

# Micropalaeontology of the Permian Marls of Merbah el Oussif (Jebel Tebaga, Tunisia) with special emphasis on the Ostracods

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**ABSTRACT** - The Marls of Merbah el Oussif are part of the Permian series of the Jebel Tebaga of Médénine in Tunisia. They belong to the uppermost Murghabian, a stage intermediate between the Wordian and the Capitanian. These green marls were deposited in lows at the base of sponge bioherms. The sedimentation rate was high and the environment well oxygenated. The marls contain a relatively rich assemblage of isolated sponges, gastropods, smaller foraminifera, fusulinids, dasycladacean algae and ostracods. Amongst those, for the first time reported from the Permian of Tunisia, 14 species have been identified and one new species described, *Bairdiacypris postrectiformis* sp. nov. The geographic and stratigraphic distribution of several species are discussed. This ostracod fauna indicates a shallow nearshore environment and suggests a western, not eastern connection between the Tethys and the Texas Sea.

## PRESENTATION OF THE JEBEL TEBAGA SERIES (S.R. & D.V.)

The Jebel Tebaga is located 25 km north-west of the town of Médénine, in southern Tunisia. It outcrops in a group of hills 13 km long and 3 km wide, bordering the Djefara plain (Fig. 1). The outcrop is a monoclinical series that reaches about 1000 metres in thickness and can be divided into five lithologic units (Fig. 1). From bottom to the top these are:

(a) **Unit I, Dar Njana and Batun beni Zid** includes intertidal or infratidal cross-bedded sandstones, a layer with *Ottonosia* oncolites, massive sandstones, and bioclastic limestones very rich in calcareous algae, *Hemigordiopsis renzi* Reichel, 1945, *Yabeina syrtalis* (Douvillé, 1934), *Neosch-*

*wagerina* spp., all of the group of *Neoschwagerina craticulifera* (Schwager, 1883).

(b) **Unit II, Jebel Tebaga sensu stricto**, formed by *Archaeolithoporella* algal buildups and associated bioclastic limestones, often dolomitized.

(c) **Unit III, Merbah el Oussif**, consisting of laterally extensive green marls surrounding isolated sponge reefs. These marls are the object of this micropalaeontological study.

(d) **Unit IV, Oudjah el Rhar**, containing *Archaeolithoporella* algal buildups (Razgallah *et al.*, 1987).

(e) **Unit V, Halk el Djemmel**, formed by ferruginous bioclastic limestones with the calcareous algae *Permocalcu-*

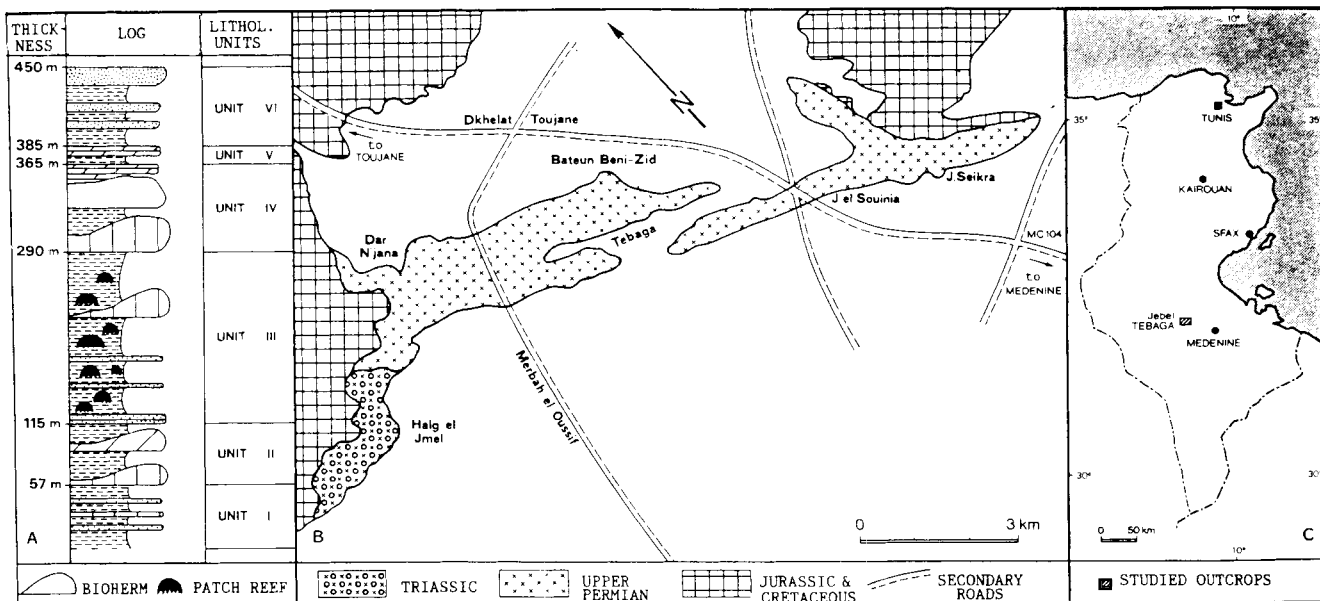


Fig. 1 Location map and synthetic stratigraphic column of Jebel Tebaga of Medenine.

*lus* spp., *Mizzia velebitana* Schubert, 1908, and the fusulinid *Yabeina syrtalis* (Douvillé, 1934). At the top of this unit are dolomitized beds with common oncolites, *Ottosonia laminata* Twenhofel, 1919.

The eastern outcrops (Jebel Grous, Jebel es Souinia, Chaabet Tarfaïa, Jebel es Seïkra), rather tectonically disturbed by an important pre-Jurassic transform fault, probably belong to this last unit. These outcrops are rich in *Dunbarula mathieuï* Ciry, 1948, *Permocalculus* spp.....

**(f) Unit VI, Chegoumi (or Maasra)**, consists of a series of sandstones and tidal-flat clays with vertical borings and rare vertebrate tracks (Newell *et al.*, 1976)

Several publications have discussed and illustrated the bioclastic composition of these levels: Glintzboeckel & Rabaté (1964); Termier, Termier & Vachard (1977), Driggs (1977), Vachard (1985), Khessibi (1985), Gargouri & Vachard (1988), Vachard & Razgallah (1988).

#### AGE OF THE SERIES (D.V.)

Based on the presence of fusulinids, the series has been attributed to the Late Permian (Douvillé, 1934). But only very recently, and for the first time, Khessibi (1985) questioned the precise age of the series. He concluded that units I to III were of Late Murghabian age because of the presence of *Neoschwagerina* and *Yangchienia* and that units IV and V were of Dzhulfian age because of the presence of *Yabeina*, *Reichelina* and *Codonofusiella*.

With incorporation of new field, laboratory observations and recent modifications of the Permian chronostratigraphy (Vachard & Razgallah, in press), we will improve on these datings (Fig. 2). First, the Dzhulfian does not directly overlie the Murghabian; the Midian stage, (introduced by Leven, 1981), although poorly defined, is situated between these two stages. Also the *Reichelina* and *Codonofusiella*, which are very rare and localised in the Jebel Tebaga, are known since the Murghabian; either the Later Murghabian (Vachard, 1980) or the Middle Murghabian (Lys *et al.*, 1980). Finally, we have found *Yabeina* in the whole series and associated with *Neoschwagerina* at Bateun beni Zid.

Skinner & Wilde (1967) also made this observation. Furthermore, they stated (p. 16) that in their samples, *Neoschwagerina* was present in levels situated above those with *Yabeina*.

As in Jebel Tebaga, *Yabeina*, *Neoschwagerina*, *Yangchienia*, as well as *Reichelina* and *Codonofusiella*, co-exist in Turkey (Skinner, 1969).

All these elements lead us to the conclusion that all the outcrops of the Jebel Tebaga are of the same age, Murghabian, containing three biozones with *Neoschwagerina*, or Midian which markers are *Yabeina* and *Lepidolina*. Since the *Lepidolina* are totally absent in the Jebel Tebaga, we can exclude the Midian and suggest that the Jebel is of Murghabian age. The marker for the Late Murghabian, *Neoschwagerina margaritae*, is absent in the Jebel Tebaga but seems to be generally more developed in the eastern part of the Tethys. The three species (or sub-species) of

*Neoschwagerina* described in the Tebaga all belong to the *Neoschwagerina craticulifera* (Schwager, 1883) group, a species considered as a marker for the Murghabian in the Soviet Pamir. The whole assemblage is more advanced than the typical Middle Murghabian of Sosio in Sicily (Skinner & Wilde, 1966). It contained only *Neoschwagerina* ex gr. *craticulifera* (Schwager, 1883) but no *Yabeina*, and *Rugososchwagerina yabei* (Staff, 1909) which is considered to be a rather reliable marker for the Middle Murghabian in the Tethys.

In the Murghabian stratotype, in the Soviet Pamir (Miklukho-Maclay, 1958, 1963; Dutkevitch, 1976; Leven, 1981), *Neoschwagerina craticulifera* (Schwager, 1883) is present in the Late Murghabian (Leven, 1967), whereas *Yabeina* appears only at the top of the stage.

If all these data are taken into consideration, we are tempted to recognise a zone with *Neoschwagerina* and with *Yabeina* at the top of the Murghabian for the Jebel Tebaga series. In order to place this zone in a bio- and chronostratigraphic framework, we used the Japanese succession proposed by Minato *et al.* (1978), the synthetic classification of Kozur (1977), the fusulinid zonation of Wilde (1975) for the U.S.A. and the official Soviet Union zonation, although obsolete and difficult the use. These correlations are presented in Figure 2. This table is in general agreement with the work of Nakazawa & Kapoor (1977).

In the Western Tethys, the zone with *Neoschwagerina* and *Yabeina* is known in the Jebel Tebaga, Turkey, and probably in Yugoslavia (Kochansky, 1975; Kochansky & Ramovs, 1978).

In conclusion, it should be noted that the series is more complete in boreholes. It can reach about 7000 m and contains possible Late Murghabian (zone with *Dunbarula* and *Codonofusiella* of Glintzboeckel & Rabaté, 1964), Middle Murghabian (zone with "*Polydiexiodina*" of Glintzboeckel & Rabaté, 1964: pl. 52-55, 90-92; with common *Afghanella* and *Polydiexiodina*) and possible Early Murghabian (zone with "*Parafusulina*" of Glintzboeckel & Rabaté, 1964: pl. 89-108). There is a probable important hiatus since all the boreholes directly penetrated basal Permian and Late to Middle Carboniferous below the Murghabian (Glintzboeckel & Rabaté, 1964: pl. 1-33).

The Dzhulfian may be present with characteristic *Codonofusiella* and *Parareichelina* (Glintzboeckel & Rabaté, 1964: Pl. 56, Fig. 1 a-b and Pl. 58).

#### THE MARLS OF MERBAH EL OUSSIF (D.V. & S.R.)

According to Khessibi (1985: p. 436-347), these green marls, channelised, extended about 3 km between sponge buildups. Their thickness varies from 250m to 300m and includes reefal buildups ranging in size from several tens to several hundreds of metres. Khessibi also reported numerous large size (several centimetres) sponge debris.

After being washed for micropalaeontological analysis, these marls proved to be highly fossiliferous. Three main

CHRONO-STRATIGRAPHY		GENERALIZED ZONATION SCHEME		TUNISIA (this paper)	JAPAN (MINATO et al. 1978)	KOZUR 1977		U.S.A. (WILDE 1975)	U.S.S.R.	
DORASHAMIAN		CHANGH-SINGIAN	-		?	-		DORASHAMIAN	TATARIAN	
DZHUFLIAN			CODONOFUSIELLA/ REICHELINA	PALAEOFUSULINA	?	Palaeofusulina sinensis + Colaniella parva	DZHUFLIAN			
"MIDIAN"				LEPIDOLINA	?	Palaeofusulina simplex + Colaniella minima				BAISALIAN
				YABEINA-LEPIDOLINA		?				
				?	Yabeina globosa + Lepidolina multiseptata	ABADEHIAN		LATE		
						CAPITANIAN			GUADALUPIAN	
										MIDDLE GUADALUPIAN
MURGHABIAN	Uppermost	NEOSCHWAGERINA-YABEINA		Tebaga outcrops	"N <sup>a</sup> " douvillei	WORDIAN		KAZANIAN		
	Upper	N <sup>a</sup> craticulifera-N <sup>a</sup> margaritae		?	N <sup>a</sup> margaritae					
	Middle	N <sup>a</sup> craticulifera		Tebaga borehole Afghanella-Eopolydiexodina	N <sup>a</sup> craticulifera					
	Lower	N <sup>a</sup> simplex		?	Tebaga borehole Parafusulina				N <sup>a</sup> simplex + Parafusulina kaerimizensis	UFIMIAN

Fig. 2 Correlation table of several Upper Permian Stratigraphic scales.

groups of microfossils are common in the washed residues:

(a) Unidentified **gastropods**;

(b) **green and red algae**: *Permocalculus plumosus* Elliott, 1955, *Permocalculus tenellus* (Pia, 1937), *Mizzia velebitana* Schubert, 1908, *Mizzia yabei* (Karpinsky, 1908), *Velebitella triplicata* Kochansky, 1964;

(c) **foraminifera**: dominated by *Climacammina valvulinoides* Lange, 1925, with *Globivalvulina graeca* Reichel, 1946 and the fusulinid *Neoschwagerina* ex gr. *craticulifera* (Schwager, 1883) and *Dunbarula mathieui* Ciry, 1948;

(d) **ostracods**, which will be discussed in more details in the next chapters.

Marly layers are rather frequent in the Jebel Tebaga series. These are always associated with sandstones and very shallow-water limestones, which are very rich in photophile algae. The Marls of Merbah el Oussif are situated between sponge buildups. Also, channelised sandstones are often present between the algal buildups of units II and IV.

Therefore, this is not a succession between "deeper water" marls, "shallow water" reefal limestones and beach sandstones, but clastic influxes deposited between the reefs during lateral migration of distributory channels. We can consider the sandstones as being deposited by distributory channels and the marls as corresponding to interdistributory areas. An alternative interpretation is that the sandstones are proximal deposits and the marls are distal sediments deposited close to the mud-line of the deltaic lobes (Blanc, 1982).

The water-depth during the deposition of these marls was most likely to have been between a few metres and a few tens of metres. They seem to be a bionomic equivalent of the coastal terrigenous muds, which have been intensively studied in recent and fossil sediments (Peres & Picard, 1964; Masse, 1976; Plaziat, 1984).

Dasycladacean algae, sessile forms growing on hard

substrate, could have developed *in situ* since they can grow on isolated pebbles in a muddy environment (observation by D.V. in recent environments). Some ostracods, gastropods and small foraminifera could have been epiphytal on these algae. On the other hand, the sponges, which are broken and of large size, most likely to have been transported. Such mixtures have been observed in the Paleocene "*Turitella* Marls" in southern France and northern Spain. Plaziat (1984) interpreted those as: (a) a mixing of decantation autochthonous deposits and shelly mud-flows during major storms; (b) bay and prodelta sediments deposited between littoral, often reefal, limestones and marls with nummulitids (larger foraminifera). Such a model seems to be applicable to the Marls of Merbah el Oussif.

The green colour of the marls clearly indicates that the environment was well oxygenated. The sedimentation rate was high as indicated by the scarcity of bioturbation and of endobiontic organisms.

#### OSTRACODS FROM THE MARLS OF MERBAH EL OUSSIF (F.L & J.-P.C.)

In this study we recognised for the first time in the Permian of Tunisia (Bismuth, 1984), 14 species of ostracods. This record is not necessarily complete since several fragments of other species are present, believed to belong to the superfamily Kirkbyacea and to the genus *Buregia*? Termier *et al.* (1977), reported and illustrated thin sections of specimens assigned to the genus *Cryptophyllus* in the Batun Beni zid Unit. Therefore, complementary studies appear to be necessary. However, some biostratigraphical, paleoecological and paleogeographical conclusions can be proposed and a new species described.

The species collected are listed below; plate and figure numbers are given; figured specimens are deposited in the collection of the Laboratoire de Micropaléontologie, Université, Paris VI).

## Amphissitidae Knight, 1928

*Amphissites* cf. *A. centronotus* (Ulrich & Bassler, 1906): Pl. 1, fig. 1.

## Hollinellidae Bless &amp; Jordan, 1971

*Hollinella* (*H.*) *herrickana* (Girty, 1909): Pl. 1, figs. 2-4;  
*Hollinella* (*H.*) *menardensis* Harlton, 1929: Pl. 1, fig. 5.

## Serenididae Rozhdestvenskaja, 1972

"*Cavellina*" (= *Serenida*) cf. "*C.*" *bisecta sensu* Cooper (1946): Pl. 1, figs. 6-7;  
*Sargentina whitei* (Bradfield, 1935): Pl. 1, figs. 8-9; Pl. 2, fig. 1-2.

## Cavellinidae Egorov, 1950

*Sulcella sulcata* Coryell & Sample, 1932: Pl. 2, fig. 3;  
*Sulcella* cf. *S. rotunda* (Cooper, 1946): Pl. 2, fig. 7.

## Bairdiocyprididae Shaver, 1961

*Silenites* cf. *S. grayi* (Crespin, 1945): Pl. 3, fig. 5.

## Bairdiidae Sars, 1888

"*Bythocypris*" (= *Bairdiocypris*) *shideleri sensu* Schneider (1948): Pl. 3, fig. 4;  
*Bairdiocypris deloi* Bradfield, 1935: Pl. 2, fig. 9;  
*Bairdiocypris postrectiformis* sp. nov.: Pl. 2, figs. 4-6, 8; Pl. 3, fig. 3;  
*Bairdiocypris praewangi* Kozur, 1985: Pl. 3, figs. 1-2;  
*Bairdia consimilis* Gusseva, 1971: Pl. 3, figs. 6-7;  
*Bairdia* cf. *B. mucronulata* Gusseva, 1971: Pl. 3, fig. 8.

Although marine Permian ostracods are relatively well known in the North American shelf, they have been rarely studied in Europe, Asia and Australia. In North Africa, very few species have been published. In north east Egypt, Adindani *et al.* (1977) reported *Knightina bassleri* Kellett, 1933, *Bythocypris osagensis* Kellett, 1935 and *Healdia ciscoensis* Harlton, 1927 in the basal Permian and Wasfi *et al.* (1977) also mentioned *Healdia parallela* Kellett, 1935.

In Israel, 28 species have been recently reported in the Late Permian (Gerry *et al.*, 1987); several are similar to those described by Kozur (1985) in Hungary and by Wang (1978) in China. In Oman, amongst 18 marine species from a probable Late Permian, 13 are related to North American species (F.L. unpublished report).

Until now the stratigraphic range of the Late Carboniferous and Permian ostracod species having wide geographical distribution could not be accurately determined. For this reason, long distance correlations are only approximate. The Marls of Merbah el Oussif have been dated as uppermost Murghabian age by means of fusulinids. The discovery of this ostracod fauna is important because it improved our knowledge of their stratigraphic distribution. As a result of our work, we are able to extend the range of several species upwards into the Permian (Fig. 3). In particular, the Late Carboniferous species such as *Bairdiocypris deloi* Bradfield, 1935, *Hollinella* (*H.*) *menardensis* Harlton, 1929, *Sargentina whitei* (Bradfield, 1935) and *Sulcella sulcata* Coryell & Sample, 1932, are now found to extend up into the Late Permian with total ranges of about 50 My. A tendency toward long duration of ostracod species during the Late Carboniferous and the Permian is confirmed. For long distance correlations, it will be necessary therefore to use interval-zones. This type of zonation has recently been proposed for the Late Carboniferous and Early Permian of Texas (Melnik & Maddocks, 1988b).

Some paleoecological interpretations can be proposed for the sedimentary environment of the Marls of Merbah el Oussif. The ostracod genera encountered are known to be benthic, shallow-marine forms, living near the water-substratum interface or on plants. The ecological requirement of some of these species has been established by detailed studies on the relationship between facies and species in the Early Permian of Texas (Melnik & Maddocks, 1988a) and Kansas (Peterson & Kaesler, 1980; Costanzo & Kaesler, 1987). For example, *Amphissites centronotus* (Ulrich & Bassler, 1906) is abundant offshore and becomes rare as it is the case here, nearshore. It has also been found associated

## Explanation of Plate 1

All specimens are from the Merbah el Oussif Marls (Jebel Tebaga, Tunisia), Late Permian (Late Murghabian).

Fig. 1 *Amphissites* cf. *A. centronotus* (Ulrich & Bassler, 1906), right lateral view (x100), sample 205, P6M 10000.

Fig. 2 *Hollinella* (*Hollinella*) *herrickana* (Girty, 1909); fig. 2a, male right lateral view; fig. 2b, male carapace, dorsal view (x100), sample H 11, P6M 10001.

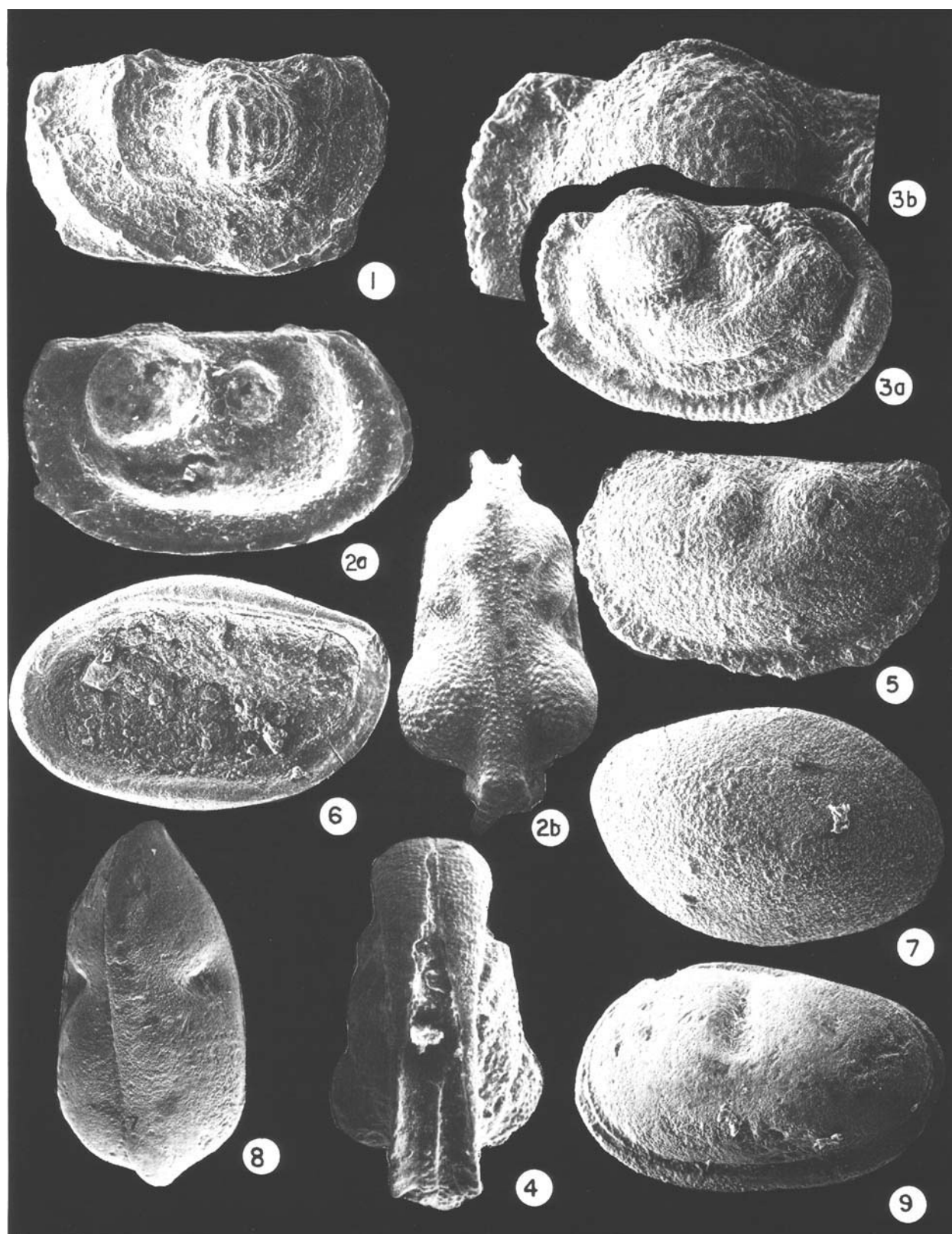
Fig. 3 *Hollinella* (*Hollinella*) *herrickana* (Girty, 1909); fig. 3a ? female, right lateral view (x50); fig. 3b, same specimen, detail postero-dorsal area (x100), sample H 11, P6M 10002.

Fig. 4 *Hollinella* (*Hollinella*) *herrickana* (Girty, 1909), ? female carapace, ventral view (x50), sample H 11, PM 10003.

Fig. 5 *Hollinella* (*Hollinella*) *menardensis* Harlton, 1929, left valve, lateral view (x75), sample 205, P6M 10004.

Figs. 6-7 "*Cavellina*" cf. *C. bisecta sensu* Cooper, 1946; fig. 6, right valve, interior view (x50), sample 224, P6M 10005; fig. 7, right valve, lateral view (x50), sample 224, P6M 10006.

Figs. 8-9 *Sargentina whitei* (Bradfield, 1935); fig. 8, heteromorph dorsal view (x75), sample 224, P6M 10007; fig. 9, heteromorph left view (x85), sample 228, P6M 10008.



OSTRACOD SPECIES	N°	SILESIAN			PERMIAN		GEOGRAPHIC OCCURRENCE
		Nam.	West.	St.	inf.	sup.	
<i>Amphissites cf. centronotus</i> (ULRICH & BASSLER, 1906)	1	cf.	cf. cf. cf.	cf. cf.	cf.	cf. ○	U.S.A. (cf.), Spain, Russ. platf., China <u>Tunisia</u>
<i>Bairdia consimilis</i> GUSSEVA, 1971 ?	2					X ○	Russ. platf. (?), <u>Tunisia</u>
<i>Bairdia cf. mucronulata</i> GUSSEVA, 1971	3					cf. ○	Russ. platf. (cf.), <u>Tunisia</u>
<i>Bairdiacypris deloi</i> BRADFIELD, 1935	4		X X	X X		○	U.S.A., <u>Tunisia</u> , China (?)
<i>Bairdiacypris postrectiformis</i> n.sp.	5					○	<u>Tunisia</u>
<i>Bairdiacypris praewangi</i> KOZUR, 1985	6					X ○	Hungary, <u>Tunisia</u>
" <i>Bythocypris</i> " <i>shideleri</i> sensu SCHNEIDER, 1948	7					⊗	Transcaucasia, <u>Tunisia</u>
" <i>Cavellina</i> " cf. <i>bisecta</i> sensu COOPER, 1946	8		cf. cf.			○	U.S.A. (cf.), <u>Tunisia</u>
<i>Hollinella</i> (H.) <i>herrickana</i> (GIRTY, 1909)	9				X X X	X ○	U.S.A., Transcaucasia, <u>Tunisia</u>
<i>Hollinella</i> (H.) <i>menardensis</i> HARTON, 1929	10		X X	X X		○	U.S.A., Egypt, <u>Tunisia</u>
<i>Sargentina whitei</i> (BRADFIELD, 1935)	11		X X	X		○	U.S.A., <u>Tunisia</u>
<i>Silenites cf. grayi</i> (CRESPIN, 1945)	12				cf. cf. cf.	cf. ○	Australia (cf.), <u>Tunisia</u>
<i>Sulcella cf. rotunda</i> (COOPER, 1946)	13		cf. cf. cf.			○ cf.	U.S.A. (cf.), <u>Tunisia</u> , China
<i>Sulcella sulcata</i> CORYELL & SAMPLE, 1932	14	?	X X	X X	X X X	? ○	U.S.A., Italy, Hungary, Russ. platf., <u>Tunisia</u>

Fig. 3 Stratigraphic and geographic occurrences of the Jebel Tebaga ostracod species.

with probable reworked freshwater *Carbonita*. *Sulcella sulcata* Coryell & Sample, 1932 often corresponds to quiet lagoonal environments, with normal to brackish salinities. *Bairdiacypris deloi* Bradford, 1935 belongs to the nearshore *Bairdiacypris* group of species. Large species of *Hollinella*, with developed adventral structure (velum), can characterise environments such as interdistributary bay prodelta and interdeltatic embayment lagoons. Species of *Bairdia*, which are normally abundant in carbonate open marine environments, are relatively rare. Few taphonomic characters can be used. Carapaces of the species of *Hollinella* are often fragmented and the species *Bairdiacypris postrectiformis* sp.

nov. shows only adults and the last larval stage (Fig. 4). These characters indicate either a high energy biocoenosis, or a thanatocoenosis, following Whatley (1983, 1988) and Brouwers (1988). However, transportation was limited since most individuals of the latter species are represented by closed carapaces indicating a soft substratum and a relatively high sedimentation rate (Oertli, 1971).

In conclusion, the ostracod fauna from the Marls of Merbah el Oussif shows that the paleoenvironment was shallow marine, between 1 and about 15 metres deep, with normal salinity, (slight variations in salinity are possible) and limited and localised bottom currents.

#### Explanation of Plate 2

All specimens are from the Merbah el Oussif Marl (Jebel Tebaga, Tunisia) Late Permian (Late Murghabian).

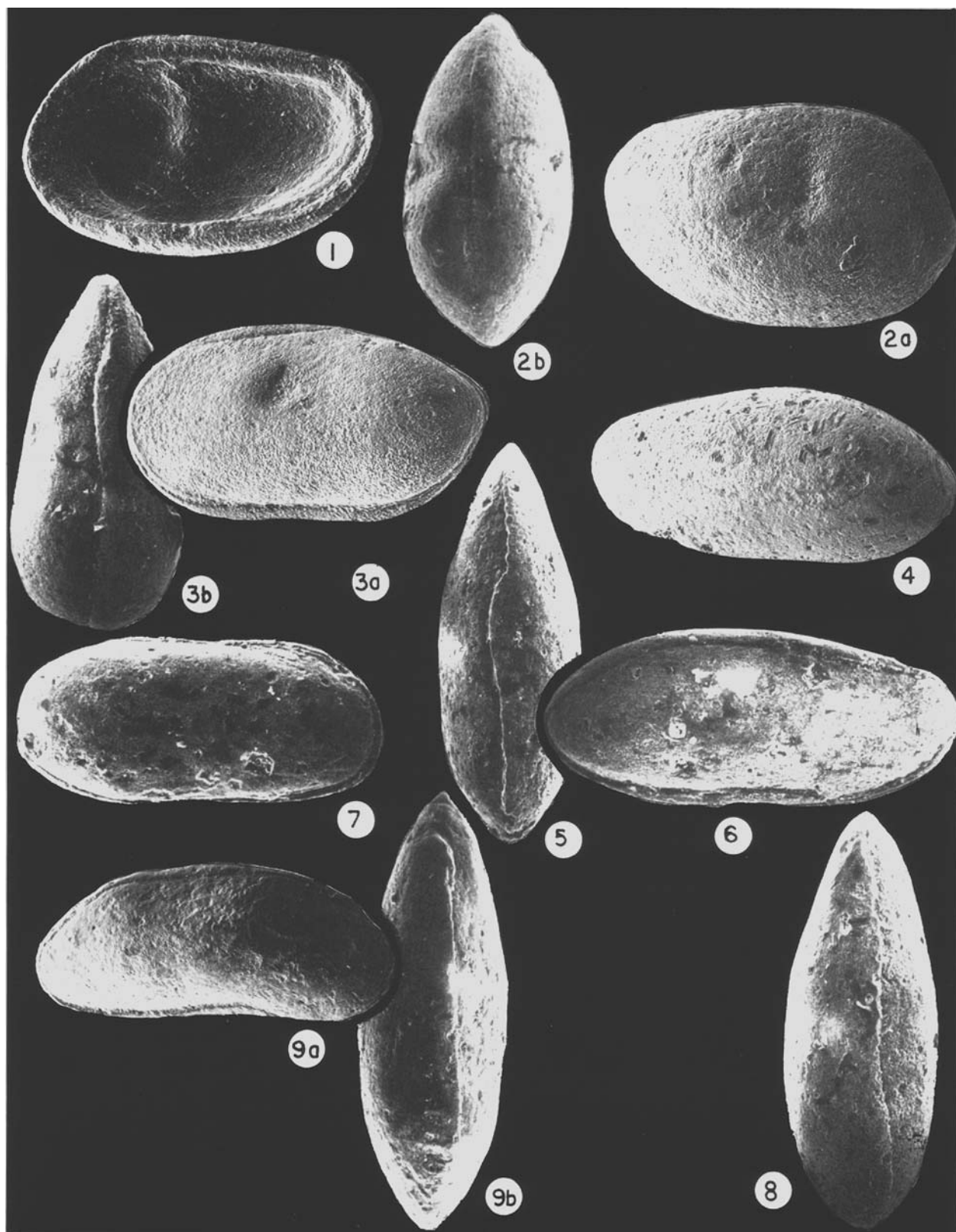
Figs. 1-2 *Sargentina whitei* (Bradfield, 1935); fig. 1, heteromorph right valve interior view (x90), sample 224, P6M 10009; fig. 2a, tecnomorph right lateral view (x90), sample 224, P6M 10010; fig. 2b, tecnomorph dorsal view (x90), sample 224, P6M 10010.

Fig. 3 *Sulcella sulcata* Coryell & Sample, 1932, tecnomorph specimen; fig. 3a, carapace, left lateral view (x95); fig. 3b, carapace, dorsal view (x95), sample 228, P6M 10012.

Figs. 4-6, 8 *Bairdiacypris postrectiformis* sp. nov., sample H 11; fig. 4, left lateral view (x 60), paratype, P6M 10016; fig. 5, carapace, ventral view (x70), paratype, P6M 10015; fig. 6, carapace, right lateral view (x70), holotype, P6M 10017; fig. 8, carapace, dorsal view (x70), paratype, P6M 10019.

Fig. 7 *Sulcella cf. S. rotunda* (Cooper, 1946), heteromorph right view (x 70), sample H 11, P6M 10011.

Fig. 9 *Bairdiacypris deloi* Bradfield, 1935, sample H5A, P6M 10024; fig. 9a, carapace, right lateral view (x55); fig. 9b, carapace, dorsal view (x65).





## PALEOGEOGRAPHIC AND BIOSTRATIGRAPHIC REMARKS (D.V., J. -P.C., F.L.)

Fusulinids, smaller foraminifera and algae of the Jebel Tebaga seem to present a certain provincialism, which confine them to Tunisia, Sicily, Yugoslavia and Turkey. The ostracod microfauna is rather peculiar. Local ecological control however can limit the lateral distribution of some taxa. In fact, Tethyan faunas are present more or less from one end to the other of the Tethys, from Tunisia to Japan and Southern China.

What is the place of the ostracods in this Tethyan realm? Gerry *et al.* (1987) recently published a study on this subject which warrants some discussion. In Israel the Permian is only known from subsurface, essentially in the Negev, and the major study from this area was carried out about 20 years ago (Weissbrod, 1969). However, Gerry *et al.* (*op. cit.*) did not differ significantly from the conclusions of the earlier work. The Early Permian is represented by the Sa'ad Formation about which we have no comments. The Late Permian is represented by the Arqov Formation. According to Weissbrod (1969, p.7), this formation has yielded Late Carboniferous ostracods and Late Permian foraminifera, *Hemigordiopsis* cf. *renzi* Reichel, 1945 (identified by M. Hamaoui). Weissbrod's illustrations (Pl. 1, figs. 7-11) leave no doubt regarding the misidentification; the specimen illustrated is, in fact, *Pilamina densa* Pantic, 1965, which is characteristic of the Middle-Late Anisian (Early Triassic). This does not necessarily invalidate the attribution to the Late Permian since contamination by cavings is always possible in boreholes. The Arqov Formation has been correlated by Gerry *et al.* with the Khuff Formation in Saudi Arabia (Table 1, p.199). This formation has been recently studied by one of the authors (D.V.). The age is Dzhulfian, Dorshamian and Early Scythian, therefore Permo-Triassic. In conclusion, the Arqov Formation is poorly dated and is unlikely to be synchronous with the Jebel Tebaga outcrop.

Gerry *et al.* (1987, p. 200) pointed out that except in Italy, Permian ostracods have not been described from the Mediterranean realm and the Middle East. The Italian level, described by Pasini (1981) belongs to the upper part of the Bellerophon Formation of the Dolomites, which would correspond to the Dorshamian (Noe, 1987) or even the Early Scythian according to Giacobbe (1987).

The only fusulinid reported in Israel, *Codonofusiella* sp. (Gerry *et al.*, 1987), cannot give a more precise age than Late Murghabian to Early Dzhulfian. A very similar taxon, *Paradoxiella* can range higher into the Late Dzhulfian (Lys *et al.*, 1980).

We think that the Israeli ostracod assemblage with *Italo-geisina-Hungarogeisina* is of Dzhulfian-Dorashamian age, contemporaneous with the Italian Bellerophon limestones, but more recent than the Jebel Tebaga levels. Few Israeli species are in common with those described from the Bukk area in Hungary (Kozur, 1985), dated as Abadehian, or those of Late to latest Permian from Southern China (Wang, 1978). The Israeli authors mentioned other affinities with the Middle Permian of Japan and the Early Triassic of Pakistan. Therefore, the paleogeographical correlations proposed by Gerry *et al.*, based on non synchronous datings are not strictly reliable.

A more peculiar affinity of the ostracod fauna of the Jebel Tebaga deserves further attention. It is necessary to extend the relations with the Russian platform on one side, with Texas and Oklahoma on the other side. In fact, amongst the 14 species recognised in the Jebel Tebaga, 5 are already known in the U.S.A. and 3 are very closely related to U.S. species. This tendency confirms the affinities formerly evoked for Egypt and Oman. At least 10 Permian species from Texas and Oklahoma are reported from the Russian platform (see for example Belousova, 1962 and Urasina & Zekina, 1970). Most authors consider that the Jebel Tebaga is the most western marine Permian outcrop of the Tethys and that this western extremity is totally separated from the North American marine platform by a laterally extensive continental area (Termier, Termier & Vachard, 1977; Termier & Termier, 1979; Ziegler *et al.*, 1979; Ross & Ross, 1985). We therefore agree that a connection existed between the two margins of the present Pacific Ocean.

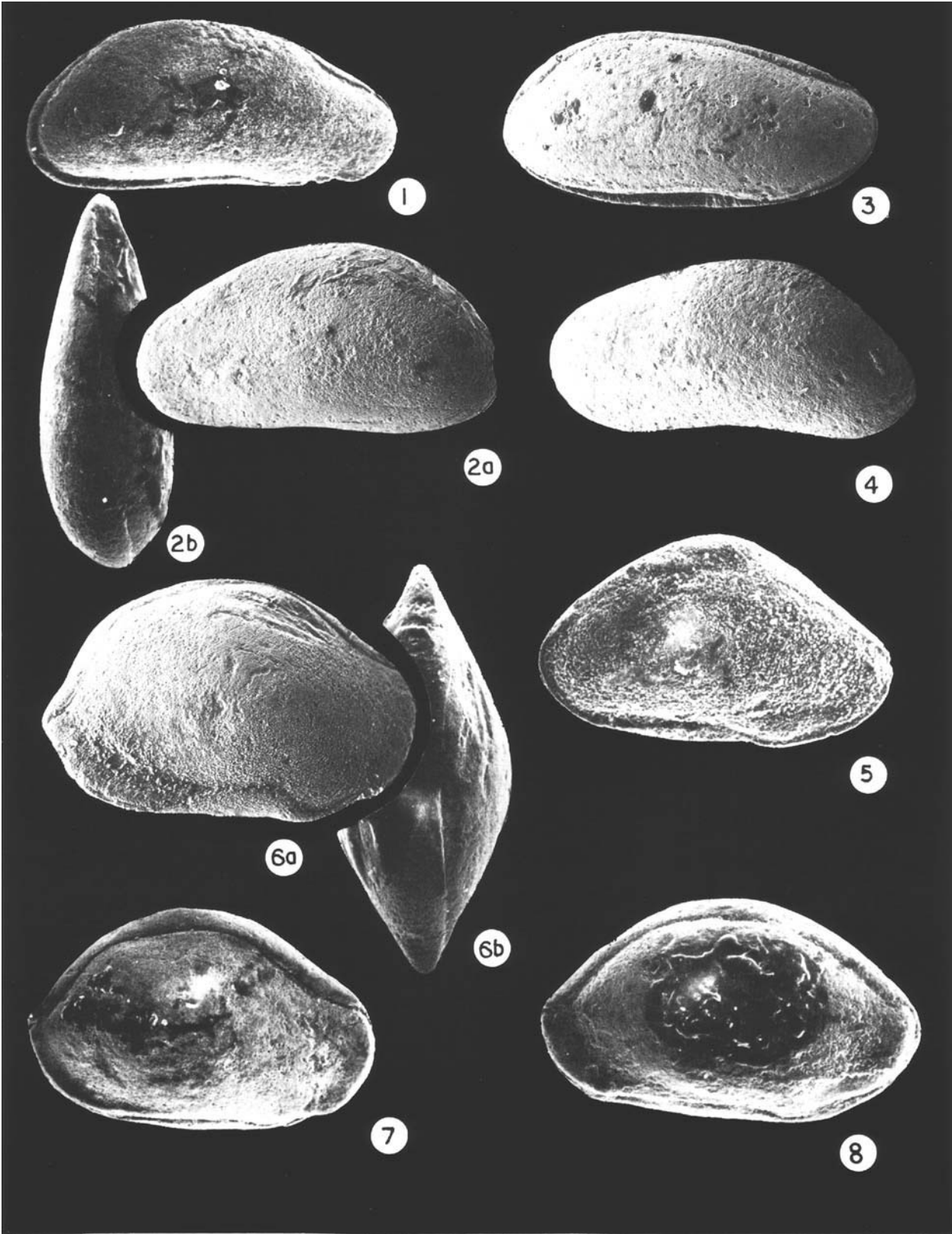
The comparisons between "Tethyan" and "Occidental", i.e. North-American provinces, based on Fusulinid associations was first elaborated by Wilde (1975). Wilde showed that greater differences existed between the two provinces during the period equivalent to the Late Murghabian. He distinguished a *Yabeina-Neoschwagerina* population in the Tethys and a *Polydiexodina* population in the U.S.A. Once more, additional precise analyses need to be carried out

### Explanation of Plate 3

All specimens are from the Merbah el Oussif Marls (Jebel Tebaga Tunisia), Late Permian (Late Murghabian)

- Figs. 1-2 *Bairdiacypris praewangi* Kozur, 1985; fig. 1, carapace, right view (x 60), sample 224, P6M 10013; fig. 2a, left view (x60), sample 224, P6M 10014; fig. 2b, carapace, dorsal view (x 60), sample 224, P6M 10014.  
 Fig. 3 *Bairdiacypris postrectiformis* sp. nov. carapace, right lateral view (x65), paratype, P6M 10018;  
 Fig. 4 "*Bythocypris*" *shideleri* (Delo) *sensu* Schneider, 1948, left lateral view (x55), sample H5a, P6M 10020.  
 Fig. 5 *Silenites* cf. *S. grayi* (Crespin, 1945), carapace, right lateral view (x 80), sample 224, P6M 10021.  
 Figs. 6-7 *Bairdia consimilis* Gusseva, 1971; fig. 6a, carapace, right lateral view (x90), sample 228, P6M 10022; fig. 6b, carapace, dorsal view (x90), sample 228, P6M 10022; fig. 7, carapace, right lateral view (x 75), sample 224, P6M 10023;  
 Fig. 8 *Bairdia* cf. *B. mucronulata* Gusseva, 1971, carapace, right lateral view (x70), sample 224, P6M 10025.





before reliable biostratigraphical and paleogeographical correlations can be made.

### OSTRACOD SYSTEMATICS (F.L.)

This chapter is limited to the description of one new species *Bairdiacypris postrectiformis* sp. nov. Catalogue nos. (P6M) refer to the collection of the Laboratoire de Micropaléontologie, Université Paris VI.

Family Bairdiidae Sars, 1988

Genus *Bairdiacypris* Bradfield, 1935

(see Sohn, 1983, p.231)

*Bairdiacypris postrectiformis* sp. nov.

(Pl. 2, figs. 4-6,8; Pl.3, fig. 3)

**Derivation of name.** After the phyletic lineage of *Bairdiacypris rectiformis* (Shaver, 1959).

**Diagnosis:** A species of the genus *Bairdiacypris* with the following characters: ventral margin short and straight; antero-dorsal margin long, straight or slightly concave; rounded part of the anterior margin short, in an upwards position; outline elongated and anteriorly pointed in dorsal view.

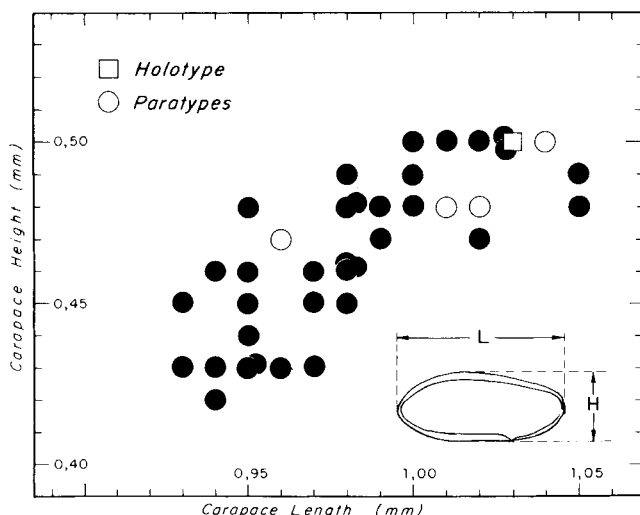
**Holotype.** One carapace, Pl.2, fig. 6, P6M 10017.

**Paratypes.** Four carapaces, Pl.2, figs. 4,5,8, P6M 10015, 10016, and 10019; Pl.3, fig. 3, P6M 10018.

**Type-locality.** Jebel Tebaga, Tunisia.

**Type-level.** Marls of Merbah el Oussif, Late Permian, uppermost Murghabian.

**Material.** 40 specimens from samples H11, H54, 205, 224.



**Description.** Carapace ovoid with short dorsal margin, slightly convex to straight, parallel to the ventral margin, short and straight. Antero-dorsal margin straight to slightly concave and inclined towards the anterior. Anterior margin with its rounded part short and situated upwards, near or

slightly above the mid-height, giving a narrow elongate anterior part. Antero-ventral margin strongly convex. Posterior margin as a short rounded narrow angle slightly below the mid-height. Weak overlap of the left valve over the right valve along the anterior and anteroventral margins, marked along the antero-dorsal and dorsal margins and more important along the postero-dorsal margin. Distinct ventral overlapping lip, near or slightly in front of the mid-length. In dorsal view, fusiform outline with maximum thickness near or slightly behind the mid-length; lateral sides sometimes flattened; anterior end representing about 1/3 of the length with sides sub-straight; posterior end short with sides slightly convex. Smooth surface.

**Dimensions.** see Fig. 4.

	Length	Height	Width
		(mm)	
Holotype (P6M 10017; Pl.2, fig. 6)	1.03	0.50	0.43
Paratype (P6M 10015; Pl.2, fig. 5)	0.96	0.47	0.40
Paratype (P6M 10016; Pl.2, fig. 4)	1.04	0.50	0.45
Paratype (P6M 10018; Pl.3, fig. 3)	1.01	0.48	0.43
Paratype (P6M 10019; Pl.2, fig. 8)	1.02	0.48	0.40

**Remarks.** *B. postrectiformis* sp. nov. possesses a general morphology similar to several species from the Late Carboniferous-Early Permian of the southern and central U.S.A. such as *Bairdiacypris wharthini* (Bradfield, 1935) and *Bairdiacypris acetalata* (Coryell & Billings, 1932) (see synonymies in Sohn, 1961). Our species differs by the diagnostic characters and especially by its straight ventral margin and the narrow elongate anterior part in lateral view. *Bairdiacypris postrectiformis* sp. nov. belongs to the phyletic lineage of *Bairdiacypris rectiformis* (Shaver, 1959) (see synonymy in Sohn, 1983, p. 124) of the Westphalian (Akontan) of Illinois and Ohio. Nevertheless, it differs by the shorter rounded part of the anterior margin and a more accentuated overlap along the postero-dorsal margin, visible especially in dorsal view. Also, our species is similar to *Bairdiacypris obuncus* Belousova, (1965) from the basal Triassic of Transcaucasia; it differs by its straight ventral margin and its less flattened dorsal outline. The lateral outline of our species also is reminiscent of *Bairdiacypris parva* (Wang, 1978) from the Late Permian of China. It differs by its dorsal outline showing a long and acuminate anterior.

**Distribution.** Only known from the type-locality and type-horizon.

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