Ann. Naturhist. Mus. Wien	98 A	17 - 33	Wien, Februar 1997

Diptyxis OPPENHEIM (Nerineacea, Gastropoda) from the Lower Cretaceous of Albania. On the distribution of the genus *Diptyxis*

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(With 2 plates)

Manuscript submitted on October 1st, 1996,
the revised manuscript on November 18th, 1996

Summary

Diptyxis luettickei (BLANCKENHORN), *D. munellae* n.sp. and *D. mirditae* n.sp. are described from Barremian to Aptian beds of Albania. Tectonically, they are part of the Mirdita Zone. The genera *Favria* COSSMANN, which has been renamed into *Julesia* by COX (1954) for priority reasons, and *Cylindroptyxis* PCHELINTSEV are considered as synonyms. They therefore belong to the family Nerineidae, not to the Itieriidae as was proposed by earlier authors. *Diptyxis* species possess one columellar plait and one parietal plait. This morphologic character also occurs in the Cretaceous Campanilidae. Stratigraphically, *Diptyxis* ranges from the Sequanian to the Upper Cenomanian.

Zusammenfassung

Aus Ablagerungen des Barremiums/Aptiums Albaniens werden *Diptyxis luettickei* (BLANCKENHORN), *D. munellae* n.sp. und *D. mirditae* n.sp. beschrieben. Tektonisch gehören die Ablagerungen der Mirdita Zone an. Die Gattung *Favria* COSSMANN, die von COX (1954) aus Prioritätsgründen zu *Julesia* umbenannt wurde, und *Cylindroptyxis* PCHELINTSEV sind synonym mit *Diptyxis*. Sie gehören nicht, wie von früheren Autoren angenommen, den Itieriidae an sondern den Nerineidae. *Diptyxis* besitzt je eine Columellarfalte und eine Parietalfalte. Dieses morphologische Kennzeichen ist auch bei bei Campanilidae der Kreidezeit zu beobachten. Die stratigraphische Reichweite von *Diptyxis* ist Sequanium – oberes Cenomanium.

1. Introduction

The nerineacean genus *Diptyxis* OPPENHEIM (1889) is common in Upper Jurassic deposits. Although it ranges stratigraphically upwards into the Cenomanian, Cretaceous recordings are rare. In this contribution, new finds from the Lower Cretaceous of Albania are described. They are part of a diverse nerineacean fauna from the Mirdita Zone (PEZA 1989). For further use, the occurrences of *Diptyxis* throughout the history of the earth are reviewed. The criterium for the identification was a sutural notch which is characteristic for the nerineaceans and as generic characters the presence of a large palatal plait and a plait in the abapical part of the columella.

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The whorls of Nerineacea are almost always filled with substratum or calcite when they are collected. Therefore, internal plaits cannot be studied in three dimensions but by their contours in axial shell sections. Besides artefacts due to differences in the cutting plane the shape of the contour depends on biological factors like

+ Individual variability

+ Changes with ontogeny (see Wieczorek 1979).

The review of species has convinced us that the literature is overburdened with inadequate species descriptions and determinations. A considerable number of species has been based on insufficiently preserved material. Additionally, the species concept of various authors is very too narrow. Minute differences of the plait contours which can easily be recognized as individual variations have been used to define new species. Finally, quite a large number of authors are guilty of an insufficient knowledge of original material and literature.

We consider the outline of the whorls and the number and relative size of internal plaits as criteria for distinguishing nerineacean genera. Internal plaits are expressions of the hitherto not understood soft part anatomy (VAUGHAN 1988). A genus has to be considered as an artificial group of species of common origin which have evolved by spreading into ecological niches and subsequent genetic isolation. The nerineacean niches were located in lagoonal to inner shelf shallow marine environments.

We consider the external sculpture to be essential for the differentiation of nerineacean species. It remains unresolved if the general anatomy was differentiated to such a degree that different plait patterns occurred in individual species. According to our observations even well-documented species (see for example WIECZOREK 1979) do not show plait patterns that differ convincingly from others. The use of the external sculpture for defining species poses two problems:

1. The sculpture of early ontogenetic stages of the teleoconch, which would be important for a determination is generally not preserved.
2. In many cases the shells cannot be isolated from the rock. They have to be studied from sections, which means that the sculpture cannot be studied adequately.

At least based on current knowledge, determinations of nerineacean sections can hardly ever exceed the generic level. Nerineacean genera may range over several stages. Nevertheless, a bio-zonation can be established from the first appearance and the extinction of genera in shallow marine environments. Such zones represent partial range zones.

2. Geological setting of the Albanian occurrences (Fig. 1)

The material originates from two sections: The Munella mountain (north Albania) and the Farreti section (central Albania). They both belong to the Mirdita Zone (Fig. 1).

2.1. Munella section (Fig. 2.1.)

In the Munella mountain, Cretaceous rocks overlie transgressively ophiolitic rocks which mainly consist of keratophyrs, diabases, spilites, etc. PEZA & al. (1983) have subdivided the Cretaceous section from base to top as follows:

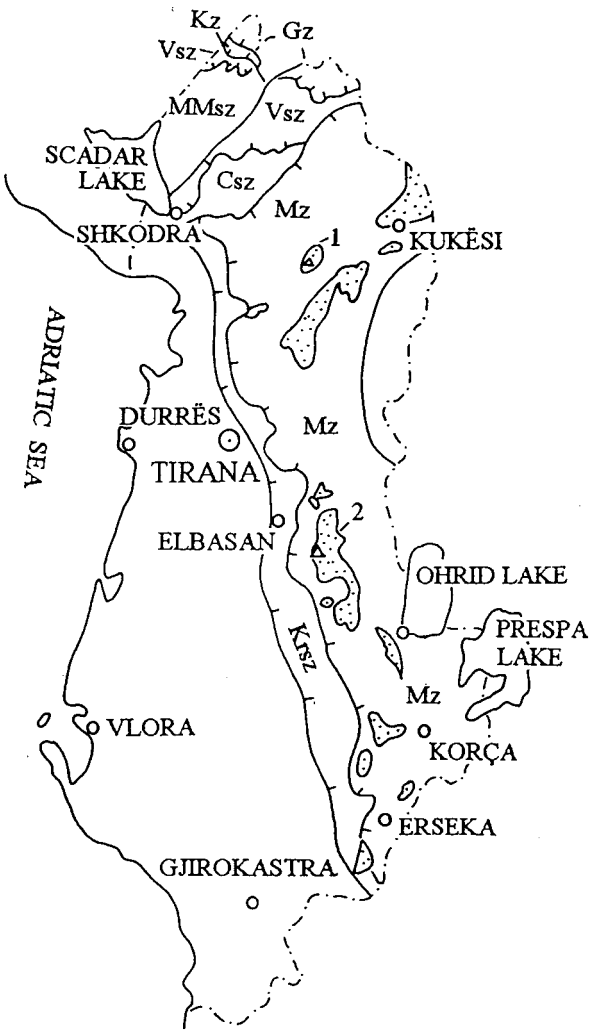

Fig. 1. Distribution of Cretaceous rocks (dotted) in the Mirdita zone of Albania (MZ). Sections mentioned in this paper: Munella section (1) and Farreti section (2). For other tectonic zones see PEZA (1989).

1. Coarse breccia. The lithoclasts consist mainly of ophiolitic material. Lithoclasts of Triassic to Jurassic limestones are subordinate.

2. Flyschoid sediments consisting of alternating biocalcarenitic and turbiditic limestones and sandstones, green marls and subordinate breccias. In the limestones and marls, calpionellids are abundant. *Calpionellopsis oblonga* (CADISH), *C. simplex* (COLOM), *Tintinopsella longa* (COLOM), *T. carpathica* (MURGEANU & FILIPESCU), *Remaniella cadishiana* (COLOM), *Calpionella elliptica* CADISH, *Trocholina alpina* (LEOPOLD) indicate a Middle Berriasian to basal Valanginian age.

3. Breccia, fine-grained sandstone and marls. Some levels of the marls are rich in microfossils: *Calpionellites darderi* (COLOM), *Calpionellopsis oblonga* (CADISH), *Calpionellopsis simplex* (COLOM), *Tintinopsella carpathica* (MURGEANU & FILIPESCU), *Amphorinella subacuta* COLOM indicate a Valanginian age.

4. Alternation of sandstones, conglomerates, and marly limestones with *Trocholina friburgensis* (GUILLAUME & REICHEL), *Requienia* sp., *Actaeonina syriaca* WHITFIELD, *Microschiza (Coronatica) heybroeki* DELPEY.

5. Alternation of conglomerates, sandstones and rare layers of marly limestones. Some argillaceous layers contain coal lenses. The megafossil assemblage consists of *Protocardia anglica anglica* WOODS, *Tellina multilineata* COQUAND, *Rutitrigonia longa* AGASSIZ, *Corbula* sp., *Turritella* sp., *Nerinea* sp.

6. Various types of limestones with rare intercalations of conglomerates and sandstones. These deposits are rich in micro- and megafossils: *Salpingoporella melitae* (RADOICIC), *Macroporella pygmaea* (GÜMBEL), *Choffatella decipiens* SCHLUMBERGER, *Trochalia friburgensis* (GUILLAUME & REICHEL), *Requienia ammonia* GOLDFUSS, *Nerinea aptiensis* DELPEY, *N. diffusa* DELPEY, *N. coquandi* D'ORBIGNY, *N. chloris* COQUAND, *N. gigantea* D'HOMBRE-FIRMAS, *N. vogti* DE MORTILLET, *N. pauli* COQUAND, *Nerinella libanotica* DELPEY, *Nerinella* sp., *Actaeonina syriaca* WHITFIELD, *Terebrella sanctaecrucis* (PICTET & CAMPICHE), *Pseudomelania clio* PICTET, *Neithea deshayesiana* MATHERON, *Panopea plicata* SOWERBY, *Astarte subcostata* D'ORBIGNY.

The series 4 to 6 are developed in Urgonian facies and are of Barremian – Aptian age. Besides the other fauna, *Diptyxis luttickei* (BLANCKENHORN), *Diptyxis munellae* n. sp. and *Diptyxis mirditae* n.sp. have been collected there.

7. Thick-bedded platform limestones with rare conglomeratic intercalations. In the uppermost part of the series, oolithic limestones predominate. The limestones are rich in *Carpathoporella fontis* (PATRULON), *Salpingoporella dinarica* (RADOICIC), *S. melitae* (RADOICIC), *Cylindroporella sugdeni* ELLIOT, *Macroporella pygmea* (GÜMBEL), *Palaeodictyoconus arabicus* HENSON, *Choffatella dicipiens* SCHLUMBERGER, *Nautiloculina oolithica* MOHLER. The deposits are developed in Urgonian facies and are of Aptian age.

2.2. Farreti section (fig.2.2.).

The Farreti section is situated south of the town of Kibrazhdi in central Albania (see fig. 1). Over ophiolitic rocks (ultrabasic rocks, diabase, etc.) the following section of Cretaceous rocks was recorded:

1. A few tens of metres of alternating conglomerates and sandstones. The source of the lithoclasts are ophiolitic rocks and Triassic – Jurassic limestones. *Nerinea coquandi* (d'ORBIGNY) and *Nerinea gigantea* D'HOMBRE-FIRMAS were recorded in this part of the section.

2. Alternating micritic and conglomeratic limestones with *Nautiloculina oolithica* MOHLER, *Salpingiporella dinarica* (RADOICIC), *Trocholina friburgensis* (GUILLAUME & REICHEL).

3. Limestones similar to 2. but with limonitic layers.

4. Well-bedded limestones with rare chert lenses. Sandy limestones in the upper part are rich in megafossils. The gastropod taxa *Neoptyxis astrachanica* (REHBINDER), *Multiptyxis dayi* (BLANCKENHORN), *Multiptyxis prefleuriaui* (DELPEY), *Aptyxiella fraasi* (BOEHM), *Nerinella dupiniana* (d'ORBIGNY), *Diptyxis munellae* n.sp., and the coral taxa *Epismilia robusta* (KOBY), *Epismilia* sp., *Montlivaltia* cf. *kaufmanni* KOBY, *Stylina* sp., *Diploctaenia* sp., *Epistreptophyllum* sp., *Dermosmilia* sp. are frequent. The micro-assemblage contains

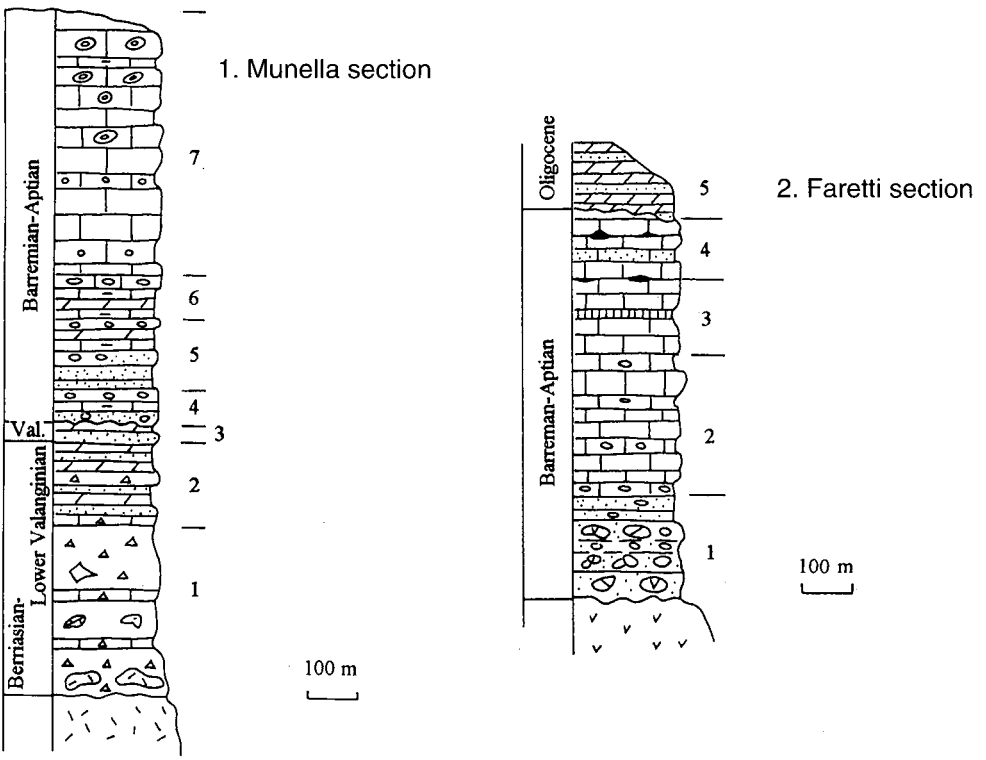

Fig. 2. 1. Munella section; 2. Farreti section. The numbers correspond with the description of the rocks in the text.

Cylindroporella sugdeni ELLIOT, *Salpingoporella melitae* (RADOICIC), *Carpathoporella fontis* (PATRULON), *Trocholina friburgensis* (GUILLAUME & REICHEL). The age is Barremian – Aptian. The uppermost part of the section may be of Aptian age.

3. Systematic part

Superfamily Nerineacea

Family Nerineidae

Genus: *Diptyxis* OPPENHEIM, 1889

Synonymous: *Favria* COSSMANN (1916); *Julesia* COX (1954); *Cylindroptyxis* PCHELINTSEV (1965).

D i a g n o s i s of genus (given herewith): Nerineaceans with concave whorls possessing a sculpture of tubercles. Last whorl with angular periphery and convex base. Internally with 1 short columellar plait and a long, bent parietal plait.

R e m a r k s: In a contribution to the geology of the Island of Capri, Italy, OPPENHEIM (1889) has named a nerineacean gastropod *Nerinea (Diptyxis?) biplicata* n.sp. OPPENHEIM neither gives an additional description of the subgenus *Diptyxis* nor does he comment on the question mark which he had added to the new sugeneric name. The subgenus was not accepted by DIETRICH (1925). He remarked that the subgenus was only based on a single specimen which also could be a certhiacean gastropod. It was not even mentioned by WENZ (1938–44). Based on OPPENHEIM's figure, PCHELINTSEV (1931), has applied the name to specimens possessing a short columellar plait and a long parietal plait.

OPPENHEIM's use of the subgeneric name certainly does not correspond strictly with rules of nomenclature. It is obvious that OPPENHEIM wanted to emphasize the difference between *Nerinea biplicata* and other taxa of nerineaceans but was not sure if a new subgenus or even genus was justified. We therefore agree with PCHELINTSEV that *Diptyxis* should be kept as a subgeneric or generic name.

Favria was considered as a subgenus of *Phaneroptyxis* by COSSMANN (1916, 1918) and as a genus by COSSMANN (1918a). We consider *Favria* COSSMANN (1916) as a synonym of *Diptyxis*. The type species of *Favria* is *Phaneroptyxis pellati* COSSMANN (1907). It is small and high pupoid. Its shell angle is 15 – 20°. The whorls are strongly concave and possess tubercles at the abapical suture. The base is inclined at about 45° towards the shell angle. The last whorl has an umbilical slit. The columellar and the parietal plait are strong.

The shells which COSSMANN (1916) assigned to *Favria* are relatively stout. COSSMANN has therefore assigned them to the family Itieriiedae. Actually, the large shell angle is common in early ontogenetic stages of *Diptyxis* and there is no fundamental difference to higher-spired specimens which are considered to be nerineaceans. The assignment to another family or even super-family (PCHELINTSEV 1965) is therefore unjustified. According to COX (1954), *Favria* COSSMANN is a homonym of *Favria* Tutt. COX therefore replaced the generic name by the new name *Julesia*. As we consider *Favria* to be a synonym of *Diptyxis*, this is obsolete. VAUGHAN (1988) kept both genera, *Diptyxis* and *Julesia*. She stated that *Julesia* belonged to an uncertain Nerineacea subfamily but not to the Itieriidae.

PCHELINTSEV (1965) has established the genus *Cylindroptyxis*, with *Nerinea mikoi* HERBICH (1886) as type species. The genus was described as follows: "Big, slender, turriculate shells which are almost cylindrical in general outline and consist of flat, feebly concave whorls. The sutural ridges often bear a row of tubercles. Sometimes, the whorl surface bears tubercles as well. The umbilicus is narrow, closed" (translated from the Russian). PCHELINTSEV emphasizes the close relationship between *Cylindroptyxis* and *Diptyxis*. He distinguishes *Cylindroptyxis* from *Diptyxis* by a "thin, closed, umbilicus". Obviously, PCHELINTSEV refers to a narrow hollow space in the columella. It is developed between the former siphonal neck of a whorl and the columellar wall of the following one. The breadth of this hollow space varies depending on the tightness of coiling. There is no reason for establishing different genera on its variable width.

Description of species

Diptyxis luettickei (BLANCKENHORN, 1890)

(Plate 1, Figure 1)

1890 *Nerinea Lüttickei* BLANCKENHORN: 106, pl. 8, fig. 4.
1925 *Nerinea* (s. s.) *Lüttickei* BLANCKENHORN – DIETRICH: 127.
1927 *Nerinea Lüttickei*, BLANCKENHORN: 152.
1940 *Nerinea Luttickei* BLANCKENHORN – DELPEY: 176, fig. 137, pl. III, fig. 1,2.
1989 *Oligoptyxis lüttickei* (BLANCKENHORN) - KOUYOUMONTZAKIS, Nerineidae: 25, pl. 1, fig. 1.

Non: 1980 *Cossmannea (Eunerinea) luttickei* (BLANCKENHORN) – BUITRÓN & BARCELÓ-DUARTE: 51, fig. 6a–d.

? 1986 *Diptyxis luettickei* (BLANCKENHORN) – CALZADA: 11, pl. III, fig.4.

1976 *Oligoptyxis lüttickei* (BLANCKENHORN) – PRATURLON & SIRNA, Piattaforma Laziale-Abbruzzese: 103, textfig. 22 (= *Diptyxis cottai* GEINITZ)

? 1986 *Cylindroptyxis* sp. – CALZADA: 8, pl. III, fig. 2.

1993 *Diptyxis lüttickei* (BLANCKENHORN) – SIRNA & MASTROIANNI, Campoli Appennino: 143, pl. 1, fig. 4; pl. 3, fig. 2 (= *Diptyxis cottai* GEINITZ)

M a t e r i a l: 5 incomplete specimens.

D e s c r i p t i o n: The shells are broad turriculate. The whorls are moderately concave with the zone of deepest depression in the abapical half. The suture lies slightly adapical of the sutural ridge. The monocline growth lines curve backwards at the adapical suture. The base is moderately high and slightly convex. The periphery is broadly bulging. The aperture is not preserved. Axial sections show a high and straight columellar wall with a broad but low plait at the limit between abapical and medium third. The basal and the palatal wall form a broad arc. The parietal plait is long and bent.

D i m e n s i o n s:

Height/shell	Max.diameter	Whorl height	Height/Diameter
55 mm (fragm.)	28 mm	11 mm	0.392

sutural angle 18°, apical angle 35°

R e m a r k s: The absence of tubercles at the sutural ridge distinguishes *Diptyxis luettickei* (BLANCKENHORN, 1890) from most other species of *Diptyxis*. Shells described by BUITRÓN & BARCELÓ-DUARTE (1980: 51, fig. 6) as *Cossmannea (Eunerinea) luttickei* (BLANCKENHORN) definitely belong to *Diptyxis* but they differ from *Diptyxis luettickei* by the low shell angle. Probably, the very broad sutural ridge bore an adapical row of tubercles which is eroded. CALZADA (1986: 11, pl. III, fig. 4) assigned a fragmentary internal mould to *Diptyxis luettickei* (BLANCKENHORN). A determination beyond the generic level is not possible. The same applies to *Cylindroptyxis* sp., of which an axial section was figured by CALZADA in plate 3, fig. 2. *Oligoptyxis lüttickei* PRATURLON & SIRNA (1976) and *Diptyxis lüttickei* SIRNA & MASTROIANNI (1993) differ from *D. luettickei* by their almost flat whorls. They belong to *Diptyxis cottai* (GEINITZ).

Biostratigrapical distribution. Barremian – Aptian in the Mirdita zone of Albania. From Lebanon, DELPEY (1940) described the species from beds that are below the "Falaise de Blanche". It is considered as basal Upper Aptian by all authors (SAINT-MARC 1981). The beds containing *Diptyxis luettickei* are therefore considered as Lower Aptian in age.

L o c a l i t i e s:

Albania. Munella mountain, northeast Albania. Sample nr 116/7, collection of Ing. Dede MARKU.

Occurrences in Lebanon were listed by DELPEY (1940).

Diptyxis munellae n. sp.

(Plate 1, Figures 8–10)

N a m e: After the Munella mountain.

L o c u s t y p i c u s: Munella mountain, northern Albania.

D i a g n o s i s: *Diptyxis* possessing high, deeply and narrowly incised whorls which bear adapically a row of prominent, rounded tubercles.

M a t e r i a l: Holotype and 1 paratypoid (both incomplete)

D e s c r i p t i o n: The shells are moderately broad turriculate. The whorls are concave with a deep, narrow incision in the abapical half. The adapical half bears a row of strong, rounded tubercles which are very prominent in the last whorl. The periphery is protruding horizontally. The base is high, convex.

A x i a l s e c t i o n: The whorls before last are angular at the periphery. The whorl interior is high and broadly rhombic in cross section. The columella is solid. Within the columella, contours of former siphonal necks extend in abapical direction until the columellar plait of the following whorls. The columellar plait is low, has a broad base and is situated in the abapical half of the columella. Adapically of the plait the columella is straight. The prominent parietal plait is situated in the middle of the parietal wall, thin and slightly bent.

D i m e n s i o n s:

Height/shell	Max.diameter	Height/whorl	Height/Diameter
76 mm	26 mm	14 mm	0,538

Apical angle 37°, spiral angle 25°

Remarks. *Diptyxis munellae* n.sp. differs from *D. luettickei* by its higher, deeply incised whorls and the strong tubercles at the suture.

In *Diptyxis crispa* (ZEUSCHNER, 1849) the adapical tubercles are smaller. *Diptyxis plassenensis* (PETERS, 1855) possesses large tubercles and a high, flat base. Probably all species described by HERBICH (1886) which belong to *Diptyxis* fall within the variability of *D. plassensis* (see chapter 3). Differences of the shell angle, the general outline of the shell (pupoid in small specimens and turriculate in larger ones) and the whorl shape (almost cylindrical to concave) are fluent. The incision of the whorls is not as narrow as

in *Diptyxis munellae* n.sp. Judging from HERBICH's figures, the differences between these specimens and those described by PCHELINTSEV (1931) under various names are minimal. The whorls in *Diptyxis alsusensis* PCHELINTSEV are broadly concave and the periphery is rounded. In specimens with less overlapping whorls, two rows of tubercles exist on the sutural ridge like in *Nerinea transylvanica* HERBICH (1886).

Stratigraphical level in the Mirdita Zone. Barremian to Aptian.

O c c u r r e n c e: The holotype was collected by the engineer Dede MARKU in a sandstone of the Munella mountain. The paratypoid was collected by L. PEZA in sandy limestone of the upper part of the Farreti section (collection L.H. PEZA, sample 2081).

Diptyxis mirditae n.sp.

(Plate 1, Figure 2–7)

N a m e: From the Mirdita Zone, which is a major tectonic zone of Albania

L o c u s t y p i c u s: Munella mountain, Albania.

M a t e r i a l: Holotype and 4 paratypoids.

D i a g n o s i s: *Diptyxis* with low, moderately concave whorls; early ontogenetic whorls with row of coarse adapical tubercles. Last whorl with moderately bulging periphery and low base.

D e s c r i p t i o n: The shell is turriculate. The shell angle, which is over 30° in early ontogenetic whorls, decreases with ontogeny to less than 20°. The whorls are low and moderately deep concave. Early ontgenetic whorls bear adapically a row of regular, prominent tubercles. The tubercles become indistinct and irregular in later whorls. In some specimens the abapical part of the whorls bears a smooth rib. The periphery is moderately bulging. The base is low, convex.

A x i a l s e c t i o n: The whorl outline resembles a parallelogramme. The columellar plait is strong, with a broad base. The parietal plait is situated in the middle of the parietal wall, thin and bent in an adapical direction.

D i m e n s i o n s:

Height/shell	Max.diameter	Height/whorl	Height/Diameter
64 mm (fragm.)	32 mm	11 mm	0.343
36 mm (fragm.)	24.5 mm	7.5 mm	0.306

Apical angle = 40°, spiral angle = 21°

R e m a r k s: The overlap of the whorls is variable. In some specimens the peripheral bulge of the whorls is visible as a smooth costa.

In *Diptyxis munellae* n. sp. the whorls are higher and more deeply incised. The sculpture of *Diptyxis mirditae* n. sp. resembles that of *Diptyxis plassensis* (PETERS) and *D. coniodea* (PETERS). In these species the whorls are higher.

O c c u r r e n c e: A sandstone of the Munella mountain (collection PEZA number 116/7), Farreti section (collection of engineer D. MARKU).

3. Recordings of *Diptyxis* taxa

In this review, specimens with a small columellar plait and a large bent parietal plait are assigned to *Diptyxis*. It is almost entirely based on the literature. The quality of information on the morphology, the biostratigraphic distribution and locality data is not equal. In most cases, a revision of species was therefore not possible. The purpose of this chapter is to improve our knowledge of the stratigraphic and geographic distribution of *Diptyxis*. The species are listed with their original generic assignment. They are arranged in geographic and biostratigraphic order according to the literature.

Upper Jurassic

Diptyxis fogdti PCHELINTSEV (1931); Crimea, "Sequanian".

Diptyxis csaklyana HERBICH (1886), *D. bidentata* GEMMELLARO, *D. cerithiformis*, *D. mikoi* HERBICH, *D. böckhi* HERBICH, *D. conoidea* PETERS, *D. corgunensis* VOGDT, *D. dilata* PCHELINTSEV, *D. longiptyxis* PCHELINTSEV, *D. rara* PCHELINTSEV, *D.satuensis* PCHELINTSEV.– PCHELINTSEV (1931, 1965); Crimea; Tithonian.

Nerinea crispa ZEUSCHNER. Inwald and Roczyny, Poland.– ZEUSCHNER (1849); Tithonian.

Nerinea fichteli HERBICH, *N. transylvanica* HERBICH, *N. csaklyana* HERBICH, *N. syndjecavae* HERBICH, *N. boeckhi* HERBICH, *N. mikoi* HERBICH, *N. sicula* GEMMELLARO, *N. crispa* ZEUSCHNER, 1849, *N. conoidea* PETERS, *N. plassenensis* PETERS, *N. petrea* HERBICH, *N. bidentata* GEMMELLARO. After HERBICH (1886); Rumania; Upper Jurassic. Remarks. The species concept of HERBICH is extremely narrow (see chapter 2). Obviously, all species are synonyms of *Diptyxis plassensis* (PETERS).

Nerinea syndjecavae HERBICH, *N. micoi* HERBICH, *N.* cf. *transylvanica* HERBICH, *N.* cf. *crispa* ZEUSCHNER – KRIVIC (1974). Trnovski Gozd, Banjska Planot, Slowenia; Upper Jurassic. Remarks. The fauna was determined from axial sections. The assignment to species is doubtful.

Nerinea conoidea PETERS, *N. syndjecavae* HERBICH, *N.* cf. *crispa* ZEUSCHNER – NIKLER (1969); Velike Kapele, Croatia; Tithonian.

Nerinea (?Diptyxis) biplicata OPPENHEIM (1889). Capri, Italy; Upper Jurassic. Type species.

Nerinea bidentata GEMMELLARO; Cruci di Monto Pellegrino, environment of Palermo.

Nerinea crispa ZEUSCHNER, *N. wosinskiana* ZEUSCHNER, *N. conoidea* PETERS – OOSTER (1869). Wimmis, Switzerland; Upper Jurassic.

Nerinea plassensis PETERS, *Nerinea crispa* ZEUSCHNER – PETERS (1855). Plassen mountain, Upper Austria; Upper Jurassic.

Nerinea conoidea PETERS – ZITTEL (1873); Stramberg, Czech Republic; Tithonian.

Lower Cretaceous

Diptyxis rara PCHELINTSEV, *D. distincta* PCHELINTSEV, *D. alsusensis* PCHELINTSEV, *D. anormalis* PCHELINTSEV – PCHELINTSEV (1931); Crimea; Valanginian.

Nerinea sp. TOULA (1892). Ruscuk, Lome Valley, Bulgaria. "Neocomian".

Julesia pellati (COSSMANN) – VAUGHAN (1988), Upper Hauterivian, Sintra area, Portugal.

Nerinea euphyes FELIX, 1891; Tehuacan, State Pueblo, Mexico; *Nerinea euphyes* ALENCASTER (1956) from Zapotitlan, Mexico; *Nerinea (Nerinea* s.str.) *titania* FELIX, 1891 from Tehuacan, State Pueblo, Mexico; *Nerinea azteca* ALENCASTER (1956) from Zapotitlán; *Cossmannea (Eunerinea) lutickei* BUITRON & BARCELO-DUARTE (1980) from San Juan Raya-Santa Ana Teloxtoc; *Nerinea* sp. ALENCASTER (1956) from San Juan Raya-Zapotitlán, Mexico. All specimens are from the Zapotitlan Formation and from the Aqua del Burro Formation (Barremian).

Phaneroptyxis pellati COSSMANN, 1907, *Phaneroptyxis (Favria) pellati* COSSMANN (1916). Brouzet-Les-Alais, Gard, France; Urgonian.

Cylindroptyxis sp. CALZADA (1986). ?Aptian, Ares del Maeste, NE Spain; Described is the axial section of a fragmentary internal mould.

Diptyxis luttickei (BLANCKENHORN), *Diptyxis* species 1, *Diptyxis* species 2 – VAUGHAN (1988). Lower Aptian, St.Juliano, Portugal.

Nerinea lüttickei BLANCKENHORN (1890); DELPEY (1940). Lower Aptian, Lebanon.

? Nerinea nötlingi BÖHM (1900). Ijzim, Karmel. Aptian.

? *Nerinea byzacaenica* PERVINQUIÈRE, 1912; Algeria, Mt. Mrhila. Aptian age according to PERVINQUIÈRE. The doubtful specimens are low-spired and are preserved as fragmentary internal moulds. The morphology of the moulds closely resembles that of *Mrhilaia* (see below).

Nerinea (Ptygmatis) hottingeri COLLIGNON, 1972. Tarfaya, Marocco; Upper Albian.

Upper Cretaceous

Oligoptyxis lüttickei (BLANCKENHORN) – PRATURLON & SIRNA, 1976. This and the following recording are only known from sections. The whorls are high and almost flat. These specimens do not belong to *Diptyxis lüttickei* but probably to *Diptyxis cottai* (GEINITZ); Latium-Abruzzi Platform, Central Appenines, Italy; Upper Cenomanian.

Diptyxis lüttickei (BLANCKENHORN) – SIRNA & MASTROIANNI 1993; Campoli Appennino, Italy; Upper Cenomanian.

Nerinea (Nerinea) parva LUPU, 1965; Cherghes, Rumania; ?Lower Cenomanian.

Nerinea cottai GEINITZ (1874). Koschütz near Dresden, Germany; Upper Cenomanian.

Nerinea cottai GEINITZ – FRIC (1911). Zlosejn, Czech Republic; Korycany Formation, Upper Cenomanian.

Diptyxis cf. *cottai* (GEINITZ). Akros Mountains, Greece; Upper Cenomanian (coll. KOLLMANN, unpublished).

Oligoptyxis sp., PCHELINTSEV (1953). Armenia; ? Turonian

Doubtful recordings

Diptyxis tibetica YÜ (1982). Tibet; ? Lower Cretaceous. The specimens are pupoid. There is only a parietal plait observable. The whorls are low and narrow. The species may also belong to *Oligoptyxis* PCHELINTSEV.

Remarks on taxa which possess a columellar and a parietal plait but do not belong to *Diptyxis*

Cimolithium COSSMANN (1906). Type species: *Cerithium belgicum* d'ARCHIAC. COSSMANN has described tubercles at the adapical suture and the four-cornered aperture but did not mention internal plaits. In a schematic figure, DELPEY (1941–42) arranged *Cimolithium* together with forms which possess a columellar plait and a parietal plait. KOLLMANN (1979) has described a short columellar plait and a long and thin parietal plait in *Cimolithium*. The parietal plait is situated close to the adapical end of the columella.

Because of strictly monocline growth lines, *Cimolithium* cannot be assigned to the nerineaceans. DELPEY mentions impressions of 2 tooth-like protrusions each on the palatal and the basal portions at the beginning of the final whorl-half of internal moulds. DELPEY (1941–42) and KOLLMANN (1979) assigned *Cimolithium* to the Campanilidae.

Mrhilaia PERVINQUIÈRE, 1912. Type species: *Mrhilaia haugi* PERVINQUIÈRE. According to the orginal description, this species possesses 2 internal plaits (columellar plaits after PERVINQUIÈRE). Actually, one of them is a parietal plait. As in *Cimolithium*, the columellar plait is close to the adapical end of the columella. PERVINQUIÈRE has figured deep impressions of internal protrusions on the palatal part of the mould. PERVINQUIÈRE correctly assigned *Turritella nerineaeformis* COQUAND (1862) to *Mrhilaia*. This species has also been described by GRECO (1916) from Egypt. The palatal part of the mould shows a broad and flat furrow. One of the specimens figured by PERVINQUIÈRE shows a long columellar plait.

Nerinea kentensis STANTON (1947), which was described from the Lower Cenomanian Buda limestone of the Kent area, Texas, probably belongs to *Mrhilaia*. Specimens figured by STANTON show the two internal plaits. The specimen of STANTON's plate 62, figure 18 is obliquely cut. The position of the plait in the adapical portion of the columella is indicative for a systematic position within *Mrhilaia*. This is affirmed by material collected by KOLLMANN, DECKER and LEMONE at the type locality (unpublished).

The combination of a columellar plait and a parietal plait therefore does not occur exclusively in nerineaceans but also in the Cretaceous Campanilidae. Externally, they differ from the Nerineacea by the lack of a sutural notch. The only noticeable difference in axial sections, especially when the shell is recrystallized, is the more adapical situation of the columellar plait. Generic determinations of sections must therefore be treated with caution.

Conclusions

The Early ontogenetic shells in *Diptyxis* are pupoid, while large ones are almost cylindrical. The stratigraphic range of *Diptyxis* is Upper Jurassic ("Sequanian") to Cenomanian. Jurassic occurrences are known from European carbonate platforms. In the Lower Cretaceous, *Diptyxis* was distributed all over the Tethyan realm. There are recordings from south and southeast Europe, north Africa, the Near East, doubtfully from Tibet, and from southern North America.

In the Upper Albian, *Diptyxis* has only been recorded in Algeria. *Diptyxis hottingeri* (COLLIGNON) possesses slightly convex whorls. Similar whorls are developed in all Cenomanian species. Together, they form a distinct group. In the Cenomanian, *Diptyxis*

is occurring in the eastern part of Tethyan province. The westernmost occurrence is south Italy. From the Upper Cenomanian, only *Diptyxis cottai* (GEINITZ) is known. It extends north into marginal Tethyan zones (Czech Republic, Saxony). A single specimen was recorded from Turonian strata of Armenia (*Oligoptyxis* sp. PCHELINTSEV 1953). It does not fit into this pattern.

As in *Diptyxis*, a columellar and a parietal plait are developed in the Campanilidae genera *Cimolithium* COSSMANN and *Mrhilaia* PERVINQUIÈRE.

Acknowledgements: The authors are grateful to Dr. Jozef WIECZOREK, Krakow, for reviewing this paper and valuable comments. The cooperation has been made possible by financial supports of the Czech Academy of Sciences and the Naturhistorisches Museum, Vienna, to Luftulla H. PEZA.

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Plate 1

Fig. 1. *Diptyxis luettickei* (BLANCKENHORN). Munella mountain.

Fig. 2, 3. *Diptyxis mirditae* n.sp. Holotype. Munella mountain, locality 116/7.

Fig. 4. *Diptyxis mirditae* n.sp. Abapical part of Holotype. Munella mountain, locality 116/7.

Fig. 5. *Diptyxis mirditae* n.sp. Paratypoid. Farreti section.

Fig. 6. *Diptyxis mirditae* n.sp. Paratypoid, Munella mountain, locality 116/7.

Fig. 7. *Diptyxis mirditae* n.sp. Large paratypoid showing the change of shell angle. Farreti section.

Fig. 8, 9. *Diptyxis munellae* n.sp. Holotype. Munella mountain.

Fig. 10. *Diptyxis munellae* n.sp. Paratypod. Munella mountain, locality 2081.

Photographs: Alice SCHUMACHER, Naturhistorisches Museum Wien. All figures in natural size.