SOME BAJOCIAN AMMONITES FROM WESTERN SCOTLAND

by N. MORTON

ABSTRACT. In western Scotland Bajocian ammonites occur in the Bearreraig Sandstone of Skye and Raasay. In the Humphriesianum Zone (Lower Bajocian) the fauna includes Stephanocerataceae and rare Haploceratataceae (*Lissoceras*) and Oppeliaceae (*Oppelia*). The Stephanocerataceae are represented by one family Stephanoceratidae, divided into two subfamilies on the basis of type of dimorphism—Stephanoceratinae (including Otoitinae) and Sphaeroceratinae. In Skye the Stephanoceratinae are represented mainly by the genus *Stephanoceras*, with the macroconch (subgenus *Stephanoceras*) much more abundant than the microconch (subgenus *Normannites*). *Teloceras* also occurs, but is rare. The Sphaeroceratinae, represented by *Chondroceras*, are also rare. In the Upper Bajocian the Perisphinctaceae are represented by species of *Garantiana* from the Subfurcatum Zone.

THE Bearreraig Sandstone is the thickest known development of the Aalenian and Bajocian in Britain. The stratigraphy has already been described (Morton 1965, 1969). The Lower Bajocian is mainly composed of sandstones, cross-bedded in southern Skye (Strathaird) and Raasay, but in northern Skye (Trotternish) normal-bedded and ammonitiferous. The Upper Bajocian is shale or clay over most of the area, but passing into sandstone in northern Trotternish. The purpose of this paper is to describe the ammonite fauna of the Bajocian, excluding the Sonniniidae which will be discussed later.

The zones and subzones of the Bajocian Stage are summarized in Table 1. The arrangement of those in the lowermost Bajocian (Sowerbyi Zone) is provisional, but does not affect the present discussion (see also Torrens 1969, p. 302). As used here Lower Bajocian is synonymous with Middle Bajocian of traditional British usage. The recognition of a separate Aalenian Stage in accordance with the recommendations of the 1967 Luxembourg Jurassic Colloquium leaves a Bajocian Stage divided into two parts—Upper Bajocian as before, and Lower Bajocian, formerly called Middle Bajocian.

STRATIGRAPHY

Lower Bajocian. With the exception of the Sonniniidae the ammonites of the Lower Bajocian were all found in Trotternish, north-east Skye, at three localities in the Upper Sandstones (Morton and Hudson 1964, p. 532 = Rigg Sandstone of Anderson and Dunham 1966, p. 12). From south to north these are:

1. Torvaig (NG 502444): In the basal bed of the Upper Sandstones (see Morton 1965, pp. 197–8) there occur *Stephanoceras* (*Stephanoceras*) *nodosum* (Quenstedt), *S.* (*S.*) aff. *nodosum* and aff. *macrum* (Quenstedt), ? *Chondroceras evolvescens* (Waagen) and *Lissoceras oolithicum* (d'Orbigny).

2. Bearreraig: Ammonites were found mainly at two localities in the Upper Sandstones. In the pipeline cutting (NG 515524) *Stephanoceras* (*Stephanoceras*) *pyritosum* (Quenstedt), *S.* (*S.*) aff. *triplex* Weisert, *S.* (*Normannites*) sp. were found *in situ* approximately 30 m above the base, and 4 m higher a single specimen of *Teloceras* (*Teloceras*) *blagdeni* (J. Sowerby). On the north side of Bearreraig Bay,

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TABLE 1. Zones and Subzones of the Bajocian Stage.

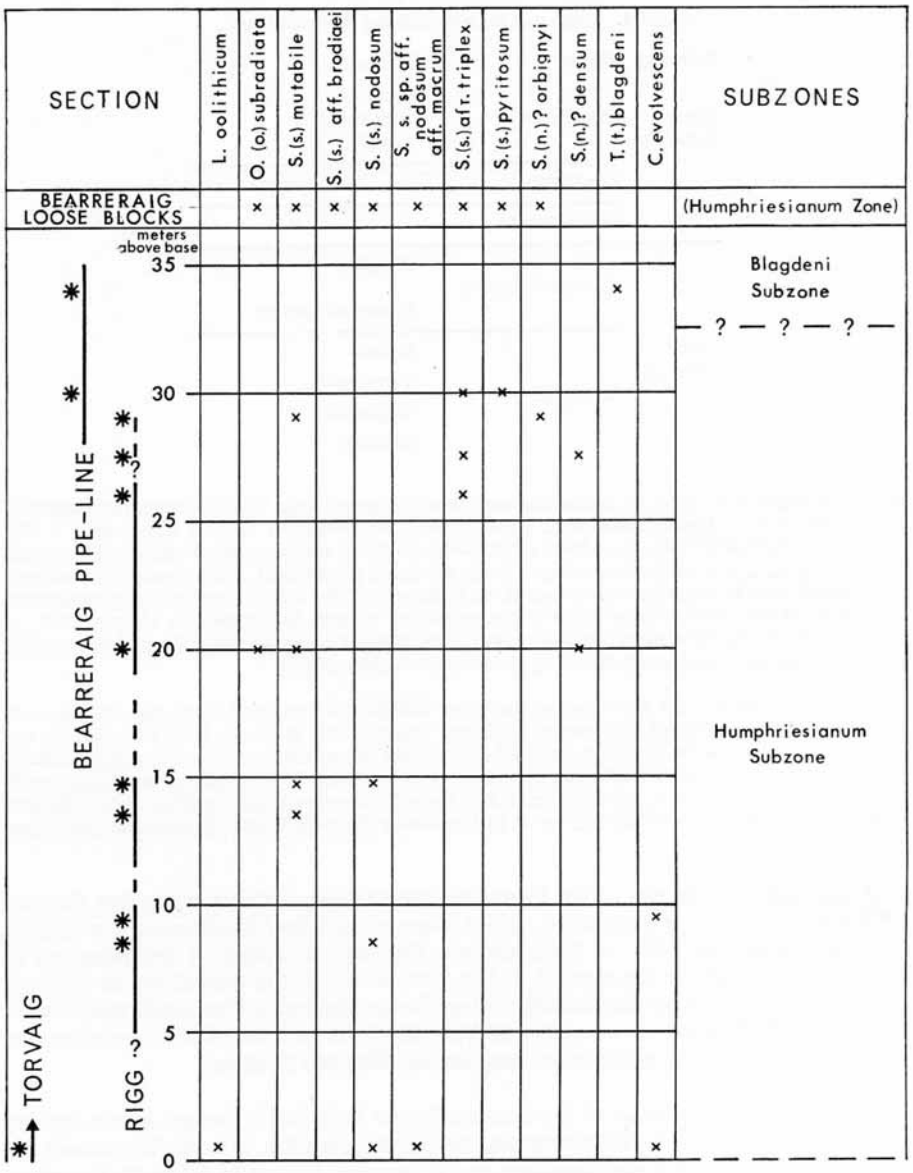
Substages	*Zones*	*Subzones*
Upper Bajocian	Parkinsoni	Bomfordi Parkinsoni Truelli
	Garantiana	
	Subfurcatum	
	Humphriesianum	Blagdeni Humphriesianum
Lower Bajocian	Sowerbyi	Sauzei Laeviuscula Trigonalis Discites

at Rudha Sughar (NG 518537), ammonites were found in loose blocks from the lower part (approximately 30 m) of the Upper Sandstones: *Stephanoceras* (*Stephanoceras*) *mutabile* (Quenstedt), *S.* (*S.*) aff. *brodiaei* (J. Sowerby), *S.* (*S.*) *nodosum* (Quenstedt), *S.* (*S.*) aff. *nodosum* and aff. *macrum* (Quenstedt) (intermediate), *S.* (*S.*) aff. *triplex* Weisert, *S.* (*S.*) *pyritosum* (Quenstedt), *S.* (*Normannites*) ? *orbignyi* (Buckman), *Oppelia* (*Oppelia*) ? *subradiata* (J. de C. Sowerby). The blocks from the Upper Sandstones can easily be distinguished from those of the underlying Massive Sandstone (see Morton 1969, p. D28), but more detailed stratigraphy is not possible and even the distinctive purplish-weathering matrix of some specimens could not be traced in the outcrops further south.

3. Rigg (NG 521566): The lower part of the Upper Sandstones is exposed on the shore to the north and south of Rigg waterfall. The base of the Upper Sandstones is below sea level, but probably not more than 5–10 m below the lowest exposed bed, so that the ammonites come from approximately the same part of the Upper Sandstones as those at Rudha Sughar. The succession is summarized in text-fig. 1, together with data from Bearreraig and Torvaig. Two specimens from Rigg in the collection of the Geological Survey, Edinburgh are *S.* (*S.*) *pyritosum* (Quenstedt) and *Chondroceras evolvescens* (Waagen).

These faunas all belong to the Humphriesianum Zone, and it appears that the base of the zone in Trotternish coincides with the base of the Upper Sandstones. It is marked faunally by the incoming of *Stephanoceras*. The earliest species of *Stephanoceras* in Skye is *S.* (*S.*) *nodosum* (Quenstedt), but in other areas this and related species ('*Skirroceras*'), occur earlier, in the Sowerbyi Zone (Sauzei Subzone). The single specimen of *Teloceras* (*T.*) *blagdeni* (J. Sowerby) at Bearreraig, above most of the *Stephanoceras*, suggests that it may be possible to recognize the Blagdeni Subzone.

Upper Bajocian. Over most of the area the Upper Bajocian is marked by the sudden incoming of clay or shale sedimentation, the Garantiana Clay. In north Trotternish the Garantiana Clay passes into sandstone and it becomes difficult to define the boundary between the Bearreraig Sandstone and the overlying Great Estuarine Series, other than at the top of the highest bed containing marine fossils (Hudson 1969).



TEXT-FIG. 1. Ammonite succession in the Upper Sandstones (Humphriesianum Zone) of Trotternish, Skye.

Ammonites were found in the Garantiana Clay in the cliffs above Prince Charles's Cave, Trotternish—*Garantiana* (*G.*) *filicosta* Bentz—and at Capach, Strathaird—*G.* (*G.*)? *baculata* (Quenstedt) and *G.* (*G.*) *filicosta* Bentz. Ammonites from Storab's Grave, Isle of Raasay, were identified by Buckman (in Lee 1920), and the revised identifications are:

Spec. no.	*Buckman's identification*	*Revised identification*
GSE 2888	*Strenoceras bifurcatum*	*G.* (*G.*) *filicosta*
GSE 2889	*Strenoceras subfurcatum*	*G.* (*G.*) ? *baculata*
GSE 2921–2	*Garantiana coronata?*	*G.* (*G.*) ? *baculata*
GSE 2925	*Garantiana alticosta?*	? *Strenoceras* sp.
GSE 2926	*Garantiana alticosta?*	*Garantiana* sp. indet.
GSE 2927	? *Garantiana subgaranti*	*G.* (*G.*) *filicosta*
GSE 2928	? *Garantiana subgaranti*	*G.* (*G.*) *filicosta*
GSE 2929	*Strenoceras minimum*	*G.* (*G.*) sp.
GSE 2930	*Strenoceras minimum*	*G.* (*G.*) sp.

The specimens from Raasay were identified by Buckman (in Lee 1920, p. 47) as indicating the presence of both the Subfurcatum and Garantiana Zones. However, both *G.* (*G.*) *baculata* (Quenst.) and *G.* (*G.*) *filicosta* Bentz come from the Subfurcatum Zone (Bentz 1928, Buckman 1925, Hahn 1966, Pavia and Sturani 1968, Westermann 1967), so that only the Subfurcatum Zone is proved in the Garantiana Clay.

The Garantiana Clay passes up into the Basal Oil Shale and the White Sandstone of the Great Estuarine Series, which may also be of Upper Bajocian age (see Hudson 1962), but are not of normal marine facies and do not contain ammonites.

Dimensions. The dimensions given for the specimens are as follows:

D. Diameter of specimen (H, O, S, P).
Wh. Whorl height (H, O, S, P).
Wb. Whorl breadth (H, O, S, P).
Ud. Diameter of umbilicus (H, O, S, P).
Pl. Length of primary rib, from umbilical seam to tubercle or point of furcation (S, P).
Pn. Number of primary ribs in the last whorl, or part of whorl (S, P).
Pd. Distance between primary ribs at mid-whorl position, at part of whorl where D., etc., were measured (S, P).
Sl. Length of secondary rib, from tubercle or point of furcation to mid-venter (S, P).
Sn. Number of secondary ribs in the last whorl or part of whorl (O, P).
Tn. Number of tubercles in the last whorl. Where possible this has been measured at half-whorl intervals, along with the umbilical diameter (the only size measurement which can be made directly on inner whorls), such specimens are indicated with an asterisk (S).
Td. Distance between tubercles, at point where D., etc., were measured (S).
Tp. Position of tubercles: $(A/B \times 100$, where A is the distance from the tubercle to the umbilical seam, and B the height of the whorl, both measured along a line through the centre of the umbilicus) (S).

The letters in brackets indicate to which of the superfamilies the measurement is appropriate: H—Haploceratacеae, O—Oppeliaceae, S—Stephanocerataceae, P—Perisphinctaceae. The dimensions are given in millimetres and are also expressed as percentages of the diameter. In cases where the dimension given is approximate, it is indicated by being preceded by '*c.*' (*circa*).

SYSTEMATIC DESCRIPTIONS

Superfamily HAPLOCERATACEAE Zittel 1884

Arkell (1957) combined the haploceratids and oppeliids in one superfamily, but they should probably be regarded as distinct superfamilies (Callomon *in litt.*, Dec. 1969).

The Haploceratacea are rare in the Bajocian of western Scotland, only one specimen having been found in Trotternish.

Family HAPLOCERATIDAE Zittel 1884

Genus LISSOCERAS Bayle 1879

Type species. Ammonites psilodiscus Schloenbach 1865, by original designation.
Includes. Lissoceratoides Spath 1923.

Lissoceras oolithicum (d'Orbigny)

Plate 40, figs. 1–2

1845 *Ammonites oolithicus* d'Orbigny, p. 383, pl. 126, figs. 1–4.
1923 *Lissoceras oolithicum* d'Orbigny; Fallot and Blanchet, pp. 141–2.
1927 *Lissoceras oolithicum* d'Orbigny; Roman and Pétouraud, p. 48, pl. 5, figs. 12–14.
1937 *Lissoceras oolithicum* d'Orbigny; Gillet, p. 110.

Material. One specimen—HMS 26350.

Dimensions.	*D.*	*Wh.*	*Wb.*	*Ud.*
HMS 26350	30·5	16·2 (53)	9·4 (31)	6·0 (20)

Description. Involute, moderately compressed; smooth except for faint growth-lines especially where the shell is preserved and on outer half of whorl sides on body chamber; venter rounded and unkeeled; suture line moderately complex, with second lateral saddle at least as large as first lateral saddle.

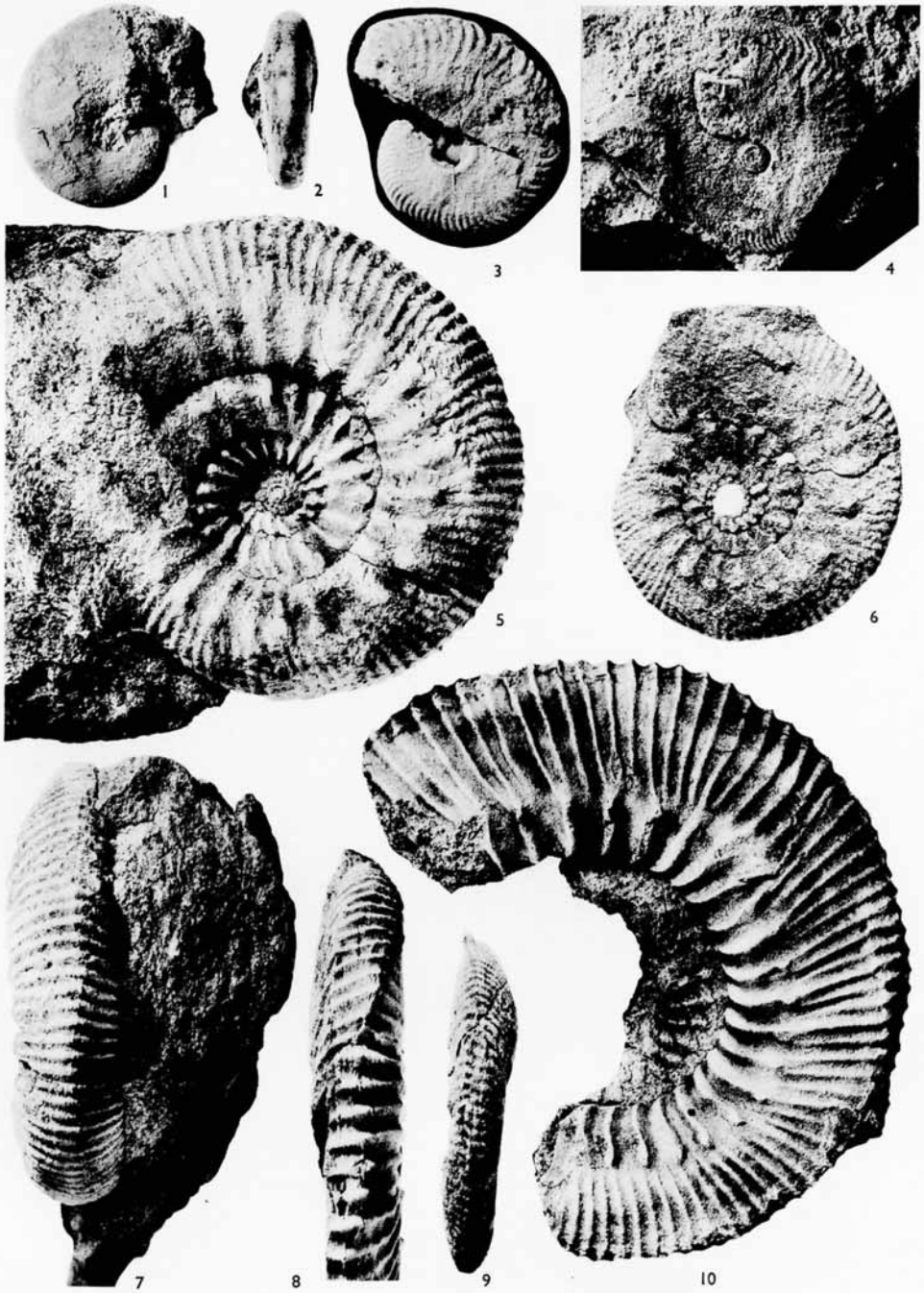
Discussion. The specimen is a typical smooth *Lissoceras*. It is smoother than the Sowerbyi Zone *L. semicostulatum* Buckman, and appears to be identical with the common *L. oolithicum* (d'Orbigny). Most records of this species are from the Upper Bajocian, with the exception of Gillet (1937), who recorded it from the Sauzei Subzone.

Locality. Humphriesianum Zone; basal bed of Upper Sandstones, Torvaig, Trotternish, Skye.

EXPLANATION OF PLATE 40

All figures natural size.

Figs. 1, 2, *Lissoceras oolithicum* (d'Orbigny); HMS 26350, Humphriesianum Zone, basal bed of Upper Sandstones, Torvaig, Trotternish, Skye. 3, *Oppelia* (*Oppelia*) ? *subradiata* (J. de C. Sowerby); HMS 26351, Humphriesianum Zone, loose block of Upper Sandstones, Rudha Sughar, Bearreraig, Trotternish, Skye. 4, *Oppelia* (*Oppelia*) ? *subradiata* (J. de C. Sowerby); HMS 26352, Humphriesianum Zone, lower part of Upper Sandstones, shore just north of Rigg waterfall, Trotternish, Skye. 5, 7, *Stephanoceras* (*Stephanoceras*) *mutabile* (Quenstedt); HMS 26353, Humphriesianum Zone, loose block of Upper Sandstones, Rudha Sughar, Bearreraig, Trotternish, Skye. 6, 9, *Stephanoceras* (*Stephanoceras*) *mutabile* (Quenstedt); HMS 26354, Humphriesianum Zone, lower part of Upper Sandstones, shore just south of Rigg waterfall, Trotternish, Skye. 8, 10, *Stephanoceras* (*Stephanoceras*) *mutabile* (Quenstedt); HMS 26356/1, Humphriesianum Zone, lower part of Upper Sandstones, shore just north of Rigg waterfall, Trotternish, Skye.



MORTON, Bajocian ammonites

Superfamily OPPELIACEAE Bonarelli 1894

Family OPPELIIDAE Bonarelli 1894

The Oppeliaceae are represented by rare *Oppelia* in the Humphriesianum Zone in Trotternish. The dimorphism of Lower Bajocian Oppeliidae is not entirely clear, but the microconch *Oecotraustes* Waagen 1869, monographed by Stephanov (1966), ranges down into Lower Bajocian (cf. Arkell 1957, p. L276) and appears to be the microconch of *Oppelia*.

Genus OPPELIA Waagen 1869

Macroconch subgenus *Oppelia* Waagen 1869

Type species. Ammonites subradiatus J. de C. Sowerby 1823, subsequent designation by H. Douvillé 1884 (ICZN Opinion 324, see Arkell 1957, p. L275). A later designation by Buckman (1920) of *A. subradiatus* Waagen (non Sowerby) (= *O. lectotypa* Buckman 1924) is invalid.

Oppelia (*Oppelia*) ? *subradiata* (J. de C. Sowerby)

Plate 40, figs. 3–4

1823 *Ammonites subradiatus* J. de C. Sowerby, p. 23, pl. 421, fig. 2.
1909 *Ammonites subradiatus* J. de C. Sowerby; Buckman and Secretary, pl. 6, fig. 3 *a–b*.
1951 (1951–9) *Oppelia* (*Oppelia*) *subradiata* (J. de C. Sowerby); Arkell, pp. 50–1, text-fig. 11.

Material. Two crushed specimens—HMS 26351, HMS 26352.

Dimensions.	*D.*	*Wh.*	*Wb.*	*Ud.*	*Sn.*
HMS 26351	37·9	20·5 (54)	4·1 (11)	5·2 (14)	31/½ wh.
HMS 26352	37·8	20·6 (55)	–	4·8 (13)	–

Description. Involute, flattened by post-depositional compaction; no primary ribs visible so that inner half of whorls appears smooth; outer half with close fine secondary ribs which curve forwards onto the edge of the venter; venter (visible on HMS 26351) narrow, smooth except for faint suggestion of a keel locally; suture (partially visible on HMS 26351) moderately complex with second lateral saddle almost as large as first lateral saddle.

Discussion. The poor preservation, especially the crushing, makes certain identification almost impossible, but the specimens seem to be very close to the typical *O.* (*O.*) *subradiata* (J. de C. Sowerby) figured by Arkell (1951–9).

The holotype of the species comes from the Sauzei Subzone (Arkell 1951, p. 50, 1957, p. L275), whereas Roman (1938, p. 157) and other authors indicate Upper Bajocian (Garantiana Zone).

Localities. Humphriesianum Zone; HMS 26351 from loose block of the Upper Sandstones, Rudha Sughar Bearreraig; HMS 26352 from lower part of Upper Sandstones, shore below Rigg. Both localities in Trotternish, Skye.

Superfamily STEPHANOCERATACEAE Neumayr 1875

Arkell (1957, pp. L287–308), Schindewolf (1965, pp. 137–238) and Krimholz, Sasonov and Kamiseva-Elpatevskaja (1958, pp. 75–9) differ in their grouping of Middle and Upper Jurassic ammonites, but in the Bajocian distinction between Stephanocerataceae and Perisphinctaceae is clear.

The classification of Bajocian stephanoceratids by Arkell (1957) is in need of revision, partly because of recent work on sexual dimorphism (Callomon 1963, Makowski 1963, Westermann 1964). Difficulties arise in deciding which dimorphs belong together and the procedure followed here mostly follows Callomon (1963, pp. 47–51) and Westermann (1964, pp. 40–4) in using macroconch/microconch subgenera (cf. Makowski 1963 and Cope 1967). For further discussion of the problem in general see Westermann (1969).

Arkell (1957) grouped north-west European genera into Otoitidae (Mascke 1907), Stephanoceratidae (Neumayr 1875), and Sphaeroceratidae (Buckman 1920). However, the otoitid *Normannites* is probably the microconch of *Stephanoceras*, and the Sphaeroceratidae and Otoitidae are similarly intertwined (Westermann 1964). I see no reason to recognize more than the one family Stephanoceratidae.

Family STEPHANOCERATIDAE Neumayr 1875

Includes. Stepheoceratidae Buckman 1898, Otoitidae Mascke 1907, Stemmatoceratidae Mascke 1907, Sphaeroceratidae Buckman 1920, Normannitinae Westermann 1954, Cadomitinae Westermann 1964.

As now revised the Stephanoceratidae includes a great variety of forms, generally with sharp ribbing which passes over the venter without interruption, and is usually differentiated into primary and secondary ribs. At the point of furcation tubercles are frequently developed. The suture is complex (see also Westermann 1967).

Dimorphism is striking and there may be considerable differences in size between the macroconchs and the microconchs. There are two main types of dimorphism, as described by Westermann (1964). In one type there is not only a difference in size between the macroconch and microconch, but whereas the macroconch has a collared and lipped aperture (e.g. *Stephanoceras*, *Docidoceras* and *Stemmatoceras*), the microconch aperture has lappets (e.g. *Otoites*, *Normannites*, and *Polyplectites*). In the second type of dimorphism the main difference between the macroconchs and microconchs is one of size, the aperture in both being collared and lipped (e.g. *Sphaeroceras*, *Chondroceras*). The difference in type of dimorphism might be used as a basis for dividing the Stephanoceratidae into two subfamilies—Stephanoceratinae (including Westermann's 1964 Otoitinae) and Sphaeroceratinae (cf. later Stephanocerataceae, e.g. Bathonian Tulitidae—Enay 1959).

Subfamily STEPHANOCERATINAE Neumayr 1875

Includes. Stepheoceratidae Buckman 1898, Stemmatoceratidae Mascke 1907, Otoitidae Mascke 1907 (pars), Normannitinae Westermann 1954, Cadomitinae Westermann 1964.

Description. As for family; strongly dimorphic with the macroconchs having collared and lipped aperture and much larger than the microconchs, which have lappets.

Genus STEPHANOCERAS Waagen 1869

Macroconch subgenus *Stephanoceras* Waagen 1869

Type species. Ammonites Humphriesianus J. de C. Sowerby 1825, subsequent designation by Buckman 1898 (ICZN Opinion 324, see Arkell 1957, p. L289).

Includes. Stepheoceras Buckman 1898 (obj.), *Skirroceras* Mascke 1907, *Grahamites* Kilian and Reboul 1909, *Stephoceras* Rollier 1911 (obj.), *Kallistephanus*, *Rhytostephanus*, *Oecostephanus*, *Skolekostephanus* Buckman 1921, *Mollistephanus*, ? *Kumatostephanus* Buckman 1922, *Kreterostephanus*, ? *Phaulostephanus* Buckman 1927, ? *Gibbistephanus* Buckman 1928, *Dolichoecus*, *Bayleia*, *Freycinetia*, *Brodiaei*, *Romania* Roché 1939.

Discussion. The nomenclatural history of the genus *Stephanoceras* and the problem of the type species were discussed by Spath (1944). Many genera created by Buckman (1909–30), Mascke (1907) and others may be regarded as synonyms, see also Weisert (1932) and Spath (1936). French authors (e.g. Gillet 1937, Roman and Pétouraud 1927, Fallot and Blanchet 1923) tended to use the generic name *Cadomites* (Munier-Chalmas 1892) in an extended sense to include the older *Stephanoceras*, while Roché (1939, pp. 167–217) also created a series of sections (subgenera) without any regard whatever for the older generic names of Buckman and Mascke which must take priority as senior synonyms (see also Spath 1944).

Stephanoceras (*Stephanoceras*) *mutabile* (Quenstedt)

Plate 40, figs. 5–10

1886 *Ammonites Humphriesianus mutabilis* Quenstedt, p. 537, pl. 66, fig. 5.
1932 *Stephanoceras mutabile* Quenstedt emend. Weisert; Weisert, pp. 153–5, pl. 17, fig. 6.
1938 *Stephanoceras mutabile* Quenstedt; Schmidtill and Krumbeck, pp. 340–1, pl. 11, fig. 3, pl. 14, figs. 6–7.
1939 *Cadomites mutabilis* Quenstedt; Roché, p. 201.

Material. Nine specimens, mostly rather fragmentary—HMS 26353; HMS 26354; HMS 26355/1; HMS 26355/2; HMS 26356/1; HMS 26356/2; HMS 26356/3; HMS 26357.

Dimensions.	*D.*	*Wh.*	*Wb.*	*Ud.*	*Pl.*	*Sl.*	*Td.*	*Tp.*	*Tn.*
HMS 26353	79·0	24·4 (31)	*c.* 23·0 (29)	32·8 (42)	11·4 (14)	22·0 (28)	6·2 (8)	43·8	27*
HMS 26354	55·0	19·5 (35)	—	21·9 (40)	8·1 (15)	14·5 (30)	4·8 (9)	43·8	21*
HMS 26355/2	—	25·5	17·2	—	12·2	22·0	*c.* 12·0	44·0	—
HMS 26356/1	99·0	32·0 (32)	—	41·0 (41)	9·5 (10)	*c.* 23·0 (23)	7·0 (7)	32·1	33
HMS 26356/3	40·9	14·4 (35)	—	15·9 (39)	6·5 (16)	12·0 (29)	3·0 (7)	34·6	*c.* 28

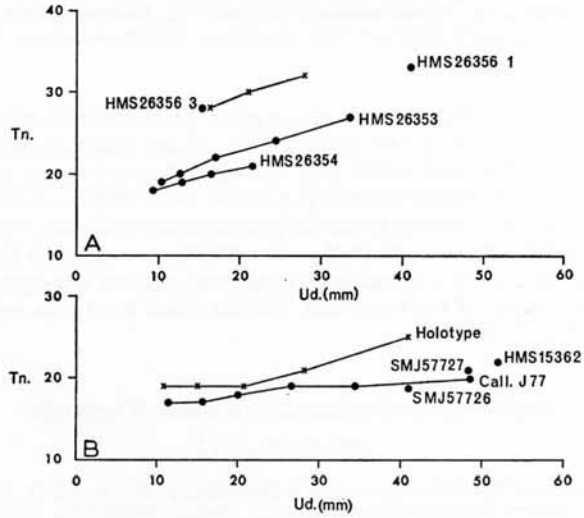
Spec. no. HMS 26353:

Tn.	27	24	22	20	19
Ud.	33·9	24·3	17·0	12·7	10·2

Spec. no. HMS 26354:

Tn.	21	20	19	18
Ud.	21·9	16·6	13·0	9·4

Description. Evolute; small but prominent tubercles situated below the mid-whorl position; primary ribs strongly developed and sharp, slightly rursiradiate to rectiradiate, curved, bending forwards and fading only slightly towards the umbilical seam; secondary ribs not very strong but sharp, prorsiradiate, curving backwards on the venter; from each tubercle there are two or more, usually three, secondary ribs, with sometimes an extra rib intercalated between the tubercles. The number of tubercles per whorl increases gradually with increasing size, from 18 at Ud. 9·4 mm in HMS 26354 to



TEXT-FIG. 2. Number of tubercles per whorl (Tn.) plotted against diameter of umbilicus (Ud.) for *Stephanoceras* (*Stephanoceras*) *mutabile* (Quenstedt) (A), and *S.* (*S.*) aff. *brodiaei* (Sowerby) (B).

33 at Ud. 41·0 mm in HMS 26356/1. This is also seen in the ontogenetic development of HMS 26353 and HMS 26354 (text-fig. 2A). HMS 26353 is septate and has only a small part of the body chamber preserved; the other specimens do not show any sutures. HMS 26356/1 is pathological, showing local disturbance of the ornament for 1·5 cm just below the mid-whorl position. It is interesting to note that the injury did not cause permanent disfigurement of the shell, because the ornament returns to normal after less than one quarter of a whorl (cf. Guex 1967).

Discussion. The specimens are very similar in style of ornament (including Tn.) to *S.* (*S.*) *humphriesianum* (Sow.), but differ in being more involute. The relative size of the umbilicus, and the style of the ornament are similar to *S.* (*S.*) *brodiaei* (Sow.), but the Skye specimens have more numerous tubercles per whorl (Tn.). *S.* (*S.*) *plagium* (Buck.), *S.* (*S.*) *kreter* (Buck.) and *S.* (*S.*) *plicatum* (Quenst.) are more evolute, while *S.* (*S.*) *umbilicum* (Quenst.) appears to have the tubercles situated higher on the whorl sides. The specimens are closest to *S.* (*S.*) *mutabile* (Quenst.), although not all have quite as

many tubercles per whorl (see text-fig. 2). Quenstedt (1886) figured only a ventral view (pl. 66, fig. 5), but a side view of the holotype was figured by Weisert (1932, pl. 17, fig. 6).

In Swabia *S.* (*S.*) *mutabile* (Quenst.) comes from the Humphriesianum-Schichten, the middle part of Dogger δ, that is Humphriesianum Zone and Subzone (Weisert 1932, p. 185; Hahn 1966, p. 29, pl. 4). In the Basses-Alpes it is recorded from the same level by Pavia and Sturani (1968, p. 312).

Localities. Humphriesianum Zone; HMS 26353 from loose block of the Upper Sandstones, Rudha Sughar, Bearreraig; HMS 26354 and HMS 26355/1–2 from lower part of Upper Sandstones, shore just south of Rigg waterfall; HMS 26356/1–3 from 5 m. higher, just north of Rigg waterfall: HMS 26357 from lower part of Upper Sandstones at Leac Treshnish, Trotternish, Skye.

Stephanoceras (*Stephanoceras*) aff. *brodiaei* (J. Sowerby)

Plate 41, figs. 1–2

1832 *Ammonites Brodiaei*, J. Sowerby, p. 71, pl. 351.
1908 *Ammonites Brodiaei* J. Sowerby; Buckman and Secretary, pl. 5, fig. 1; pl. 7, fig. 3.
1923 *Cadomites Brodiaei* Sowerby; Fallot and Blanchet, p. 148, pl. 4, figs. 2–3; pl. 10, figs. 8–9; pl. 13, fig. 2.
1937 *Cadomites Brodiaei* Sowerby; Gillet, pp. 80–1, fig. 61.
? 1938 *Stephanoceras* (*Stepheoceras*) cf. *brodiaei* S. Buck.; Schmidtill and Krumbeck, p. 334, pl. 12, fig. 4.
1939 *Cadomites brodiaei* Sowerby; Roché, p. 196.
1951 *Stephanoceras brodiaei* Sowerby; Maubeuge, pp. 54–5, pl. 5, fig. 2, pl. 12, fig. 1.

Material. Four specimens—HMS 15362; SMJ 57726; SMJ 57727; Call.J77.

Dimensions.	*D.*	*Wh.*	*Wb.*	*Ud.*	*Pl.*	*Sl.*	*Td.*	*Tp.*	*Tn.*
HMS 15362	107·7	*c.* 29·0 (27)	*c.* 48·0 (44)	*c.* 52·0 (48)	19·0 (18)	28·0 (26)	13·0 (12)	51·9	22
Call.J77	110·0	35·6 (32)	*c.* 47·5 (43)	48·5 (44)	18·5 (17)	39·0 (35)	13·0 (12)	48·5	20*
SMJ 57726	90·6	29·3 (32)	40·0 (44)	41·0 (45)	*c.* 15·0 (17)	28·0 (31)	12·5 (14)	46·4	19
max. *c.* 104									
SMJ 57727	107·0	34·7 (32)	*c.* 47·0 (44)	48·3 (45)	24·0 (22)	35·0 (33)	13·0 (12)	52·2	*c.* 21

Spec. no. Call.J77.						
Tn.	20	19	19	18	17	17
Ud.	48·5	34·5	26·7	20·0	15·7	11·5

Description. Evolute; very strong tubercles, rather blunt on outer whorls but large and pointed on inner whorls, and situated on mid-whorl position; primary ribs rather weak, straight and approximately rectiradiate, fading and almost disappearing before reaching umbilical seam; secondary ribs not strongly developed, very slightly prorsiradiate and with slight backwards curvature on venter; from each tubercle there are usually three secondary ribs, with an extra secondary rib intercalated between the tubercles. The number of tubercles per whorl increases gradually from 17 at Ud. 11·5 mm to 20 at Ud. 48·5 mm in Call.J77, and 22 at Ud. 52·0 mm in HMS 15362 (text-fig. 2B). The specimens do not show sutures except Call.J77 which shows part of three sutures at one place. All four specimens show signs of having been eroded on one side.

Discussion. Of the species of the *humphriesianum* group, *S.* (*S.*) *humphriesianum* (Sowerby), *S.* (*S.*) *mutabile* (Quenst.), *S.* (*S.*) *umbilicum* (Quenst.), and *S.* (*S.*) *kreter* (Buck.) have more tubercles per whorl than these specimens. *S.* (*S.*) *brodiaei* (Sow.), *S.* (*S.*) *plicatum* (Quenst.) and *S.* (*S.*) *plagium* (Buck.) have approximately the same number of tubercles per whorl, but *plagium* is too evolute, and *plicatum* has the tubercles situated too low on the whorl sides. The specimens are most similar to *S.* (*S.*) *brodiaei* (Sowerby), but differ in being slightly more evolute (Ud. 44–48% of *D.* compared with 39% in the holotype figured by Buckman and Secretary 1909), and in having the tubercles situated slightly higher on the whorl sides (Tp. = 46–52 compared with 43 in the holotype). The two specimens from the Sedgwick Museum were identified as *Stephanoceras* aff. *brodiaei* (J. Sow.) by W. J. Arkell in 1951.

The precise locality and horizon of the holotype of *S.* (*S.*) *brodiaei* (J. Sowerby) is uncertain, but Roché (1939, p. 196) suggested the lower part of the Humphriesianum Zone.

Locality. Humphriesianum Zone; loose blocks of the Upper Sandstones, Rudha Sughar, Bearreraig. Three of the specimens have a purple colour on parts of the surface, the fourth (HMS 15362) is not so strongly coloured. Possibly they come from one particular bed in the Upper Sandstones.

Stephanoceras (*Stephanoceras*) *nodosum* (Quenstedt)

Plates 42–45

1858 *Ammonites Humphriesianus nodosus* Quenstedt, p. 399, pl. 54, fig. 4.
1886 *Ammonites Humphriesianus nodosus* Quenstedt, p. 532, pl. 65, fig. 17.
1932 *Stephanoceras nodosum* Quenstedt emend. Weisert; Weisert, pp. 136–8, pl. 15, figs. 1–2.
1938 *Stephanoceras nodosum* Quenstedt; Schmidtill and Krumbeck, pp. 327–8, pl. 14, fig. 5.
1939 *Cadomites nodosus* Quenstedt; Roché, p. 187, fig. 5.
1951 *Stephanoceras nodosum* and aff. *nodosum* Quenstedt; Maubeuge, pp. 57–60, pl. 6, figs. 5–6; pl. 10, fig. 6; pl. 11, fig. 3.

Material. Fourteen specimens, some fragmentary—HMS 15359/1,3; HMS 15360/1–2; HMS 26360/1–2; HMS 26361/1–2; HMS 26362/1–3; SMJ 57728; SMJ 57735; Call.J473; Call.J474.

Dimensions.	*D.*	*Wh.*	*Wb.*	*Ud.*	*Pl.*	*Sl.*	*Td.*	*Tp.*	*Tn.*
HMS 15359/1	229	59·0 (26)	71·0 (31)	122·0 (53)	29·0 (13)	61·0 (27)	23·0 (10)	43·9	26*
HMS 15360/1	—	65·8	—	—	33·0	61·0	23·0	39·4	—
HMS 15360/2	—	65·2	51·0	—	33·0	57·0	22·0	38·7	—
Call.J473	*c.* 164	44·0 (27)	—	*c.* 79·0 (48)	21·0 (13)	39·0 (24)	14·0 (9)	41·5	*c.* 25
HMS 26360/1	*c.* 263	79·0 (30)	85·0 (32)	123·0 (47)	39·0 (15)	78·0 (30)	23·0 (9)	31·5	*c.* 24*
HMS 26361/1	*c.* 192	43·0 (22)	*c.* 32·0 (17)	*c.* 111·0 (58)	28·0 (19)	37·0 (19)	16·0 (8)	47·6	27
HMS 26362/1	192	48·0 (25)	56·0 (29)	103·0 (54)	29·0 (15)	46·0 (24)	14·0 (7)	44·0	29*
HMS 26362/2	235	57·0 (24)	—	127·0 (54)	25·0 (11)	*c.* 45·0 (19)	18·0 (8)	34·5	31*
HMS 26362/3	173	49·6 (29)	40·2 (23)	86·7 (50)	22·0 (13)	41·0 (24)	17·0 (10)	40·5	25
SMJ 57728	115	31·6 (27)	—	56·4 (49)	15·0 (13)	34·0 (30)	11·0 (10)	38·7	*c.* 26
SMJ 57735	*c.* 275	54·0 (20)	*c.* 60·0 (22)	*c.* 160 (58)	32·0 (12)	54·0 (20)	25·0 (9)	41·8	*c.* 32

EXPLANATION OF PLATE 41

Figs. 1, 2, *Stephanoceras* (*Stephanoceras*) aff. *brodiaei* (J. Sowerby); Call.J77, Humphriesianum Zone, loose block of Upper Sandstones, Rudha Sughar, Bearreraig, Trotternish, Skye. ×1. 3, *Stephanoceras* (*Stephanoceras*) aff. *nodosum* (Quenstedt) and aff. *macrum* (Quenstedt); HMS 15359/2, Humphriesianum Zone, basal bed of Upper Sandstones, Torvaig, Trotternish, Skye. ×0·72.

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Spec. no. HMS 15359/1:

Tn.	26	23	22	22	21	19	18	17	16
Ud.	130	98	72	54	38	29	20	14	12

Spec. no. HMS 26360/1:

Tn.	*c.* 24	—	—	—	23	22	21	21	19
Ud.	123	—	—	—	35	25	18	13	*c.* 10

Spec. no. HMS 26362/1:

Tn.	29	28	27	25				
Ud.	103	86	50·4	36·6				

Spec. no. HMS 26362/2:

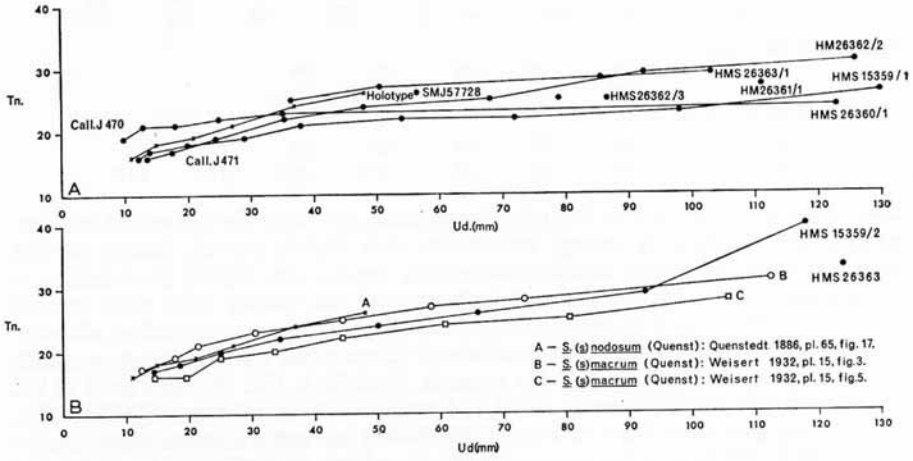
Tn.	31	29	25	24	22	19	17	16
Ud.	126	92·2	68	48	35·3	24·5	17·2	13·0

Description. Evolute; large strong tubercles situated just below the mid-whorl position; primary ribs moderately strong, rursiradiate and slightly curved, fading towards umbilical seam; secondary ribs also moderately strong, very slightly prorsiradiate or rectiradiate, practically straight, and uninterrupted on venter; from each tubercle there are normally three secondary ribs, sometimes with an extra secondary rib intercalated between the tubercles. The number of tubercles per whorl increases gradually with increasing size (text-fig. 3A), for example, from 16 at Ud. 13·0 mm to 31 at Ud. 126 mm in HMS 26362/2, from 16 at Ud. 12·0 mm to 26 at Ud. 130 mm in HMS 15359/1. Three of the specimens show sutures: HMS 26360/1 has half a whorl of body chamber preserved; HMS 15359/1 has approximately two-thirds of a whorl of body chamber and begins to show an increase in the relative umbilical diameter, but is also incomplete; HMS 26362/1 is complete, having the peristome partially preserved, and shows just over three-quarters of a whorl of body chamber. There is an increase in the relative umbilical diameter in just over the last half-whorl, and modification of the ornament in the last eighth-whorl associated with which there is a slight constriction followed by an expansion of the whorl, then a second constriction and a further expansion to the peristome.

Discussion. The style of the ornament of these specimens is typical of the *macrum* group. The typical species, however, *S.* (*S.*) *macrum* (Quenstedt), *S.* (*S.*) *freycineti* (Bayle), and *S.* (*S.*) *leptogyrale* (Buckman) are more evolute and have more numerous tubercles per whorl. The specimens are closest to *S.* (*S.*) *nodosum* (Quenstedt), which has a relatively narrower umbilicus than the other species but similar style of ornament. There are specimens intermediate between *nodosum* and *macrum* (see below).

The holotype of *S.* (*S.*) *nodosum* (Quenstedt) come from the Dogger δ of Swabia (Quenstedt 1886, p. 532), while Weisert (1932, p. 185) indicated lower and middle Dogger (Giganteus-Thone and untere Humphriesi-Schichten). It was interpreted as coming from the Sauzei Subzone by Roché (1939, p. 187), but Hahn (1966) includes both beds in the Humphriesianum Zone. It would appear that *S.* (*S.*) *nodosum* (Quenst.) may be younger than *S.* (*S.*) *macrum* (Quenst.) (cf. Weisert 1932, p. 185), which is recorded mainly from the Sauzei Subzone (e.g. Westermann 1967, p. 105). Pavia and Sturani (1968, pp. 311–12) record *S.* (*S.*) *nodosum* (Quenst.) from the Sauzei Subzone and lower part of the Humphriesianum Zone in the Basses-Alpes.

Localities. Humphriesianum Zone; (1) HMS 15359/1, 3 from the basal bed of the Upper Sandstones, Torvaig; (2) HMS 15360/1–2, HMS 26360/1–2, HMS 26361/1–2, SMJ 57728, SMJ 57735, and Call. J473–4 from loose blocks of the Upper Sandstones, Rudha Sughar, Bearreraig; (3) HMS 26362/1–3 from the lower part of the Upper Sandstones, shore just south of Rigg waterfall. All localities are in Trotternish, Skye.



TEXT-FIG. 3. Number of tubercles per whorl (Tn.) plotted against diameter of umbilicus (Ud.) for *Stephanoceras* (*Stephanoceras*) *nodosum* (Quenstedt) and *Stephanoceras* (*Normannites*) ? *orbignyi* (Buckman) (A), and *S.* (*S.*) aff. *nodosum* and aff. *macrum* (Quenstedt) (B). Data from figured specimens of *S.* (*S.*) *nodosum* and *S.* (*S.*) *macrum* are also shown for comparison.

Stephanoceras (*Stephanoceras*) aff. *nodosum* (Quenstedt) and aff. *macrum* (Quenstedt)

Plate 41, fig. 3

aff.

1886 *Ammonites Humphriesianus macer* Quenstedt, p. 528, pl. 65, fig. 11 (non fig. 10).
Ammonites Humphriesianus nodosus Quenstedt, p. 532, pl. 65, fig. 17.

EXPLANATION OF PLATE 42

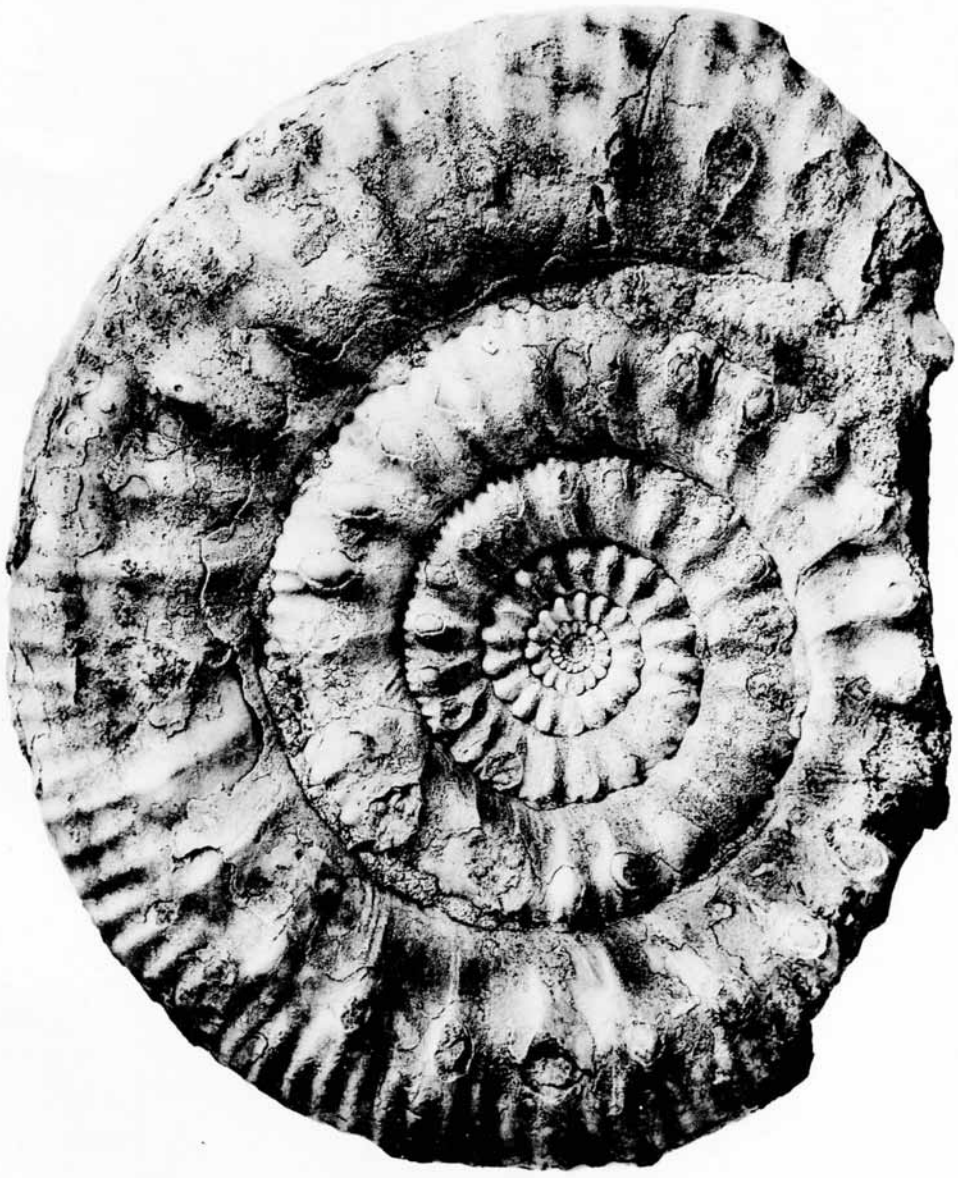
Fig. 1. *Stephanoceras* (*Stephanoceras*) *nodosum* (Quenstedt); HMS 15359/1, Humphriesianum Zone, basal bed of Upper Sandstones, Torvaig, Trotternish, Skye. ×0·82.

EXPLANATION OF PLATE 43

Fig. 1. *Stephanoceras* (*Stephanoceras*) *nodosum* (Quenstedt); HMS 26362/1, Humphriesianum Zone, lower part of Upper Sandstones, shore just south of Rigg waterfall, Trotternish, Skye. ×0·88.

EXPLANATION OF PLATE 44

Fig. 1. *Stephanoceras* (*Stephanoceras*) *nodosum* (Quenstedt); HMS 15359/1, ventral view of Plate 42, fig. 1. ×1·0. 2. *Stephanoceras* (*Stephanoceras*) *nodosum* (Quenstedt); HMS 26362/1, ventral view of Plate 43, fig. 1. ×1·0.



MORTON, Bajocian ammonites

MORTON, Bajocian ammonites

1 2

MORTON, Bajocian ammonites

Material. Two specimens—HMS 15359/2; HMS 26363.

Dimensions.	*D.*	*Wh.*	*Wb.*	*Ud.*	*Pl.*	*Sl.*	*Td.*	*Tp.*	*Tn.*
HMS 15359/2	*c.* 195	48·1 (25)	53·0 (27)	*c.* 118 (61)	24·0 (12)	43·0 (22)	12·0 (6)	38·3	*c.* 40*
HMS 26363	244	52·0 (21)	*c.* 65·0 (27)	*c.* 148 (61)	30·0 (12)	53·0 (22)	19·0 (8)	38·9	35*

Spec. no. HMS 15359/2:

Tn.	*c.* 40	*c.* 29	26	24	22	20	18	17
Ud.	*c.* 118	92·5	66·2	50·0	34·4	25·0	18·7	14·4

Spec. no. HMS 26363:

Tn.	35	33
Ud.	*c.* 148	124

Discussion. The two specimens are very similar to the specimens described above as *S.* (*S.*) *nodosum* (Quenstedt) especially in style of ornament, for example the number of tubercles per whorl (text-fig. 3B). They differ only in the relative size of the umbilicus, which is just over 60% of the diameter compared with 48–58%. Previously figured specimens of *nodosum* have relative Ud. 51·6 (holotype, Quenstedt 1886, pl. 65, fig. 17) and 52·4 (Weisert 1932, p. 15, fig. 1), while specimens of *macrum* have relative Ud. 61·7 (Weisert 1932, p. 15, fig. 3), 62·1 (Weisert 1932, pl. 15, fig. 5), and 66 (Buckman 1921, pl. 248). There is, however, obviously every gradation between these two species as indicated by these specimens and the specimens described above under *S.* (*S.*) *nodosum* (Quenstedt). (See also Weisert 1932, p. 138.)

Localities. Humphriesianum Zone; HMS 15359/2 from basal bed of Upper Sandstones, Torvaig; HMS 26363 from loose block of Upper Sandstones, Rudha Sughar, Bearreraig, Trotternish, Skye.

Stephanoceras (*Stephanoceras*) aff. *triplex* Weisert

Plate 46, figs. 1, 2; Plate 47, figs. 1, 2

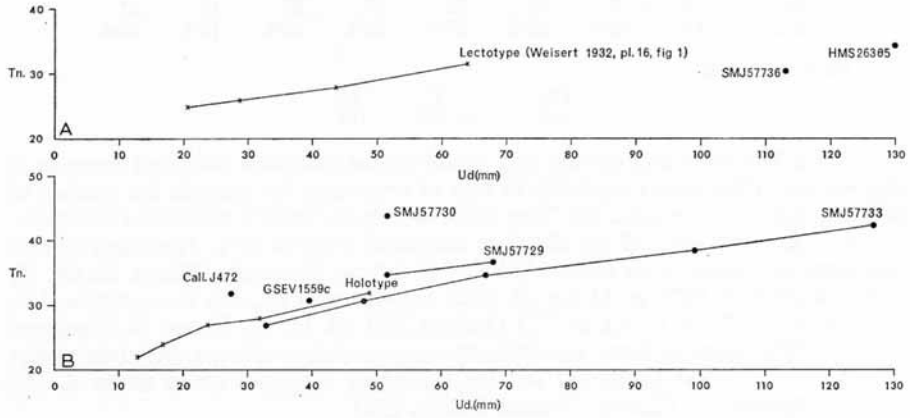
1932 *Stephanoceras triplex* Mascke emend. Weisert; Weisert, pp. 152–3, pl. 16, fig. 1.
1939 *Cadomites triplex* Mascke; Roché, p. 195.

Material. Six specimens, rather fragmentary—HMS 15358/2; HMS 26364; HMS 26365; HMS 26366; HMS 26367; SMJ 57736.

Dimensions.	*D.*	*Wh.*	*Wb.*	*Ud.*	*Pl.*	*Sl.*	*Td.*	*Tp.*	*Tn.*
HMS 26365	*c.* 234	59·0 (25)	28·4 (12)	*c.* 130 (56)	22·0 (9)	50·0 (21)	13·0 (6)	27·9	*c.* 45
SMJ 57736	*c.* 228	61·0 (27)	*c.* 38·0 (17)	*c.* 113 (50)	25·0 (11)	57·0 (25)	16·0 (7)	28·8	*c.* 31

Description. Evolute; tubercles situated well below the mid-whorl position, small and not very prominent compared with the ribbing; primary ribs very strong, rursiradiate, slightly curved. especially near umbilical seam; secondary ribs very strong, slightly prorsiradiate to rectiradiate with slight backwards curvature over the venter; from each tubercle there are generally two secondary ribs, sometimes three and rarely one,

with one extra secondary rib intercalated between the tubercles. The number of tubercles per whorl is *c.* 31 at Ud. *c.* 113 mm in SMJ 57736 and *c.* 45 at Ud. *c.* 130 mm in HMS 26365. It is rather difficult to compare these approximate figures with those for the much smaller specimen figured by Weisert (text-fig. 4A). None of the specimens shows sutures.



TEXT-FIG. 4. Number of tubercles per whorl (Tn.) plotted against diameter of umbilicus (Ud.) for *Stephanoceras* (*Stephanoceras*) aff. *triplex* Weisert (A), and *S.* (*S.*) *pyritosum* (Quenstedt) (B).

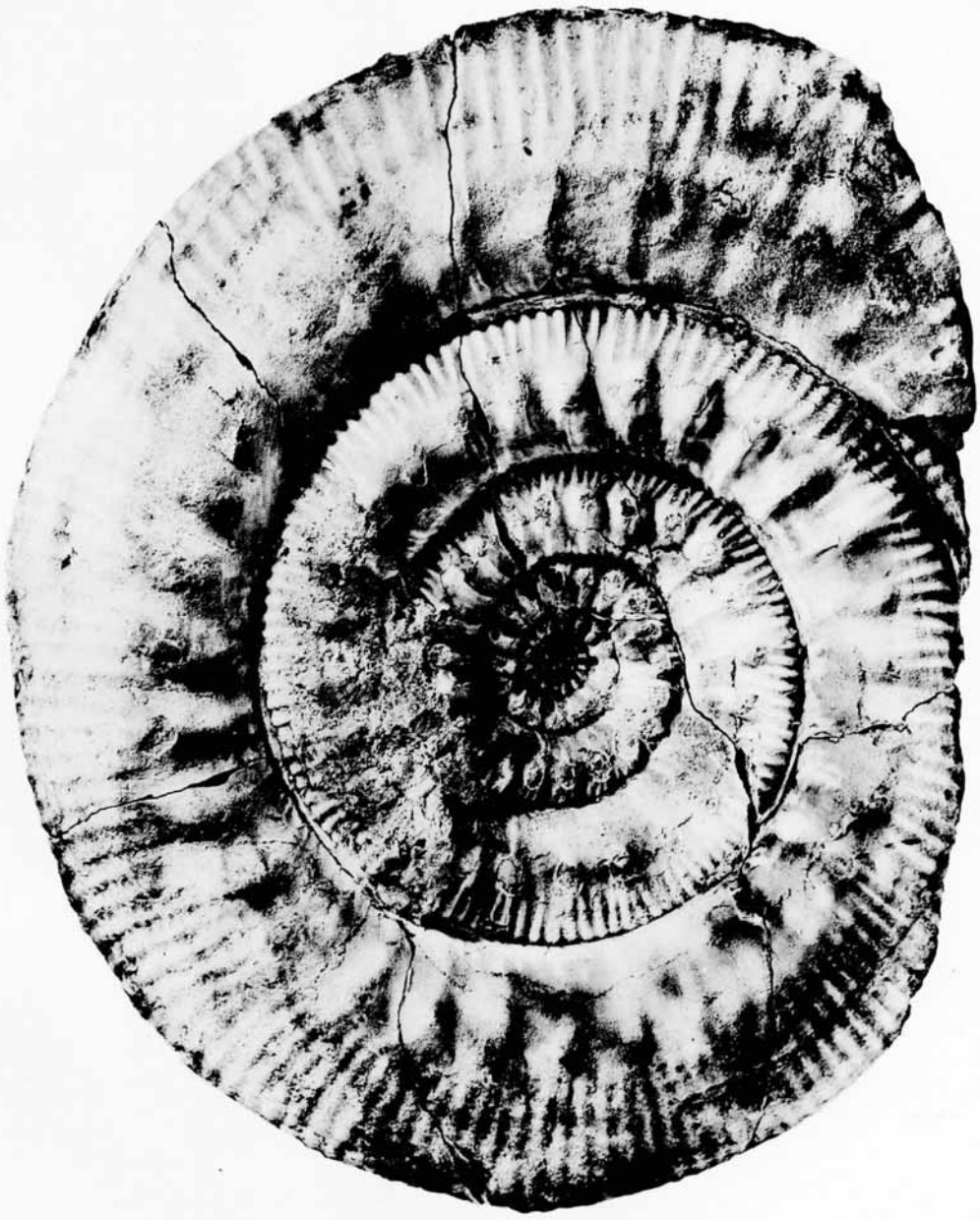
Discussion. The strong ribbing associated with the comparatively insignificant tubercles is typical of species like *zieteni*, and the specimens may be related to this species. *S.* (*S.*) *zieteni* (Quenst.) and *S.* (*S.*) *kalus* (Buck.) are both more evolute and have more numerous tubercles per whorl, while *S.* (*S.*) *subzieteni* Schmidtill and Krumbeck is more evolute. The specimens are most similar to *S.* (*S.*) *triplex* Weisert, but they differ from this and the other species in having the tubercles situated relatively lower on the whorl sides. This, however, may be an apparent effect due to partial crushing.

According to Weisert (1932, p. 185) the species *S.* (*S.*) *triplex* comes from the upper Humphriesi-Schichten, middle Dogger δ of Swabia, i.e. Humphriesianum Zone.

Localities. Humphriesianum Zone; HMS 15358/2 from approx. 30 m. above base of Upper Sandstones, pipeline cutting at Bearreraig; HMS 26364 and SMJ 57736 from loose blocks of the Upper Sandstones, Rudha Sughar, Bearreraig; HMS 26366, HMS 26365, and HMS 26367 from the lower part of Upper Sandstones, shore just north of Rigg waterfall, Trotternish, Skye.

EXPLANATION OF PLATE 45

Fig. 1. *Stephanoceras* (*Stephanoceras*) *nodosum* (Quenstedt); HMS 26362/2, Humphriesianum Zone, lower part of Upper Sandstones, shore just south of Rigg waterfall, Trotternish, Skye. ×0·79.



MORTON, Bajocian ammonites

Stephanoceras (*Stephanoceras*) *pyritosum* (Quenstedt)

Plate 47, figs. 3, 4; Plates 48, 49; Plate 50, figs. 1, 2

1886 *Ammonites Humphriesianus pyritosus* Quenstedt, pp. 536–7, pl. 66, fig. 4.
1934 *Stepheoceras* (*Normannites*) *pyritosum* Quenstedt; Kakhadzé, p. 134, pl. 5, fig. 1.
?1938 *Stephanoceras* aff. *pyritosum* Quenstedt; Schmidtill and Krumbeck, p. 337, pl. 14, fig. 10.
1951 *Stephanoceras pyritosum* Quenstedt; Maubeuge, p. 56, pl. 11, fig. 2.

Material. Five specimens—HMS 15357; SMJ 57729; SMJ 57730; SMJ 57733; GSEV 1559*c*; Call.J472.

Dimensions.	*D.*	*Wh.*	*Wb.*	*Ud.*	*Pl.*	*Sl.*	*Td.*	*Tp.*	*Tn.*
SMJ 57729	154	47·0 (31)	—	68·0 (44)	14·0 (9)	*c.* 45·0 (9)	8·0 (5)	28·6	37*
SMJ 57730	124	41·5 (33)	22·3 (18)	51·6 (42)	4·0 (11)	38·0 (31)	5·5 (4)	26·8	44
SMJ 57733	248	66·0 (27)	70·0 (28)	127·0 (51)	35·0 (14)	70·0 (28)	13·0 (5)	30·8	43*
GSEV 1559*c*	93·0	32·4 (35)	25·8 (28)	39·7 (43)	12·0 (13)	*c.* 29·0 (31)	6·0 (6)	29·0	31
Call.J472	74·3	29·7 (40)	23·0 (31)	27·3 (37)	13·5 (18)	26·0 (35)	5·0 (7)	39·3	32

Spec. no. SMJ 57729:

Tn.	37	35	
Ud.	68·0	51·7	

Spec. no. SMJ 57733:

Tn.	43	39	35	31	27
Ud.	127	99	67	48	33

Description. Evolute; small, not very prominent tubercles situated well below the mid-whorl position; primary ribs strong, becoming sharp in some, slightly rursiradiate, with pronounced forward curvature towards umbilical seam, fading only at umbilical shoulder and usually almost reaching umbilical seam; secondary ribs close, moderately strong, sharp, slightly prorsiradiate but curving backwards to become approximately rectiradiate on venter; from each tubercle there are two, sometimes three secondary ribs, with one extra secondary rib intercalated between the tubercles. The number of tubercles per whorl increases from 27 at Ud. 33 mm to 43 at Ud. 127 mm in SMJ 57733, and this and the other specimens are comparable with the type (Quenstedt, pl. 66, fig. 4), with the exception of SMJ 57730 which, although the style of the ornament is similar, has a relatively greater number of tubercles per whorl than the other specimens (text-fig. 4B). Only SMJ 57733 shows sutures and it has just over one whorl of body chamber. The peristome is partially preserved and there is an increase in the relative diameter of the umbilicus, but no modification of the ornament (cf. *S.* (*S.*) *nodosum* described above).

Discussion. The style of the ornament of the specimens is typical of species similar to *S.* (*S.*) *scalare*. A number of closely ribbed species of *Stephanoceras* have been described, particularly by Schmidtill and Krumbeck (1938) from Franconia, S. Germany, and many of these are probably synonyms. Most of these species are more finely ribbed than the Skye specimens. *S.* (*S.*) *scalare* (Mascke figd. Weisert) and *S.* (*S.*) *rhytum* (Buckman)

are similar in the style of the ornamentation but differ in having more numerous tubercles per whorl. The same appears to be the case for the fragment figured by Quenstedt as *A. H. plicatissimum*, although the specimen figured by Weisert (1932, pl. 16, fig. 5) under the same name may be more similar. The specimens from Skye are closest to *S.* (*S.*) *pyritosum* (Quenstedt), a name which appears to have been neglected by most authors.

The holotype of *S.* (*S.*) *pyritosum* (Quenstedt) comes from Dogger δ of Swabia (Quenstedt 1886, p. 536), presumably from the Humphriesianum Zone.

Localities. Humphriesianum Zone; HMS 15357 from approx. 30 m above the base of the Upper Sandstones, pipeline cutting at Bearreraig; SMJ 57729–33 and Call.J472 from loose blocks of the Upper Sandstones, Rudha Sughar, Bearreraig; GSEV 15559*c* from the lower part of the Upper Sandstones, shore just south of Rigg waterfall, Trotternish, Skye.

Microconch subgenus *Normannites* Munier-Chalmas 1892

Type species. Normannites orbignyi Buckman 1908 (ICZN Opinion 309, see Arkell 1957, p. L289).

Includes. Epalxites Mascke 1907, *Masckeites* Buckman 1920, *Parallites*, *Gerzenites*, *Germanites* Westermann 1954, *Germanoides* Westermann 1956. The status of *Itinsaites* (McLearn 1927), with synonyms *Kanastephanus* (McLearn 1929) and *Platystomites* (Westermann 1954) is less certain. It was regarded by Arkell (1957, p. L289) as a synonym of *Normannites*, but by Westermann (1964, p. 68) as the microconch of *Teloceras*.

Discussion. Apart from the differences in size and in the nature of the aperture, *Normannites* is very similar to *Stephanoceras*, but at this stage it is difficult to suggest any pairs of species.

The number of stephanoceratid microconchs which have been found in Skye is remarkably small compared with the number of macroconchs. This may be partly due to collection failure, but is probably also a reflection of the original composition of the fauna. This problem of differing macroconch: microconch ratios has been discussed by Makowski (1963) and Callomon (1963).

Stephanoceras (*Normannites*) ? *orbignyi* (S. Buckman)

Plate 51, figs. 1, 2

1845 *Ammonites Braikenridgii* d'Orbigny, pl. 135 (non Sowerby).
1927 *Normannites orbignyi* S. Buckman, pl. 734.
1939 *Normannites orbignyi* Buckman; Roché, pp. 219–20, pl. 1, figs. 3–4.
1954 *Normannites* (*Normannites*) *orbignyi* S. Buckman+subspp.; Westermann, pp. 135–52, pl. 5, figs. 3–4; pl. 6, figs. 1, 3–5; pl. 7, figs. 1–5; pl. 8, fig. 1.

Material. Two specimens and four fragments—HMS 26370/1–2; HMS 26371; Call.J469; Call.J470; Call.J471.

Dimensions.	*D.*	*Wh.*	*Wb.*	*Ud.*	*Pl.*	*Sl.*	*Td.*	*Tb.*	*Tn.*
Call.J471	50·5	16·8 (33)	22·3 (44)	18·1 (36)	8·2 (16)	17·5 (35)	6·0 (12)	46·1	*c.* 18
Call.J470	20·1	6·9 (34)	12·7 (63)	8·3 (41)	3·4 (17)	7·0 (35)	2·6 (13)	42·9	*c.* 20

Description. Evolute; strong prominent tubercles situated below the mid-whorl position; primary ribs fairly strongly developed, approximately rectiradiate, only very slightly curved, fading towards umbilical seam; secondary ribs strongly developed, sharp, approximately rectiradiate and straight on venter; from each tubercle there are usually three secondary ribs with one extra secondary rib sometimes intercalated between the tubercles. Call.J471 has only the body chamber and last septum preserved, and also has large lappets. There are between two-thirds and three-quarters of a whorl of body chamber (excluding lappets), and there is no modification of the ornament near the aperture.

Discussion. The style of the ornament, particularly the strong tubercles and secondary ribbing, is very similar to that of *S.* (*N.*) *orbignyi* (Buckman), but the specimens are not sufficiently well preserved to allow a definite identification with that species.

Comparison with the macroconch species from Skye described above shows the specimens to be very similar to *S.* (*S.*) *nodosum* (Quenstedt), not only in general style of ornament but also in number of tubercles per whorl at comparable sizes (expressed as Ud.) (text-fig. 3A).

S. (*N.*) *orbignyi* (Buckman) comes from the Humphriesianum Zone (*Epalxites* hemera) in Dorset (Buckman 1927).

Localities. Humphriesianum Zone; Call.J469–71 from loose blocks of the Upper Sandstones, Rudha Sughar, Bearreraig, one specimen showing a distinctive purplish colour (see p. 76); HMS 26370/1–2 from lower part of Upper Sandstones, shore north of Rigg waterfall; HMS 26371 from lower part of Upper Sandstones, Leac Treshnish, Trotternish, Skye.

Stephanoceras (*Normannites*) ?*densum* (S. Buckman)

Plate 51, fig. 3

1920 *Masckeites densus* S. Buckman, pl. 152.
1954 *Masckeites densus* Buckman; Westermann, pp. 332–4.

Material. Two poorly preserved specimens, one fragment, mostly at least partly distorted—HMS 26372/1–2; HMS 26373.

Dimensions.	*D.*	*Wh.*	*Wb.*	*Ud.*	*Pl.*	*Sl.*	*Td.*	*Tp.*	*Tn.*
HMS 26372/1									
max.	56·5	20·9 (37)	31·4 (56)	20·4 (36)	6·3 (11)	*c.* 18·6 (35)	*c.* 4·0 (7)	—	*c.* 23
min.	22·8	9·1 (40)	—	8·7 (38)					
HMS 267373	26·5	11·0 (42)	—	10·0 (38)	3·2 (12)	*c.* 8·0 (30)	*c.* 2·0 (8)	34·5	30

Description. Evolute; tubercles weakly developed, situated well below mid-whorl position (allowance being made for distortion); primary ribs prorsiradiate, curving to become approximately rectiradiate towards umbilical margin and also fading slightly in that direction; secondary ribs close and sharp, also not strongly developed, approximately rectiradiate and only very slightly curved on venter; from each tubercle there

are either two or three secondary ribs, often with an extra secondary rib intercalated between the tubercles. None of the specimens is complete or shows sutures.

Discussion. The style of the ornament in the specimens is much finer than in the previous species, and is very similar to that of Buckman's Type Ammonites species *Masckeites densus*. However, the specimens are not sufficiently well preserved to allow definite identification with that species. When compared with the macroconch species from Skye the specimens are perhaps most similar to *S.* (*S.*) *pyritosum* (Quenstedt).

The holotype of *S.* (*N.*) *densum* (Buckman) was figured by Buckman (1920) as from 'Bajocian post-*sauzei*/*Masckeites*/', i.e. Humphriesianum Zone, of Dorset.

Locality. Humphriesianum Zone; lower part of Upper Sandstones, shore just south of Rigg waterfall, Trotternish, Skye.

Genus TELOCERAS Mascke 1907

Macroconch subgenus *Teloceras* Mascke 1907

Type species. Ammonites Blagdeni J. Sowerby 1818, original designation by Mascke (1907, p. 23).

Includes. Blagdenia Roché 1939 (objective synonym).

Discussion. In Skye, only one specimen of *Teloceras* has been found, at Bearreraig, but this may be due to the inaccessibility of the outcrops rather than to any other factors.

According to Westermann (1964, p. 68) the microconch of *Teloceras* is *Itinsaites* (McLearn 1927), with synonyms *Kanastephanus* (McLearn 1929) and *Platystomites* (Westermann 1954).

Teloceras (*Teloceras*) *blagdeni* (J. Sowerby)

Plate 50, fig. 3

1818 *Ammonites Blagdeni* J. Sowerby, p. 231, pl. 201.
1908 *Ammonites Blagdeni* J. Sowerby; Buckman and Secretary, pl. 2; pl. 3, fig. 1.
1932 *Teloceras Blagdeni* Sowerby sp. emend. Weisert; Weisert, pp. 168–72, pl. 18, fig. 2.
1937 *Cadomites Blagdeni* Sowerby (non d'Orbigny); Gillet, p. 83, pl. 5, figs. 9–9*a*.
1939 *Cadomites Blagdeni* Sowerby; Roché, pp. 213–14.
1943 *Cadomites Blagdeni* Sowerby; Roché, pp. 17–18.
1957 *Teloceras blagdeni* (Sowerby); Arkell, fig. 342: 5*a–b*.

Material. One highly distorted specimen—HMS 26374.

Dimensions.	*D.*	*Wh.*	*Wb.*	*Ud.*	*Pl.*	*Sl.*	*Td.*	*Tn.*
max.	*c.* 250	*c.* 70 (28)	*c.* 150 (60)	125 (50)	35 (14)	*c.* 85 (34)	12 (5)	*c.* 13/½ wh.
HMS 26374 min.	*c.* 70	23 (33)	135 (193)	33 (47)				

The relative Wh. and Ud. closely approximate the original dimensions.

Description. Evolute; whorl section trapezohedral, width much greater than height; large tubercles situated at the angle between the whorl sides and the broad almost flat

venter; primary ribs broad and blunt, slightly rursiradiate, straight, fading towards umbilical seam; from each tubercle there are normally three secondary ribs which curve backwards slightly across the venter.

Discussion. In a comparison of the specimen with described species allowance must be made for the distortion, however, in the relative size of the umbilicus, style of ornamentation, and number of tubercles per whorl the specimen is very similar to *T.* (*T.*) *blagdeni* (J. Sowerby). This species is typical of the upper part of the Humphriesianum Zone, the Blagdeni Subzone (e.g. Westermann 1967, pp. 149–50).

Locality. Humphriesianum Zone, Blagdeni Subzone; 34 m above base of Upper Sandstones, pipeline cutting, Bearreraig, Trotternish, Skye.

Subfamily SPHAEROCERATINAE Buckman 1920

Mainly involute sphaerocones, some with occluded umbilicus, but with the last whorl contracted so that the umbilicus becomes more open. In some the coiling is elliptical. The Sphaeroceratinae are similar to the Stephanoceratinae in having generally sharp ribbing differentiated into primary and secondary ribs which pass over the venter, but rarely are tubercles developed at the point of furcation. There is marked dimorphism, but the microconchs differ from the macroconchs mainly in size, both having a collared and lipped aperture.

The arrangement of the genera in the Sphaeroceratinae by Arkell (1957) was modified by Westermann (1964) to take account of sexual dimorphism. In the taxonomic arrangement of Westermann the dimorphism varies from being infraspecific to subgeneric distinction of the dimorphs.

Genus CHONDROCERAS Mascke 1907

Type species. Ammonites gervillii J. Sowerby 1817, original designation by Mascke 1907, p. 24.

Includes. Defonticeras, *Saxitoniceras* McLearn 1927, *Schmidtoceras* Westermann 1956*b*, ? *Praetulites* Westermann 1956*a*.

Discussion. The most extensive discussion of *Chondroceras* is by Westermann (1956*b*), which was published after the *Treatise* (Arkell 1957) was in press (see also Arkell 1957*a*). Westermann (1956*b* and 1964) recognized as subgenera of *Chondroceras Chondroceras* (s.s.), and also *Defonticeras* and *Saxitoniceras* created by McLearn (1927) for Canadian species, and two new subgenera *Schmidtoceras* and *Praetulites* (Westermann 1956*a*). With the possible exception of *Praetulites* the differences between these subgenera and *Chondroceras* (s.s.) are not sufficient to justify their separation (see also Arkell 1957; Imlay 1964, 1967).

According to Westermann (1964, p. 54) dimorphism within the genus *Chondroceras* can be regarded, from the taxonomic point of view, as infraspecific.

Chondroceras evolvescens (Waagen)

Plate 51, figs. 4–7

1867 *Ammonites evolvescens*, Waagen, p. 604, pl. 1, fig. 7.
1923 *Chondroceras wrighti* Buckman, pl. 415.
1956*b* *Chondroceras* (*Chondroceras*) *evolvescens* (Waagen); Westermann, pp. 55–8, pl. 1, figs. 7–8; pl. 2, figs. 1–2.
1956*b* *Chondroceras* (*Chondroceras*) *wrighti* Buckman with subspp. *wrighti* and *minor* n. subspp.; Westermann, pp. 58–61, pl. 2, figs. 3–4; pl. 3, figs. 1–3.
1964 *Chondroceras* (*Chondroceras*) *evolvescens* (Waagen); Westermann, p. 54.

Material. Two specimens—HMS 26375 and GSEV 1539*c*—and one doubtful specimen—HMS 15363

Dimensions.	*D.*	*Wh.*	*Wb.*	*Ud.*	*Pl.*	*Sl.*	*Pd.*	*Pn.*
HMS 26375	40·0	17·7 (44)	17·4 (44)	10·7 (27)	7·5 (19)	16·2 (41)	2·6 (7)	30/1 Wh.
GSEV 1539*c*	33·2	*c.* 13·8 (42)	—	9·3 (28)	—	—	—	16/½ Wh.
HMS 15363	29·6	12·0 (41)	—	8·1 (28)	—	—	—	—

Description. Involute; body chamber contracts slightly near the aperture so that there is a slight increase in the relative size of the umbilicus; umbilical edge fairly sharp, becoming vertical; venter broad and rounded; ribbing moderately sharp, close (30 primary ribs in the last whorl); primary ribs prorsiradiate, curving forwards slightly towards middle of whorl sides, fading towards umbilical seam, mostly trifurcate but some bifurcate; secondary ribs close, not strongly developed, prorsiradiate but curving backwards slightly across the venter; body chamber approximately one whorl, aperture (partially visible on HMS 26375) contracted and collared.

Discussion. In the relative size of the umbilicus and the style of the ribbing the specimens are similar to *C. gervillii* (Sowerby), *C. evolvescens* (Waagen) and *C. wrighti* Buckman.

EXPLANATION OF PLATE 46

Figs. 1, 2. *Stephanoceras* (*Stephanoceras*) aff. *triplex* Weisert; SMJ 57736, Humphriesianum Zone, loose block of Upper Sandstones, Rudha Sughar, Trotternish, Skye. ×1·0.

EXPLANATION OF PLATE 47

All figures natural size.

Figs. 1, 2. *Stephanoceras* (*Stephanoceras*) aff. *triplex* Weisert; HMS 26365, Humphriesianum Zone, lower part of Upper Sandstones, shore just north of Rigg waterfall, Trotternish, Skye. 3, 4. *Stephanoceras* (*Stephanoceras*) *pyritosum* (Quenstedt); Call.J472, Humphriesianum Zone, loose block of Upper Sandstones, Rudha Sughar, Bearreraig, Trotternish, Skye.

EXPLANATION OF PLATE 48

Fig. 1. *Stephanoceras* (*Stephanoceras*) *pyritosum* (Quenstedt); SMJ 57733, Humphriesianum Zone, loose block of Upper Sandstones, Rudha Sughar, Bearreraig, Trotternish, Skye. ×0·82.

EXPLANATION OF PLATE 49

Fig. 1. *Stephanoceras* (*Stephanoceras*) *pyritosum* (Quenstedt); SMJ 57729, Humphriesianum Zone, loose block of Upper Sandstones, Rudha Sughar, Bearreraig, Trotternish, Skye. ×1·0.

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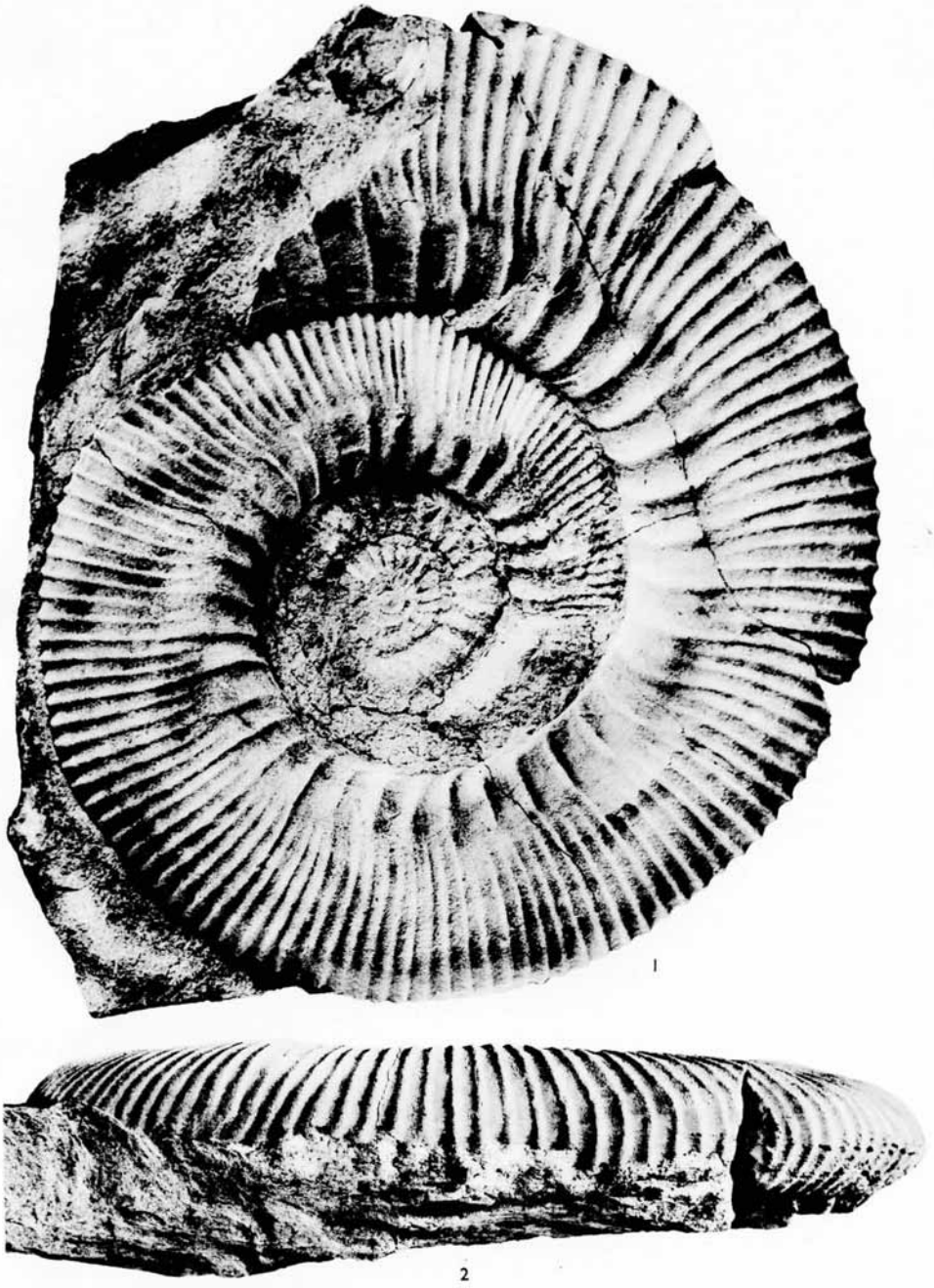
MORTON, Bajocian ammonites



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Other species differ in one or both of these characters. *C. gervillii* (Sowerby), however, has slightly closer ribbing (34–40 in the last whorl compared with 30 in HMS 26375). *C. wrighti* Buckman is very similar to *C. evolvescens* (Waagen) and is almost certainly a junior synonym (see also Westermann 1964, p. 54), and the specimens from Skye compare very closely with *C. evolvescens* (Waagen) (holotype figured by Westermann 1956*b*, pl. 1, figs. 1 *a–c*). The species comes from the Humphriesianum Zone (Buckman 1923; Pavia and Sturani 1968, p. 312; Westermann 1956*b*, 1964).

Localities. Humphriesianum Zone; HMS 26375 and GSEV 1539*e* are from the lower part of the Upper Sandstones, shore below Rigg; HMS 15363 from basal bed of Upper Sandstones at Torvaig, Trotternish, Skye.

Superfamily PERISPHINCTACEAE Steinmann 1890

The Perisphinctaceae are discussed by Arkell (1957), and other authors; those of the Upper Bajocian and Bathonian by Arkell (1951–9), Sturani (1967), Wendt (1964) and others. In Skye and Raasay, Bajocian Perisphinctaceae are found only in the Garantiana Clay, which is exposed in a few localities mostly difficult of access. Preservation is poor, the ammonites having been crushed in a clay and none have so far been found in the calcareous nodules which sometimes occur.

Family PARKINSONIIDAE Buckman 1920

The Parkinsoniidae are characterized by sharp ribbing, interrupted on the venter by a smooth band or groove. The arrangement of genera by Arkell (1957) will have to be revised to take account of dimorphism. For present purposes the pairing of *Garantiana* (s. l.) as macroconch with *Strenoceras* and *Pseudogarantiana* as microconchs is suggested (Torrens, *in litt.*, Jan. 1970).

Genus GARANTIANA Mascke 1907

Macroconch subgenus *Garantiana* Mascke 1907

Type species. Ammonites Garantianus d'Orbigny 1846, ICZN Opinion 324, see Arkell (1957, p. L308).

Includes. Garantia Rollier 1911 (obj.), *Baculatoceras* Mascke 1907, *Odontolkites* Buckman 1925.

Discussion. The main discussions of the genus *Garantiana* are by Bentz (1924, 1928) and Spath (1928). The subgenera recognized by Bentz were mostly accepted by Arkell (1957, pp. L308–9): *Garantiana* (*Hlawiceras*) Buckman 1921 (synonym *Subgarantiana* Bentz 1928) differing from *Garantiana* s.s. in having the secondary ribs projected ventrally; *Garantiana* (*Orthogarantiana*) Bentz 1928 having lateral but not ventral tubercles.

Garantiana (*Garantiana*) ? *baculata* (Quenstedt)

Plate 51, figs. 8, 9, 11, 12

1858 *Ammonites baculatus* Quenstedt, p. 402, pl. 72, fig. 1.
1886 *Ammonites baculatus* Quenstedt, pp. 574–5, pl. 70, figs. 7, 9–10.
1924 *Garantia baculata* (Quenst.); Bentz, pp. 154–5, pl. 4, fig. 13.
1925 *Baculatoceras baculatum* (Quenst.); Buckman, pl. 581.
1928 *Garantiana* (*Garantiana*) *baculata* (Quenst.); Bentz, pp. 177–9.

Material. Four specimens, mostly fragmentary and not well preserved—GSE 2889; GSE 2921–2 (impressions of opposite sides of same fragment); HMS 26376/1–2.

Dimensions.	*D.*	*Wh.*	*Wb.*	*Ud.*	*Pl.*	*Sl.*	*Pn.*	*Sn.*	*Pd.*
GSE 2889	—	10·9	—	—	6·2	5·9	9/¼ wh.	16/¼ wh.	—
GSE 2921–2	—	11·8	—	—	approx. equal		*c.* 10/¼ wh.	—	—
HMS 26376/1*	*c.* 28·0	10·8 (39)	—	9·0 (32)	—	—	27/1 wh.	19/¼ wh.	2·2 (8)
HMS 26376/2	—	*c.* 7·0	—	—	—	—	9/¼ wh.	—	—

* Distorted.

Description. Moderately evolute; ribbing sharp, fairly close (Pd. approx. 8% of D. at point of furcation, 27 primary ribs in last whorl); primary ribs straight, slightly prorsiradiate, curving forwards at umbilical shoulder towards umbilical seam; almost all bifurcate or have secondary ribs intercalated at about mid-whorl position; secondary ribs not straight, but curving forwards slightly towards the venter; small but prominent ventral tubercles are visible on three of the specimens, and small lateral tubercles on GSE 2889 where the shell is preserved and possibly on HMS 26376/1, but otherwise the specimens are not well enough preserved.

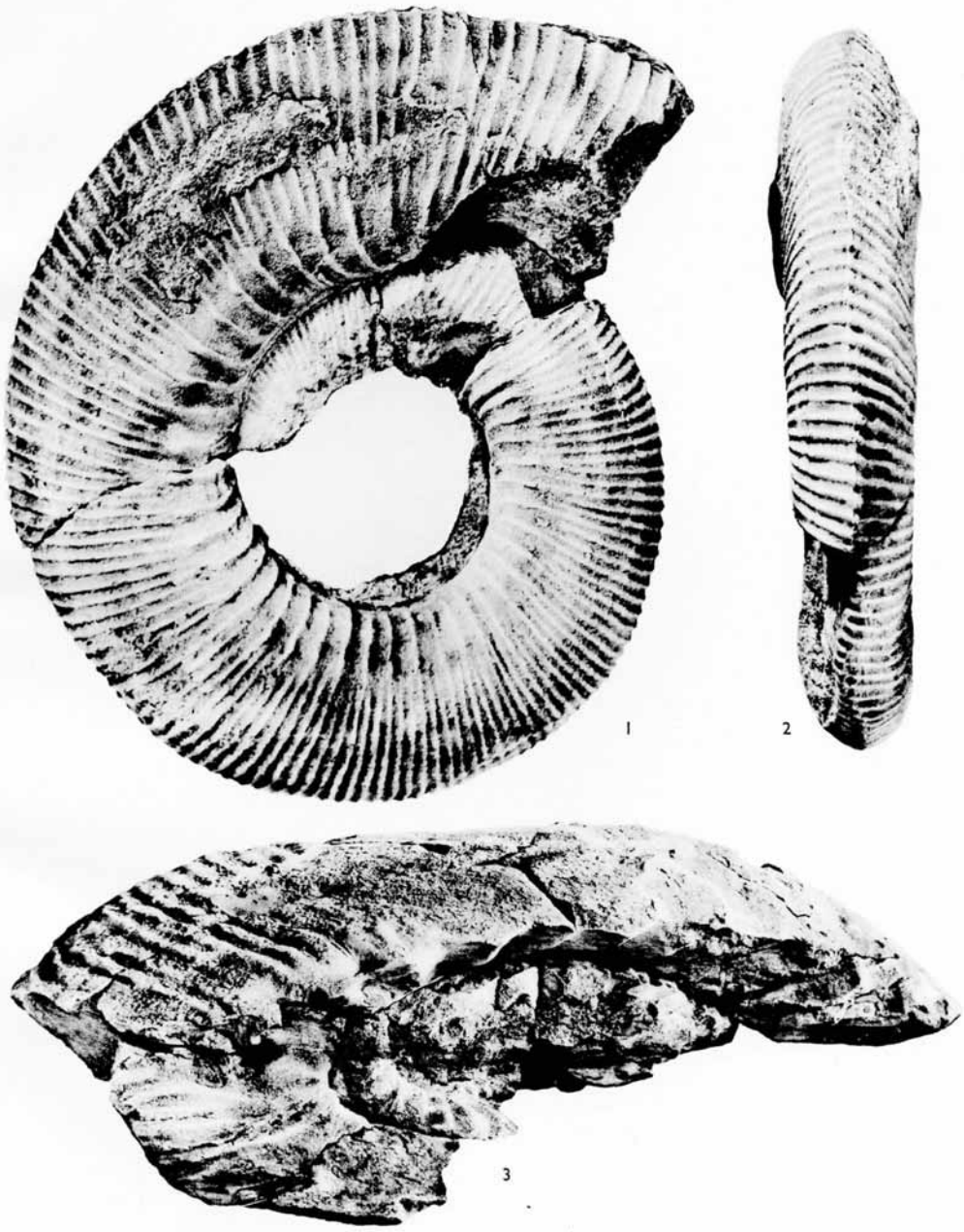
EXPLANATION OF PLATE 50

Figs. 1, 2. *Stephanoceras* (*Stephanoceras*) *pyritosum* (Quenstedt); SMJ 57730, Humphriesianum Zone, loose block of Upper Sandstones, Rudha Sughar, Bearreraig, Trotternish, Skye. ×1·0. 3. *Teloceras* (*Teloceras*) *blagdeni* (J. Sowerby); HMS 26374, Humphriesianum Zone, Blagdeni Subzone, 34 m above base of Upper Sandstones, pipeline cutting, Bearreraig, Trotternish, Skye. ×0·60.

EXPLANATION OF PLATE 51

All figures natural size.

Figs. 1, 2. *Stephanoceras* (*Normannites*) ?*orbignyi* (S. Buckman); Call.J471, Humphriesianum Zone, loose block of Upper Sandstones, Rudha Sughar, Bearreraig, Trotternish, Skye. 3. *Stephanoceras* (*Normannites*) ?*densum* (S. Buckman); HMS 26373, Humphriesianum Zone, lower part of Upper Sandstones, shore just north of Rigg waterfall, Trotternish, Skye. 4, 5. *Chondroceras evolvescens* (Waagen); HMS 26375, Humphriesianum Zone, lower part of Upper Sandstones, shore just south of Rigg waterfall, Trotternish, Skye. 6, 7. *Chondroceras evolvescens* (Waagen); GSEV 1559*c*, Humphriesianum Zone, lower part of Upper Sandstones, shore below Rigg, Trotternish, Skye. 8. *Garantiana* (*Garantiana*) ?*baculata* (Quenstedt); GSE 2889, Subfurcatum Zone, Garantiana Clay, Storab's Grave, Isle of Raasay. 9. *Garantiana* (*Garantiana*) ?*baculata* (Quenstedt); HMS 26376/1, Subfurcatum Zone, Garantiana Clay, Capach, Strathaird, Skye. 10. *Garantiana* (*Garantiana*) *filicosta* Bentz; GSE 2888, Subfurcatum Zone, Garantiana Clay, Storab's Grave, Isle of Raasay. 11, 12. *Garantiana* (*Garantiana*) ?*baculata* (Quenstedt); GSE 2921 (fig. 12) and GSE 2922 (fig. 11), Subfurcatum Zone, Garantiana Clay, Storab's Grave, Isle of Raasay. 13. *Garantiana* (*Garantiana*) *filicosta* Bentz; GSE 2928, Subfurcatum Zone, Garantiana Clay, Storab's Grave, Isle of Raasay. 14. *Garantiana* (*Garantiana*) *filicosta* Bentz; HMS 15365, Subfurcatum Zone, Garantiana Clay, cliffs above Prince Charles's Cave, Trotternish, Skye. 15. *Garantiana* (*Garantiana*) *filicosta* Bentz; GSE 2927, Subfurcatum Zone, Garantiana Clay, Storab's Grave, Isle of Raasay. 16, 17. *Garantiana* (*Garantiana*) sp.; GSE 2929 (fig. 16) and GSE 2930 (fig. 17), Subfurcatum Zone, Garantiana Clay, Storab's Grave, Isle of Raasay.



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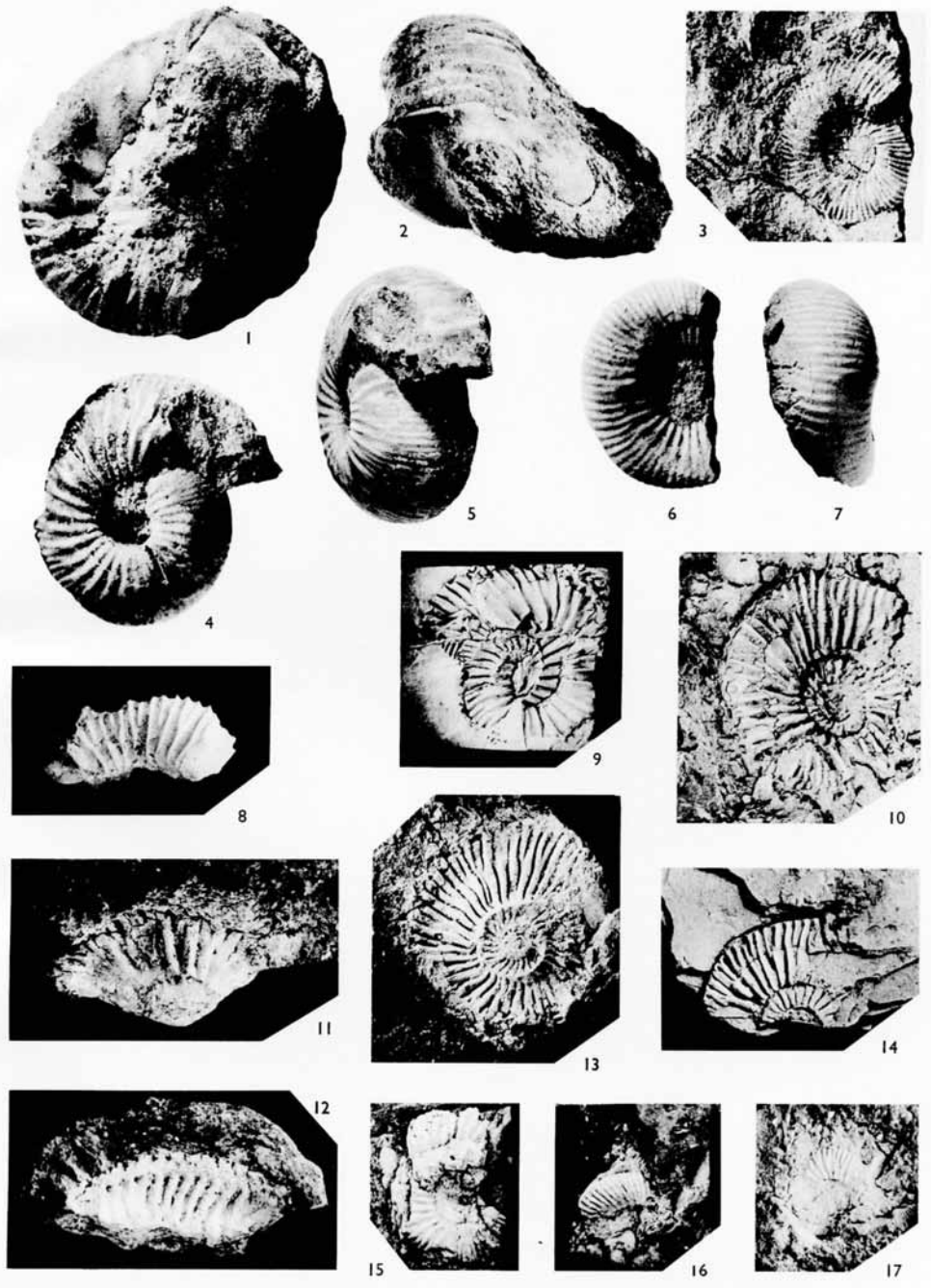

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Discussion. The presence of two rows of tubercles and the secondary ribs not being projected ventrally indicate that the specimens belong to *Garantiana* (*Garantiana*) as defined by Bentz. The number of primary ribs in the last whorl is fewer than in most species, including *garantiana* (d'Orbigny), *parkinsoni longidens* (Buckman), *filicosta* Bentz and *althoffi* Bentz. The specimens are more involute than *oligopleurum* Bentz and are most similar to *baculata* (Quenst.), but are not sufficiently well preserved for definite identification.

According to Bentz (1928, p. 179) *G.* (*G.*) *baculata* (Quenstedt) comes from the lower *Subfurcatus*-Schichten at Bielefeld, while Buckman (1925, pl. 581) figures the species from the *niortensis* hemera of Dorset. The species would therefore seem to come from the Subfurcatum Zone, and this is confirmed by Hahn (1966, p. 30) in Swabia, by Schmidtill and Krumbeck (1938, p. 300) and Westermann (1967, p. 147) in Franconia, and by Pavia and Sturani (1968, p. 314) in the Basses-Alpes.

Localities. Subfurcatum Zone; GSE 2889 and GSE 2921–2 from Garantiana Clay, Storab's Grave, Isle of Raasay; HMS 26376/1–2 from Garantiana Clay, Capach, Strathaird, Skye.

Garantiana (*Garantiana*) *filicosta* Bentz

Plate 51, figs. 10, 13–15

1928 *Garantiana* (*Garantiana*) *filicosta* n. sp., Bentz, pp. 179–80, pl. 15, fig. 4.

Material. Five specimens—GSE 2888; GSE 2927; GSE 2928; HMS 15365; HMS 26377.

Dimensions.	*D.*	*Wh.*	*Wb.*	*Ud.*	*Pl.*	*Sl.*	*Pn.*	*Sn.*	*Pd.*
GSE 2888	34·9	12·5 (36)	—	12·4 (36)	8·0 (23)	8·1 (23)	32/1 wh.	32/½ wh.	2·4 (7)
GSE 2927	24·6	9·5 (39)	—	9·1 (37)	—	—	*c.* 16/½ wh.	—	—
GSE 2928	31·3	13·1 (42)	—	11·8 (38)	6·9 (22)	6·8 (22)	34/1 wh.	21/¼ wh.	
HMS 15365	—	10·2	—	—	5·6	5·5	*c.* 10/¼ wh.	*c.* 17/¼ wh.	2·0
HMS 26377	31·8	11·6 (36)	—	12·4 (39)	5·9 (19)	5·7 (18)	18/½ wh.	17/¼ wh.	2·3 (7)

Description. Moderately evolute; ribbing sharp, close (30–35 primary ribs in last whorl); primary ribs slightly flexed and slightly prorsiradiate, most bifurcating or having secondary rib intercalated, a few remaining single; secondary ribs straight or slightly flexed, with very little projection ventrally; small prominent ventral tubercles present, and where shell is preserved on GSE 2888 small lateral tubercles are also present.

Discussion. These specimens are more closely ribbed than the previous species. The presence of lateral and ventral tubercles and the non-projected secondary ribs indicate *Garantiana* (s.s.) as defined by Bentz. The ornamentation is similar to that of *baculata* (Quenst.), *filicosta* Bentz, and *oligopleura* Bentz, and the relative size of the umbilicus and number of primary ribs in the last whorl is closest to *filicosta* Bentz. On the figured specimens of *filicosta* (Bentz 1928, pl. 15, fig. 4 and p. 179) the lateral tubercles are better developed, but this difference is interpreted as due to different preservation, especially lack of shell.

G. (*G.*) *filicosta* Bentz (p. 180) comes from the upper *Subfurcatus*-Schichten at Bielefeld, and therefore indicates the Subfurcatum Zone.

Localities. Subfurcatum Zone; GSE 2888, GSE 2927, and GSE 2928 from Garantiana Clay, Storab's Grave, Isle of Raasay; HMS 15365 from Garantiana Clay, cliffs above Prince Charles's Cave, Trotternish; HMS 26377 from Garantiana Clay, Capach, Strathaird, Isle of Skye.

Garantiana (*Garantiana*) sp.

Plate 51, figs. 16, 17

Material. Two small fragments—GSE 2929; GSE 2930.

Dimensions. GSE 2930—Wh. 5 mm, Pn. *c.* 7/¼ whorl.

Description. Ribbing moderately sharp, close; primary ribs straight, ? prorsiradiate, all bifurcating; secondary ribs straight, not projected; small ventral and lateral tubercles present.

Discussion. The style of the ornamentation is typical of *G.* (*Garantiana*) as defined by Bentz, but the specimens are probably too small and fragmentary for specific determination.

Locality. Subfurcatum Zone; Garantiana Clay. Storab's Grave, Isle of Raasay.

Microconch subgenus *Strenoceras* Hyatt 1900

Type species. Ammonites niortensis d'Orbigny 1846, junior synonym of *Ammonites bajocensis* Defrance 1830.

? *Strenoceras* sp.

Material. One fragment, poorly preserved—GSE 2925.

Dimensions. Wh. *c.* 10 mm, Pd. 1·6 mm.

Description. The specimen is a fragment of one whorl showing apparently simple ribbing, with ventral tubercles and possibly also lateral tubercles.

Discussion. The specimen is not sufficiently well preserved to be certain that the ribbing is simple, but if it is so then the specimen probably belongs to *Strenoceras* rather than *Garantiana*.

Locality. Subfurcatum Zone; Garantiana Clay, Storab's Grave, Isle of Raasay.

CONCLUSIONS

1. The Lower Bajocian ammonite fauna of Skye and Raasay is dominated by Sonniniidae (not included in this study) and Stephanoceratidae, especially *Stephanoceras*.

2. In the Bajocian Stephanoceratidae two types of dimorphism are the basis for the recognition of two subfamilies—Stephanoceratinae (including Otoitinae *pars*) and Sphaeroceratinae.

3. In Skye, *Stephanoceras* first appears at the base of the Humphriesianum Zone, and the macroconch (subgenus *Stephanoceras*) is much more abundant than the microconch (subgenus *Normannites*).

4. A single specimen of *Teloceras* (*Teloceras*) *blagdeni* (Sowerby) suggests that it is possible to recognize an upper Blagdeni Subzone in the Humphriesianum Zone in Skye as elsewhere.

5. In the Humphriesianum Zone the other groups which occur—Haploceratacеae, Oppeliaceae, and Sphaeroceratinae—are comparatively unimportant.

6. In the Upper Bajocian only the Subfurcatum Zone is proved by the occurrence of species of *Garantiana*.

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N. MORTON
Department of Geology
Birkbeck College
Malet Street
London, W.C. 1

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