

# *Frogdenites*, the early Sphaeroceratid ammonite from the lower Bajocian of the Bakony and Gerecse Hills, Hungary

András GALÁ CZ

Department of Palaeontology, Eötvös L. University, 1117 Budapest, Pázmány Péter sétány 1/C, Hungary  
E-mail: galacz@ludens.elte.hu

(With 1 plate)

Genus *Frogdenites* and its two species are described on the basis of new finds from the Bajocian of Hungary. The study supports the previously suggested conclusions on systematic and stratigraphy: the genus, which represents the earliest member of the family Sphaeroceratidae, is a rare, but very good index of the topmost part of the Laeviuscula Zone. Dimorphism is demonstrated in both species, with a very low size ratio between macro- and microconchs.

## Introduction

*Frogdenites* BUCKMAN 1921, this rare Sphaeroceratid ammonite has been known only in some areas of Europe: in southern England, the type region (see PARSONS 1974, 1977), Portugal (FERNÁNDEZ-LÓPEZ et al. 1988), Spain (SANDOVAL 1983, 1990; FERNÁNDEZ-LÓPEZ 1985) and in Hungary (GALÁ CZ 1982). Recently a fine specimen was figured (as *Otoites* sp.) from Morocco (BENSHILI 1989, pl.23, fig.7). The earlier record from Lókút, Transdanubian Hungary was based on a loose specimen, but now new finds from bed-by-bed collections of other localities are

available. The new specimens represent the two species of BUCKMAN: *Frogdenites spiniger*, the genotype (BUCKMAN 1921, pl.215, figs 1–4) and *F. extensus* (BUCKMAN, 1921), where the other named species of BUCKMAN, *F. profectus* also belongs. The two forms are easy to distinguish by size, coiling and sculpture. While all new specimens are macroconchs, other records and specimens kept in English collections from BUCKMAN original localities may help to conclude on the style of dimorphism and corresponding microconchs.

## Localities

One of the localities is Gombápuszta in the southern Bakony, where a greyish–yellowish marly limestone yielded a rich ammonite fauna from the *Witchellia laeviuscula* and *Otoites sauzei* Zones. The three specimens came from Beds 28 and 25, just below Bed 22 where *Labyrinthoceras*, a good index for the *Sauzei* Zone first appears. This is the lower part of the sequence, where *Sonninia*, *Skirroceras*, *Otoites*, *Emileia* spp. are common, with rarer *Witchellia* and *Amblyoxyites* spp. The first *Kumatostephanus* also occurs in this level.

The other locality is in the Gerecse Hills, in the Nagypisznice Quarry, where a section of 46 beds in

the dark red Rosso Ammonitico exposed the Bajocian, from the *Discites* up to the *Humphriesianum* Zone. Beds 28 and 27 gave two specimens of *Frogdenites*. The accompanying fauna contains *Emileia*, *Otoites*, *Skirroceras*, *Papilliceras*, and *Mollistephanus*. The first *Kumatostephanus* also appears in Bed 27.

The stratigraphic position in both locality confirms the previous data (GALÁ CZ 1982) that *Frogdenites* is a genus restricted to a very narrow stratigraphic interval, i.e. to the top of the *Laeviuscula* Zone (Bj–10, *Witchellia laeviuscula* faunal horizon in CALLOMON & CHANDLER 1990).

## Descriptions

Order Ammonoidea ZITTEL, 1884  
Suborder Ammonitina HYATT, 1889  
Superfamily Stephanocerataceae NEUMAYR, 1875  
Family Sphaeroceratidae BUCKMAN, 1920  
Subfamily Sphaeroceratinae BUCKMAN, 1920

Genus *Frogdenites* BUCKMAN, 1921

*Frogdenites spiniger* BUCKMAN, 1921  
Plate 1, figs 1 and 2.

- \*v 1921 *Frogdenites spiniger*, nov. – BUCKMAN, pl.240, figs 1–4.  
 v 1922. *Labyrinthoceras gibberulum*, nov. – BUCKMAN, pl.278, figs 1, 2.  
 v 1982. *Frogdenites spiniger* BUCKMAN, 1921 – GALÁ CZ, p.25, text–figs 1,2.

1983. *Frogdenites spiniger* BUCKMAN, 1921 – SANDOVAL, p.200, pl.4, fig.3, text–fig.90H.  
 1989. *Emileia (Otoites)* sp. – BENS HILI, p.177, pl.23, fig.7

Material: Two specimens, one from Gombá spuszta, Bakony Mts, and one from Nagypisznice, Gerecse Hills.

## Measurements

Specimen	D	H	H/D	W	W/D	U	U/D	Pr	S
Holotype GSM32039	45 30.5	14.5 11.5	0.33 0.37	32 26.5	0.71 0.87	13.5 6.5	0.30 0.21	27	76
" <i>L.gibberulum</i> " GSM47113	31 23.5	14.5 10.5	0.46 0.47	29.5 22.5	0.95 0.95	6 4.5	0.19 0.19	31	~96
GALÁ CZ 1982, texfig.1	37 26	17 13	0.41 0.50	22.5 20.5	0.61 0.79	12 6.3	0.28 0.24	31 31	
Nagypisznice; Pl. 1, fig.1	66 41 31	21 20 12.5	0.31 0.48 0.40	21 39 30	0.31 0.95 0.96	19 9 5.5	0.28 0.21 0.17	18*	38*
Gombá spuszta; Pl. 1, fig.3	62 48	22 22	0.35 0.46	33 37	0.53 0.77	19 19	0.30 0.39	16*	~39*

\*counted on the last half whorl

Description: The holotype (Geol.Surv.Mus. 32039) is an incomplete form, the apertural piece of the body–chamber is missing. BUCKMAN estimated the entire diameter as 55 mm. The Hungarian specimens are somewhat bigger, attaining 65 mm at the aperture. The species has extremely depressed, broad inner whorls with narrow umbilicus up to the end of the phragmocone, where gradual contraction begins, resulting in opening of the umbilicus, and laterally narrowing cross–section on the body–chamber. The ribbing is dense on the phragmocone, with fine, sharp inner ribs ending in tiny tubercles (see "*Labyrinthoceras*" *gibberulum* BUCKMAN 1922, pl.278, figs 1–2). The tubercles appear just above the maximal width of the whorl. The body–chamber shows strong, rounded ribs, which endure up to the aperture in gradually decreasing number. Suture–line cannot be seen.

The probable microconch is a 37–38 mm diameter form with contracted and strongly ribbed and tuberculate body–chamber. This is the form

figured previously from the Bakony (Lókút, GALÁ CZ 1982, text–figs 1–2) and recently from Morocco by BENS HILI (1989, pl.7, fig.7).

*Frogdenites extensus* (BUCKMAN, 1921)  
 Plate 1, figs 2, 4–6.

- \* v 1921 *Labyrinthoceras extensum*, nov. – BUCKMAN, pl.214, figs 1–2.  
 1923. *Frogdenites profectus*, nov. – BUCKMAN, pl.430, figs 1–3.  
 non 1939. *Sphaeroceras profectum* BU. 1923 – HILTMANN, p.196.  
 ? 1985. *Frogdenites* sp. nov. – FERNÁNDEZ–LÓPEZ, p.376, pl.40, figs 5–6.

Material: Three specimens, two from Gombá spuszta, Bakony Mts, one from Nagypisznice, Gerecse Hills.

## Measurements

Specimen	D	H	H/D	W	W/D	U	U/D	Pr	S
Holotype (GSM 32038)	32	14	0.43	30.5	0.95	7.8	0.24	32	~78
<i>Frogdenites profectus</i> type	43 27	18 10.5	0.42 0.44	28 23.5	0.65 0.88	10.5 3	0.25 0.12	29 30	~90
Gombá spuszta; Pl. 1, fig.5	48	17	0.38	26	0.54	19	0.39	16*	34*
Gombá spuszta; Pl. 1, fig.4	48	18	0.37	~37	~0.77	13	0.27	17*	36*
Nagypisznice; Pl. 1, fig 2	51	18	0.35	31	0.60	17	0.33	34; 17*	38*
Sherborne, Sedgwick Mus.J.24532 Pl. 1, fig.6	24.5 20	9.5 9.5	0.39 0.47	20.5 18.5	0.83 0.93	6 4	0.25 0.20	30 30	61

\*counted on the last half–whorl

Description: The holotype (Geol.Surv.Mus. 32038) is an incomplete specimen, septate up to 30 mm diameter, with only a portion of the body–chamber. It was originally ranged into *Labyrinthoceras* by BUCKMAN, but the presence of tubercles on the furcation points makes it as distinct (see PARSONS 1974; GALÁ CZ 1982, 1990). The entire form can be better demonstrated by the

conspecific specimen named by BUCKMAN as *Frogdenites profectus* from Dundry, the same locality as that of the type. This specimen shows that the general look is a barrell–shape cadicone, where the body–chamber becomes excentric only on the last 1/3 whorl, with strong contraction in width just before the aperture. The peristome is bordered by a flared, laterally extended mouth–

border. The sculpture changes with growth: while the dense inner ribbing consists of prorsiradiate primaries ending in tiny, sharp tubercles, and giving rise usually three, prorsiradiate secondaries, the ribs become rarer, stronger, radiate, and the tubercles disappear on the last 1/3 part of the body-chamber.

The Hungarian specimens are similar, though poorly preserved. They are of 48–51 mm diameter, and septate up to 30–35 mm diameter, densely ribbed on the middle whorls, but having rarer, rounded ribs on the last 1/2 – 2/3 whorl. The bigger specimen from Gombáspuszta (Pl.1,fig.5) indicates the aperture: a flared, extended peristomal border with strong lateral contraction just behind.

Suture-lines cannot be seen.

## Conclusions

The hitherto known two species of genus *Frogdenites* seem to be clearly distinguished. *F. spiniger* is bigger, attaining 66 mm diameter near the aperture, while *F. extensus* is smaller, with 45–47 mm maximum diameter. The excentric coiling is also different. *F. spiniger* has a gradually opening umbilicus on the last whorl, while abrupt opening of the last whorl's umbilicus appears behind the aperture in *F. extensus*.

The aperture, which is missing or incomplete in all the new specimens, indicates flared, laterally extended, but unlappeted peristome after a deep preapertural constriction, just as it is shown on BUCKMAN's *Frogdenites* "profectus" specimen.

The new specimens seem all to be macroconch forms. Microconchs possibly could not be distinguished by aperture, because in *Frogdenites*, just as in the later relative *Chondroceras/Sphaeroceras*, the peristome of the adult forms are similar: flared, but without lappets in microconchs. The distinguishing feature is most probably the size, but as it was suggested earlier (PARSONS 1977, p.114; GALÁ CZ 1990, p.345), the size ratio in *Frogdenites* micro- and macroconchs is probably low. If it is the case, the previously described *Frogdenites spiniger* (in GALÁ CZ 1982), and "*Emileia (Otoites)* sp." of BENS HILL, with their 37 and 38 mm maximum diameters could be

BUCKMAN's figured specimens and the here described Hungarian examples all are macroconchs. Two specimens of the possible microconchiate were found in the Sedgwick Museum (J.24531–24532, Walker Collection, from Stoke Knap, Sherborne). These specimens are tiny variants of the typical *F. extensus*. One (J.24532) is figured here on Pl. 1, fig 6. Additionally to the small size these forms differ in sculpture also: here the tubercles endure on the body-chamber. These specimens are very similar to the incomplete forms of FERNÁNDEZ-LÓPEZ (1985, pl.40, figs 5, 6), the only difference is that the Spanish forms seem to be less depressed, and the ribbing remains dense on the body-chamber.

microconchs of typical *F. spiniger* (ca. 66–67 mm adult size), and the small specimens of FERNÁNDEZ-LÓPEZ (1985, pl.40, figs 5, 6) could be matched with *F. extensus* as its microconch. In this latter species the macroconchs show 45–51 mm maximum diameter, while the suggested microconchs are of 20–25 mm. Thus the macroconch/microconch adult size ratio is 1.77 for *F. spiniger* and 2.1 for *F. extensus* – on the basis of the very limited available data.

As of phylogeny, the earlier suggestions (DONOVAN et al. 1981; GALÁ CZ 1990) as to regard *Frogdenites* as the earliest Sphaeroceratid, of which lineage continues with *Labyrinthoceras/Manselites* and *Chondroceras/Sphaeroceras* in the Bajocian, stands the test of these new findings.

Stratigraphically *Frogdenites* is one of the best index to identify the uppermost level of the Lower Bajocian Laeviuscula Zone. All available data (PARSONS 1974, CALLOMON & CHANDLER 1990) suggests the beds just below the Sauzei Zone as the source of *Frogdenites* in the type area. These new Hungarian finds came also from the higher or topmost beds of the Laeviuscula Zone, and other, well-documented records (SANDOVAL 1983; FERNÁNDEZ-LÓPEZ 1985) indicate the same age.

## Acknowledgements

This work was supported by the grant N° FKFP 0163/1999 from the Ministry of Culture and Education of Hungary.

## References

- BENS HILL, K. (1989): Lias-Dogger du Moyen-Atlas plissé (Maroc). Sedimentologie, biostratigraphie et évolution paléogéographique. – *Doc. Lab. Géol. Lyon*, 106, 1–285, Lyon.
- BUCKMAN, S.S. (1909–1930): Type Ammonites. Vols I–VII, 790 pls. Wheldon & Wesley, London.
- CALLOMON, J.H. & CHANDLER, R. (1990): A review of the ammonite horizons of the Aalenian – Lower Bajocian stages in the Middle Jurassic of southern England. – *Mem. Descr. Carta Geol. d'It.*, 40, 85–112, Roma.
- DONOVAN, D.T., CALLOMON, J.H. & HOWARTH, M.K. (1981): Classification of the Jurassic Ammonitina. – In: HOUSE, M.R. & SENIOR, J.R. (Eds): *The Ammonoidea. Syst. Ass. Spec. Vol. No.18*, 101–155, Academic Press, London and New York.
- FERNÁNDEZ-LÓPEZ, S. (1985): El Bajocense en la Cordillera Iberica. – *Dept. Paleont., Fac. Cien. Geol. Univ. Madrid*, 850 p., Madrid.

- FERNÁNDEZ-LÓPEZ, S., HENRIQUES, M.E., MOUTERDE, R., ROCHA, R.B. & SADKI, D. (1988): Le Bajocien inférieur du Cap Mondego (Portugal) – Essai de biozonation. – In: ROCHA, R.B. & SOARES, A.F. (Eds): 2nd Intern. Symp. Jurassic Stratigr., 1987 Lisboa, Vol.I, pp. 301–313. Lisbon.
- GALÁ CZ, A. (1982): *Frogdenites* (Ammonitina, Otoitidae) from the Bajocian of Lókút, Bakony Mts., Hungary. – *Ann. Univ. Sci. Budapest., Sect. Geol.*, 21, 25–29, Budapest.
- GALÁ CZ, A. (1990): Taxonomy, dimorphism and phylogenetic significance of the Bajocian (Middle Jurassic) ammonite *Labyrinthoceras*. – In: PALLINI, G. et al. (Eds.): Atti II Conv. Int. F.E.A., Pergola, 1997. 341–348, Roma.
- HILTERMANN, H. (1939): Stratigraphie und Paläontologie der Sonnienschichten von Osnabrück und Bielefeld. I. Stratigraphie und Ammonitenfauna. – *Palaeontographica*, 90, A, 109–209, Stuttgart.
- PARSONS, C.F. (1974): The *sauzei* and 'so called' *sowerbyi* Zones of the Lower Bajocian. – *Newsl. Stratigr.*, 3/3, 153–180, Leiden.
- PARSONS, C.F. (1976): A stratigraphic revision of the *humphriesianum/subfurcatum* Zone rocks (Bajocian Stage, Middle Jurassic) of Southern England. – *Newsl. Stratigr.*, 5/2–3, 114–142, Berlin–Stuttgart.
- PARSONS, C.F. (1977): Two new Bajocian Otoitid ammonites and their significance. – *Palaeontology*, 20/1, 101–118, London.
- SANDOVAL, J. (1983): Bioestratigrafía y paleontología (Stephanocerataceae y Perisphinctaceae) del Bajocense y Bathonense en las Cordilleras Béticas. – *Doct. Thesis, Univ Granada*, 613 p., Granada.
- SANDOVAL, J. (1990): A revision of the Bajocian divisions in the Subbetic Domain (southern Spain). – *Mem. Descr. Carta Geol. d'It.*, 40, 141–162, Roma.

## **Plate**

**Plate 1**

All figures natural size

- Fig. 1. *Frogdenites spiniger* BUCKMAN, 1921 (M); Nagypisznice (Gerecse Hills), Bed 27, topmost Laeviuscula Zone. 1a: ventral view, 1b: lateral view.
- Fig. 2. *Frogdenites extensus* (BUCKMAN, 1921) (M); Nagypisznice (Gerecse Hills), Bed 28, higher Laeviuscula Zone.
- Fig. 3. *Frogdenites spiniger* BUCKMAN, 1921 (M); Gombáspuszta (Bakony Mts), Bed 25, topmost Laeviuscula Zone. 3a: ventral view, 3b: lateral view.
- Fig. 4. *Frogdenites extensus* (BUCKMAN, 1921) (M); Gombáspuszta (Bakony Mts), Bed 25, topmost Laeviuscula Zone. 4a: ventral view, 4b: lateral view.
- Fig. 5. *Frogdenites extensus* (BUCKMAN, 1921) (M); Gombáspuszta (Bakony Mts), Bed 28, higher Laeviuscula Zone. 5a: ventral view, 5b: lateral view.
- Fig. 6. ? *Frogdenites extensus* (BUCKMAN, 1921) (m); Stoke Knap, Sherborne, Sedgwick Museum, Cambridge, J.51848. 6a: ventral view, 6b: lateral view.



**1a**



**1b**



**2**



**3a**



**3b**



**4a**



**4b**



**5a**



**5b**



**6a**



**6b**

