Cingolites n.gen., a new lower Toarcian Hildoceratinae (Ammonitina) from the Marchean Apennines (Cingoli, Macerata, Italy)

Stefano SASSAROLI & Federico VENTURI

ABSTRACT - New biostratigraphic data are provided from the Marchean Apennines (Marconessa quarry, near Cingoli, Macerata, Italy) where a lower Jurassic outcrop yielded a remarkable Toarcian ammonite assemblage, very rich in early Hildoceratinae (Ammonitina). The site is historically meaningful, because in the past two centuries Italian palaeontologists have figured ammonoid specimens from “Marconessa”. Here, the nodular limestone and grey marl of the Bugarone Formation have recorded a great amount of well preserved Toarcian inner moulds of ammonoids sometimes large sized. From the lower and middle Toarcian layers of the Marconessa quarry sections we collected several ammonite genera, such as Hildaites, Orthildaites, Hildoceras, Harpoceras, Taffertia, Rakusites, Martanites, Mercaticeras, Mercaticeras, Lytoceras, Frechielia, Phymatoceras, Lytoceras, Praepolyplectus, Polyplectus, Orthodactylites, Mesodactylites, Nodicoeloceras, very rare Dactylioceratidae and Nejdia, Lyrtothyloceras, Calliphylloceras, Phylloceras. We establish herein a new genus Cingolites, to which we ascribe three new species (C. clavatus, C. picenus and C. spiralis) and an already established species (C. stefaninii), which was previously assigned by Merla (1932) to the genus Mercaticeras. To the present-day the genus Cingolites seems to have a Mediterranean Tethys dispersal, mainly in the Apennines, where it occurs with other endemic Hildoceratinae fauna. These ammonite assemblages found in our Apennines sections seem to show a certain amount of provincialism that affected some Hildoceratinae lineages of the lower Toarcian.


FOREWORD

This work concerns the ammonites of the new genus Cingolites (Hildoceratinae), which were collected in the lower Toarcian of the Apennines (Marchean Apennines, Italy). We found the earliest Cingolites specimens near the top of the Hildaites serpentinus Zone (sensu Mouterde, 1967; Pelosio, 1968; Elmi et al., 1974; Gabily, 1976) or the Hildaites levisoni Zone (sensu Guex, 1976 and Elmi et al., 1994). In the Apennines the occurrence of both indexes H. serpentinus and H. levisoni is, nevertheless, very questionable and our new biostratigraphic data need a revised early Toarcian ammonite zonation for the Mediterranean Province (or West Tethyan), being in our opinion the Standard Zonation (Page, 2003, 2004) unsuitable to correlate this Province with Submediterranean and Subboreal Provinces. On the other hand, according to Donovan (1958) Harpoceras serpentinum and Harpoceras falciferum, which are the typical index species for the early Toarcian of NW Europe, are not suitable for the Apennines.

We carried out a bed-by-bed biostratigraphic sampling of ammonite specimens from the Liassic outcrop of the Marconessa quarry near Cingoli (Macerata, Italy). This outcrop is located on the orographic left side of the valley cut by Rudileu creek in the Jurassic sequences, between Carcatora Mt. and S. Angelo Mt. (see Fig. 1; Carta IGM F°124 I NO-F°117 II SO; Carta Geologica d’Italia F°124
mainly of ammonites and other molluscs. Several earlier ammonite specialists, such as Meneghini (1867-1881), Bonarelli (1899, 1899), Merla (1932) and Ramaccioni (1939), have often quoted and figured specimens coming from the “Marconessa” of Cingoli. Over the years a number of amateurs collected in the detritus of the Marconessa quarry a remarkable amount of ammonites, which are often well preserved and sometimes very large sized as calcareous inner moulds. More recently some ammonites of the Marconessa quarry were studied by Dezi & Ridolfi (1975, 1978) and Sassaroli & Venturi (2005).

All specimens of the Sassaroli-Venturi collection here studied and figured are temporarily housed in the Department of the Earth Sciences – Perugia University.

**BIOSTRATIGRAPHY OF THE MARCONESSA QUARRY SECTIONS**

The ammonites described here were collected from two sections of Marconessa quarry. In the logs of the sections 2 and 3 (Figs. 2-4) a numbered arrow indicates the fossiliferous beds where the specimens were found. In sections 2 and 3, above the black shales of the oceanic anoxic event (OAE) a calcareous layer of variable thickness occurs: here we have observed the first occurrence of the genus *Hildaites*. Above this layer the nodular limestone and grey marl occur, with several beds yielding the genera *Taffertia, Rakusites, Martianites, Harpoceras, Praepolyplectus, Polyplectus, Neotaffertia, Phymatoceras, very rare *Dactylioceras* and *Nejdia, Mesodactylites, Nodicoeloceras, Rarenodia, Mercaticeras, Leukadiella, Frechiella, Phylloceras, Calliphylloceras, Lytoceras* and the new genus *Cingolites*, as well as several *Hildaites* and *Orthildaites*, which are genera that are here recorded with already described species and some new ones. We observed the first occurrence of the genus *Hildoceras* at the bottom of the Bifrons Zone. Because the Mediterranean Tethys Standard Zonation is very difficult to apply to our Marconessa quarry sections for the lower Toarcian, we propose here a provisional zonation based on two typical *Hildaites* taxa collected in the Apennines sections, both shapes are already well-known such as *Hildaites striatus* Guex, 1973 and *Hildaites undicosta* (Merla, 1932). Both early Toarcian Striatus and Undicosta chronozones could be provisionally compared to the Levisoni Zone of the Tethys Mediterranean Standard Zonation (Elmi et al., 1994). We provisionally subdivide our Bifrons chronozone, commonly characterized from the first occurrence to the disappearance of *Hildoceras*, in four sub-chronozones (*H. sublevisoni, H. lusitanicum, H. angustisiphonatum* and *H. semipolitum*) being this genus broadly dispersal both in the West Tethyan Province and in the European Province, which may be easily thus correlated. *Hildoceratinae* may be also useful to correlate the earliest Toarcian (excluding the Tenuicostatum and Polymorphum or Mirmible zones) of these Provinces, being the early Toarcian post-OAE characterized in our section from the sudden appearance of *Hildaites*. Thus, we subdivide our Undicosta Zone in a *Hildaites crassus*
S. Sassaroli, F. Venturi - Cingolites n.gen. from the Toarcian of the Apennines

In our Marconessa outcrop we observe a gap in the fossil record with regard to the underlying early Toarcian beds pre-OAE, ascribed to the Tenuicostatum Zone by the NW European Standard Zonation (Page, 2003, 2004) or Polymorphum Zone by the “Tethyan Standard” (Elmi et al., 1994). In fact, it seems that the dark marly layers which record the OAE lay on a calcareous bed of the top of the Domerian (upper Pliensbachian) where a hardground surface occurs (see logs, Figs. 2, 4). About 20 cm under this hardground, a calcareous bed into the Corniola Formation has recorded the last occurrence of *Jaraphyllites* sp. indet. and *Neolioceratoides schopeni* (Gemmellaro, 1886), which are forms commonly believed occurring in the uppermost Pliensbachian (Cantaluppi, 1970; Ferretti, 1975), although the latter

![Diagram](image)

Fig. 2 - Log of the Marconessa quarry section 2 (part 1) and ranges of *Cingolites* and other ammonites, chiefly Hildoceratinae, in the early Toarcian.
<table>
<thead>
<tr>
<th>STAGE</th>
<th>ZONE</th>
<th>Subzone</th>
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<tbody>
<tr>
<td>BIFRONS</td>
<td>Sublevensoni</td>
<td>bed 10: Hildoceras gr. cattinì; Hildoceras sublevensoni; Hildoceras sublevensoni var. sulcosa; Hildoceras acarnanicum; Hildoceras sp. indet.; Phymatoceras elegans; Mercaticeras rursicostatum; Mercaticeras sp. indet.; Polypectus pluricoastatus; Harpoceras sp. indet.; Nodicoeloceras gr. angoloni; Mesadactylites gr. sapphicus (Renz, 1912); Mesadactylites sp. indet.; Phylloceras (doderleinianum); Phylloceras sp. indet.; Calliphylloceras nilssonii; Calliphylloceras capitanei.</td>
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<td>bed 10b: Hildoceras cattinì; Hildoceras sublevensoni; Hildoceras sublevensoni var. sulcosa; Hildoceras acarnanicum Mitzopoulos, 1930; Hildoceras sp. indet.; Mercaticeras rursicostatum; Mercaticeras sp. indet.; Pseudomercoloceras sp. indet.; Harpoceras sp. indet.; Phymatoceras cf. elegans; Phymatoceras sp. indet.; Mesadactylites mediterraneus (Meister, 1913); Lytoceras comuncia; Lytoceras sp. indet.; Phylloceras (doderleinianum); Phylloceras sp. indet.; Calliphylloceras capitanei; Calliphylloceras sp. indet.</td>
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<td>bed 10c: Hildoceras gr. cattinì; Hildoceras sublevensoni; Hildoceras sublevensoni var. sulcosa Mitzopoulos, 1930; Hildoceras sp. indet.; Mercaticeras rursicostatum; Mercaticeras sp. indet.; Pseudomercoloceras sp. indet.; Harpoceras sp. indet.; Phymatoceras cf. elegans (Mela, 1932); Nodicoeloceras cf. angoloni (Ramacconi, 1939); Nodicoeloceras sp. ind.; Harpoceras gr. mediterraneum Pinna, 1968; Phylloceras (doderleinianum); Phylloceras sp. indet.; Calliphylloceras capitanei (Catullo, 1853); Calliphylloceras nilssonii.</td>
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<td>bed 8d: Hildaites sp. indet.; Orthohildaites sp. indet.; Cingolites clavatus n. sp.; Nodicoeloceras gr. lobatum; Lytoceras sp. indet.; Phylloceras sp. indet.; Calliphylloceras sp. indet.</td>
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<td>bed 8c: Hildaites cf. intermedius (Guex, 1973); Hildaites sp. indet.; Cingolites clavatus n. sp.; Cingolites picanus n. sp.; Orthohildaites gr. douvillei; Orthohildaites sp. indet.; Urtikites sp. indet.; Phymatoceras sp. indet.; Polypectus pluricoastatus (Haas, 1913); Nodicoeloceras gr. lobatum; Nodicoeloceras sp. indet.; Harpoceras sp. indet.; Lytoceras sp. indet.; Phylloceras (selenoides); Phylloceras (doderleinianum) (Sowery, 1820); Phylloceras (doderleinianum).</td>
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<td>bed 8b: Hildaites forte (Buckman, 1921); Hildaites cassus; Hildaites sp. indet.; Cingolites clavatus n. sp.; Cingolites picanus n. sp.; Orthohildaites gr. douvillei Haug, 1864; Orthohildaites sp. indet.; Nodicoeloceras gr. lobatum (Buckman, 1827); Mesadactylites sp. indet.; Urtikites sp. indet.; Phymatoceras sp. indet.; Lytoceras sp. indet.; Lytoceras comuncia (Young &amp; Bird, 1822); Phylloceras sp. indet.; Calliphylloceras sp. indet.; Apulycus sp. indet.</td>
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<td>bed 8a: Hildaites undicosta (Mela, 1932); Hildaites cf. undicosta; Hildaites cassus (Guex, 1973); Hildaites sp. indet.; Cingolites clavatus n. sp.; Nodicoeloceras sp. indet.; Mesadactylites sp. indet.; Lytoceras francisci (Oppel, 1869); Lytoceras sp. indet.; Phylloceras sp. indet.; Calliphylloceras sp. indet.</td>
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<td>bed 6: Hildaites undicosta (Mela, 1932); Hildaites sp. indet.; Cingolites clavatus n. sp.; Nodicoeloceras sp. indet.; Mesadactylites sp. indet.; Lytoceras francisci (Oppel, 1869); Lytoceras sp. indet.; Phylloceras sp. indet.; Calliphylloceras sp. indet.</td>
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<td>TOARCOSTA</td>
<td>Crassus</td>
<td>bed 3b: Hildaites exilis; Hildaites pseudolevisoni; Hildaites sp. indet.; Harpoceras sp. indet.; Praepolyplectus sp. indet.; Nodicoeloceras sp. indet.; Phylloceras sp. indet.</td>
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<td>bed 3a: Hildaites exilis; Hildaites pseudolevisoni; Hildaites sp. indet.; Taffertia sp. indet.; Praepolyplectus sp. indet.; Nodicoeloceras sp. indet.; Mesadactylites gr. annulatiflorus (Bonarelli, 1899); Phylloceras sp. indet.</td>
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<td>bed 2c: Hildaites gr. subserpentinos; Hildaites striatus; Hildaites pseudolevisoni Venturi, 1981; Hildaites sp. indet.; Mesadactylites (?) sp. indet.; Raksulites cf. t everculatus Guex, 1973; Phylloceras sp. indet.</td>
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<td>bed 2b: Hildaites gr. subserpentinos; Hildaites striatus; Hildaites exilis Venturi, 1973; Hildaites sp. indet.; Praepolyplectus sp. indet.; Nodicoeloceras sp. indet.; Mesadactylites (?) sp. indet.; Taffertia sp. indet.; Harpoceras sp. indet.; Phylloceras sp. indet.</td>
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<td>bed 2a: Hildaites gr. subserpentinos; Hildaites striatus; Hildaites sp. indet.; Nodicoeloceras gr. cressoides (Simpson, 1855); Mesadactylites sp. indet.; Orthadactylites sp. indet.; Praepolyplectus sp. indet.; “Harpoceratoides” sp. indet.; Phylloceras sp. indet.</td>
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<td>bed 1: Hildaites gr. subserpentinos Buckman, 1921; Hildaites striatus Guex, 1973; Hildaites sp. indet.; Harpoceras sp. subserpentinos (Schiolteim, 1813); Harpoceras sp. gr. magrebensis Guex, 1973; Harpoceras sp. indet.; Praepolyplectus sp. indet. (Renz, 1925); Mesadactylites (?) sp. indet.; Orthadactylites (Buckman, 1926) sp. indet.; Phylloceras sp. indet.; Lytoceras sp. indet.</td>
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**Early Toarcian Oceanic Anoxic Event**

Tab. 1 - Ranges of *Cingolites* and other ammonites in the Marconessa quarry section 2, part 1: from Levisoni Zone (Striatus and Undicosta zones) to lowermost Bifrons Zone.
form is believed by few authors occurring also in the earliest Toarcian (Polymorphum or Mirabile zones) (see Macchioni, 2002). (For an updated review and new data on the ammonites in relation to OAE and across the Pliensbachian-Toarcian boundary in the Apennines, see Bilotta et al., 2010).

The stratigraphic occurrence of the ammonoid fauna across both sections of the Marconessa quarry studied is here broadly displayed in the tables (Tabs. 1, 2 and 3), but these data are incomplete and provisional being our sampling and study still in progress (a more detailed report with a formal description of new collected taxa

### Marconessa quarry - section 2

<table>
<thead>
<tr>
<th>STAGE</th>
<th>ZONE</th>
<th>Subzone</th>
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<tr>
<td><strong>Toarcian</strong></td>
<td><strong>Bifrons</strong></td>
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<td><strong>Angustisiphonithum</strong></td>
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<td>bed 13c: <strong>Hildoceras semipollitum</strong>: Hildoceras cf. angustisiphonithum; Hildoceras sp. indet.; Phymatoceras iserense (Oppel, 1856); Furloceras conumipica (Merla, 1952); Merocatoceras dilatum; Merocatoceras sp. indet.; Crassoceras sp. indet.; Harpoceras subexaratum; Harpoceras cf. falciferum; Harpoceras subplanatum (Oppel, 1856); Polyplectus discoides; Nodicoeloceras sp. indet.; Mesodactylites sp. indet.; Lytoceras sp. indet.; Phylloceras sp. indet.; Caliiphylloceras capitanei; Calliphylloceras sp. indet.</td>
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<td>bed 13b: <strong>Hildoceras semipollitum</strong>: Hildoceras sp. indet.; Mercatoceras dilatum; Mercatoceras cf. mercati; Harpoceras gr. falciferum (Sowerby, 1820); Pseudomercatoceras sp. indet.; Mesodactylites sp. indet.; Teildactylites sp. indet.; Lytoceras ktenasi Mitzopoulos, 1930; Alocyoceras dorcadis; Phylloceras heterostrophum; Phylloceras doderleinianum; Calliphylloceras sp. indet.</td>
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<td>bed 13a: <strong>Hildoceras semipollitum</strong> Buckman, 1902; Hildoceras cf. angustisiphonithum; Hildoceras sp. indet.; Pseudomercatoceras sp. indet.; Harpoceras sp. indet.; Polyplectus discoides (Zielen, 1931); Mesodactylites sp. indet.; Lytoceras sp. indet.; Calliphylloceras capitanei; Calliphylloceras sp. indet.</td>
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<td>bed 12f: <strong>Hildoceras gr. bifrons</strong>: Hildoceras cf. apertura; Hildoceras gr. angustisiphonithum; Hildoceras sp. indet.; Mercatoceras mercati; Mercatoceras dilatum (Meneghini, 1885); Harpoceras sp. indet.; Rarenoceras sp. indet.; Pseudomercatoceras sp. indet.; Lytoceras conumipica; Phylloceras doderleinianum; Phylloceras sp. indet.; Calliphylloceras capitanei; Calliphylloceras sp. indet.</td>
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<td>bed 12e: <strong>Hildoceras gr. bifrons</strong>: Hildoceras apertura; Hildoceras gr. angustisiphonithum; Mercatoceras mercati; Pseudomercatoceras sp. indet.; Polyplectus pluricostatus; Frechiella sp. indet.; Nodicoeloceras sp. indet.; Phylloceras heterostrophum; Phylloceras doderleinianum; Phylloceras sp. indet.; Calliphylloceras nilssonii.</td>
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<td>bed 12d: <strong>Hildoceras gr. lusitanicum</strong>: Hildoceras bifrons (Bruguère, 1789); Harpoceras sp. indet.; Phylloceras doderleinianum; Phylloceras sp. indet.; Calliphylloceras nilssonii; Calliphylloceras sp. indet.</td>
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<td>bed 12c: <strong>Hildoceras lusitanicum</strong>: Hildoceras cf. bifrons; Hildoceras angustisiphonithum Prinz, 1904; Hildoceras apertura Gabbilly, 1976; Hildoceras sp. indet.; Nodicoeloceras sp. indet.; Phylloceras heterostrophum; Phylloceras doderleinianum; Phylloceras sp. indet.; Calliphylloceras nilssonii.</td>
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<td>bed 12b: <strong>Hildoceras sp. indet.</strong>: Polyplectus pluricostatus; Mesodactylites sp. indet.; Phylloceras heterostrophum; Phylloceras sp. indet.; Calliphylloceras nilssonii; Calliphylloceras sp. indet.</td>
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<td>bed 12a: <strong>Hildoceras lusitanicum</strong>: Hildoceras cf. lusitanicum; Hildoceras sp. indet.; Frechiella sp. indet.; Rarenoceras n. sp.; Mercatoceras sp. indet.; Mesodactylites sp. indet.; Phylloceras sp. indet.; Calliphylloceras nilssonii.</td>
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<td>bed 11c: <strong>Hildoceras sp. indet.</strong>: Hildoceras n. sp. indet.; Harpoceras subexaratum; Harpoceras gr. mediterraneianum; Polyplectus pluricostatus; Frechiella subcarinata; Frechiella n. sp.; Mercatoceras sp. indet.; Pseudomercatoceras sp. indet.; Lytoceras gr. conumipica; Lytoceras septatum; Phylloceras sp. indet.; Calliphylloceras sp. indet.</td>
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<td>bed 11b: <strong>Hildoceras lusitanicum</strong> Meister, 1913; Hildoceras sp. indet.; Mercatoceras gr. thyreonicum; Phymatoceras sp. indet.; Frechiella sp. indet.; Nodicoeloceras sp. indet.; Mesodactylites mediterraneus; Lytoceras sp. indet.; Phylloceras sp. indet.; Calliphylloceras capitanei.</td>
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<td>bed 11a: <strong>Hildoceras gr. subleviosoni</strong>: Hildoceras subleviosoni var. sulcata; Hildoceras gr. acarnanicum; Hildoceras sp. indet.; Mercatoceras thyreonicum; Mercatoceras gr. mercati; Pseudomercatoceras sp. indet.; Harpoceras subexaratum Bonarelli, 1899; Phylloceras doderleinianum; Phylloceras sp. indet.; Calliphylloceras capitanei; Calliphylloceras nilssonii; Calliphylloceras sp. indet.</td>
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<td>bed 10g: <strong>Hildoceras cf. subleviosoni</strong>: Hildoceras subleviosoni var. sulcata; Hildoceras cf. acarnanicum; Cingolites steinifoni; Phymatoceras elegans; Mercatoceras umbilicatum; Mercatoceras gr. rursicostatum; Mercatoceras gr. heinianum (Renz, 1905); Mercatoceras gr. thyreonicum (Fucini, 1905); Mercatoceras gr. mercati (Hauer, 1856); Frechiella subcarinata (Young &amp; Bird, 1920); Audaxlytoceras dorcadis; Lytoceras sepustum; Phylloceras doderleinianum; Phylloceras heterostrophum; Phylloceras sp. indet.; Calliphylloceras capitanei; Calliphylloceras nilssonii; Calliphylloceras sp. indet.</td>
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<td>bed 10f: <strong>Hildoceras subleviosoni</strong>: Hildoceras subleviosoni var. sulcata; Hildoceras acarnanicum; Phymatoceras cf. elegans; Mercatoceras umbilicatum; Mercatoceras sp. indet.; Polyplectus pluricostatus; Harpoceras sp. indet.; Nodicoeloceras sp. angulonii; Mesodactylites sp. indet.; Phylloceras doderleinianum; Phylloceras sp. indet.; Calliphylloceras capitanei; Calliphylloceras nilssonii; Calliphylloceras sp. indet.</td>
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**Tab. 2 - Ranges of *Cingolites* and other ammonites in the Marconessa quarry section 2, part 2: Bifrons Zone.**
Fig. 3 - Log of the Marconessa quarry section 2 (part 2) and ranges of *Cingolites* and other ammonites, chiefly Hildoceratinae, in the early Toarcian.

will be provided by us in further papers). Furthermore, some meaningful ammonite taxa for biostratigraphy, chiefly the ranges of Hildoceratinae, Mercaticeratinae, Harpoceratinae are plotted against the logs (Figs. 2, 3 and 4).

**SYSTEMATIC PALAEONTOLOGY**

Order Ammonoidea Zittel, 1884
Suborder Ammonitina Hyatt, 1889

Superfamily Hildocerataceae Hyatt, 1867
Family Hildoceratidae Hyatt, 1867

Subfamily Hildoceratinae Hyatt, 1867

According to Arkell et al. (1957, p. L259) the Hildoceratinae are characterized by shells *Evolute planulates with quadrate whorl section, tricarinate-bisulcate venter, and falcate ribs which may be interrupted by longitudinal groove on whorl side*. Géczy (1967, p. 127) has reviewed Schindewolf’s (1963)
(1963) diagnosis of the subfamily, which includes the suture line in diagnosis, and he wrote that this group is characterized by a «nombre réduit de lobes ombrilicaux et par une selle externe sans incision médiane». Howarth (1992, p. 165) provided a broader diagnosis than above quoted authors, and for the first time he emphasizes the variability of the whorl section, which is «quadrate or elliptical» with «keeled or tricarinate-bisulcate venter», and of the ornament, which shows «Ribs vary from fine to strong, and from straight to falcate or strongly angled». Howarth includes into this subfamily eight genera: *Hildaites*, *Orthildaites*, *Hildoceras*, *Mercaticeras*, *Renziceras*, *Parahildaites*, *Hildaitoides*, *Atacamiceras*.

We think that the genus *Renziceras*, which is a shape typical of the West Mediterranean Tethys characterized by an evolute coiling and wider than high whorl section with tricarinate-bisulcate venter and strong, straight and spiny ribs, should be excluded from the Hildoceratinae subfamily. According to Macchioni & Venturi (2000) *Renziceras* must be included in the subfamily *Leukadiellinae*. According to Guex (1974) the Mediterranean genus *Mercaticeras*, characterized by small sized shapes, should be included in the subfamily *Mercaticeratinae*. We agree with these authors.

We are unable to carry out a critical evaluation about the taxonomic range of the genus *Parahildaites* (Blaison, 1967), found in the Arabian Palaeoprovince, because we have not enough data. The genera *Hildaitoides* and *Atacamiceras* of the South America Palaeoprovince described by Hillebrandt (1987) show, in our opinion, only a seeming affinity with European Hildoceratinae. These American taxa, in fact, have rectiradiate, or gently
arched, and very thin ribs with rounded section. These shells, moreover, have an evolute ovoidal-rounded whorl section, and they have also a rounded or sub-acute venter, never bisulcate. Since the genera *Parahildaites* and *Hildaitoides* do not have the typical traits described by Arkell, Géczy and Howarth, we think that they should be excluded from the subfamily *Hildoceratinae*. Therefore, we suggest an amended diagnosis of this subfamily, which includes only the genera that show a geographic dispersal in Subboreal, Submediterranean and Mediterranean Palaeoprovinces, such as *Hildaites*, *Orthoidalites*, *Cingolites* (new genus) and *Hildoceras*.

***Amended diagnosis of Hildoceratinae*** - From very evolute to moderately involute shells. Variable whorl section, which may be sub-quadrate, low or high sub-rectangular and sub-trapezoidal, with wide or narrow venter, which may be sub-rounded (mainly in the body chamber) sub-tabulate, bisulcate and tricarinate-bisulcate. The keel is more or less raised, strong or fine. The ornament varies showing ribs from fine to coarse; they are usually falcate-falcoid or sigmoidal (sinuous-§flexuous) in the inner whorls, more or less retroverted near the umbilical edge and more or less projected on the ventro-lateral edge, and sometimes moderately falcate,
almost straight and rectiradiate in the grown-up stage (mainly in *Orthildaites* and *Cingolites*). Usually, the ribs are single, but sometimes they are also bifurcating or bundled showing near the umbilical edge fine tubercles or bullae and dimples. The ending of the ribs on the ventro-lateral edge varies also: in *Hildaites* the ribs usually come until the ventro-lateral edges; among *Orthildaites* and a few *Hildoceras* as well the ribs disappear before the ventro-lateral edges; whereas, in *Cingolites* the ribs come until the ventro-lateral edge enlarged and swollen, forming a typical coronate venter.

Among the genera of this subfamily only *Hildoceras* shows, both in the juvenile stage and in the grown-up stage, a spiral groove that cuts the ribs, forming a typical more or less wide dorsal smooth band.

The sutures are typically ammonitic, i.e. usually simple, poorly indented (jagged) and showing spaced lobes. The ratio of the E/L lobes varies, but normally the ES saddle is wider than LS saddle. The sutures show also two umbilical lobes (U3 and U2), one of which (U3) is only just longer than L; a short U2 lobe, a dentiform U3 lobes; it shows a narrow E lobe, as long as the L lobe or more or less projected on the umbilical wall and they have not a regularly raised appearance. The sub-quadrato whorls section, differently from *Orthildaites*, is very wide, swollen and it always shows a strongly tricarinate-bisulcate venter with deep sulci. The suture distinguishes also *Cingolites* from *Orthildaites*. In fact, the former genus shows a very simple suture, similar to *Mercaticeras*; whilst *Orthildaites* has a suture resembling both the latest *Hildaites* and the earliest *Hildoceras* shells.

Nevertheless, *Cingolites* is distinguished from *Mercaticeras* in having a coarser ornamentation with clavate, irregularly raised and not falcoide ribs and a more evolute, swollen and wide whorl section. Besides, they differ in size, being *Cingolites* larger sized, and in stratigraphic occurrence. The later taxon *Cingolites stefaninii* is the most similar to *Mercaticeras*; in fact, it was assigned by Merla (1932), Pinna (1963) and Zanzuccchi (1963) to this well-known and typical Mediterranean genus.

*Cingolites* also differs from the taxa figured by Hillebrandt (1987) as *Atacamiceras* and *Hildaitoides*. These American ammonoids, in fact, have a rounded or sub-elliptical whorl section, without sulci, and straight ribs, which are neither flexuous nor clavate.

*Cingolites* has some degree of similarity with *Hildaites crassus* (Guex, 1973) in having a wide tricarinate-bisulcate venter with deep sulci and a strong keel and a simple suture line, with short E and L lobes. However, *H. crassus* shows coarser ribs with a hildaitic rursiradiate-falcate appearance and they are also not clavate. In any case, the earlier shapes of *Cingolites* have the same stratigraphic occurrence of *H. crassus*. These likeness and affinity make plausible a common evolutionary descent.

**Palaeogeographic dispersal** - At the present state of knowledge, three of the four species of *Cingolites* (namely, *C. clavatus*, *C. picenus* and *C. spiralis*) occur in the Apennines only. The fourth species *C. stefaninii*, already described by Merla (1932), occurs in Southern Alps (Entratico, Alpe Turati, Alta Brianza) and Greece (Lefkas Island).

*Cingolites clavatus* n. sp.  
(Figs. 5, 7, 11; Pl. 1, figs. 1-4)

**Material** - Eight well preserved specimens of medium and small size (MSA: 86, 87, 259, 431, 432, 433, 802 and 804), all from Marconessa quarry.

**Derivatio nominis** - Because of its typical strongly clavate and coarser ribs.
Holotype - A well preserved specimen MSA 87 of medium size with a portion of body chamber (Figs. 5 a-b; Pl. 1, figs. 1a-b), collected from Marconessa quarry, section 2, bed 6.

Stratus typicus - Nodular limestone and grey marl of the Undicosta Zone.

Diagnosis - Platycone very evolute shell, sub-quadrate whorl section, wide tricarinate-bisulcate venter with keel. The sinuous, coarse and sparse ribs are characterized by clavi forming a coronate venter. The ammonitic suture is simple. It differs from other Cingolites for the strongly clavate appearance of the ornament, for the coarser ribs and for the sub-quadrate whorl section wider than high.

Holotype description - Very evolute shell characterized by a slow growth of coiling, with a sub-quadrate whorl section noticeably wider than high. The wide tricarinate-bisulcate venter shows deep and wide sulci, with a strong and moderately raised keel. The swollen sides show an almost vertical umbilical wall with rounded edges.

The flexuous, coarse and spaced ribs have a moderately retroverted proximal segment, a long stretched medial segment and a short and gently projected distal segment. The ribs end enlarged and swollen on the ventro-lateral edges, here reaching the maximum thickness; thus, they take on a typical claviform appearance and forming a coronate area viewed from the venter. Besides, the ribs of C. clavatus are unevenly raised, more or less swollen; they are 24 in number in the last whorl of the phragmocone.

The suture is simple, showing distanced lobes; an E lobe as long as L lobe, which is short and wide; a moderately developed U lobe and a dentiform U lobe, which is placed on the umbilical wall. The ES saddle is about twice as wide than LS, with an almost dentiform A lobe.

Paratypes - The variously sized paratypes are very similar to the holotype, so that see the holotype diagnosis. They all show the typical characters of the ornament, which clearly distinguish C. clavatus from other Cingolites and furthermore both from the various shapes of Orthildaites and from Hildaites crassus.

Occurrence - Undicosta Zone.

Cingolites picenus n. sp.

(Material - Nine specimens of medium-large size from Marconessa quarry, some of which well preserved (MSA: FV1, 88, 91, 105, 207, 359, 434, 855 and 870). Two specimens of medium size (SAF 9 and SAF 18) were collected ex-situ from the celebrated S. Anna quarry of Furlo Pass (Pesaro).

Derivatio nominis - From the location of recording, the Marchean Apennines, which long ago was inhabited by the ancient people named “Piceni”.

Holotype - A well preserved specimen MSA FV1 of medium-large size with the body chamber (Figs. 6 a-b; Pl. 1, figs. 7a-b), collected from Marconessa quarry, section 2, bed 8b.

Stratus typicus - Nodular limestone and grey marl of the upper Undicosta Zone.
Diagnosis - Platycone evolute shell, sub-quadrate whorl section, tricarinate-bisulcate venter with keel. The strong, gently clavate and sparse ribs are almost rectiradiate in the inner whorls and they become more sinuous in the outer ones. The ammonitic suture is simple.

Holotype description - Evolute shell with a sub-quadrate whorl section. The venter is tricarinate-bisulcate with deep sulci and moderately strong keel. The umbilical wall is moderately high and rounded in the inner whorls, almost vertical and higher in the outer whorls.

The ribs are strong, spaced, almost rectiradiate in the inner whorls, more flexuous in the outer whorls, when they appear slightly retroverted in the proximal segment, stretched or gently arched in the medial segment and moderately projected with short distal segment on the ventro-lateral edges. In the phragmocone the rib termination appears gently claviform, but the clavi disappear on the body chamber,
when the ribs progressively become faded. We count 29 ribs in the last whorl of the phragmocone.

The suture is simple with a L lengthened, which is longer than E lobe; moderately developed umbilical lobes and a short A lobe.

Paratypes - The paratypes show some variances in the ornament, with more or less strong ribs, which sometimes appear more falcoid than in the holotype, mainly in the outer whorls. The suture also shows a variance in the L lobe, usually shorter than that of the holotype.

Remarks - This species differs from _C. clavatus_ in having a narrower and less swollen whorl section; a narrower venter; more regularly risen and less coarse ribs and the appearance of gentle clavi in the phragmocone only. It differs from _C. spiralis_ in having less arched and coarse ribs, a less wide venter and more flattened sides. It finally differs from _C. stefaninii_ in having a wider tricarinate-bisulcate venter and less swollen and more flexuous ribs in the outer whorls too.

Occurrence - From uppermost Undicosta Zone to the lowermost Bifrons Zone.

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**Cingolites gr. picenus**

(Figs. 6 g-h, m; Pl. 2, figs. 6-7)

*Material* - A very well preserved specimen MSA 157 of medium size with the body chamber and a badly preserved specimen of the same size MSA 844, both from Marconessa quarry.

*Remarks* - Very evolute shell with a sub-quadrate whorl section in the phragmocone, only just higher than wide in the body chamber. The venter is typically tricarinate-bisulcate, but less wide than _C. clavatus_, with raised and thin keel.

The specimen MSA 157 is very interesting for its stratigraphic occurrence, which is lower than _C. picenus_, and for its undoubted transitional traits between _C. clavatus_ and _C. picenus_. In fact, the ornament of this specimen shows almost rectiradiate ribs in the inner whorls, which are unevenly risen and strongly clavate like _C. clavatus_; whereas, in the outer whorl, which is including the body chamber, the ornament shows a more regularly risen and more coarse and flexuous ribs, which become progressively falcoid and faded in the body chamber, like _C. picenus_ and they lose the clavi. The collected from detritus specimen MSA 884 has the same ornament.

The suture shows the E lobe as long as lobe L, which is wide and short; a dentiform A lobe and a long and narrow _U_ lobe.

*Occurrence* - Upper Undicosta Zone.

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**Cingolites spiralis** n. sp.

(Fig. 8; Pl. 2, figs. 8, 10-11)

*Material* - One well preserved specimen MSA 21 from Marconessa quarry; two fragments collected from Maranghi quarry section (Burano Valley, Pesaro) and from Lecceti section (Bosso Valley, Pesaro): BU1 and LE1 respectively.

*Derivatio nominis* - For its typical evolute coiling with serpenticone appearance.

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**EXPLANATION OF PLATE 1**

Figs. 1-4 - _Cingolites clavatus_ n. sp.
1 - holotype MSA 87, section 2, bed 6.
2 - paratype MSA 86, section 2, bed 8b.
3 - paratype MSA 259, section 2, bed 8a.
4 - paratype MSA 431, section 2, bed 8c.

Figs. 5-8 - _Cingolites picenus_ n. sp.
5 - paratype MSA 207, collected from detritus of the uppermost Undicosta zone (section 2).
6 - paratype MSA 105, collected from detritus of the uppermost Undicosta zone (section 3).
7 - holotype MSA FV1, section 2, bed 8b.
8 - paratype MSA 91, section 2, bed 8c.

All photographs are natural size provided.
Holotype - Specimen MSA 21 collected *ex situ* from the detritus of the upper Undicosta Zone (Figs. 8 a-c; Pl. 2, figs. 8 a-b), coming from Marconessa quarry.

Stratus typicus - Nodular limestone and grey marl of the upper Undicosta Zone.

Diagnosis - Very evolute almost serpenticone compressed shell, sub-quadrato whorl section, tricarinate-bisulcate venter with keel. The coarse, gently clavate, very sparse ribs are characterized by an almost concave-prorsiradiate appearance. The ammonitic suture is very simple.

**Holotype description** - Very evolute shell with serpenticone appearance and sub-quadrato whorl section, which is wider than high, characterized by a slow growth coiling. The wide venter is tricarinate-bisulcate with wide and moderately deep sulci. The sides are rounded and the low umbilical wall is rounded too.

The ornament shows coarse and spaced ribs, which are broader than the interspace between ribs. The ribs start from the umbilical wall, with stretched proximal and medial segments, characterized by an almost prorsiradiate appearance; they are swollen and enlarged near the moderately projected distal segment, where they have a gently claviform appearance, ending on the ventrolateral edges and forming a coronate ventral area. We count 23 ribs in the last whorl of phragmocone.

The suture is very simple, showing a short and wide L lobe; an E lobe as long as L, a little developed A lobe, and the umbilical lobes with a dentiform U3. The saddle ES is about twice as wide than LS1 saddle.

Paratypes - The two fragmented paratypes are very similar to the holotype in the ornament, whorl section and venter; they differ in the suture line only, where the E lobe is longer than L lobe.

Remarks - This species differs from *Orthildaites* and *Hildaites* shells for its typical strongly serpenticone evolute appearance. Besides, the claviform coarser ribs and the strongly tricarinate-bisulcate venter reveal its close affinity with *Cingolites clavatus*. Furthermore, some traits of the ribs appearance and of the suture are similar to *Hildaites crassus*.

Occurrence - Upper Undicosta Zone.

*Cingolites stefaninii* (Merla, 1932)

(Fig. 9; Pls. 3, figs. 1-4, 6, 8-9)

1930 *Hildoceras* (Lilia) Mercati (Hauer) var. *ellenica* (Renz) - MITZOPULOS, Pl. 6, figs. 6a-b.
1932 *Mercaticeras* stefaninii Merla, Tav. 6, figs. 8-9.
1963 *Mercaticeras* stefaninii Merla - ZANZUCCHI, Tav. 19, fig. 1.
1995 *Praemercaticeras* sp. indet. PETTINELLI et al., Pl. 2, fig. 5.

Material - Nine well preserved specimens of medium and small size (MSA: 264, 281, 388, 435, 843, 845, 847, 849, 891, 903).
846, 886 and two fragmented specimens (MSA: 411 and 485), all from Marconessa quarry.

Remarks - These specimens are very close to Merla’s species *stefaninii*, which was ascribed to the genus *Mercaticeras*. Nevertheless, the characters of the whorl section and the ornament are typical of *Cingolites*, to which both the Merla’s specimen and the Marconessa quarry specimens must be ascribed.

Amended diagnosis - Very evolute shell with a sub-quadrate whorl section from tricarinate-bisulcate venter. The sulci are not much wide and moderately deep. The sides are flattened or barely rounded. The umbilical wall is low with rounded edge.

The strong and spaced ribs are almost straight and rectiradiate; they are gently flexuous in the outer whorl of medium sized specimen. The ribs start from the umbilical wall and they end clavate on the ventro-lateral edges, here forming a coronate area in the inner whorl, which is visible among small specimens only. The clavi disappear on the body chamber and in the outer whorl of the medium sized specimens.
The simple suture shows the E lobe as long as L lobe, the A lobe moderately developed and umbilical lobes with a more or less developed lanceiform U', and a dentiform U", which is placed on the umbilical wall.

Our specimens, variously located in the stratigraphic column, show some variances in having a more or less evolute whorl section and more or less strong ribs. The larger specimen MSA 886 shows the main diagnostic characters of this species in the inner whorls, but in the outer whorls the ribs become finer, arched and almost prorsiradiate. Unfortunately, this specimen was not collected in situ.

Occurrence - From lower Bifrons Zone (Sublevisoni Subzone).

*Cingolites* sp. indet. 1
(Figs. 10 a-c; Pl. 3, fig. 5)

**Material** - One specimen MSA 150 with a portion of the body chamber, coming from Marconessa quarry.

**Remarks** - Evolute shell with a sub-quadrate whorl section and tricarinate-bisulcate venter. The moderately strong and almost rectiradiate ribs show gentle clavi on the ventro-lateral edges, mainly in the outer whorls. The simple suture shows the E lobe as long as L lobe, which is low and wide; the umbilical lobes and the A lobe moderately developed.

It differs from *C. clavatus* by having a lesser shell evolution, finer and denser ribs, which are gently clavate never forming a real coronate ventral area. Some traits of the ornament and of the suture line reveal a certain affinity with *Cingolites*. On the other hand, the coiling, the whorl section appearance and the ribs course of the inner whorls are more similar to the later specimens of *Hildaites pseudolevisoni* (Venturi, 1981) and the earlier specimens of *Hildaites crassus*. Therefore, it is a clearly transitional shape.

**Occurrence** - Lower Undicosta Zone.

*Cingolites* sp. indet. 2
(Figs. 10 d-e; Pl. 3, fig. 7)

**Material** - A medium-large specimen with the body chamber, MSA 155, coming from Marconessa quarry.

**Remarks** - Evolute shell with a sub-quadrate whorl section, only just higher than wide, and a broad tricarinate-bisulcate venter. The ribs are flexuous in the inner whorls; more straight and strong in the outer whorls. The suture is simple, poorly jagged, with A lobe not much developed and a long lobe L.

It differs from *C. clavatus* and *C. spiralis* in having more rectiradiate not clavate ribs in the outer whorls. Thus, it is for some traits similar to *Hildaites crassus*. It is another transitional shape.

**Occurrence** - Lower Undicosta Zone.

*Cingolites* sp. indet. 3
(Figs. 10 f-g)

**Material** - A fragment of the phragmocone and of the body chamber, MSA 280, coming from Marconessa quarry.

**Remarks** - Evolute shell with a sub-quadrate whorl section. The rectiradiate ribs, starting from the umbilical wall, are weakly projected on the ventro-lateral edges, not really clavate. The suture is simple with a wide and short L lobe.

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**EXPLANATION OF PLATE 2**

Figs. 1-5, 9 - *Cingolites picenus* n. sp.  
1 - paratype MSA 88, section 2, bed 8b.  
2 - paratype MSA 870, collected from detritus of the uppermost Undicosta zone (section 2).  
3 - paratype MSA 359, collected from detritus of the uppermost Undicosta zone (section 3).  
4 - paratype MSA 855, collected from detritus of the uppermost Undicosta zone.  
5 - paratype SAF 9, collected *ex situ*.  
9 - paratype SAF 18, collected *ex situ*.

Figs. 6-7 - *Cingolites gr. picenus*  
6 - specimen MSA 157, section 3, bed 6e.  
7 - specimen MSA 844, collected from detritus of the uppermost Undicosta zone (section 2).

Figs. 8, 10-11 - *Cingolites spiralis* n. sp.  
8 - holotype MSA 21, collected from detritus of the uppermost Undicosta zone (section 3).  
10 - paratype BU 1, collected *ex situ* from detritus of the uppermost Undicosta zone.  
11 - paratype LE 1, collected *ex situ* from detritus of the uppermost Undicosta zone.

All photographs are natural size provided.
S. Sassaroli, F. Venturi - Cingolites n.gen. from the Toarcian of the Apennines

Pl. 2
It noticeably differs from the other *Cingolites* sp. indet. 1 and 2 for its stratigraphic occurrence.

**Occurrence** - Lower Bifrons Zone (Sublevisoni Subzone).

**THE DESCENT OF CINGOLITES**

A more detailed account of the evolutionary trends of the lower Toarcian Hildoceratinae would need a separate study. However, we propose here some provisional questions into the evolutionary framework shown by the above treated fossil record evidences.

In the fossil record of studied Apennines sections, after the occurrence of the black shales of the OAE, we observe a remarkable adaptive radiation of the ammonoid fauna when new genera and species of Hildoceratinae appear to replace the taxa that had become extinct in the previous anoxic biological crisis of the early Toarcian (see Bilotta et al., 2010). The descent of Hildoceratinae from the late Domerian Protoparammoceratinae is very likely, although there are no direct evidences provided by the fossil record, being unfortunately the ammonoid collections of the European and Mediterranean sections usually poor or missing across the Domerian (late Pliensbachian)-Toarcian transition. For instance, the OAE black shales of Marconessa quarry sections have not preserved any ammonites, thus in the lowermost Levisoni Zone (our Striatus Zone) the appearance of Hildoceratinae seems to be sudden. However, this sudden appearance of Hildoceratinae is not due to a “punctuation” *sensu* Eldredge & Gould (1972), but clearly to the incompleteness of the fossil record. In fact the Hildoceratinae occurring in our sections above the OAE black shales are already well differentiated in many species and varieties. These evolutionary changes from the common ancestors, which were maybe located in the Apennines or elsewhere, clearly occurred in a time span between the fall (see the hardground surface in figs. 2 and 4) and the rise of the sea level (see the OAE recording in figs. 2 and 4) when the fossil record is missing.

In fact, we have found in the lower Toarcian (*Hildaites striatus* zone) of the Marconessa quarry several new and unfortunately still unpublished taxa of the genus *Hildaites*: some shapes are moderately involute, with flat and narrow venter and fine ribs whereas other forms are instead evolute, with bisulcate or tricarinate venter and strong ribs. These last robust ones become more abundant in the stratigraphic sequence, and they replace totally the former gentle ammonites in the *Hildaites undicosta* zone, when the genera *Orthildaites* and *Cingolites* appear. This remarkable evolutionary event occurred in the middle-late portion of the Undicosta chron, when firstly *Cingolites* and later *Orthildaites* originated, probably from a group of *Hildaites* characterized by tricarinata-bisulcate venter and coarser ribs in the ornament, like those of the group of *Hildaites crassus* (Guex, 1973). Finally, in the earliest Bifrons chron the genus *Hildoceras* appears. It is possible that at the bottom of this zone the genus *Mercaticeras* originated from *Cingolites*, probably from the small sized shapes of *C. stefaninii* group. Considering the growing bistratigraphic data from the Apennines outcrops, we hope we will be able to prove that all Hildoceratinae taxa are linked by a common descent, as shown by several transitional specimens of our collection. A new and exhaustive phylogenetic framework for this subfamily will be attempted by us in a forthcoming paper.

**REMARKS AND DISCUSSION ON THE PALAEOGEOGRAPHIC DISPERSAL OF CINGOLITES IN THE MEDITERRANEAN TETHYS REALM**

The richness of our collection coming from Marconessa quarry allowed us to establish the new genus *Cingolites*, which we include in the subfamily Hildoceratinae. We have also established three new species of *Cingolites* (namely, *C. clavatus*, *C. picenus* and *C. spiralis*) and we ascribed to this genus an already recognized species as *C. stefaninii* (Merla, 1932), which was previously assigned to the genus *Mercaticeras* by Merla (1932). We have furthermore collected some transitional and undetermined shells referable to *Cingolites*. *Cingolites stefaninii* is reported in the Apennines, the Southern Alps (Zanzucchi, 1963, Tav. 19, fig. 1; Pinna, 1963, Tav. 10, fig. 14) and Greece (Lefkas Island) (Pettinelli et al., 1995, Pl. 2, fig. 5), where the same pelagic depositional facies of red or grey marly nodular limestone occurring in the Tuscan-Ümbrian-Marchean basin has been observed. To the present-day

**EXPLANATION OF PLATE 3**

Figs. 1-4, 6, 8-9 - *Cingolites stefaninii* (Merla, 1932)
1 - specimen MSA 264, section 2, bed 10a.
2 - specimen MSA 388, collected *ex situ* from detritus of the uppermost Undicosta Zone (section 3).
3 - specimen MSA 845, collected *ex situ* from detritus of lowermost Bifrons Zone (section 2).
4 - specimen MSA 886, collected from detritus of the lowermost Bifrons Zone (section 2).
5 - specimen MSA 485, section 2, bed 10a.
6 - specimen MSA 843, section 2, bed 10g.
7 - specimen MSA 435, collected from *detritus* of the lowermost Bifrons Zone (section 2).

Fig. 5 - *Cingolites* sp. indet. 1, specimen MSA 150, section 3, bed 6c.
Fig. 7 - *Cingolites* sp. indet. 2, specimen MSA 155, section 3, bed 6b.

All photographs are natural size provided.
S. Sassaroli, F. Venturi - Cingolites n.gen. from the Toarcian of the Apennines

Pl. 3
the other species of Cingolites herein designed, i.e. C. clavatus, C. picenus and C. spiralis, seem to be endemic of the Apennines. On the other hand, C. stefaninii seems to have only a Western Mediterranean Tethys dispersal (Apennines, Southern Alps, Greece).

At species and genus level, our data related to the stratigraphic occurrence and geographical dispersal of the early Hildoceratinae therefore seem to confirm the existence of different ammonoid faunal realms and provinces in the European and the Mediterranean areas during the early Toarcian. Furthermore, our data about the endemic occurrence of these taxa allow to conjecture a certain degree of provincialism for the ammonite faunas of the Apennines. For these reasons the concepts of centre of origin and spreading therefore cannot be rejected a priori.

Page (1996, 2003, 2004, 2008) has recently provided an useful synthesis of the current palaeogeographical knowledge on Jurassic ammonoids, adopting simple hierarchical biogeographic units (Realm, Subrealm and Province) and distinguishing two European Realm, the Boreal and the Tethyan. During the late Pliensbachian-early Toarcian the Boreal Realm includes a Subboreal Province (northern Britain, Russian Platform) and in the same substages the Tethyan Realm includes a West Tethyan Subrealm, which was divided in several Provinces: a Mediterranean (or West Tethyan) Province (southern Spain, Italy, Austria, Hungary, Bulgaria, North Africa); a Submediterranean Province (northern Spain, southern and central France, southern Germany, Switzerland) and an Ethiopian (or Arabo-Malagach) Province (Ethiopia, Arabia, Turkey, Madagascar). Obviously, the boundaries and the same status of these Provinces are changing in space and time, being affected by plate tectonics, eustasy, ecology and climate change.

Westermann (2000a, 2000b; see also Cecca, 2002) provided an updated framework of biogeographic units in the light of the new concept of biochore, defined by the overall endemism of its biota within a geographic area (chorotype) and within a temporal limit (chronotype). However, any definition has its problems. For instance, the choice of the quality and quantity of taxa to define a biogeographic unit is somehow subjective. Cecca’s (2002) effort to solve the question leads him to establish a difference between the long temporal scale, when provincialism occurred in relation to vicariance processes, and a short temporal scale (i.e. ammonite biozones), when different taxa occurred in relation to the ecology, and hence endemism is limited to the species or genus level. Nevertheless not only physical barriers, but also ecological and climatic factors obstruct the fauna dispersal and both plate tectonics and eustasy affect on these factors. Thus, a sharp distinction between a long and a short temporal scale (i.e. between the vicariance and the historical issues in palaeobiogeography) seems to be not practically possible. The role of the centres of origin and spreading therefore is not yet ruled out.

Rosen’s (1992) warning on some constraints of the palaeobiogeographical data, such as those related to the incompleteness of the fossil record or the stratigraphical correlation and the mistake in taxonomic judgements, is useful. It is possible that the short biostratigraphic and palaeobiogeographic account provided in this paper could be conditioned by the incompleteness of the fossil record. Nevertheless, we believe that there are some evidences for the claim of provincialism and endemism between the European and Mediterranean Hildoceratinae ammonoid faunas of the early Toarcian.

CONCLUSIONS

The lower Toarcian Apennines outcrops preserved a remarkable early Hildoceratinae fossil record in the layers of the Marconessa quarry near Cingoli (Macerata, Italy), where we collected several species of Hildaites, Orthildaites, plus three new species which we ascribed to the new genus Cingolites. We collected also several undetermined and transitional specimens attributable to these genera. To the present-day knowledge Cingolites includes four species: C. clavatus, C. picenus and C. spiralis (all collected from the beds of the Undicosta Zone), which have been described for the first time in this paper and a later species C. stefaninii (collected from the beds of the Bifrons Zone), which was previously assigned by Merla (1932) to the genus Mercaticeras.

The genus Cingolites seems to have its descent from a group of Hildaites of the Undicosta Zone characterized by evolute shells with tricarinate-bisulcate venter and coarser ribs; the same group has probably originated the later genera Orthildaites, Hildoceras and Mercaticeras.

Many of these taxa show a clear provincialism like Cingolites, being this new genus confined chiefly to the Apennines or anyway to the Mediterranean Tethys (Southern Alps and Lefkas Island, Greece). Generally speaking, several ancient Hildoceratinae seem to have an early occurrence in the Mediterranean Tethys, as shown by the recording of our Apennines sections. However a more detailed account for this early Toarcian fauna sampled by us in the Apennines outcrop of the Marconessa quarry will be provided in further papers.

ACKNOWLEDGMENTS

We thank Prof. Maria Paola Maceratini, Prof. Johannes S. Pignatti, Dr. Massimiliano Bilotta and Prof. Enrico Serpagli for kindly revising the manuscript and for their useful suggestions, which helped us to improve this paper. We are also grateful to Prof. Mikhail Rogov and Prof. Louis Balleau, who gently reviewed this paper, for very useful critical comments.

Fig. 11 - Cingolites clavatus n. sp.: a-b-c) specimen MSA 802 (x1), microconch from Undicosta zone.
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Manuscript received 22 March 2009
Revised manuscript accepted 15 February 2010