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# DATA ON THE UNKNOWN: THE EMBRYO OF *IRAQIA SIMPLEX* HENSON, 1948 (LARGER BENTHIC FORAMINIFERA; EARLY APTIAN, CENTRAL IRAN)

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**Abstract.** *Iraqia simplex* Henson, the type-species of this orbitolinid genus, is classified among the Dictyoconinae Schubert that is principally defined by a simple megalospheric embryo. However, neither the original nor any later description of the taxon contained any specifications (or illustration) of this taxonomically important feature except that it should be situated eccentrically at the beginning of an early spiral stage. Abundant material from the early Aptian Taft Formation of Central Iran, that is in perfect conformity with Henson's Iraqi type-material, shows the presence of a simple embryo positioned centrically at the apex of the generally high-conical tests. Apart from other differences in the internal test structure, this feature therefore appears to represent a further distinguishing criterion to the allied genus *Orbitolinopsis* Henson. The available material also provides a relatively good overview of the so far unknown embryo's biometric variability. Among the Dictyoconinae, a centric embryo can be considered as the exception rather than the rule.

**Keywords**: Orbitolinidae, taxonomy, systematics, Lower Cretaceous

## INTRODUCTION

Lower Cretaceous orbitolinids have been reported from different structural parts of Iran, e.g., from the Zagros Zone in the south, from Central Iran and from the northern part (Koppeh Dagh, Alborz) (e.g. Henson, 1948; Schroeder, 1965; Sampò, 1969; Mehrnusch, 1973; Simmons et al., 2000; Schroeder et al., 2010; Babazadeh et al., 2010; Yazdi-Moghadam & Amiri, 2010; Schlagintweit et al., 2013; Schlagintweit & Wilmsen, 2014; Yazdi-Moghadam et al., 2017; Hanifzadah et al., 2015). In Central Iran the widespread Lower Cretaceous platform carbonates are known as "*Orbitolina* Limestones" belonging to the Shah Kuh (Khur area), and Taft formations (Yazd area) (Wilmsen et al., 2013).

A common taxon of the early Aptian orbitolinid assemblages is *Iraqia simplex* Henson, 1948 described from the northeastern part of Iraq (type-locality). Henson (1948, pl. 1, figs. 1-3) illustrated three specimens, one axial and two transverse sections. The embryonic apparatus was indicated as „*small, excentric, consisting of a spherical proloculum 0.11 mm in diameter, followed by one or more chambers in spiral arrangement*" (op. cit., p. 70). Bassoullet & Moullade (1962) and Billiard & Moullade (1964) described several „species" of the genus from the Aptian of Spain as *I. minima*, *I. flandrini*, *I. rubiensis* and *I. hensoni*, that were all considered synonyms of *I. simplex* by Schroeder et al. (1967) a view that is shared here. These „species" were distinguished by differences in size and the ratio height/diameter and fall into the variability of the type-species. It is interesting to note that from the numerous plates with a large number of specimens including all types of sections not a single specimen clearly showing the megalospheric embryo has explicitly been provided. Just for *I. hensoni*, Billiard & Moullade (1964, p. 239) remarked the presence of „*a very pronounced initial trochospiral part that forms a well visible apical bishop's crozier starting with a comparatively large bilocular embryo*" („*au départ trochospiralé très important formant une "crosse" apicale bien visible, debutant par un assez gros embryon biloculaire*"). In fact, the oblique section of the specimen shown in plate 1, figure 14 therein shows a seemingly unilocular embryo in a central position and surrounded by some larger chambers or chamberlets. The specimen of *I. hensoni* shown in plate 1, figure 13 therein, and interpreted as an oblique axial section obviously should serve as evidencing the initial spiral stage. In our opinion, this interpretation is not convincing and can be instead related to any test irregularities. The numerous intercalary beams visible in the marginal chamber part at the top documents the obliquity of the section not allowing any final conclusion. The original material also includes two isolated orbitolinids (including the holotype) that correspond very well to the reported pronounced initial spire. These two specimens however are from the Barremian of France and can be referred to any other dictyoconid (e.g., *Urgonina*? *Palaeodictyoconus*?) while the thin-section images refer to the Aptian of Spain and Afghanistan.

The statement of an eccentric embryo as indicated by Henson (1948), without any real evidence and/or new data, was later simply adopted by subsequent workers (Arnaud-Vanneau, 1978; Douglass, 1960, p. 260, „*initial chambers in a spire*"; Schroeder, 1963; Douglass et al. in Loeblich & Tappan, 1964; Loeblich & Tappan, 1987). Material from the lower Aptian of the Taft Formation with abundant material of *Iraqia simplex* yields numerous



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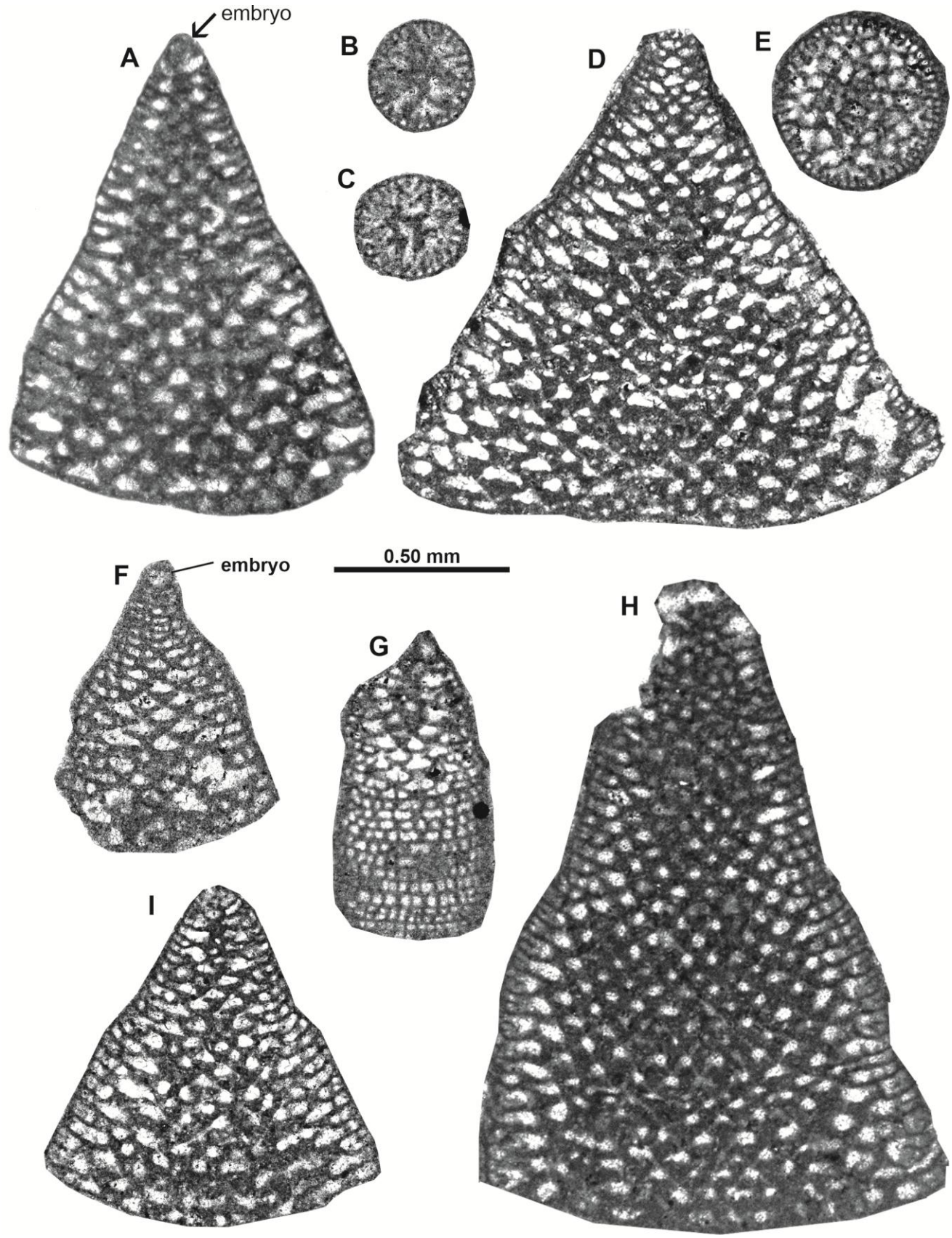


**Fig. 1**. *Iraqia simplex* Henson from the Aptian? of NE Iraq (**A**) and the early Aptian Anarak section of Central Iran (**B-I**). **A, H-I:** Axial sections (**A:** Syntype from Henson, 1948, pl. 1, fig. 1). **B-C, E:** Transverse sections. **D, F:** Subaxial sections. **G:** Tangential section. Thin-sections: AQ 18 (**B-C, F, H-I**), AQ 25 (**D**), AQ 20 (**E, G**).

axial sections nicely showing the previously little to almost unknown embryo, examples of which are presented here. It also provides, for the first time, biometric data on the embryo.

## GEOLOGICAL SETTING AND BIOSTRATIGRAPHY

The mountainous region around Anarak (Nain County, Isfahan Province) belongs to the so-called Yazd Block of Central Iran (Berberian & King, 1981; Aghanabati, 2004, for overviews). Together with the Tabas and Lut Blocks, it is part of the so-called Central-East Iranian microcontinent (Takin, 1972). Towards the north, the Yazd Block is bounded by the Doroneh fault and towards the west by the Naien Baft ophiolite belt. Lower Cretaceous shallow-water limestones occur transgressively upon conglomerates and sandstones which in turn are underlain by the Late Paleozoic to Triassic Anarak metamorphic complex (e.g., Torabi, 2011; Buchs et al., 2013). For a geological sketch map of the Anarak region see Torabi (2011, fig. 2). The Lower Cretaceous shallow-water carbonates of the Yazd Block were investigated with respect to microfacies, sedimentology and micropaleontology by Bucur et al. (2012) and Wilmsen et al. (2013). The material of our present study derives from the Anarak section previously studied by Schlagintweit & Rashidi (2022). The base of the studied section is located ~ 3 km north of Anarak village. The coordinates of the Anarak section base are N 33º, 20', 20.23" and E 53º, 41', 55.94".

The outcropping Taft Formation consists of well-bedded limestones, and marly limestones with rudists, gastropods, benthic foraminifera and dasycladaleans [e.g., *Morelletpora turgida* (Radoičić)]. The occurrence of praeorbitolinas near the base of the Taft Formation indicates a late early Aptian (late Bedoulian) age (e.g., Schroeder et al., 2010). *Iraqia simplex* is one of the most frequently observed orbitolinid in this section along with *Palaeodictyoconus actinostoma* Arnaud-Vanneau & Schroeder and *Dictyoconus*? *pachymarginalis* Schroeder.

## MATERIAL AND REPOSITORY

All specimens are from thin-sections stored at the Ardakan Payame Noor University, Iran, in the Rashidi collection, under the original sample numbers with the prefix AQ for the Anarak section.

## SYSTEMATIC DESCRIPTION

The high-rank classification (Phylum–Class) follows Pawłowski et al. (2013). For the low-rank classification see Kaminski (2014). For a glossary of terms, see Hottinger (2006).

Class: FORAMINIFERIDA d´Orbigny, 1826
Order: Loftusiida Kaminski & Mikhalevich, 2004 (in Kaminski, 2004)
Suborder: Orbitolinina Kaminski & Mikhalevich, 2004 (in Kaminski, 2004)
Superfamily: Orbitolinacea Martin, 1890
Family: Orbitolinidae Martin, 1890
Subfamily: Dictyoconinae Schubert, 1912

Genus ***Iraqia*** Henson, 1948

***Iraqia simplex*** Henson, 1948
Figs. 1-2

*1948 *Iraqia simplex* n. gen., n. sp. – Henson, p. 69-70, pl. 1, figs. 1-3.
1962 *Iraqia simplex* Henson – Bassoullet & Moullade, p. 110, pl. 1. figs. 16-19.
1962 *Iraqia rubiensis* n. sp. – Bassoullet & Moullade, p. 112, pl. 1. figs. 8-12.
1963 *Orbitolinopsis simplex* (Henson) – Schroeder, p. 322, not figured.
1969 *Orbitolinopsis* sp. – Sampò, pl. 45, fig. 1.
1971 *Orbitolinopsis simplex* (Henson) – Ramirez del Pozo, p. 276, pl. 36, fig. 1 pars, 45, fig. 2 pars, pl. 46, fig. 1 pars.
1972 *Iraqia* sp. – Samuel et al., pl. 8, figs. 1-3.
1976 *Orbitolinopsis simplex* (Henson) – Peybernès, pl. 22, figs. 10-12, ?13 ("*Simplorbitolina*" *praesimplex*).
1981 *Iraqia simplex* Henson – García-Hernández, pl. 1 pars.
1981 *Orbitolinopsis* gr. *kiliani* – Mas, pl. 27, figs. 3-4.
1985 *Iraqia simplex* Henson – Pascal, pl. 11, fig. 6.
1987 *Iraqia simplex* – Reitner, fig. 109c.
1992 *Iraqia simplex* Henson – Masse et al., pl. 1, figs. 1-2.
1998 *Iraqia simplex* Henson – Whittaker et al., pl. 12, fig. 3, pl. 13, fig. 2, pl. 61, figs. 5-6 (non fig. 4), pl. 62, fig. 1.
2002 *Orbitolinopsis simplex* (Henson) – Ulastre et al., pl. 3, figs. 4-6.
2008 *Iraqia simplex* Henson – BouDagher-Fadel, p. 302, pl. 5.13, figs. 2-3 (syntypes from Henson, 1948, pl. 1, figs. 1, 3).
2010 *Iraqia simplex* – Yazdi-Moghadam, fig. 2I.
2010 *Orbitolinopsis cuvillieri* – Yazdi-Moghadam, fig. 2F.
2013 *Vercorsella* sp. – Carević et al., fig. 16CC.
2013 *Orbitolinopsis* sp. – Schlagintweit et al., pl. 3, figs. 9, 12-13.
2015 *Paracoskinolina* sp., *Paleodictyoconus* sp. – Babazadeh & Dehej, fig. 7V-W.
2016 *Orbitolinopsis*? *simplex* (Henson) – Schlagintweit et al., fig. 7F-G, I.
non 2016 *Iraqia simplex* Henson – Noori et al., pl. 1, fig. 1.
non 2016 *Iraqia simplex* Henson – Noori et al., Pl. 1, fig. 1.
non 2017 *Iraqia simplex* Henson – Hamedanian et al., pl. 1, fig. H.

2016 *Orbitolinopsis* sp. – Schlagintweit et al., pl. 3, figs. 9, 12-13.
2016 *Orbitolinopsis*? *simplex* (Henson) – Schlagintweit et al., fig. 7F-G, I.
2019 ?*Iraqia* sp. – Bucur et al., fig. 16c.
2019 *Iraqia simplex* Henson – Bucur et al., fig. 17a, c-e.
2021 *Iraqia simplex* Henson – Yazdi-Moghadam et al., fig. 5A-C.
2021 *Iraqia simplex* Henson – Manhi & Alsultani, fig. 4a.
2022 *Iraqia simplex* Henson – Schlagintweit & Rashidi, p. 7, fig. 4g-i.
2022 *Neoiraqia insolita*, *Neoiraqia* cf. *convexa*, *Valserina broennimanni*, *Valserina primitiva*, *Mesorbitolina parva* – Hassani, fig. 10.3-10.6, 10.8.
2023 *Iraqia simplex* Henson – Yazdi-Moghadam & Schlagintweit, text-fig. 7.1, non 7.2, 7.3-7.12.

**Description:** Test high-conical either with continuously widening chambers during ontongeny or adult chambers with tendency to become cylindrical. The test base is convex and transverse section are circular in outline. The embryo appears to consist of a single almost spherical chamber located in a central (apical) position. A subdivision or constriction of the embryonic chamber indicating a biloculine embryo (protoconch + deuteroconch) is either not evident or only vaguely (if ever) visible (Figs. 2D, H, J-K). In some specimens, the first neanic chambers beneath the embryo appear larger than the subsequent chambers and could be related to a few spiral chambers (needing confirmation). The rest of the test consists of up to 40 rectilinear chambers. In the juvenile parts, rafters are seemingly absent. One rather short rafter is present in each chamber of the adult part („*at least in the later chambers…rare or rudimentary*"; Henson, 1948, p. 69 ; syntype in pl. 1, fig. 1, refigured here in fig. 1A). Transverse sections through the adult test parts show the subdivision into a marginal zone with short beams enlarging inwards, then forming a reticulate network exhibiting a vesicular cellular appearance (Fig. 1E). Transverse sections through the early cone stages instead just refer to the marginal zone and the reticulate central zone is (almost) absent (Figs. 1B-C; Henson, 1948, pl. 1, fig. 2). There are two to three intercalary beams between two radial main partitions. Tangential sections through the marginal zone exhibit a pattern of rectangular network (Fig. 1G lower part) while the central zone shows triangular chamberlets alternating in position between subsequent chambers (Fig. 1G upper part). The foramina are restricted to the central zone where they show a cross-wise oblique pattern (Fig. 1A, I). Test dimorphism has not been observed. The wall is homegeneous and finely agglutinated.

**Dimensions (in mm):**
Test height up to 1.85 mm
Test diameter up to 1.56 mm
Number of chambers last 0.5 mm axial length (adult specimens): 9-10
Inner diameter embryonic chamber: 0.06 mm-0.14 mm (mean 0.10 mm, n = 12)

**Remarks:** The specimens from the early Aptian Taft Formation of Central Iran are fully in conformity with the images provided by Henson (1948) and the underlying description. The indicated „*small, eccentric*" embryo and „*early spiral stage*" in the original description however cannot be confirmed. Although not illustrated, Henson (1948, p. 70) indicated an embryo diameter of 0.11 mm that equals more or less the mean value of our measurements. In fact, as already mentioned by Schlagintweit & Yazdi-Moghadam (2023), the syntype of Henson (1948, pl. 1, fig. 1) shows in our opinion an apical embryo badly (if ever) recognizable in Henson's original plate but in the new image provided by Whittaker et al. (1998, pl. 61, fig. 6) (Fig. 1A). The eccentric embryo as indicated by Henson (1948) was probably referring to an unillustrated metatype specimen not from the „probably Aptian" type-locality (Alane Gorge, NE Iraq) but from the late Albian Mauddud Limestone recovered from the Zubair-3 well at Basra, Iraq. A metatype from this well has been illustrated by Whittaker et al. (1998, pl. 61, fig. 4) with a clearly eccentric embryo stating that this „*is the first megalospheric form to be illustrated*" of *I. simplex*. In this context, Whittaker et al. (1998) also stated that the high-conical syntype of Henson (1948, pl. 1, fig. 1, re-illustrated here in Fig. 1A) „*was a microspheric form*". From what is known from various dictyoconids (and also orbitolininids), the microspheric specimens are characterized by low-conical large-sized tests. Based on our analysis, the eccentric megalospheric embryo of the mentioned meta-type does not correspond to the centric embryo of the Aptian forms. The lack of any rafters in the metatype is meaningless as these are often missing in juvenile forms. The chamber height appears higher than the type-material from Alana Gorge. The status of this specimen has to be left open, pending further material to study. In any case, it is considered as not belonging to *Iraqia simplex*. It should be mentioned that an apical embryo is the exception rather than the rule in dicytoconids. In many genera it is located eccentrically within an early trochospire such as *Simplorbitolina* Ciry & Rat, *Orbitolinopsis* Henson, *Palaeodictyconus* Moullade (Loeblich & Tappan, 1987) or simply Henson's metatype. It is also worth mentioning that the megalospheric embryos observed in the Taft Formation mostly refer to juvenile forms. Finally, the rich Iranian material of *I. simplex* also yielded greater maximum test heights and diameters than as indicated by Henson (1948) respectively 1.3 mm and 1.0 mm.

**Stratigraphy:** According to Ramírez del Pozo (1971), *I simplex* characterizes the upper Bedoulian (see also Moullade et al., 1985; Masse, 2003). Based on ammonites and strontium-isotope stratigraphy data from the Maestrat Basin, eastern Spain, Bover-Arnal et al. (2016) indicated a range of *I. simplex* from the *furcata* (upper Bedoulian) to the upper part of the *martini* (lower Gargasian) zone.

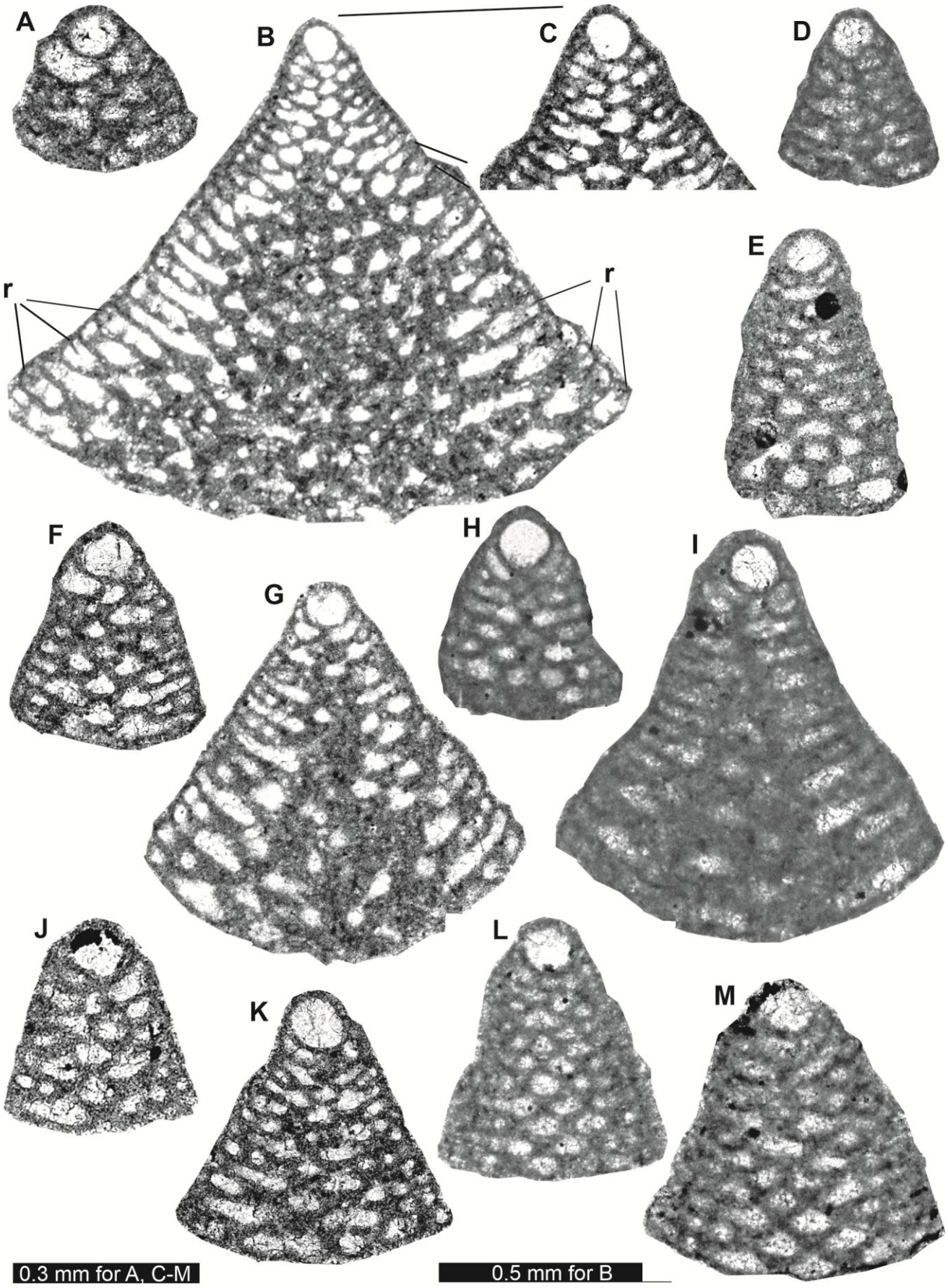


**Fig. 2**. Specimens of *Iraqia simplex* Henson from the early Aptian of Central Iran showing apical centric megalospheric embryo. All images refer to axial sections of mostly juvenile specimens. Abbreviation r = rafters. Thin-sections: AQ 18 (**A, D, F, I**), AQ 30 (**B-C, G**), H 43 (**E**), H 25 (**H**), M 31 (**J**), AQ 21 (**K**), AQ-R (**L**), AQ 24 (**M**). AQ from Anark sections, H and M from nearby sections.

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**REFERENCES**

Aghanabati, A. 2004. The Geology of Iran. Geological Survey of Iran: 1-389.

Arnaud-Vanneau, A., 1978. Fichier des types figurés d'Orbitolinidae. Edit. S.N.E.A., Boussens, 143 espèces.

Babazadeh, S.A. & Dehej, T.E., 2015. Stratigraphical study of the Taft Formation in the Bohruk area from the Yazd Block, Central Iran. Journal of Earth Science, 26 (5): 729-739.

Babazadeh, S.A., Raisossadat, S.N. & Ahrari, F., 2010. Biostratigraphy and evolutionary trend of the Cretaceous orbitolinids in the sedimentary succession of east Lut Block, south west of Qayen. Sedimentary Facies, 3 (1): 1-10.

Bassoullet, J.P. & Moullade, M., 1962. Les Orbitolinidae du Crétacé inférieur de la Sierra de Montsech, Province de Lerida (Espagne). Revue de Micropaléontologie, 5 (2): 104-114.

Berberian, M., & King, G., 1981. Towards a paleogeography and tectonic evolution of Iran. Canadian Journal of Earth Sciences, 18: 210-265.

Billiard, J. & Moullade, M., 1964. Etude de quelques représentants du genre *Iraqia* (Orbitolinidae) dans l'Aptien des contreforts Pyrénéens Français et Espagnols. Revue de Micropaléontologie, 6 (4): 237-242.

Bover-Arnal, T., Moreno-Bedmar, J., Frijia, G., Pascual-Cebrian, E. & Salas, R., 2016. Chronostratigraphy of the Barremian – Early Albian of the Maestrat Basin (E Iberian Peninsula): integrating strontium-isotope stratigraphy and ammonoid biostratigraphy. Newsletters on Stratigraphy, 49 (1): 41-68.

Boudagher-Fadel, M., 2008. Evolution and geological significance of larger benthic Foraminifera. Developments in Palaeontology and Stratigraphy, 21: 1-571.

Buchs, D., Bagheri, S., Martin, L., Hermann, J. & Arculus, R., 2013. Paleozoic to Triassic ocean opening and closure preserved in Central Iran: Constraints from the geochemistry of metaigneous rocks of the Anarak area. Lithos. http://dx.doi.org/10.1016/j.lithos.2013.02.009.

Bucur, I.I., Rashidi, K. & Senowbari-Daryan, B., 2012. – Early Cretaceous calcareous algae from Central Iran (Taft Formation, south of Aliabad, near Yazd). Facies, 58: 605-626.

Bucur, I.I., Yarahmadzahi, H. & Mircescu, C.V., 2019. The Lower Cretaceous Tirgan Formation in the Gelian section (Kopet Dagh, North Iran): Microfacies, microfossils, and their biostratigraphic significance. Acta Palaeontologica Romaniae, 15 (1): 13-33.

Carević, I., Taherpour Khalil Abad, M., Ljubović-Obradović, D., Vaziri, S.H., Mirković, M., Aryaei, A.A., Stejić, P. & Ashouri, R.A., 2013. Comparisons between the Urgonian platform carbonates from eastern Serbia (Carpatho-Balkanides) and northeast Iran (Kopet-Dagh Basin): Depositional facies, microfacies, biostratigraphy, palaeoenvironments and paleoecology. Cretaceous Research, 40: 110-130.

Douglass, R.C., 1960. Revision of the family Orbitolinidae. Micropaleontology, 6 (3): 249-270.

Douglass, R.C., Loeblich, A.R.Jr. & Tappan, H., 1964. Orbitolinidae. Pp. C. In: Loeblich, A. R.Jr. & Tappan, H., Eds., *Treatise on invertebrate paleontology, Pt. C, Protista 1*, Univers. Kansas Press, Lawrence: 308-313.

García-Hernández, M., 1981. Biozonation du Crétacé inférieur à l'aide des foraminifères benthiques et des algues Dasycladacées dans le Prébetique occidental (Cordillères Bétiques, Esp.). Géobios, 14: 261-267.

Hamedanian, M.K., Vaziri, S.H., Shakarami, M.A., Arian, M. & Arzani, N., 2017. Lithostratigraphy and microbiostratigraphy of Gadvan and Darian Formations in South

Semirom, East of Zagros Basin, South-Central Iran. Open Journal of Geology, 7: 119-131.

Hanifzadah, R., Rashidi, K. & Shahkarami, M.A., 2015. Barremian-Aptian biostratigraphy in Yazd Block, Central Iran. Open Journal of Geology, 5: 405-421.

Hassani, M.J., 2022. Microbiostratigraphy, microfacies analysis and lateral basin evolution of Lower Cretaceous deposits in the south of Kerman region, SE Iran. Boletín de la Sociedad Geológica Mexicana, 74 (2): A240322.

Henson, F.R.S., 1948. Larger imperforate Foraminifera of south-western Asia. Families Lituolidae, Orbitolinidae and Meandropsinidae. Monograph British Museum (Natural History), London, 127 pp.

Hottinger, L., 2006. Illustrated glossary of terms used in foraminiferal research. Carnets de Géologie / Notebooks on Geology, Memoir 2006/02 (CG2006_M02).

Kaminski, M.A., 2004. The year 2000 classification of the agglutinated foraminifera. In: Bubik, M., Kaminski, M.A. (Eds.), Proceeding of the 6th international workshop on agglutinated foraminifera. Grzybowski Foundation Special Publication, 8: 237-255.

Kaminski, M.A., 2014. The year 2010 classification of the agglutinated foraminifera. Micropaleontology, 60 (1): 89-108.

Loeblich, A.R., Jr. & Tappan, H., 1987. Foraminiferal genera and their classification, Van Nostrand Reinhold, New York.

Manhi, M.R. & Alsultani, H.A.A., 2021. Stratigraphy and depositional environment of Mauddud Formation in Ratawi Oil wells of Southern Iraq. IOP Conference

Series: Earth and Environmental Science, 877: 012030.

Martin, K., 1890. Untersuchungen über den Bau von *Orbitolina* (*Patellina* auct.) von Borneo. Sammlungen Geol. Reichsmus. Leiden, Ser. 1, 4: 209-231.

Mas, J.R., 1981. El Cretácico Inferior de la région noroccidental de l aprovincia de Valencia. Seminarios de Estratigrafia, Serie Monografías, 8: 1-476.

Masse, J.P., 2003. Integrated stratigraphy of the Lower Aptian and applications to carbonate platforms: a state of the art. In: Gili et al. (eds.). North African Cretaceous Carbonate Platform Systems: 203-214.

Masse, J.P., Arias, C. & Vilas, L., 1992. Stratigraphy and biozonation of a reference Aptian–Albian, p.p. Tethyan carbonate platform succession: The Sierra del Carche series (oriental Prebetic zone – Murcia, Spain). In: Kollmann, H.A., Zapfe, H. (eds), New aspects on Tethyan Cretaceous fossil assemblages. Österreichische Akademie der Wissenschaften, Schriftenreihe der Erdwissenschaftlichen Kommission, 9: 201-221.

Mehrnusch, M., 1973. Eine Orbitoliniden-Fauna aus der Unterkreide von Esfahan (Zentral.Iran). Neues Jahrbuch für Geologie und Paläontologie Monatshefte, 6: 374-382.

Moullade, M., Peybernès, B., Rey, J. & Saint-Marc, P., 1985. Biostratigraphic interest and paleobiogeographic distribution of early and mid-Cretaceous Mesogean orbitolinids (Foraminiferida). Journal of Foraminiferal Research, 15 (3): 149-158.

Noori, N.A., Al-Sheikly, S.S.J. & Al-Dulaim, S.I.M., 2016. Biostratigraphy of Mauddud Formation in Badra well – 1; Eastern Iraq. Journ. Babylon Univ. Pure and Appl. Sci., 3 (24): 740-754.

Orbigny, A.D.d'., 1826. Tableau méthodique de la classe des Céphalopodes. Annales des Sciences Naturelles, 7: 96-169, 245-314.

Pascal, A., 1985. Les Systems biosédimentaires urgoniens (Aptien–Albien) sur la marge Nord Ibérique. Mémoires Géologiques de l'Université de Dijon, 10: 1-569.

Pawłowski, J., Holzmann, M. & Tyszka, J., 2013. New supraordinal classification of Foraminifera: Molecules meet morphology. Marine Micropaleontology, 100: 1-10.

Peybernès B. 1976. Le Jurassique et le Crétacé inférieur des Pyrénées franco-espagnoles entre la Garonne et la Méditerranée. Thèse Doct. Toulouse, 459 pp.

Ramirez del Pozo, J., 1971. Bioestratigrafía y Microfacies del Jurásico y Cretácico del Norte de España (Region Cantábrica). Memorias del Instituto Geológico y Miniero de España, 78: 1-357.

Reitner, J., 1987. Mikrofazielle, palökologische und paläogeographische Analyse ausgewählter Vorkommen flachmariner Karbonate im Basko-Kantabrischen Strike Slip Fault-Becken-System (Nordspanien) an der Wende von der Unterkreide zur Oberkreide. Documenta naturae, 40: 1-239.

Sampò, M., 1969. Microfacies and Microfossils of the Zagros Area, Southwestern Iran (from Pre-Permian to Miocene). International Sedimentary Petrographical Series, 12: 1-102.

Samuel, O., Borza, K. & Köhler, E., 1972. Microfauna and lithostratigraphy of the Paleogene and adjacent Cretaceous of the Middle Váh Valley (West Carpathians). Geological Institute of Dionýz, Bratislava, 246 p.

Schlagintweit, F. & Rashidi, K., 2022. The "*Orbitolina* Limestone" of Central Iran: new data about microfacies, orbitolinid biostratigraphy, and palaegeography. Facies, 68: article 10.

Schlagintweit, F. & Wilmsen, M., 2014. Orbitolinid biostratigraphy of the top Taft Formation (Lower Cretaceous of the Yazd Block, Central Iran). Cretaceous Research, 49: 125-133.

Schlagintweit, F., Bucur, I.I., Rashidi, K. & Saberzadeh, B., 2013. *Praeorbitolina claveli* n. sp. (benthic foraminifera) from the Lower Aptian (Bedoulian) of Central Iran. Carnets de Géologie-Notebooks on Geology, Letter 2013/04, 255–272.

Schlagintweit, F., Rosales, I. & Najarro, M., 2016. *Glomospirella cantabrica* n. sp., and other benthic foraminifera from Lower Cretaceous Urgonian-type carbonates of Cantabria, Spain. Geologica Acta, 14 (2): 113-138.

Schroeder, R., 1963. Grundlagen einer Orbitoliniden-Biostratigraphie des tieferen Urgons im pyrenäisch-kantabrischen Grenzgebiet (Nordspanien). Neues Jahrbuch für Geologie und Paläontologie. Monatshefte, 1963 (3): 320-326.

Schroeder, R., 1965. *Dictyoconus pachymarginalis* n. sp. aus dem Apt des Elburz- Gebirges (Nord-Iran) (Studien über primitive Orbitolinidae III). Eclogae Geologicae Helvetiae, 58 (2): 976-979.

Schroeder, R., Conrad, M.A. & Charollais, J., 1967. Sixième note sur les Foraminifères du Crétacé inférieur de la région genevoise. Contribution à l'étude des Orbitolinidae: *Valserina brönnimanni* Schroeder & Conrad, n. gen., n. sp.; *Paleodictyoconus barremianus* (Moullade) et *Paleodictyoconus cuvillieri* (Foury). Archives des Sciences, 20 (2): 199-222.

Schroeder, R., Van Buchem, F.S.P., Cherchi, A., Baghbani, D., Vincent, B., Immenhauser, A. & Granier, B., 2010. Revised orbitolinid biostratigraphic zonation for the Barremian–Aptian of the eastern Arabian Plate and implications for regional stratigraphiccorrelations. GeoArabia Special Publication, 4: 49-96.

Schubert, R.J., 1912. Über *Lituonella* und *Coskinolina liburnica* Stache sowie deren Beziehungen zu den anderen Dictyoconinen. Jahrbuch der kaiserlich-königlichen Geologischen Reichsanstalt, 62 (2): 195-208.

Simmons, M.D., Whittaker, J.E. & Jones, R.W., 2000. Orbitolinids from Cretaceous sediments of the Middle

East – a revision of the F.R.S. Henson and Associates Collection. In:

Hart, M.B., Kaminski, M.A. & Smart C.W. (Eds.), Proceedings of the 5th International Workshop on Agglutinated Foraminifera. Grzybowski Foundation Special Publication, 7: 411-437.

Takin, M., 1972. Iranian geology and continental drift in the Middle East. Nature, 23: 147-150.

Torabi, G., 2011. Late Permian blueschist from Anarak ophiolite (Central Iran, Isfahan province), a mark of multi-suture closure of the Paleo-Tethys ocean. Revista Mexicana de Ciencas Geológicas, 28 (3): 544-555.

Ullastre, J., Schroeder, R., Masriera, A., 2002. Sobre la estratigrafía del singular corte de la Roca de Narieda (parte S de la serie del Cretácico inferior de Organyá). Pirineo catalán. España. Treballs del Museu de Geologia de Barcelona, 11: 67-95.

Whittaker, J.E., Jones, R.W., Banner, F.T., 1998. Key Mesozoic benthic foraminifera of the Middle East. The Natural History Museum London, 236 p., 107 pl.

Wilmsen, M., Fürsich, F.T. & Majidifard, M.R., 2013. The Shah Kuh Formation, a latest Barremian – Early Aptian carbonate platform of Central Iran (Khur area, Yazd Block). Cretaceous Research, 39: 183-194.

Yazdi-Moghadam, M. & Amiri, F., 2010. Lower Cretaceous agglutinated larger benthic foraminifera from the Sarvestan section, south of Esfahan, Iran. Ist Int. Applied Geol. Congr., Dep. of Geol., Islamic Azad Univ. Mashad Branch, 26-28 April 2010: 976-980.

Yazdi-Moghadam, M. & Schlagintweit, F., 2023. *Iraqia ultima* sp. nov. (Orbitolinidae) from a new succession encompassing the Cenomanian-Turonian boundary in SW Iran (Sarvak Formation, Zagros Zone). Palaeontographica, A, 326 (1-6): 29-48.

Yazdi-Moghadam, M., Sarfi, M., Sharifi, M., Ariafar, B., Sajjadi, F. & Abbasi, P., 2017. Early Barremian orbitolinid record from the Moghan area, NW Iran: Northern margin of the Neotethys. Cretaceous Research, 77: 133-142.

Yazdi-Moghadam, M., Parandavar, P., Sarfi, M. & Sharifi, M., 2021. Integrated biostratigraphy (orbitolinids and calacareous nannofossils) of the Lower Cretaceous Taft Formation in Isfahan, Central Iran. Cretaceous Research, 126: 104918.

Yazdi-Moghadam, M. & Schlagintweit, F., 2022. *Iraqia ultima* sp. nov. (Orbitolinidae) from a new succession encompassing the Cenomanian-Turonian boundary in SW Iran (Sarvak Formation, Zagros Zone). Palaeontographica, A, 326 (1-6): 29-48.