THE JURASSIC AMMONITE BREDYIA
BUCKMAN

by J. R. SENIOR

ABSTRACT. The lower Aalenian (Middle Jurassic) ammonite Bredyia nobiliscula (Oppel, 1856) has been investigated at several growth stages and found to be dimorphic. B. crassornata Buckman (1900a), the type species of Bredyia Buckman (1910b), is regarded as a junior synonym of Ammonites nobiliscula Oppel (1856) as are Hammatoceras novum Buckman (1892), H. fusiformisus Braid (1893), and several species described by Dumortier (1874).

The lower Aalenian genus Bredyia belongs to the Hammatoceratinae, a subfamily of ammonites which, because of their comparative rarity, have not been studied in detail, although numerous references can be found in the literature.

In the Aalenian (Middle Jurassic) of Europe, the ammonite fauna is composed predominantly of leioceratids, on which the present system of zonation is largely based (Arkell 1956, p. 10); this zonation is under review as a result of fresh field information. In addition to leioceratids, smaller numbers of metioceratids, lytoceratids, and hammatoceratids occur, and in areas of Tethyan influence phylloceratids also often constitute a large percentage of the ammonite fauna (text-fig. 1).

Some hammatoceratids are important since they are probably directly ancestral to two prolific ammonite groups in the Jurassic, the Sonninidae, and the Stepheno-
ceratacea (Arkell 1957, p. 1287), and are also probably indirectly ancestral to a third group, the Perisphinctaceae (Spath 1931, p. 279; Arkell 1957, p. L308; Sturani 1971, p. 153). Bredyia apparently remained a minor and obscure element in Lower Aalenian faunas.

SYSTEMATIC PALAEONTOLOGY

Family PHYMATOCERATIDAE Hyatt, 1867
Subfamily HAMMATOCERATINAE Buckman, 1887

The Phyomatoceratidae have been divided into two subfamilies (Arkell 1957, pp. L265 and L267; ICZN opinion 575, 1959), the ancestral Phyomatoceratinae and the Hammatoceratinae. The former is restricted to the Toarcian, but the latter ranges from the Upper Toarcian to the Lower Bajocian. Before 1960 little had been written about the keeled members of the Hammatoceratinae, but since then several authors have figured and described faunas containing them. In describing ammonite faunas from the Bassin Rhodanien, Elmi (1963) used much of the generic nomenclature erected by Buckman (1919-1928) for the keeled hammatoceratids and also described a new genus, Pseudammatomoceras and a new subgenus Rhodanoceras. Géczy (1966), however, working independently on faunas from the Mount Bakony area of Hungary, recognized only two genera within the Hammatoceratinae, Euaptoioceras and [Palaeontology, Vol. 10, Part 3, 1977, pp. 675-693, pl. 81-84]
**TEXT-FIG. 1. Analysis of cephalopod faunas from the Aalenian of Europe.**

*Hammatoceras*, the latter a genus which Arkell (1957, p. L267) considered to be confined to the Toarcian. In reviewing the work of Elmi and Géczy as well as other literature, Westermann (1969, pp. 63–72) could not 'arrive at any definite opinion regarding the classification of many of the early and intermediate Hammatoceratinae...', but concluded that '...taxonomic levels somewhere midway between the ones reviewed are strongly suggested, similar to the treatment in the Treatise...'. I endorse this moderate view of the suprageneric status of the Hammatoceratinae.

**Abbreviations.** B—Brigadier G. Bomford Collection (private collection). BM—British Museum (Natural History). GSM—Geological Survey Museum, London. LY—Collection of the University of Lyon, France. MU—University Palaeontological Collection, Munich, West Germany. MM—Manchester Museum. OUM—Oxford University Museum. SH—Department of Geology Collection, University of Sheffield. M—macroconch. m—microconch.

**EXPLANATION OF PLATE 81**

*Breidyla subinsignis* (Oppel) [M].

Figs. 1, 2. The holotype of *Breidyla crassorina* (Buckman), from the Scissum Beds of Burton Bradstock (probably Burton Cliff), Dorset. Figured by Buckman (1910a, pl. 9, fig. 1) as *Burtonia crassorina*. MM L11221 (Buckman Collection), ×0.44.

Figs. 3, 4. The paratype of *Breidyla crassorina* (Buckman), from the same locality and horizon as figs. 1, 2. Figured by Buckman (1925, pl. DLXXXII). GSM 47763 (Buckman Collection), ×0.5.
TEXT-FIG. 2. Illustrating the ontogeny of *Bredyia subinsignis* (Oppel). a–k, *B. subinsignis* (Oppel) [M], a, BM C78467, Scissum Zone, Bonscombe Hill, near Shipton Gorge, Dorset. × 0.5. b, GSM 47763, paratype of *B. cruzicornata* (S. Buckman), Scissum Bed, Burton Bradstock, Dorset. × 0.5. c, BM C78462, Scissum Zone, Burton Cliff, Dorset. × 0.5. d, GSM ZA1402, Scissum Zone, Loder’s Cross, near Bridport, Dorset. × 0.5. e, BM C78466, Scissum Zone, Bonscombe Hill, Shipton Gorge, Dorset. × 0.5. f and g, figured by Dumortier (1874, pl. 53, figs. 1–4) as *Ammonites insignis* Zieten. From La Verpillière, Isère, France. LY 9112 and LY 9118 respectively. × 0.5. h, Munich ASV 876, lectotype of *A. subinsignis* Oppel, Tornus-Buchs-Schichten, Gomaringen, near Tübingen, Germany. × 0.5. i, LY 9110, holotype of *A. aleoni* Dumortier (1874, pl. 52, figs. 3, 4), La Verpillière, Isère, France. × 0.5. j, nucleus showing nepionic constriction and k, protocoech of BM C78465, Scissum Zone, Bonscombe Hill, near Shipton Gorge, Dorset. Both × 14. l, BM C78469 (author’s collection), *Hannoveroceras insignis* (Zieten), Upper Toarcian, Leckhampton Hill, near Cheltenham, Gloucestershire. × 0.5. m, LY 9181, *H. insignis* (Zieten), figured by Dumortier (1874, pl. 54, figs. 4, 5), Upper Toarcian, Saint Nizier, Loire, France. × 0.5. n–o, BM C78458 (Oppel) [Ii], BM C78461, Scissum Beds, Burton Cliff, Dorset. × 1. a, GSM 1160HW, Northampton Ironstones, New Duston, near Northampton. × 1. p and q, BM C78457 and GSM 3666 respectively, Scissum Beds, Burton Cliff, Dorset. × 1. r, BM C77995, Northampton Sands, New Duston, near Northampton. × 1. s, BM C78458, Scissum Beds, Burton Cliff, Dorset. × 3.
Genus Bredyia Buckman, 1910
(Synonym Pseudammatoceras Elmi, 1963)

Type species. Bartonia crassornata Buckman, 1910 (= Ammonites subinsignis Oppel, 1856).

Diagnosis. Hammatoceratinitid with a massive macroconch which has a small keel and coarse nodate or tuberculate bifurcate ribbing on juvenile whorls, tending to be smooth on the last whorl of the mature shell. Moderately evolve with marked uncoiling of umbilical seam towards maturity. Sutures relatively simple even at larger diameters; the retraction of the umbilical lobe is not marked. Mature apertures are simple and collared. Microconch comparatively small also coarse nodate or tuberculate ribbing continuous up to a mature aperture, which is completed by midlateral lappets. Moderately evolve with no marked eccentricity of the umbilical seam towards maturity. Sutures very simple.

Remarks. Although Bredyia is as robust as the ancestral Hammatoceras (text-fig. 2c), the whorl sections are more massive and subquadrate in appearance, only becoming slightly more inflated at maturity in the macroconch; Bredyia (M) is larger and more robust than the macroconchs of the Upper Aalenian genera Planammatoceras and Eudammatoceras.

Ornamentation in Bredyia is also distinctive. In Hammatoceras the nodate or tuberculate part of the coarse-ribbed ornament (formed where the ribs bifurcate) is very close to the umbilical seam, whereas in Bredyia appreciably more of the primaries are seen. At the venter, the secondaries abut almost at right angles to the keel in Hammatoceras, but in Bredyia the ribs have a definite oral direction at the venter.

Bredyia differs from the contemporary Erycites which has only a rudimentary keel,

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Text-Fig. 3. Hammatoceratinitid sutures from the Upper Toarcian, Aalenian and Lower Bajocian, all x 0.5. a, paratype of Bredyia crassornata (Buckman) (GSM 47763), suture at 110 mm diameter. Scissum Zone, Lower Aalenian. b, holotype of B. crassornata (Buckman) (MM L11221), suture at 142 mm diameter. Scissum Zone, Lower Aalenian. c, B. subinsignis (Oppel) (OUM J16218), suture at c. 190 mm diameter. Opalum Zone, Lower Aalenian. d, Hammatoceras insignis (Zieten) (MM L11290), suture at c. 94 mm diameter. Upper Toarcian. e, holotype of Eudammatoceras amplectens (Buckman) (MM L11287), suture at 168.5 mm diameter. Dactites Subzone, Lower Bajocian. f, "H" sieboldi (Branco) (Bayer Coll. H20), suture at 69 mm diameter. Murchisonae Zone, Aalenian.
SENIOR, *Bredyla* from the Jurassic of Dorset
or no keel at all, with ribs which may continue over the venter and a sutural pattern which is very different with a very shallow ventral lobe and first lateral saddle. The degree of simplicity seen in the sutures of *Bredyia* distinguish it from most hammatorceratins (text-fig. 3) on sutural evidence alone and only the skeletal nature of the second lateral lobe can be used to confirm that this is a hammatorceratimid. In the microconch, because of the small sizes attained at maturity, the sutural appearance is not significantly diagnostic at a generic level.

**Distribution.** Opalifer Zone in many parts of Europe (text-fig. 4), and more commonly in the Scissum Zone, especially in England. *Bredyia* has also been reported by Westermann (1964, p. 359) from the upper Murchisonae Zone of Beaminster, Dorset, England. However, very extensive collecting at this locality and other localities with exposures of similar stratigraphical horizons has yielded no specimen of *Bredyia*.

![Text-Fig. 4. The distribution of Bredyia subinsignis (Oppel).](image)

**EXPLANATION OF PLATE 82**

* *Bredyia subinsignis* (Oppel) [M]

Fig. 1. A complete macroconch showing slight constriction of the aperture on the mature bodychamber. From Bed 22 (Scissum Bed) of Bonscombe Hill, near Shipton Gorge, Dorset. The reverse half of the specimen was eroded before subsequent deposition of Bajocian (Garantiana Zone) sediments. BM C78467 (author's collection), ×0.5.

Figs. 2, 3. A septate nucleus from the Scissum Bed of Bradford Abbas, Dorset. BM C79992 (Buckman Collection), ×1.

Fig. 4. The impression of ventral sphinctural attachment scars on the holotype of *Bredyia croasomata* (Buckman), e. 114 mm diameter. MM L12221 (Buckman Collection), ×1.5.

Fig. 5. Dorsal wrinkle layer at 7.12 mm diameter on the specimen BM C78469 (author's collection), locality and horizon as fig. 1, ×8.6.
SENIOR, *Bredyia* from the Jurassic of Dorset
Brevityia subinsignis (Oppel, 1856)

*1856 Amonites subinsignis; Oppel, p. 367 [M].
*1874 Amonites alleonii; Dumortier, p. 239, pl. 52, figs. 3, 4 [M].
71974 Amonites subinsignis Oppel; Dumortier, p. 261, pl. 53, figs. 1, 2 [M].
1883 Harpoceras insignis Schübler; Wright, p. 453, pl. LXXV, figs. 1-3 [M].
71992 Hammatoceras newtoni; Buckman, p. 259.
1893 Amonites feuerrodenense; Brasil, p. 39, pl. 5, figs. 1, 2 [M].
1904 Hammatoceras dumortieri; Prinz, p. 74.
1905 Hammatoceras subinsignis (Oppel); Benecke, p. 331, pl. XXXII, fig. 2 [M].
1904a Brotoria crassornata; Buckman, p. 97, pl. 9, fig. 1; pl. 10, fig. 1 [M].
1905 Brotoria crassornata (Buckman); p. xcv [M].
1925 Brotoria crassornata (Buckman), pl. DLXXVII [M].
1925 Hammatoceras subinsignis (Oppel); Renz, pl. 10; pl. 1, fig. 5 [M].
1962 Hammatoceras alleonii Dumortier; Migacheva, p. 82, pl. 8, figs. 1, 3 [M].
1962 Hammatoceras subinsignis Oppel; Migacheva, p. 82, pl. 8, fig. 8 [M].
1963 Pseudhammatoceras subinsignis (Oppel); Elmi, p. 13, pl. 1, figs. 1, 2, 4 [M].
1963 Paramamellitoceras alleonii (Dumortier); Elmi, p. 55, pl. VIII, fig. 1.
1963 Paramamellitoceras suballeonii Elmi, p. 57, pl. VII, fig. 4 [M].
1963 Pseudhammatoceras feuerrodenense (Brasil); Elmi, p. 93 [M].
1964 Brotoria newtoni (Buckman); Westermann, p. 359 [M].

Type material. Although described in 1856 by Oppel, this species was not figured until 1925 when Renz redescribed it in an attempt to stabilize the species. The specimen Renz figured (1925, pl. 1, fig. 5) is the only remaining example in Oppel's Collection (Dr. G. Schäfter in litt) and is here selected as lectotype of the species. The lectotype is from the Tornolus Schichtem (Oppel, 1911, ZONE) of Gomaringen, Württemberg, South West Germany and is deposited in the University Palaeontological Collection, Munich (MU AS11176).

Diagnosis. As for the genus.

Stratigraphical and geographical distribution. As for the genus.

Other material. During this study 76 examples of this species were examined (42 macronychs and 34 microconchs), all are from English sources, unless otherwise stated.

Opalinum zone

Macronychs. Burton Cliff, Burton Bradstock, Dorset, bed 5a of Richardson (1928, p. 65), BM C78456 (author's coll.), B 1907, B 778, B 4164, B 4596, B 7476. Harehfield Hill, Gloucestershire, BM C9216 (S. Buckman coll.), OUIM J16218; Fossester Hill, near Stroud, Gloucestershire, BM 67903 (Etheridge Coll.). La Verpilliere, Isère, France, LY 9110 (holotype of Amonites alleonii, Dumortier Coll.).

Microconchs. BM C77972-77975, BM C77977, BM C77982-77983 (Buckman Coll.), B 2079, B 2139, B 4580. Sandstone below Sennum Bed, Green Hill, Interscire Farm, near Bridport, Dorset, BM C78463 (author's coll.).

Scissum Zone

Macronychs. Burton Bradstock (probably Burton Cliff), Dorset, MM L1121 and GSM 47763 (holotype and para-type of Brevityia crassornata, Buckman Coll.). GSM 72799 (Spate Coll.), BM 59642 (Morris Coll.), BM C10242 (Wischell Coll.), BM C77958 (Buckman Coll.).

Scissum Bed (bed 7 of Richardson, 1928, p. 53), Burton Cliff, Burton Bradstock, B 1885, B 3592, B 4657; BM C78462 (author's coll.), Quarry Hill, Chideock, OUIM J33612 (Walford Coll.). Bed 22 Bonsonense Hill, near Shipston Gorge, BM C78463-78467 (author's coll., mentioned Senior et al. 1990, p. 116). Stony Head, Loders Cross, near Bridport, B 4556; Quarry north-east of Loders Cross (bed 2 of Broomfield, 1948, p. 148), near Bridport, B 2474-3475, SI 55104 (Broomfield Coll.), GSM ZK1401-1402 (Broomfield Coll.). Gribbs Quarry, Vinney 'Vetney' Cross, near Bridport, BM C77989 (S. Buckman Coll.). Upton Farm section, Matravers, near Bridport, GSM 75800-72800 (Spate Coll.), BM C78468 (author's coll.), bed 2 of the same locality (mentioned Senior et al. 1990, p. 110). Broad Windsor, GSM 3307 (Sharpe Coll.). Bradford Abbas, BM C77991-77992 (Buckman Coll.). Marston Road Quarry, near Sherborne, BM C77990 (Buckman Coll.). Crewkerne Station Quarry (more probably the Crewkerne Railway Station).
Cutting), BM C77993 (Buckman Coll.). Hampton, Somerton, BM C6218 (Slater Coll.). Newmarket, Nailsworth, Gloucestershire, GGM 22813 (Lycett Coll.). Ravensgate Hill, near Cheltenham, GGM 25101 (Lycett Coll.).
Leckhampton, near Cheltenham, GGM Y3444 (Hadlestone Coll.), Little Cat (Ole) Hill, near Hook Norton, Oxfordshire, GGM Z881 (Richardson Coll.,); OU M J3468 (Beeley Coll.,); OU M J3466 (Buckman Coll.);
B4563, B6062. Scissum Bed, Green Hill, Innesacre Farm, near Bridport, BM C78463 (author's coll.). Sherborne (Standford Lane), GGM 69945 (G. Buckman, ex. J. Buckman Coll.); near Stroud, Gloucestershire, BM C1023 (Buckman Coll.); Wiltford, BM C0333 (Wiltford Coll.); Duston, near Northampton, GGM Y3346–3347 (Buckman Coll.); GEM 1160 FW (Woodward Coll.); New Duston, near Northampton, BM C77994–779945 (Buckman Coll.); and Gayton, near Northampton, GGM b378 (Judd Coll.).

**Description.** Protoconchs in both forms are smooth and globular (dimension given in text-fig. 5), but none shows any apparatus other than a subcircular caecal bulb. Shallow nepionic constrictions occur approximately one whorl forward of the preceptum (between 0.80 and 1.09 mm diameter in the sample seen) and these have the form of a shallow sigmoidal groove on the internal mould (text-fig. 2). After the nepionic constriction the second growth stage occurs (cf. Currie 1944, pp. 192–194) and is marked by the formation of rounded whorl sections by 6 mm diameter in the macroconch and slightly earlier in the microconch. Early development of a subquadrate whorl profile in the microconch coincides with the first appearance of the ribbed ornament and a small keel (text-fig. 5). Although ribbing and the keel appear later in the ontogeny of the macroconch by 10 mm diameter both have very similar subquadrate whorl sections (text-fig. 2n, s). With increasing diameter the macroconch whorl profile progressively changes due to slight ventro-lateral compression and

![Table](https://via.placeholder.com/150)

<table>
<thead>
<tr>
<th>Macroconch</th>
<th>Microconch</th>
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<tr>
<td><strong>Protoconch dimensions (in millimetres)</strong></td>
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<tr>
<td>.500 diameter</td>
<td>.380 diameter</td>
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<tr>
<td>.536 width</td>
<td>.540 width</td>
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<tr>
<td><strong>Position of nepionic constriction</strong></td>
<td></td>
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<tr>
<td>170° after preceptum</td>
<td>30° after preceptum</td>
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<tr>
<td><strong>Diameter at which the nepionic constriction occurs</strong></td>
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<tr>
<td>1.08 mm</td>
<td>0.80 – 1.09 mm</td>
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<tr>
<td><strong>First appearance of ribbed ornament</strong></td>
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<tr>
<td>5–6 mm diameter</td>
<td>4–5 mm diameter</td>
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<tr>
<td><strong>Range of mature procarinate diameters</strong></td>
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<tr>
<td>64 – 203 mm</td>
<td>64 – 203 mm</td>
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<tr>
<td><strong>Mean mature conch diameters</strong></td>
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<tr>
<td>243.37 mm</td>
<td>27.98 mm</td>
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<td><strong>Shell whorls</strong></td>
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<td>4.5 – 5</td>
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<tr>
<td><strong>Body chamber length in all growth stages</strong></td>
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<td>211.55</td>
<td>215.5</td>
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</table>

**Text-fig. 5.** A comparison of macroconch and microconch data in Bredyia subinsignis (Oppel).
increasing prominence of the coarse-ribbed ornament. The resulting subtriangular or subquadratie sections are retained throughout the juvenile stage, up to about 90 mm
diameter (Pl. 84, figs. 3, 4 and text-fig. 2b), after which a mature macroconch growth
stage can be recognized when the whorl section becomes slightly inflated and fastigate with only a small keel (text-fig. 2c).

Although subquadratie whorl sections appear earlier in the microconch (at about
5 mm diameter) little further development of the whorl shape occurs and except for
moderate increases in dimensions the profile remains the same up to the mature
aperture. This profile is also accentuated by the early development of coarse falcoid
ribbing which is tuberculate or nodate where the ribs bifurcate on the lower lateral
portion of the whorl flanks (Pl. 84, figs. 9, 13). This strong ornament is supplemented
throughout growth by fine falcoid growth lines. Nodate or tuberculate ribbing with
growth lines is also a prominent feature of the macroconch (Pl. 83, figs. 1, 6) and may
give an angular appearance to the whorl section (text-fig. 2e). After about 90 mm
diameter, however, the ribbing gradually fades finally leaving the mature body-
chamber ornamented only by surface irae (Pl. 82, fig. 1). Each form of Brandyia
subinsignis has almost the same number of ribs per whorl, varying with the ontogeny
from 5 to 28, although the average for both forms is slightly different, microconch
17-34 per whorl (42 in sample), macroconch 18-72 per whorl (34 in sample).

Both sexes in subinsignis show the usual features indicative of maturity. Changes
in ornament and slight inflation of the fastigate whorl section after about 90 mm
diameter in the macroconch are also accompanied by uncoiling of the umbilical seam
(Pl. 81, fig. 4; Pl. 82, fig. 1); this occurs about one complete whorl (360°) before the
mature aperture which is simple, falcoid, and collared (Pl. 82, fig. 1). Features
indicative of maturity in the microconch are not as prominent. Ornamentation
remains virtually the same until the final aperture and growth is almost linear,
although the microconch is generally more evolute than the macroconch (compare
Pl. 84, figs. 6, 9). The mature aperture is distinctive with the development of midlateral
lappets and a small rostrum (Pl. 84, figs. 22, 24). The umbilicus in both forms is fairly
large with small steep walls and is distinctly ornamented by the ribbing of previous
immature whorls. All complete examples seen had half to three-quarters of a whorl
of bodychamber (Pl. 82, fig. 1 and Pl. 83, fig. 1).

During dissection of the material the complete sutural ontogeny of each form was
recorded at half whorl intervals and is represented in text-fig. 6. The retraction of the
umbilical lobe attributed to this genus by Buckman (1910a, p. 97) and later reiterated

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**Explanation of Plate 83**

*Brendia subinsignis* (Oppel) [M]

Figs. 1, 2. A mature and almost complete macroconch from the Cotswold Sands (Opalinum Zone) of
Haresfield Hill, Gloucestershire. OUM J16218, ×0.5.

Figs. 3, 4. The plasotype of *Ammonites albius* Dumortier (LY 9110), from the Opalinum Zone (?) of
La Verpilliere, Isère, France. Figured by Dumortier (1874, pl. 52, figs. 3, 4), ×1.

Figs. 5, 6. An unusual evolute immature macroconch from the Scissum Bed of Bradford Abbas, Dorset.
BM C7791 (Buckman Collection), ×1.
SENIOR, *Bredyia* from the Jurassic of Dorset
TEXT-FIG. 6. The suture ontogeny of *Brodvia subretinata* (Oppel). a-t, macroconch (BM C78465), from Bonsombo Hill, near Shipton Gorge, Dorset. a, prosuture at 0-48 mm diameter (× 50); b, first suture at 0-50 mm diameter (× 35); c, suture and nepionic constrictio at 1-08 mm diameter (× 35); d, 1-56 mm diameter (× 22-5); e, 2-88 mm diameter (× 15); f, 2-84 mm diameter (× 11); g, 5-23 mm diameter (× 10); h, 7-12 mm diameter (× 5); i, 13-14 mm diameter (× 3-75); j, 17-17 mm diameter (× 2-5); k, 47-8 mm diameter (× 0-7). l, 92-7 mm diameter (× 0-4); m, the paratype of *B. crassornata* (S. Buckman), from Burton Bradstock, Dorset (GSM 47763). Suture at c. 110 mm diameter (× 0-25). n, BM C78467, same locality and horizon as a-t. Suture at c. 203 mm diameter (× 0-2). a-g, BM C78463, microconch, from Green Hill, Innesacre Farm, near Bridport, Dorset. a, prosuture at 0-40 mm diameter (× 35); b, 1-36 mm diameter (× 25); c, 2-80 mm diameter (× 21-5); d, 3-84 mm diameter (× 6-25); e, 6-30 mm diameter (× 3-52); f, 6-3 mm diameter (× 1-9); g, 27-9 mm diameter (× 1-7). h, BM C77515, macroconch from Bilging Road, near Northampton, suture at 35 mm diameter (× 2-5); i-t, microconchs from Burton Cliff, Dorset; i, GSM 3666, final approximated sutures at c. 25 mm diameter; j, BM C78457, suture at c. 26 mm diameter and k, BM C77997, suture at c. 23 mm diameter. All × 2-5.
by Arkell (1957, p. L267) was not found to be noticeable. The sutural ontogeny of both sexes are very similar, especially in the early juvenile stages (text-fig. 6) although in late stages the development of the sutures in the much larger macroconch is naturally more pronounced. However, the relative simplicity of the macroconch sutures, even at the maximum of their development (about 90 mm diameter), is unusual and unlike that seen in other hammatoceratids (text-fig. 3d, f). The crowding and simplification of the final sutures in the mature examples of both sexes is a common feature in most mesozoic ammonites (text-fig. 6). Dorsal wrinkle-layer structures were seen at various dimensions on both forms (Pl. 82, fig. 5) and showed great similarity with those described in the Grahococeratidae (Senior 1971). Siphuncular attachment scars sited parallel to the siphuncle tube, described by Neaverson (1927) and Hölder (1973, p. 44) were also seen (Pl. 82, fig. 4).

**Dimorphism.** There can be little doubt that the two forms of *Bredyia* described above are conspecific dimorphs, especially since they are found in the same strata with *Cycloides* being the only other hammatoceratid present. The large differences in dimensions, especially in diameter, are a function of sexual dissimilarity only. The macroconch:microconch size ratio (6-4:1) may be misleading, as the full size range of mature individuals (especially of the microconch) is uncertain due to a shortage of suitable material. It is, however, similar to the same ratio seen in Toarcian hammatoceratids (Dr. M. K. Howarth pers. comm.). Certainly the initial growth of both forms is almost identical, having protoconchs of similar shape and size (text-fig. 5), equivalent placings of the nephric constriction, and rapid development of rounded, then robust angular whorl sections (text-fig. 2).

Graphical representation of the biometric data obtained from both forms also shows an identical relationship up to about 27 mm diameter (text-fig. 7). A direct comparison can be made between the microconch and macroconch with the whorl width/whorl height ratio; in the microconch the value of this ratio remains at above 1-00 throughout development, whereas in the macroconch, this value drops appreciably below 1-00 with the onset of maturity, after about 90 mm diameter. This change of ratio can also be correlated in the macroconch with the loss of the ribbed ornament and marked uncoiling of the umbilical seam. Similar parallel developments can be seen in other plotted ratios (text-fig. 7). Up to diameters of 27 mm there is very little to separate the sutural ontogeny of either form (text-fig. 6), although the sutures of the macroconch become more complex at a later stage, a function of the enormous difference in size (text-fig. 6k–n). The skeletal development of the second lateral saddle in the macroconch (text-fig. 6l) is of interest; this feature is not always visible in every specimen, as the acme of development seems to be reached at about 90 mm diameter and subsequent sutures become more simplified (text-fig. 6m–p). This skeletal appearance is common to most hammatoceratids (text-fig. 3) and also the sonniniids, but the invariable absence of this feature at larger diameters makes it sometimes very difficult to distinguish the macroconch of *B. subinsignis* from that of *Ludwigia hungi*. Douville, the general morphology and sutural pattern being similar.

This has possibly been one cause of misidentification, particularly the records of *Bredyia* from the Murchisonae Zone. Using the complete ontogeny of each macroconch one can readily distinguish between both species.
TEXT-FIG. 7. Graphical representation of the ontogeny of Bredyia subinsignis (Oppel), • macroconch, ○ microconch, ○ the lectotype of Ammonites subinsignis Oppel. Both axes are logarithmic and each plotted parameter or ratio on the vertical axis is offset by one cycle.
So far only two other groups of microconchs, *Kialagvikites* and *Rhodamiceras*, have been recognized in the hammatocerasid ammonites. The subgenus *Kialagvikites* was described by Westermann (1964, p. 391) from a large sample of ammonites obtained from Wide Bay, Alaska and there are general similarities in size and appearance between *Bredyia* [m] and *Kialagvikites*, yet the general lack of nodate or tuberculate ornament (with the exception of *K. spinosa*) and the minute keel in the latter makes it distinctive, as does the more complex sutural appearance. The presence of identical lappets and a small rostrum in both microconchs is probably only a general characteristic of the subfamily Hammatoceratinae.

Westermann (1964, p. 392) drew attention to the fact that the macroconch subgenus *Erycitoidea* is always associated with *Kialagvikites* and he assumed that they have a dimorphic relationship. As Westermann also noted hammatoceratid microconchs bear a strong resemblance to certain microconch Graphoceratidae. However, consideration of the whole ontogeny allows discrimination. Bearing in mind this similarity between the microconchs of these subfamilies, it is unfortunate that Elmi (1963, p. 60) failed to illustrate the sutures of the microconch *Rhodamiceras* although he writes "La ligne cloisonnaire apparent au "type hammatoceratidien"...", but it is not unreasonable that *Rhodamiceras* is the microconch form of *Eudnometoceras*, as indicated by Elmi (1963, p. 61).

**Discussion.** One of the main problems involved in the understanding of this species, was the interpretation of the five trivial names available. In 1856 Oppel described a number of hammatoceratids as *Ammonites subinsignis*, and because he never illustrated these some confusion resulted when later workers applied his nomenclature. The lecotype of this species is indifferently preserved, having a slightly contorted body-chamber (three-quarters of a whorl in length) with an entirely crushed and largely absent phragmocone (Pl. 84, figs. 3, 4). The appearance of the whorl section and level of ribbed ornament development indicate this as an immature specimen. I examined a plaster cast of the specimens figured by Renz (1925, pl. 1, fig. 9), and there is little doubt that this immature example is comparable with the better-preserved ammonites later described by Buckman (1910a, p. 97) as *Burtonia crassornata* Buckman. This comparison is also endorsed by Oppel's own account of the species (1856, p. 368) in which he recorded having found another example at Burton Bradstock, Dorset, the type area for *crassornata*. Before his description of *Bredyia crassornata*, Buckman (1892, p. 259) gave a very brief account of a small new hammatoceratid from the Inferior Oolite of Northamptonshire. To this species Buckman gave the name *Hammatoceras newtoni*, but he failed to describe or figure this species adequately, even at a later date. It is difficult to recognize this species from Buckman's description and no type material seems to be available, although the specimen figured by Wright (1883, pl. LXXV, figs. 1-3) is probably the one seen by Buckman and therefore should be regarded as the lectotype of *newtoni*. This species has often been quoted in the literature, especially from the Scissum Zone, but the interpretation of it has varied, the name having been used for immature or nuclei specimens of the macroconch *B. crassornata* (= *B. subinsignis*) (e.g. Donovan 1954, p. 49) or for microconch hammatoceratids (Westermann 1964, p. 359). Although the former interpretation is probably correct, there is a considerable degree of uncertainty attached to the use of this name. Two ammonites found at Feuguerolles-Sur-Cure and figured by Brasil (1953, pl. 5, figs. 1, 2) as *H. feuguerollesiana* would also seem to be synonymous with *subinsignis*, but regrettable these specimens were destroyed in air raids on Caen in 1944. This hammatoceratid apparently only occurs rarely in the Opalinum Zone of the Normandy region (Dr. N. Rioult in litt.). In his classic work on the Jurassic palontology of the Rhône Basin, Dumortier (1874) figured several macroconchs which are possibly either synonymous with or closely related to *B. subinsignis* (Oppel). In the former category are *A. alleni* Dumortier (1874, pl. LII, figs. 3, 4) and *A. subinsignis* Oppel (1874, pl. LII, figs. 1-4), later redescribed by Prinz (1904, p. 74) as *H. dumortieri*. Determining the stratigraphical horizon of Dumortier's specimens is difficult because he cited all the material as having come from the 'Zone de l'Ammonites Opalinus', which encompasses not only the whole of the Aalenian but also the upper portion of the Toarcian. Elmi (1963) investigated the stratigraphical position...
of Dumortier's material and concluded that *alleoni* possibly came from the Murchisona Zone and *damortieri* originated very doubtfully from the Opalinum Zone (the horizon of origin being highly condensed, from Upper Toarcian-Lower Aalenian).

**Conclusions.** A specimen from Oppel's original collection figured by Renz (1925) is cited as the lectotype of *B. subinsignis* (Oppel). The type species of *Bredyia*, *Burtonia crassornata* Buckman (1910a) is considered a junior synonym of Oppel's species as are *H. newtoni* Buckman (1892), *H. fugeurollense* Brasil (1893) and several species described and figured by Dumortier (1874); notably *A. alleoni* and *A. subinsignis* (= *H. damortieri* Prinz, 1904). The synonymy of *Bredyia* with *Hammatoceras* suggested by Géczy (1966, p. 30) is not upheld as considerable morphological differences indicate a separate generic status and *Pseudhammatoceras* Elmi (1963), a genus also based on *A. subinsignis* Oppel, is considered a junior synonym of *Bredyia*.

The stratigraphical range of *B. subinsignis* seems to be limited to the Lower Aalenian (Opalinum and Scissum Zones) and records of its occurrence in the Murchisona Zone have not been substantiated during this study. Geographically this uncommon ammonite seems to have been widely distributed throughout boreal Jurassic seas in Europe and in Tethyan sediments of Caucasus and the Northern Mediterranean.

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**EXPLANATION OF PLATE 84**

*Bredyia subinsignis* (Oppel) [M]

Figs. 1, 2. A partial internal mould of an immature macrococch from the Northampton Ironstone of Duston, near Northampton. BM C77513, ×1.

Figs. 3, 4. The plastotype of *Armatites subinsignis* (Munich ASVIII 76), from the Tortolus Schichten (Opalinum Zone) of Gruningen, near Tubingen, West Germany. Described by Oppel (1856, p. 367) and later figured by Renz (1925, pl. 1, fig. 5) ×1.

Figs. 5, 6. An ironstone internal mould of a septate nucleus from Billing Road, near Northampton. BM C77515, ×1.

*Bredyia subinsignis* (Oppel) [M]

Figs. 7, 8. A complete but immature example from the Scissum Bed of Sherborne (probably Sandford Lane), Dorset. GSM 69945 (Buckman Collection), ×1.

Figs. 9, 10. A mature specimen showing the base of lappets from the Scissum Beds (Scissum Zone) of Burton Cliff, Dorset. GSM 3666 (Buckman Collection), ×1.

Figs. 11, 12. A mature example with a broken mouth border from the Northampton Sands of New Duston, near Northampton. BM C77995 (Buckman Collection), ×1.

Figs. 13-24. Microconchs from the Scissum Beds of Burton Cliff, Dorset. 13, 14, a mature specimen with an incomplete aperture (BM C77997, Buckman Collection). 15, 16, another incomplete but adult example (BM C77985, Buckman Collection). 17, 18, and 19, 20 (BM C78460 and BM C78458 respectively, both author's collection), complete immature specimens. 21-24, a well-preserved adult showing very fine midlateral lappets and small nostrum (BM C78457, author's collection). All ×1, with the exception of fig. 24 which is ×3.
SENIOR, *Bredyia subinsignis*
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