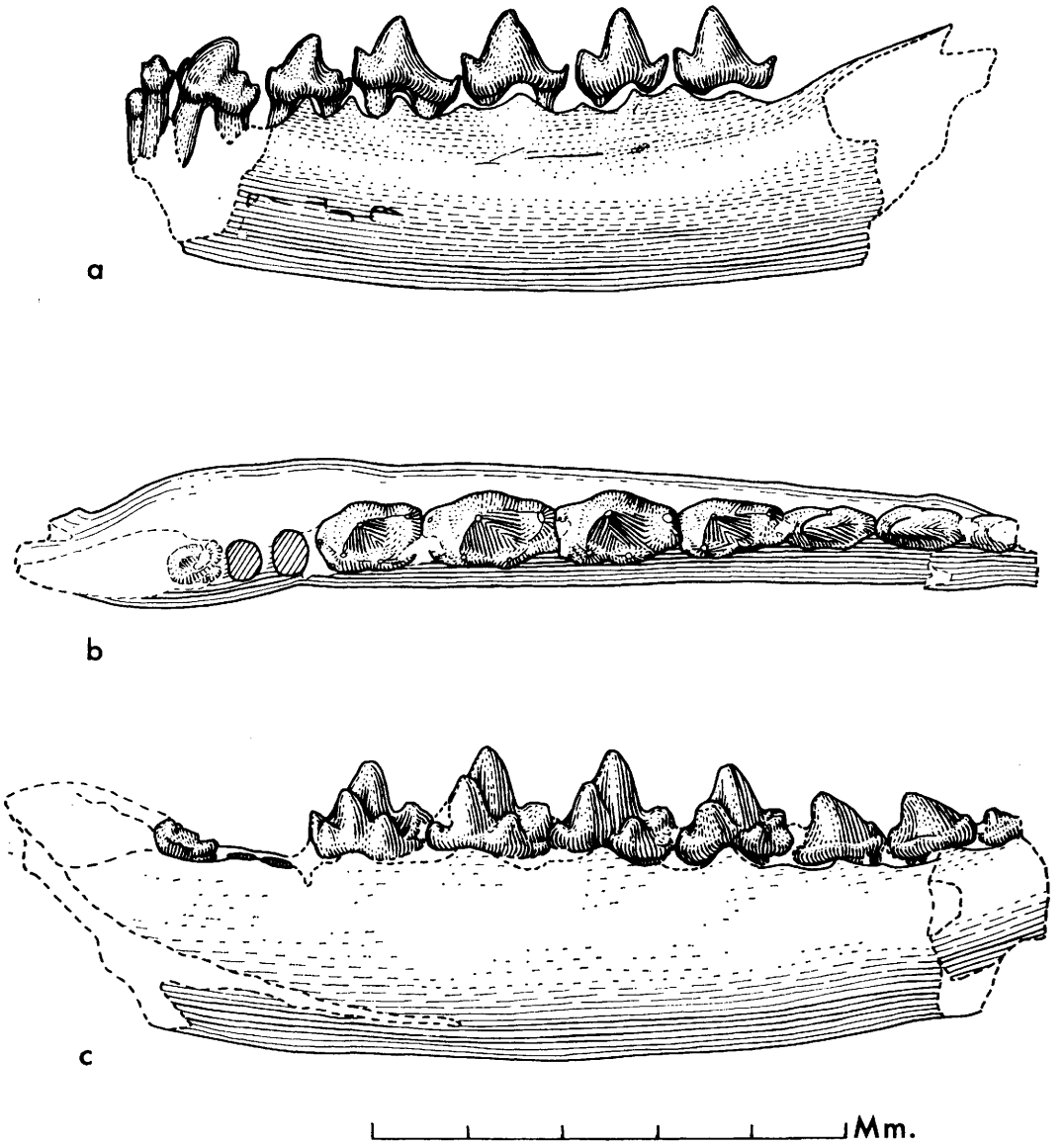

FIG. 2. Left mandible of *Borealestes serendipitus* G. & sp. nov. Holotype UBGM 20570. a) buccal aspect. b) occlusal aspect. c) lingual aspect.

Great Estuarine Series, Middle Jurassic. Locality UB 7111, Isle of Skye, Scotland.

Hypodigm. In addition to the holotype one further specimen is known from the same locality. The paratype, UBGM 20571, comprises a left mandible with four molars.

Description and remarks. Detailed description can only follow after full preparation of the material. The dental formula is not possible to assess, but the minimum number of teeth present was 6 molars and 3 premolars. The premolars are simple teeth with one major cusp, a small posterior cusplet and well defined cingulum anteriorly, internally and posteriorly. The nomenclature used for the molar cusps follows that of Hopson & Crompton (1969). Cusp *a* is the largest, high and on the labial side. Lingually and slightly posterior to cusp *a* is cingulum cusp *g*, the second largest cusp. Postero-externally there is a small posterior cingulum cusp *d*. A crest extends directly between *g* and *d*, and a cingulum follows the tooth border between the cusps. Anteriorly is a well defined *b* cusp on the labial side, while antero-internally is another well defined cusp *h*. In the hollow triangle formed by cusps *a*, *b* and *h* is a well marked embrasure pit, probably for the accommodation of the median internal cingulum cusp of the upper molar.

The two premolars are both of identical size. The molars increase in size from each end toward the middle. The teeth are a little worn on the holotype.

The mandibular ramus is long, slender and the internal mandibular groove extends anteriorly to the level of M_2.

Measurement on the Holotype UBGM 20570
Molars numbered from last premolars backward;
premolars numbered from first molar forward.

mms.	P_3	P_2	P_1	M_1	M_2	M_3	M_4	M_5	M_6
Length	—	1.0	1.0	1.3	1.4	1.4	1.2	—	—
Width	—	0.5	0.5	0.7	0.8	0.9	0.9	—	—

Comparison can be made with the Late Triassic *Eozostrodon* and the Late Jurassic *Docodon*. While both *Borealestes* and *Docodon* could be derived from an eozostrodontid, it is unlikely that they form a linear series. *Borealestes* shows a considerable reduction in the number of cingulum cusps from the condition seen in *Eozostrodon;* the arrangement of cusps and basins in *Borealestes* and *Docodon* differs in many points. The closest comparison with *Borealestes* is to be found in an unnamed species figured by Kühne (1968) from the Kimmeridgian of Guimarota, Portugal. Until more is known of the Portuguese species, precise relationships cannot be assessed.

Age of the fauna

The invertebrates give a clearly defined zonation within the Bathonian. The vertebrate elements described have characters consistent with a mid-Bathonian age. The Skye *Stereognathus* is closely similar to the Stonesfield species, suggesting that the stratigraphical levels are not very different.

The nearest morphological relative of *Borealestes* is the Guimarota docodont which occurs in beds dated as Kimmeridgian. *Borealestes* is rather more primitive than the Kimmeridgian taxon and decidedly more advanced that the late Triassic *Eozostrodon*.

Work is continuing at this and other localities in the Scottish Jurassic and there is every prospect of further new and interesting mammals being found.

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