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Ordovician Invertebrates from Jebel Qamar South,Dibba Zone, United Arab Emirates

Abdul Rahim A. Hamdan [a,*], Hakam A. Mustafa [b]

[a] The Hashemite University, Department of Earth and Environmental Sciences, Zarqa, Jordan.

[b] Yarmouk University, Department of Earth and Environmental Sciences, Irbid, Jordan.

Abstract

A limited invertebrate fauna have been collected from the detached exotic blocks in the Dibba zone at Jebel Qamar South, United Arab Emirates. The Receptaculitacea species *Cyclocrinus multicavus*, the Orthoceratidae *Orthoceras* sp., and the Nileidae *Nileus emiratus* n. sp., have been identified. According to this fauna, a Middle Ordovician age could be assigned to the upper part of the Rann Formation and the lower part of the Ayim Formation, from which the described specimens have been obtained. The fauna indicates a deposition in a shallow shelf environment with open circulation. The prevailing palaeoclimatic conditions in the area in connection with the widespread Late Ordovician Saharan glaciations postulate that the nileids and the receptaculitids probably tolerated wide range of temperature changes.

Keywords: Ordovician, Jebel Qamar, Nileids, Receptaculitids, United Arab Emirates.

1. Introduction

Very little is known about invertebrate macrofossils of Early Paleozoic sequence of the Oman Exotics terrains because of scarcity of fossils. Hudson et al. (1954) reported *Cruziana* tracks and un-identified trilobites from the Rann Grits and Shales of Jebel Qamar, and assigned the succession to the Middle Ordovician age. Robertson et al. (1990) recorded the presence of orthocones, bone material, fish teeth, and broken fish scales from the base at the Ayim Formation of the Lower Paleozoic sequence at the southeast end of Jebel Qamar South. Orthocones and echinoderm fragments also occur in the upper part of the formation. A Devonian age was assigned to the Ayim Formation based on this fauna.

The intent of this paper is to record, and describe Lower Paleozoic assemblage from the substratum of the Jebel Qamar South in the Dibba Zone of the United Arab Emirates. Knowledge of these fossils is highly desirable since the stratigraphic interval which they characterize belongs to a poorly defined stratigraphic sequence. Furthermore, the study of these taxa will shed light on Lower Paleozoic paleoenvironments and on tectonic history of the Oman Exotics.

2. Lithostratigraphy

Throughout the Oman Mountains, large detached exotic blocks of Ordovician to Triassic age occur in a sedimentary mélange (U. Cretaceous) between the Hawasina Complex (U. Tirassic – M. Cretaceous allochthonous basinal sediments) thrust sheets and the Semail Ophiolites (M. Cretaceous allochthonous oceanic crust). These exotic blocks are represented in the Dibba Zone by Jebel Qamar North and Jebel Qamar South (Long. 56° 02 E.& Lat . 25° 25 N.), which are both large blocks (16 km. by 11 km.) floating in the sedimentary mélange (Hudson et al. 1954 ; Alleman & Peters , 1972 ; Glennie et al. 1973; Sealer et al.1983 ; and Robertson et al. 1990) (Fig.1).

The sedimentary sequence of Jebel Qamar was first studied by Hudson et al. (1954) who recorded the following five rock units:

5- Shamali Limestone (? 200m.), Upper Triassic to Rhaetic . Limestones sandstones and marls. With *Dicerocardium.*
4- Ummaili Dolomite (750m. +),? Triassic. No fauna.
3-Qamar Limestone (500m. +), Middle Permian. With *Parafusulina,* Neoschwagerina, corals and brachiopods.
2- Asfar Beds (150m.) , Permian . Sandstones and limestones . With *Fenestella, Tachylasma*, productids and spiriferids brachiopods.
1- Rann Grits and Shales (250m.), Middle Ordovician . With *Cruziana* tracks and trilobites.

Robertson et al. (1990) studied Lower Paleozoic substratum of the Oman Exotics in the Dibba Zone at the southeast end beneath the unconformity at the base of the Asfar Beds. Sequences exposed in mélange blocks were measured and correlated to give a composite succession (Fig .2). They introduced the Ayim Formation (condensed shelf deposition) of Devonian age between the underlying Rann Formation and the overlying Asfar Formation. They also concluded that the thicknesses of individual rock units given by Hudson et al. (1954) included what Robertson et

* Corresponding author.hamdan@hu.edu.jo

al. (1990) recognized as mélange matrix; and are thus very excessive .

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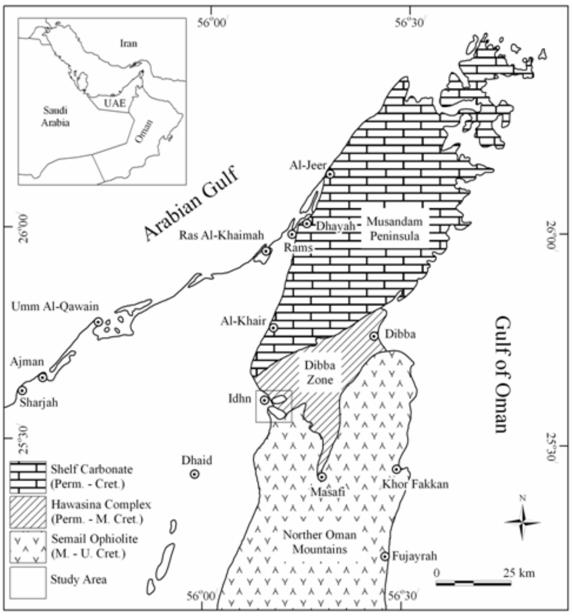


Figure 1. Geologic map of the Musandam Penensula and Dibba Zone, United Arab Emirates (modified after Searle et al., 1983) and location of study area.

Searle & Graham (1982) interpreted that the unconformable overlying Permian- Triassic massive limestone of the Jebel Qamar North and South as a carbonate buildup on a horst of basement subsequently rifted away from the continental platform .

3. Material

Owing to the particular interest of the Paleozoic sequence exposed beneath the Jebel Qamar South in the Dibba zone, the Rann Formation and the Ayim Formation, which are both poor in fossil content, have been studied and sampled for invertebrate fossils during several seasons (1980-1994). Two specimens of cyclocrinids were collected from the top of thinly-bedded, shaley, medium grained quartzose sandstone of the Rann Formation. One specimen of nileid trilobites and several specimens of orthoceratid nautiloids were collected from the lower part of the Ayim Formation which consists of finely–laminated, thinly–bedded brown shale, argillaceous calcilutite and calcareous siltstone.The orthoceratids are preferentially oriented in the succession.

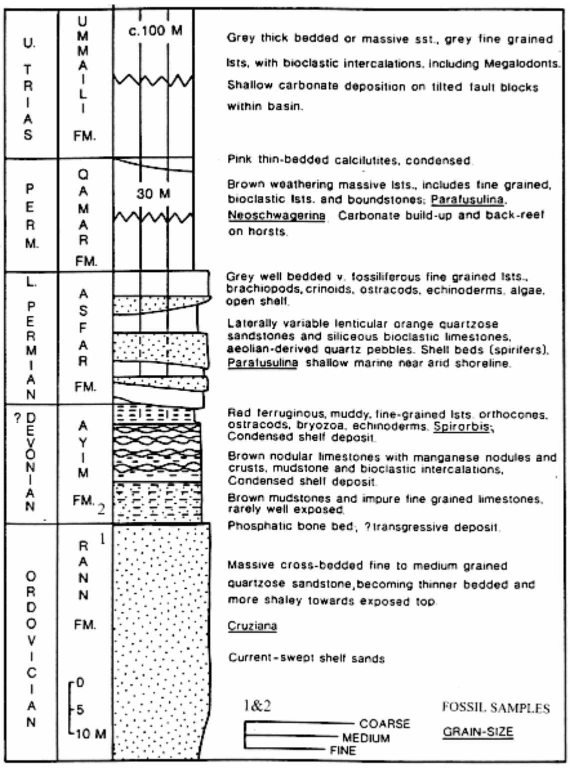


Figure 2. Composite succession of the palcozoic sediments exposed in exotic blocks in the vicinity of jebel Qamar. Position of described fossils is indicated by number 1, Cyclocrinus; and number 2. Orthoceras and Nileus (Modified from Robertson et al ., 1990).

3.1. Systematic Palaeontology

The terminology used in the present study is mainly consistent with "Treatise on Invertebrate Paleontology" (Harrington et al., in Moore 1959; and Teichert et al., in Moore 1964), and in line with Nitecki 1969 a,b and Nitecki 1972 and Fisher & Nitecki 1982.

Repository of the described specimens took place in the Hashemite University, Zarqa, Jordan.

Abbreviations: HUEES: Hashemite University Earth and Environmental Sciences. P: Palaeontology. R: Receptaculitids. N : Nautiloids. T : Trilobites.

Class Receptaculitaphyceae WEISS, 1954
Order Receptaculitales JAMES, 1885
Family Receptaculitacea EICHWALD, 1860
Genus *Cyclocrinus* STOLLEY, 1896
Cyclocrinus multicavus STOLLEY, 1896

Figures. 3, 4

Figure 3. Globose thallus, broken top; 1X.

Figure 4. The same as Fig. 3 enlarged, densely joined meroms; 3X.

3.2. Material: Two thallae, HUEES – PR 1- 2.

Remarks: The receptaculitids are problematic Palaeozoic organisms, which were placed by different authors into different animal and plant groups. This group has recently been considered to be calcareous algae, belonging to the Dasycladales (Keslings & Graham, 1962, Nitecki 1969 a, b, 1972 b), but its taxonomic position is still uncertain (Nitecki & Rietschel, 1985), although they are often well preserved.

The cyclocrinitids are also of uncertain position. They were considered by Pia (1926, 1927) as a tribe "Cyclocrineae" within the thallophyte family Dasycladaceae.Then they were placed by Nitecki (1972a) as the tribe "Cyclocriniteae" into the Receptaculitaceae.

Descripton: The better preserved thallus HUEES-PR1 described in the present study is globose, slightly compressed due to compaction, with the larger diameter of 21.4 mm and the smaller one of 18.4 mm, height about 20 mm; the top, which becomes inflated after a slight flexure, is broken in our specimen; only the base of the flexure is preserved. The surface of the thallus is covered regularly with densely joined meroms (Fig. 3). Distal plates are not preserved; excavated polygonal outer faces of the meroms are 0.3-0.5 mm in diameter.

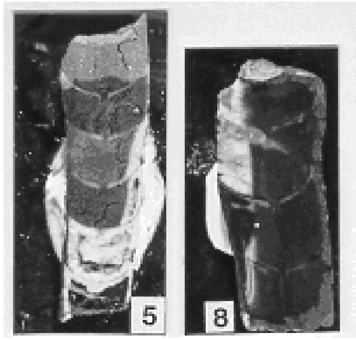
The Emiratian specimen (Fig.3-4) is comparable to the specimens described by Stolley (1896) and determined by Neben & Krueger (1979) in dimension and shape of thallus and in size, shape, and arrangement of meroms. Therefore, they have been assigned to *Cyclocrinus multicavus* STOLLEY, 1896.

Discussion: Stolley (1896) described the *Cyclocrinus multicavus* from rocks belonging to the upper parts of Ordovician.

Therefore, the Rann Formation from which our specimens are obtained can be assigned to Middle to Late Ordovician age.

Phylum	Mollusca Linneus
Class	Cephalopoda Cuvier
Subclass	Nautiloidea Agassiz, 1847
Order	Orthoceratida Kuhn, 1940
Family	Orthoceratidae M'Coy, 1844
Genus	*Orthoceras* Brugier, 1789
	Orthoceras sp.

Figures. 5, 6, 7, 8



Figures 5, 8: *Orthoceras* sp, Figure 5. Sagittal section showing strongly curved septa, central tubular siphuncle, and *orthochoanitic septal necks; HUEES-PN 1; 1,4 X, Figure 8. Sagittal section, tubular siphuncle; HUEES-PN3; 1,5X.*

Material: Five phragmocone fragments preserved as internal moulds (HUEES, PN 1-5).

Description: The phragmocone is, a small slender orthoconic longicone (Fig.6-7) with more or less circular cross section and septa that are strongly curved.

Figures 6, 7. Figure 6. Orthoconic phragmocone fragment showing wide and equal spaced septa; HUEES-PN1; 1,4X. Figure 7. Phragmocone fragment widened anteriorly; HUEES-PN2; 2X.

The cameral lengths range from 1/3 to 2/3 of diameter. In a length of 5 cm of the phragmocone, 8-9 septa occur septa. Siphuncle central and tubular make about 7-8% of the diameter of the phragmocone. Spetal necks orthochoanitic is with a length of about 0.7 mm (Figs.5, 8).

The studied phragmocone fragments did not contain cameral or siphuncular deposits.

Discussion: The studied specimens are internal moulds of phragmocone fragments. Therefore, they could not be assigned to certain species, but the general shape of the phragmocones, the central tubular siphuncle, the orthochoanitic septal necks, and the lack of cameral and siphuncular deposits indicate that these specimens belong to orthoceratid cephalopods, particularly to the genus *Orthoceras*. The specimens are most similar to the specimens described by Stait & Flower (1985) as *Orthoceras* sp. from the top of the Karmberg Limestone (Late Whiterockian to Early Chazyan) at Sunshine Road in the Florintine Valley, Tasmania, Australia.

specimens in this study have also similarities with the specimens described by Frey (1995) from the Tyrone Limestone (Rocklandian, Middle Ordovician), central Kentucky, USA., as *Pojetoceras floweri* FREY, but this species has cameral and siphuncular deposits, which are absent in the specimens described in the present study.

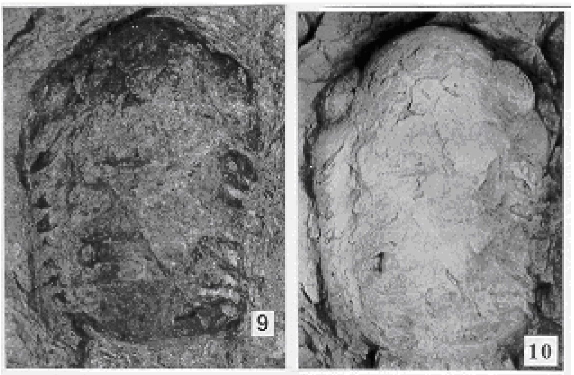
Remarks: As the Emiratian specimens described here (Figs.5-8) and the specimens described by Stait & Flower (1985) from Tasmania, Australia as *Orthoceras* sp. are closely similar and belong most probably to the same species, and the Australian specimen is of Middle

Ordovician age. Therefore, the Emiratian specimens can be assigned a Middle Ordovician age.

Stratigraphic and geographic distribution: Middle Ordovician Karmberg Limestone Tasmanian (Australia) and the Ayim Formation, Jebel Qamar South, United Arab Emirates.

Class	Trilobita WALCH, 1771
Order	Ptychopariida SWINNERTOn, 1915
Suborder	Asaphina SALTER, 1864
Superfamily	Cyclopygacea RAYMOND, 1925.
Family	Nileidae ANGELIN, 1854
Genus	*Nileus* DALMAN, 1827
	Nileus emiratus n. sp.

Figures. 9, 10



Figures. 9 , 10. *Nileus emiratus* n. sp.; holotype; HUEES-PT1, Figure 9. Semireniform cephalon thorax of 8 segments with wide axis; 1X, Figure 10. Very wide glabella, large eyes and rounded genal angles; the same as Fig. 7; 1X.

Material:
One specimen preserved as internal mould.
Derivatio nominis: After the state of the United Arab Emirates.
Locus typicus: Jebel Qamar South, the Dibba zone. United Arab Emirates.
Stratum typicum:
Lower part of the Ayim Formation, Middle Ordovician.
Holotype : HUEES-PT 1, Figs. 7-8 (of a single specimen).
Paratypes:
none.
Stratigraphical distribution:
Ordovician.
Geographical distribution:
United Arab Emirates.
Depository:
Dept. of Earth and Environmental Sciences of the Hashemite University, Zarqa, Jordan.
Diagnosis:
The cephalon is semi- reniform, almost without border, and with round genal angles extending backwards beyond anterior margin of the axis.
Dimentions of the holotype: Length of skeleton ~ 64 mm, width about 43 mm, length of glabella ~ 18 mm, width of glabella 22 mm, length of thorax 33 mm, length of pygidium ~ 13 mm, width of pygidium ~ 33 mm, palpeblar lobe 10 mm long, librigenae ~ 9 mm long.
Description: Dorsal skeleton strongly and evenly convex transversely, rounded at both ends (Figs.9-10); cephalon semireniform, rounded genal angles extended backwards beyond axial anterior margin without visible border on the mould and also without occipital furrow; glabella very wide, parallel sided and slightly and evenly convex, without lateral furrows (Figs.9-10), with length a little bit less than width and declined steeply anteriorly; eyes large crescentic; palpeblar lobes semi-elliptical and large, with length half that of cranidium, separated from glabella only by indistinct axial furrows; thorax of 8 segments, with parallel sided slightly and evenly convex wide axis making about ¾ of thorax width; semicircular convex pygidium with indistinct axis, smooth, and length making about 40% of width.
Remarks:

Fortey and Chatteron (1988) presented a new phylogenetic classification of the suborder Asaphina. These authors, who studied several nileid protaspides, placed the Family Nileidae, which was earlier included in the superfamily Asaphacea, in the superfamily Cyclopygacea. The suborder Asaphina presumably originated in the Middle Cambrian. Some taxa of the Asaphina did not survive the Middle Ordovician. The rest, including the family Nileidae, which began in the Early Ordovician, survived until the end of this period. The disappearance of this diverse and worldwide distributed group at the end of the Ordovician Period is difficult to explain, but it could be, as postulated by Fortey & Chatterton (1988), connected with a change in oceanic circulation which has affected the life of the planktic asaphoid larvae.
Discussion:
Several species of the genus *Nileus* have been described from beds ranging in age from Early to Late Ordovician in Europe, N-America and Asia. The Emiratian specimen shows similarities in cephalic features with the genus *Symphysurus* but the glabella of *Symphysurus* is more convex and its axis is also more convex and narrower than that of the species described in the present study. It has been placed in the genus *Nileus* because it has, like most species belonging to this genus a large, a very wide, slightly and evenly convex glabella, large crescentic eyes, and a wide evenly convex axis with indistinct furrows. It can be compared with the type species *Nileus armadillos* from Sweden, but *N. emiratus* has larger librigenae, larger palpeblar lobe; and is in general larger. It can be also easily differentiated from *N. walcotti* from China (Endo, 1932, Zhou et al. 1998 a.b); *N. emiratus* is larger and has larger palpeblar lobes and larger librigenae. It can be also distinguished from *N. exarmatus* and *N. orbiculatoides* from Sweden by the larger libriganae and the rounded crandium in contrast to the subangular one of those species. It differs also from *N. huanxianensis* from China by (Zhou et al. 1982, Zhou & Dean 1986) in its much larger size, larger palpeblar lobes and larger librigenae. *N. huanxianensis* has, on the internal mould, a weak medial glabellar ridge which is absent in *N. emiratus*. *N. emiratus* differs also from *N. porosus* from Spitzbergen by its larger palpeblar lobes and larger librigenae. *N. porosus* has punctae on the cranidium, and *N. emiratus* has no such punctae.

4. Discussion and Conclusion

Trilobites occur in a variety of marine lithofacies. They are abundant in limestones, shales and sandstones representing deposition in shallow, normal shelf environments with open circulation.

Whittington & Hughes (1972) delineated four Lower Ordovician faunal provinces which have been defined and named after characteristic endemic familes or genera. The bathyurid province extends over most of North America, Greenland, western Norway, Irland, Scotland, Spitzbergen and The Siberian platform. The asaphid province occupies the Balto- Scandia and the Urals. A *Selenopeltis* province covers England, southern and Eastern Europe and North Africa.

The fourth province consists of a less well- known fauna and is confined to South America and Australia. It is named after *Asaphopsis* . By Caradocian times, only the *Selenopeltis* province persisted whereas the other three provinces had merged into a single remopleuridid province.

Genera and species of the Family Nileidae have been recorded from Lower to Upper Ordovician strata of different locations. The genus *Nileus* occurs in Sweden, Spitzbergzen, China, North America, South America (Fortey 1975; Zhou et al. 1989, 1998) and the United Arab Emirates. This wide geographic distribution of the nileid fauna indicates their low endemicity.

During Late Ordovician times there was a pole situated where now the Sahara Desert is. A short but widespread glaciation is known from later Ordovician, centered on this pole. The central Arabian region lay at the northern edge of the widespread Saharan glaciation (Mclure, 1978 ; Vaslet , 1989 ; Beydoun, 1993).

In the United Arab Emirates, *Nileus* occurs in a thin-bedded, shaley, fine to medium-grained current-swept shelf sandstone of the upper Rann Formation . This detrital succession indicates deposition in a cold, carbonate deficient, shallow shelf environment. Therefore, it is assumed that the nileid community tolerated a wide range of temperature changes during Ordovician times .

Robertson et al. (1990) assigned an Ordovician age to the Rann Formation and a Devonian age to the Ayim Formation. The recorded and described cyclocrinid, orthoceratid and nileid species indicate Middle to Late Ordovician age and a shallow inner shelf marine environment of the Raan Formation and the lower part of the Ayim Formation at the southeast end of Jebel Qamar South.

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