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KIMMERIDGIAN OSTRACODES FROM THE HALUZA FORMATION IN ISRAEL

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Abstract

Fourteen ostracode species, belonging to twelve genera, are reported from sediments of the Haluza Formation in Israel. They can be grouped into the *Hutsonia adunata* (JJ-6) assemblage zone of Kimmeridgian (Late Jurassic) age, based mainly on common ostracodes, found in Lebanon. The assemblage point to an open marine environment with rather high energy. *Schuleridea bischoffi, Galliaecytheridea micra* and *Micropneumatocythere haluzaensis* are described as new species.

Key words: Ostracodes, Jurassic, Kimmeridgian, New species, Israel.

Resumen

Se reseñan catorce especies de ostrácodos, pertenecientes a doce géneros, de los sedimentos de la formación Haluza en Israel. Estas especies pueden ser incluidas en la zona de conjunto *Hutsonia adunata* (JJ-6) de edad Kimeridgiense del Jurásico Superior, basada especialmente en la fauna común existente en el Líbano. El grupo indica un ambiente marino abierto de una energía relativamente alta. Además, se describen las nuevas especies: *Schuleridea bischoffi, Galliaecytheridea micra y Micropneumatocythere haluzaensis.*

Palabras clave: Ostrácodos, Jurásico, Kimeridgiense, Nuevas especies, Israel.

INTRODUCTION

Ostracodes from Jurassic exposures in Israel and adjacent areas were described by Rosenfeld *et al.*, 1987a (Toarcian-Oxfordian; Sinai), 1987b (Oxfordian; Golan Heights), 1988 (Liassic; southern Israel) and Rosenfeld and Honigstein, 1991 (Callovian-Oxfordian; southern Israel). The present study deals with the ostracode assemblages of the Late Jurassic Haluza Formation (Eliezri, in Coates *et al.*, 1963) from boreholes in southern and northern Israel and outcrop sections in the Golan Heights (here called also Nahar Sa'ar Formation: see Hirsch, 1996).

Rather thick Jurassic successions occur throughout Israel in many boreholes for oil exploration, but only in few outcrops. The lithology of the Haluza Fm. is characterized mainly by marls, shales and shaly limestones with minor sandy and chalky intercalations. These sediments reach thicknesses of up to 250 meters in boreholes, while they are more reduced in most exposures. Indicative megafossils were not found in Israel, but were reported from Lebanon. A Late Oxfordian-Kimmeridgian age was attributed for the sediments of the Haluza Fm. in Israel, based on the Dasycladacea *Clypeina jurassica* and the foraminifera *Alveosepta jaccardi* and *A. personata* (see Picard and Hirsch, 1987).

About 300 samples of cores and cuttings from the following wells (Figure 1, all coordinates in Israeli grid) were examined for their ostracode content (for intervals see Druckman *et al.*, 1983):

Beer Sheva-1 (coord. 1285/0715; southern Israel): 1447-1538 m (incl. cores 5, 6);
Betarim-1 (coord. 1382/0811; southern Israel): 1242-1401 m;
Boqer-1 (coord. 1225/0317; southern Israel): 785-840 m;
Haluza-2 (coord. 1067/0641; southern Israel): 1486-1715 m (incl. core 5);
Hazerim-1 (coord. 1181/0653; southern Israel): 1472-1639 m;
Hazon-1 (coord. 1877/2564, northern Israel): 1486-1715 m;
Hula-2 (coord. 2024/2894; northern Israel): 755-850 m;
Kohal-1 (coord. 1610/0860; southern Israel): 998-1085 m;
Qeren-1 (coord. 1014/0450; southern Israel): 1198-1442 m (incl. cores 3-5);
Sadot-1 (coord. 0746/0675; Sinai, Egypt); 2235-2304 m;
Sukkot-1 (coord. 0596/0500; Sinai, Egypt): 2541-2680 m.

Rare to frequent ostracode assemblages were found within certain intervals only in the boreholes Beer Sheva-1, Boqer-1, Haluza-2, Hazon-1, Kohal-1 and Qeren-1 (see Figure 2). The samples of the wells in Sinai, Egypt, were barren of ostracodes.

In two outcrops in the Golan Heights (Figure 1) a rather common to abundant ostracode fauna could be observed:

Ein Qinya (coord. 21940/29375): beige beds of shaly limestones and shales of 5 m thickness in a possibly slided block from nearby, sampled in 1989 (samples AR 32 - 39/89) and resampled in 1992 (samples AR 70- 77/92).

Newe Ativ (coord. 2194/2963): brownish shales of 1 m thickness in a building excavation site, sampled in 1987 (samples 87/9/8/19-21). The sampled block is probably not in situ.

About 20 samples were taken from these locations and their ostracodes are given in Figure 3.

The type species, all other figured specimens (see Plates 1-4) and picked material are designated in the ostracode collections of the Geological Survey of Israel, Jerusalem. The abbreviations "M", "F" and "l", "h", and "w" in the following chapter refer to male or female specimens, and to their length, height and width

(in mm), respectively. The terms "Stratigraphic range" and "Zone" refer to the distribution of the ostracode species in Israel.

SYSTEMATIC DESCRIPTIONS

Genus CYTHERELLA Jones, 1849
CYTHERELLA INDEX Oertly, 1959
Plate 3, fig. 9

1959 *Cytherella index*, Oertli, p. 16, pl. 1, figs. 13-25.
1963 *Cytherella index*, Oertli, Grekoff, p. 1720, pl. 1, figs. 6-9.
1966 *Cytherella index*, Oertli, Oertli (in Maync), pl. 9, figs. 7-9.
1987 *Cytherella index*, Oertli, Depêche *et al.*, p. 226, pl.1, fig. 4.
1991 *Cytherella index*, Oertli, Rosenfeld and Honigstein, p. 135, pl. 1, fig. 3.

Measurements (mm):

l	h	w
0.58	0.39	0.32

Remarks.–This species is a rather common faunal component in our samples. It was reported hitherto from the Callovian of Madagascar (Grekoff, 1963), the Callovian-Oxfordian of Saudi-Arabia (Depêche *et al.*, 1987) and Israel (Maync, 1966; Rosenfeld and Honigstein, 1991), as well as from the Oxfordian of Switzerland (Oertli, 1959).

Material and distribution.–More than one hundred, mostly carapaces, from nearly all samples of the studied outcrops and wells.

Stratigraphic range.–Callovian-Kimmeridgian.

Zone.–JJ-4 to JJ-6.

Genus CYTHERELLOIDEA Alexander, 1929
CYTHERELLOIDEA sp.
Plate 3, fig. 10

Measurements (mm).

l	h	w
0.45	0.25	0.14

Remarks.–These rare specimens are badly preserved and partly broken. Therefore, a specific designation is not possible. A distinct rim, accompanying the entire margins, and a faint, residual median rib may refer these specimens to *Cytherelloidea aazourensis* Bischoff, 1964 (p. 9; pl. 1, figs. 4-6; Kimmeridgian of Lebanon; see also Basha, 1980, p. 238, pl. 1, fig. 3; Callovian-Kimmeridgian of Jordan and Depêche *et al.*, 1987, p. 227, pl. 1, fig. 7; Callovian of Saudi-Arabia).

Material and distribution.–Two carapaces from the Ein Qinya and Newe Ativ outcrops.

Genus PARACYPRIS Sars, 1866
PARACYPRIS sp.
Plate 4, fig. 8

Measurements (mm).

l	h	w
0.48	0.18	0.14

Remarks.–Our specimens of the genus *Paracypris* agree well with *Paracypris* sp. from the Callovian-Oxfordian of southern Israel (Rosenfeld and Honigstein, 1991, p. 137, pl. 1, fig. 8), but are somewhat smaller.

Material and distribution.–Only three carapaces from two samples of the Ein Qinya outcrop.

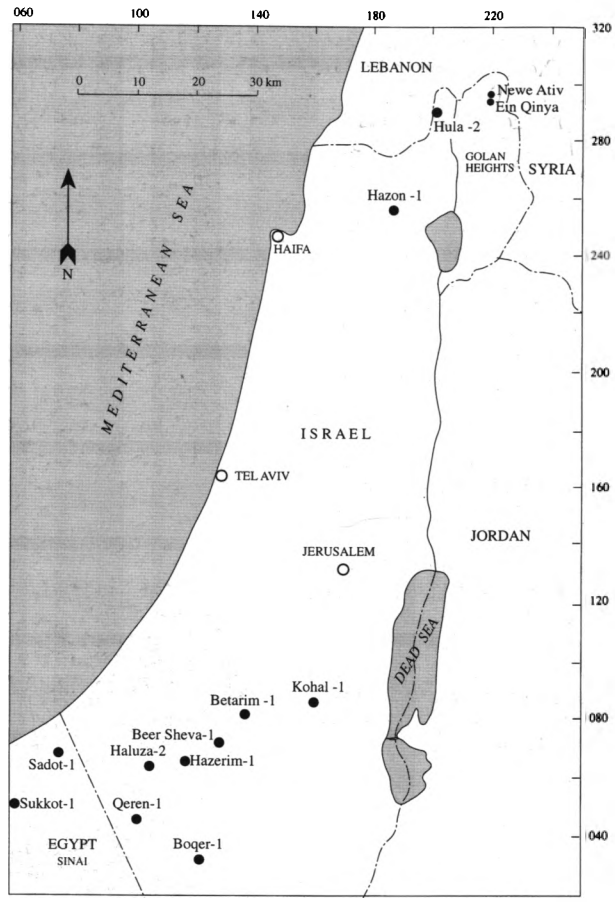


FIGURE 1–Location map.

Genus BYTHOCYPRIS Brady, 1890
BYTHOCYPRIS sp.
Plate 2, fig. 10

Measurements (mm).

l	h	w
0.58	0.26	0.26

Remarks.–These *Bythocypris* specimens show no indicative characteristics in their outline and on their surface and are, therefore, left in open nomenclature.

Material and distribution.–Seven carapaces from the Ein Qinya section.

Genus SCHULERIDEA Swartz and Swain, 1946
SCHULERIDEA BIKFAYAENSIS Bischoff, 1990
Plate 1, figs. 1-7

1990 *Schuleridea (Schuleridea) bikfayaensis*, Bischoff, 1990a, p. 106, pl. 2, figs. 23-25, pl. 3, figs. 26-35.

Measurements (mm).

l	h	w	l/h ratio	
0.45	0.28	-	M	1.60
0.42	0.28	-	F	1.50
0.44	0.25	0.24	M	1.76
0.44	0.34	-	F	1.29
0.42	0.32	-	F	1.31
0.42	0.28	0.28	F	1.50
0.42	0.24	0.22	M	1.75

Remarks.–This species occurs in large numbers in our samples and in many cases, constitutes more than 70% of the total assemblage. They are nearly identical to the specimens, figured by Bischoff (1990a, Kimmeridgian of Lebanon), but show in males a somewhat more perpendicular furrow (best seen in the dorsal view on pl. 1, fig. 6). Our specimens possess also a less punctate surface, which may be referred to slight paleoecological differences. The l/h ratios are in the same range with those reported by Bischoff, as well as the species are identical in the internal features.

Material and distribution.–Several hundreds of carapaces and valves from nearly all borehole and outcrop samples.

Stratigraphic range.–Kimmeridgian.

Zone.–JJ-6.

SCHULERIDEA BISCHOFFI n. sp.
Plate 1, figs. 8-12

Derivation of name.–In honour of Dr. G.C.O. Bischoff, Macquire University, New South Wales, Australia, who described the Late Jurassic - Cretaceous ostracode faunas from Lebanon.

Holotype.–Female left valve, pl. 1, fig. 11.

Paratypes.–One male carapace and two male left valves, pl. 1, figs. 8-10.

Type locality.–Ein Qinya, Golan Heights, sample AR-76/92, coord. 21940/29375.

Type stratum.–Haluza Fm. (Nahar Sa'ar Fm.)

Diagnosis.–Relatively high *Schuleridea* with nearly circular margins in left valves, more subquadrate in right ones. Surface smooth.

Measurements (mm).

l	h	w			l/h ratio
0.41	0.36	-	Holotype	F	1.14
0.40	0.33	0.26	Paratype	M	1.21
0.41	0.34	-	Paratype	M	1.21
0.43	0.36	-	Paratype	M	1.20
0.44	0.36	0.28		M	1.22

Description.–Small, relatively high carapaces with almost equal rounded anterior end, rounded dorsal and ventral margins in left valves and a less broadly rounded posterior end. Entire outline *"Polycope"* - like shape with greatest height at about midlength. Right valves more subquadrate with nearly straight ventral margin and convex dorsal margins; maximum height in front of midlength. Left valve overlaps significantly the right one on the entire outline. Carapaces inflated in their central parts with somewhat depressed dorsocentral, ventrocentral and posterior regions, best observed in left valves. Eye swelling very weak. Dorsal and ventral views subovoid. Surface almost smooth. Hinge antimerodont. Terminal elements high and elongated, anterior tooth with six and posterior tooth with seven crenulations. Median bar long and crenulate. Sexual dimorphism less pronounced than in most *Schuleridea* species: values of the length/ height ratio around 1.2 for males and less for females.

Remarks.–*Schuleridea bischoffi* n. sp. in our samples is best distinguished from *S. bikfayaensis* Bischoff, 1990 (1990a) by its much more rounded and nearly circular margins. *Schuleridea (Eoschuleridea) elstneri* Bischoff, 1990 (1990a, p. 98, pl. 1, figs. 1-13, pl. 2, fig. 14; Kimmeridgian of Lebanon) shows a more elliptical outline, more pronounced sexual dimorphism and slight differences in the hinge.

→

FIGURE 2–Distribution chart of ostracodes in the Haluza Formation from boreholes in Israel.

BOREHOLE	CORE No.	METERS	*Schuleridea bikfayaensis*	*Schuleridea bischoffi*	*Galliaecytheridea micra*	*Schuleridea* sp.	*Cytherella index*	*Hutsonia adunata*	*Afrocytheridea faveolata*	*Micropneumatocythere haluzaensis*	*Oligocythereis* aff. *fullonica*	*Ektyphocythere zoharensis*
BEER SHEVA-1		1453-1455		●								
	5	1459	●			●	●			●	●	
		1466					●					
		1488	●				●					
	6	1495	●				●		●	●		●
		1502					●					
		1537					●					
BOQER - 1		794			●		●					
		827	●		●	●	●					
		839					●					
HALUZA - 2		1477-1487	●				●					
		1487-1496					●					
		1496-1505	●		●		●					
		1508-1517	●				●					
		1517-1526	●		●	●	●		●	●		
		1571-1580	●				●			●		
		1590-1599	●				●	●	●			
		1626-1635					●					
		1662-1671	●		●		●					
	5	1696-1699	●	●	●		●	●				
HAZON -1		1087-1093	●		●		●			●		
		1207-1213	●				●					
KOHAL -1		1051					●					
		1069	●				●					
QEREN -1		1204-1213	●				●					
	3	1216-1221	●	●			●	●	●			
		1267-1276	●				●		●			
		1298-1307			●	●	●					
	4	1344-1355				●	●					
		1393-1402				●	●					
	5	1410-1415	●				●					●

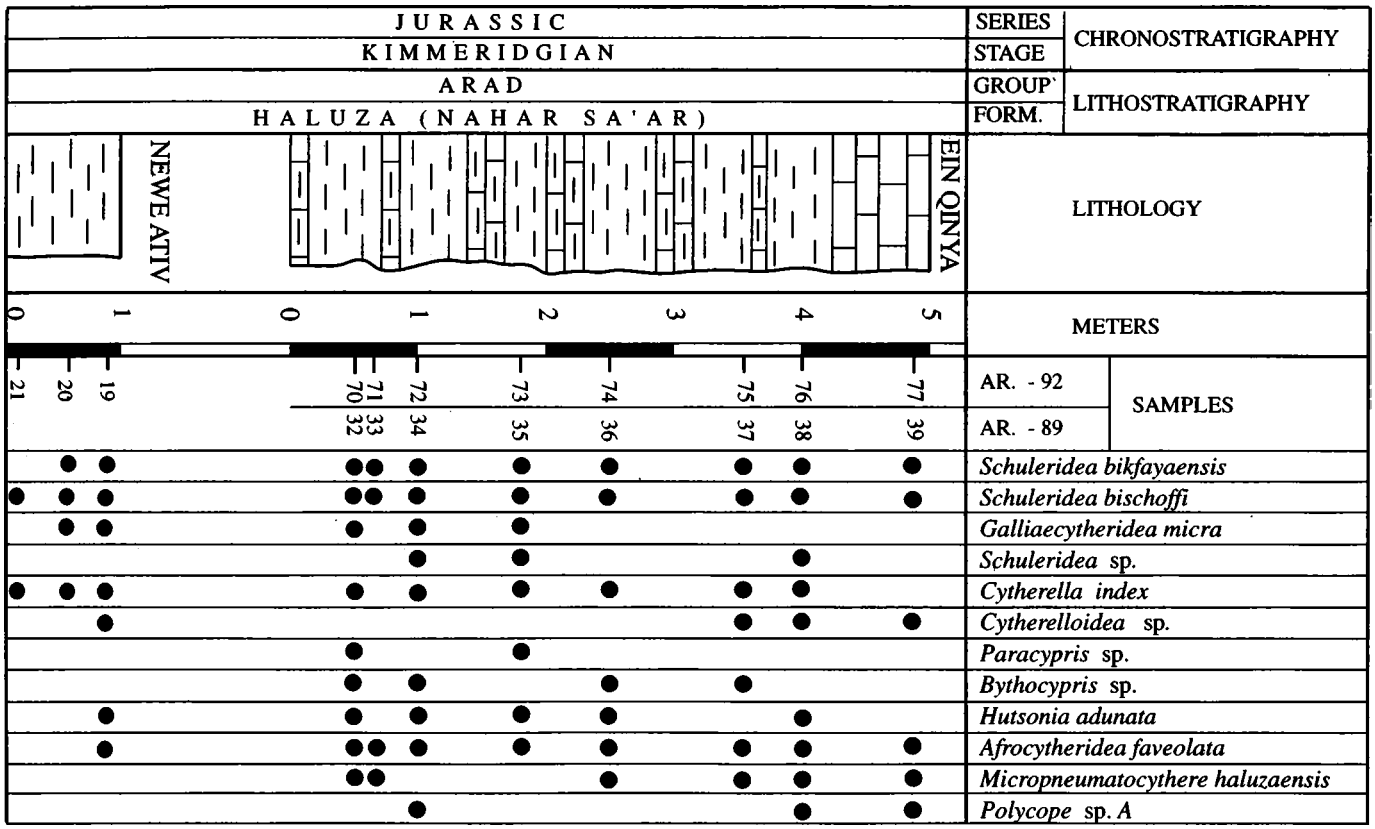


FIGURE 3–Distribution chart of ostracodes from the Ein Qinya and Newe Ativ sections.

Material and distribution.–About one hundred fifty, mostly valves and several carapaces throughout the Ein Qinya and Newe Atiw outcrops, as well as from samples of the Beer Sheva-1, Haluza-2 and Qeren-1 wells.

Stratigraphic range.–Kimmeridgian.

Zone.–JJ-6.

SCHULERIDEA sp.
Plate 1, fig. 13

Measurements (mm).

l	h	w		l/h
0.55	0.32	0.25	M	1.72

Remarks.–These specimens of the Haluza Formation resemble those, figured by Oertli (in Maync, 1966, pl. 9, figs. 1-6: "*Procytheridea* n. gen., n. sp. [nomen nudum]"; Late Oxfordian of Israel). They are similar to *Schuleridea (Schuleridea) mareliasensis* Bischoff, 1990 (1990a, p. 111, pl. 3, fig. 36-38, pl. 4, figs. 39-48; Kimmeridgian of Lebanon), but the latter possesses a less pointed posterior end and a greater overlap of the left valve. *Schuleridea dispara* Mette, 1995 (p. 287, pl. 17, see figs. 9-11; Callovian of Tunisia) agrees partially with our material, but shows also a greater overlap and a more rounded outline. Because of our findings of relatively few and smooth closed carapaces only, no internal features could be observed and, therefore, this taxa is not determined here on the species level.

Material and distribution.–Eighteen carapaces from samples of the Ein Qinya outcrop and the Beer Sheva-1, Boqer-1, Haluza-2 and Qeren-1 boreholes.

Stratigraphic range.–Kimmeridgian.

Zone.–JJ-6.

Genus GALLIAECYTHERIDEA Oertli, 1957
GALLIAECYTHERIDEA MICRA n. sp.
Plate 3, figs. 5-8

Derivation of name.–Mikros (Greek-small) from its small size, compared with other species of the genus.

Holotype.–Male(?) carapace, pl. 3, fig. 5.

Paratypes.–Two male(?) carapaces and one female(?) right valve, pl. 3, figs. 6-8.

Type locality.–Newe Ativ, Golan Heights, sample 87/9/8/19, coord. 2194/2963.

Type stratum.–Haluza Fm. (Nahar Sa'ar Fm.)

Diagnosis.–A species of *Galliaecytheridea*, characterized by its small size and elongated outline. Dorsal view subvoid with centroposterior depression on the connection of the valves. Surface smooth to finely punctate.

Measurements (mm).

l	h	w		
0.46	0.19	0.22	M(?)	Holotype
0.48	0.23	-	F(?)	Paratype
0.43	0.18	0.20	M(?)	Paratype
0.48	0.20	0.21	M(?)	Paratype

Description.–Our new species represents one of the smallest hitherto described species of the genus *Galliaecytheridea*. Anterior end broadly rounded, posterior narrowly rounded, terminating somewhat beyond midheight. Carapace elongated, dorsal and ventral margins nearly

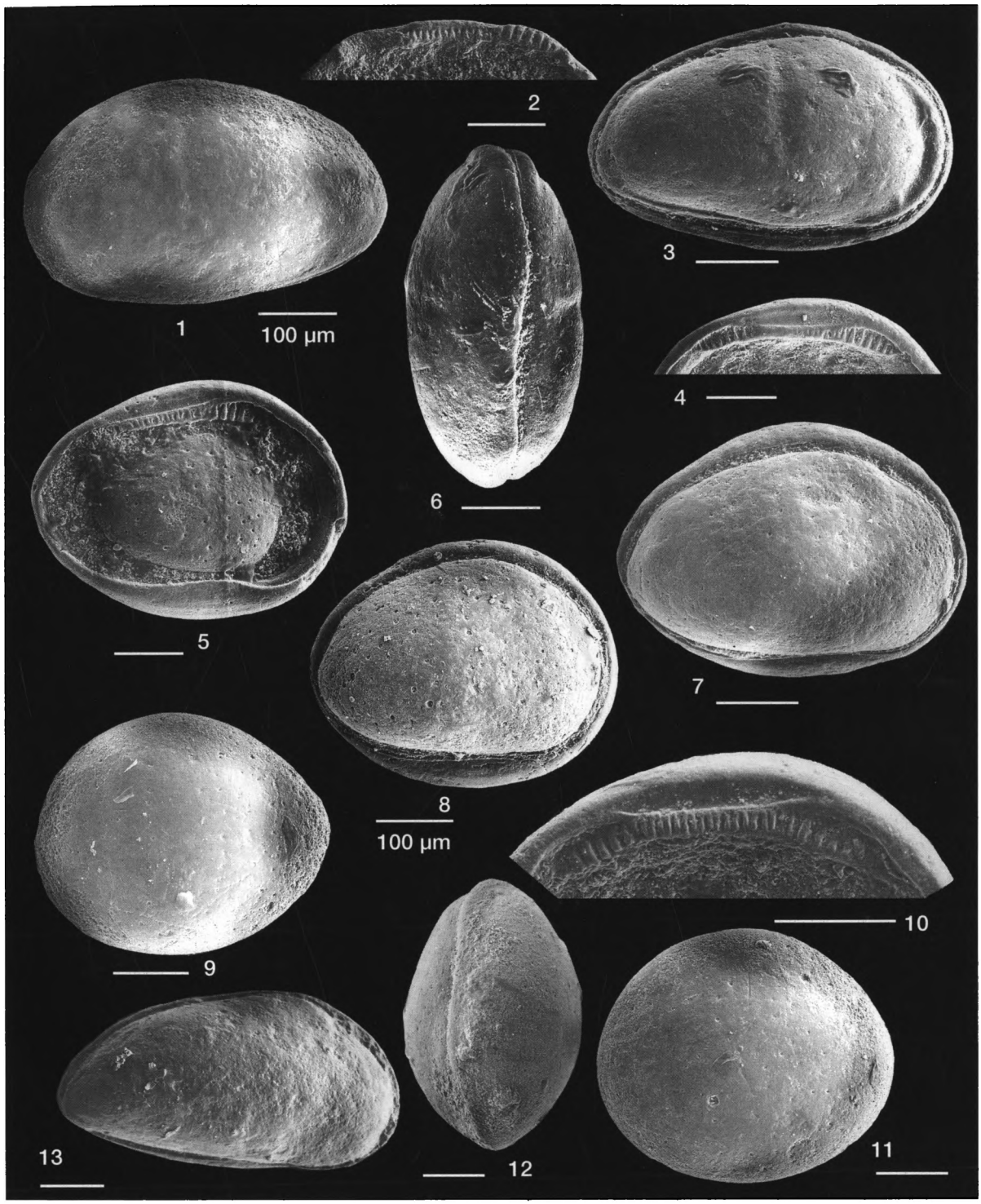


PLATE 1–*1, Schuleridea bikfayaensis* Bischoff, left valve, Ein Qinya, sample AR-74/92. *2, Schuleridea bikfayaensis* Bischoff, right valve, interior view (hinge), Ein Qinya, sample AR-36/89. *3, Schuleridea bikfayaensis* Bischoff, carapace, right valve, Ein Qinya, sample AR-76/92. *4, Schuleridea bikfayaensis* Bischoff, left valve, interior view (hinge), Ein Qinya, sample AR-76/92. *5, Schuleridea bikfayaensis* Bischoff, left valve, interior view, Ein Qinya, sample AR-76/92. *6, Schuleridea bikfayaensis* Bischoff, carapace, dorsal view, Ein Qinya, sample AR-70/92. *7, Schuleridea bikfayaensis* Bischoff, carapace, rigth view, Ein Qinya, sample AR-77/92. *8, Schuleridea bischoffi* n. sp., paratype, carapace, right valve, Ein Qinya, sample AR-75/92. *9, Schuleridea bischoffi* n. sp., paratype, left valve, Ein Qinya, sample AR-75/92. *10, Schuleridea bischoffi* n. sp., paratype, left valve, interior view (hinge), Ein Qinya, sample AR-32/89. *11, Schuleridea bischoffi* n. sp., holotype, left valve, Ein Qinya, sample AR-76/92. *12, Schuleridea bischoffi* n. sp., carapace, ventral view, Ein Qinya, sample AR-33/89 (specimen lost after photograph). FIGURE 13- *Schuleridea* sp., carapace, right valve, Qeren-1, core 3, 1216-1221 m.

straight and almost parallel. Outline ventrally slightly swollen. Dorsal view subovoid, depressed from the central area towards the posterior end on the connection of the valves. Left valve somewhat larger than right valve. Surface smooth to finely punctate. Terminal elements of the hinge, as described for the genus (Oertli, 1957), but with crenulate median bar. Sexual dimorphism not much pronounced: females probably somewhat higher than males.

Remarks.–The generic definition of *Galliaecytheridea* should be emended: "Hinge with smooth or crenulate median bar. According to a modern taxonomic/ecological conception, minor hinge variations should no longer be considered as generic differences" (H. J. Oertli, Bizanos, France, written communication, 1994). In addition, *G. manyuliensis* Bate, 1975 (p. 197, pl. 9, figs. 5-14; Kimmeridgian of Tanzania) shows the same hinge pattern with the crenulate median bar as our new species. However, the East African species, which is similar to our specimens, is considerably larger than *G. micra* n. sp. and has a more pointed posterior end. Also other African species of the genus show a crenulate median bar in contrary to most European species, so that this difference could be caused by the geographic distribution of *Galliaecytheridea* and changing paleoecolological condicions.

Material and distribution.–Thirty-six carapaces and valves from both outcrop sections, as well as from Boqer-1, Haluza-2, Hazon-1 and Qeren-1 borehole samples.

Stratigraphic range.–Kimmeridgian.

Zone.–JJ-6.

Genus EKTYPHOCYTHERE Bate, 1963
EKTYPHOCYTHERE ZOHARENSIS Rosenfeld and Gerry, 1987
Plate 2, figs. 8-9

1987 *Ektyphocythere zoharensis*, Rosenfeld and Gerry, in Rosenfeld *et al.*, 1987a, p. 263, pl. 6, figs. 5-6.
1987 *Amicytheridea dierallaensis* (Basha), forme B, Depêche *et al.*, p. 232, figs. 13-16.
1991 *Ektyphocythere zoharensis* Rosenfeld and Gerry, Rosenfeld and Honigstein, p. 143, pl. 4, figs. 3-6.
1995 *Ektyphocythere zoharensis* Rosenfeld and Gerry, Mette, p. 284, pl. 15, figs. 7-15.
1995 *Ektyphocythere zoharensis* Rosenfeld and Gerry, Kuznetsova and Dobrova, pl. 3, fig. II, 4.

Measurements (mm).

l	h	w
0.40	0.27	0.26
0.42	0.27	-

Remarks.–*Ektyphocythere zoharensis* was reported hitherto from the Callovian strata in Sinai (Rosenfeld *et al.*, 1987a), Saudi-Arabia (Depêche *et al.*, 1987), Tunisia (Mette, 1995) and Syria (Kuznetsova and Dobrova, 1995) as well as from Callovian-Oxfordian sediments from the HaMakhtesh HaGadol section in southern Israel (Rosenfeld and Honigstein, 1991) The findings in the Haluza Formation represent the highest stratigraphic position of this species. The here described specimens are characterized by a somewhat more developed centroventral reticulation pattern than the other recorded forms.

Material and distribution.–Three carapaces and one valve from the Beer Sheva-1 and Qeren-1 wells.

Stratigraphic range.–Callovian - Kimmeridgian.

Zone.–JJ-4 to JJ-6.

Genus AFROCYTHERIDEA Bate, 1975
AFROCYTHERIDEA FAVEOLATA Bate, 1975
Plate 4, figs. 1-7

1963 *Lophocythere*? 4777, Grekoff, p. 1730, pl. 3, figs. 53-54.
1963 *Lophocythere* 323A, Grekoff, p. 1730, pl. 2, fig. 47.
1966 *Progonocythere*? aff. *anoda* Peterson, Oertli (in Maync), pl. 10, figs. 81-83.
1975 *Afrocytheridea faveolata*, Bate, p. 196, pl. 8, figs. 12-13.
1987 *Afrocytheridea faveolata* Bate, Depêche *et al.*, p. 243, pl. 7, figs. 1-10.
1987 *Afrocytheridea* cf. *faveolata* Bate, Depêche *et al.*, p. 243, pl. 7, figs. 11-15.
1991 *Afrocytheridea faveolata* Bate, Rosenfeld and Honigstein, p. 139, pl. 3, figs. 1-10.
?1993 *Afrocytheridea somaliensis* Mette, p. 92, pl. 6, figs. 1-13.
1995 *Afrocytheridea faveolata* Bate, Mette, p. 288, pl. 18, figs. 7-9.
1995 *Afrocytheridea faveolata* Bate, Kuznetsova and Dobrova, p. 144, pl. 3, fig. II, 2.

Measurements (mm).

l	h	w	
0.69	0.40	0.40	M
0.66	0.44	0.38	F
0.67	0.38	-	F
0.72	0.39	-	M
0.66	0.37	-	F
0.71	0.37	0.40	M

Remarks.–This species has a wide geographic and stratigraphic distribution. The slight changes in the outline and reticulation of this taxa can be referred to paleoecological changes (see Mette, 1995). It was found also in the Late Bathonian-Oxfordian in Israel (Maync, 1966; Rosenfeld and Honigstein, 1991), Callovian of Madagaskar (Grekoff, 1963), Tanzania (Bate, 1975), Tunisia (Mette, 1995) and Syria (Kuznetsova and Dobrova, 1995), Callovian-Oxfordian of Saudi-Arabia (Depêche *et al.*, 1987) and the Oxfordian of Somalia (Mette, 1993). As for *Ektyphocythere zoharensis*, *A. faveolata* found in sediments of the Haluza Formation represents its highest stratigraphic position.

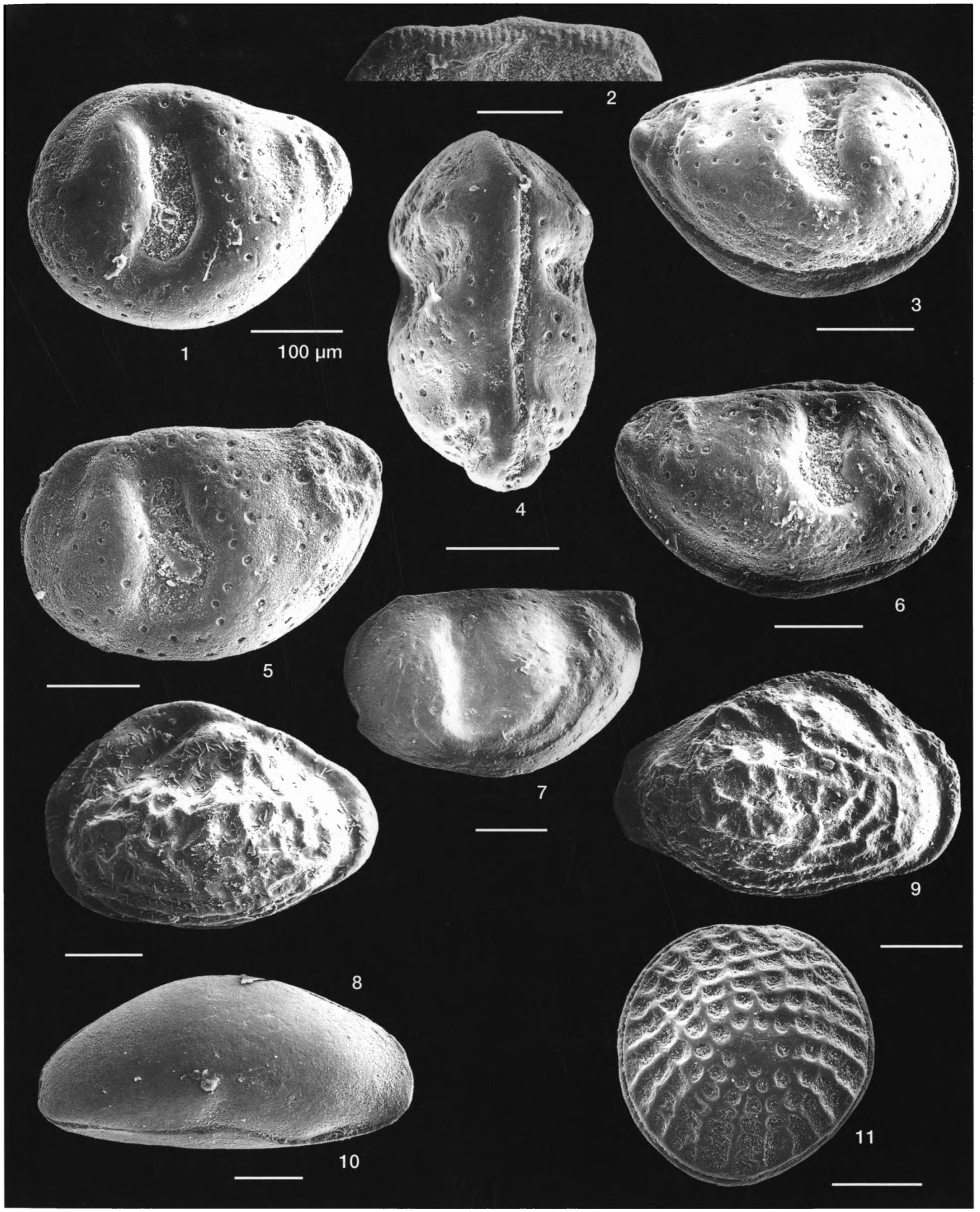
Material and distribution.–About fifty carapaces and valves throughout the Ein Qinya and Newe Ativ sections and from the Beer Sheva-1, Haluza-2 and Qeren-1 boreholes.

Stratigraphic range.–Late Bathonian - Kimmeridgian.

Zone.–JJ-3 to JJ-6.

→

PLATE 2–*1, Hutsonia adunata* Bischoff, left valve, Ein Qinya, AR-74/92. *2, Hutsonia adunata* Bischoff, right valve, interior view (hinge), Newe Ativ, sample 87/9/8/19. *3, Hutsonia adunata* Bischoff, carapace, right valve, Ein Qinya, AR-73/92. *4, Hutsonia adunata* Bischoff, carapace, dorsal view, Ein Qinya, AR-74/92. *5, Hutsonia adunata* Bischoff, carapace, left valve, Ein Qinya, AR-74/92. *6, Hutsonia adunata* Bischoff, carapace, right valve, Ein Qinya, AR-73/92.*7, Hutsonia adunata* Bischoff, carapace, left valve, Qeren-1, core 3, 1216-1221 m. *8, Ektyphocythere zoharensis* Rosenfeld and Gerry, carapace, left view, Beer Sheva-1, core 6, 1495 m. *9, Ektyphocythere zoharensis* Rosenfeld and Gerry, right valve, Beer Sheva-1, core 6, 1495 m. *10, Bythocypris* sp., carapace, right valve, Ein Qinya, sample AR-72/92. *11, Polycope* sp. *A*, carapace, right valve, Ein Qinya, sample AR-72/92.


2
1
100 µm
3
4
5
6
7
8
9
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11

Genus OLIGOCYTHEREIS Sylvester-Bradley, 1948
OLIGOCYTHEREIS aff. FULLONICA (Jones and Sherborn), 1888
Plate 4, figs. 9-10

1966 *Oligocythereis* aff. *fullonica* (Jones and Sherborn), Oertli (in Maync), pl. 9, figs. 16-18.
1987 *Oligocythereis* aff. *O. fullonica* (Jones and Sherborn), Rosenfeld *et al.*, 1987a, p. 264, pl. 5, fig. 7
1987 *Oligocythereis* aff. *O. fullonica* (Jones and Sherborn), Depêche *et al.*, p. 238, pl. 5, figs. 20-21.
1991 *Oligocythereis* aff. *fullonica* (Jones and Sherborn), Rosenfeld and Honigstein, p. 144, pl. 4, fig 7.

Measurements (mm).

l	h	w
0.56	0.30	0.26
0.52	0.27	0.30

Remarks.–This species of a wide stratigraphic range, occurs also in the Bathonian of Sinai (Rosenfeld *et al.*, 1987a), Bathonian-Oxfordian of Israel (Maync, 1966), as well as in the Callovian-Oxfordian of Saudi-Arabia (Depêche *et al.*, 1987) and southern Israel (Rosenfeld and Honigstein, 1991). In the here described strata, *O.* aff. *fullonica* is very rare.

Material and distribution.–Three carapaces from core 5 of the Beer Sheva-1 well.

Stratigraphic range.–Bathonian - Kimmeridgian.

Zone.–JJ-3 to JJ-6.

Genus MICROPNEUMATOCYTHERE Bate, 1963
MICROPNEUMATOCYTHERE HALUZAENSIS n. sp.
Plate 3, figs. 1-4

Derivation of name.–From its occurrence in the Haluza Formation.

Holotype.–Male carapace, pl. 3, fig. 2.

Paratypes.–One male and one female carapace, pl. 3, figs. 1, 4.

Type locality.–Ein Qinya, Golan Heights, sample AR-77/92, coord. 21940/29375.

Type stratum.–Haluza Fm. (Nahar Sa'ar Fm.)

Diagnosis.–A species of *Micropneumatocythere* with anterodorsal oblique sulcus. Suboval to rectangular reticulation pattern on the entire surface.

Measurements (mm).

l	h	w		
0.40	0.21	0.24	Holotype	M
0.40	0.22	0.24	Paratype	M
0.35	0.24	0.24	Paratype	F

Description.–Small sized *Micropneumatocythere* carapaces. Anterior end broadly rounded, posterior end subcentrally, pointing towards the broadly arched dorsal margin. Small and oblique sulcus beneath the anterodorsal margin. Ventral margin sinusoidal with projecting ventrolateral rounded wing. Well developed, suboval to rectangular reticulation meshes all over the valve, arranged in a nearly concentrical net with faint transversal ribs centrally. Reticulation pattern occurs even in the posterior area. Left valve overlaps slightly the right one on the entire outline. Internal features not observed. Sexual dimorphims pronounced: males more elongated and narrower than females.

Remarks.–*Micropneumatocythere haluzaensis* n. sp. differs from *M. laevireticulata* Rosenfeld and Honigstein, 1991 (p. 138, pl. 2, figs. 6-9; Callovian-Oxfordian of southern Israel) mainly by its characteristic reticulation pattern. Also, *M.* cf. *subconcentrica* (Jones, 1884) from the Callovian of Tunisia (Mette, 1995, p. 288, pl. 18, figs. 10-12) is much less reticulated than the here described new species.

Material and distribution.–About twenty five specimens throughout the Ein Qinya and Newe Ativ outcrops, as well as from the Beer Sheva-1, Haluza-2 and Hazon-1 wells.

Stratigraphic range.–Kimmeridgian.

Zone.–JJ-6.

Genus HUTSONIA Swain, 1946
HUTSONIA ADUNATA Bischoff, 1990
Plate 2, figs. 1-7

1990 HUTSONIA ADUNATA, Bischoff, 1990b, p. 408, pl. 4, figs. 46-58, text fig. 12

Measurements (mm).

l	h	w	
0.35	0.26	-	F
0.37	0.24	-	M
0.34	0.24	0.22	F
0.34	0.26	0.22	F
0.39	0.25	0.22	M
0.42	0.26	0.22	M
0.43	0.26	0.25	M

Remarks.–Species of the genus *Hutsonia* were first figured from Israel (Qeren-1 well) by Gerry (1963; unpubl. report). Our specimens agree in outline and inner features very well with the type species, described by Bischoff (1990b, op. cit.) from the middle Kimmeridgian of Lebanon. *Hutsonia adunata* is the second recorded occurrence of a species of the genus *Hutsonia* in Israel, after *H. minuta* Mette, 1995 (p. 283, pl. 14, figs. 9-20; Callovian of Tunisia) in Callovian sediments of the HaMakhtesh HaGadol (there described as *Bythoceratina* sp. 1; see Rosenfeld and Honigstein, 1991, p. 139, pl. 2, fig. 11).

Material and distribution.–About eighty carpaces and valves throughout the Ein Qinya section, in the uppermost sample of the Newe Ativ outcrop and in borehole samples from Haluza-2 and Qeren-1.

Stratigraphic range.–Kimmeridgian.

Zone.–JJ-6.

Genus POLYCOPE Sars, 1866
POLYCOPE sp. *A*
Plate 2, fig. 11

Measurements (mm).

l	h	w
0.30	0.29	0.20

Remarks.–The here figured specimen should represent a new species; however, the solely finding of one carapace does not justify the erection of a new taxa.

Polycope sp. *A* possesses a subcircular outline with a nearly straight hinge line. Pronounced and large subrectangular reticulation all over the carapace, meshes enlarging towards the peripheral areas. Reticulation pattern builds half-concentric ridges. Similar, but much less reticulated than our specimen, is *P. pelta* Fischer, 1961 (see Whatley, 1970, p. 311, pl. 1, figs. 1-4; Oxfordian of Scotland).

Material and distribution.–One carapace from the Ein Qinya section, sample AR-72/92.

Stratigraphic range.–Kimmeridgian.

Zone.–JJ-6.

CONCLUSIONS

The here described ostracode fauna is common in surface and borehole material from the Haluza Formation in northern

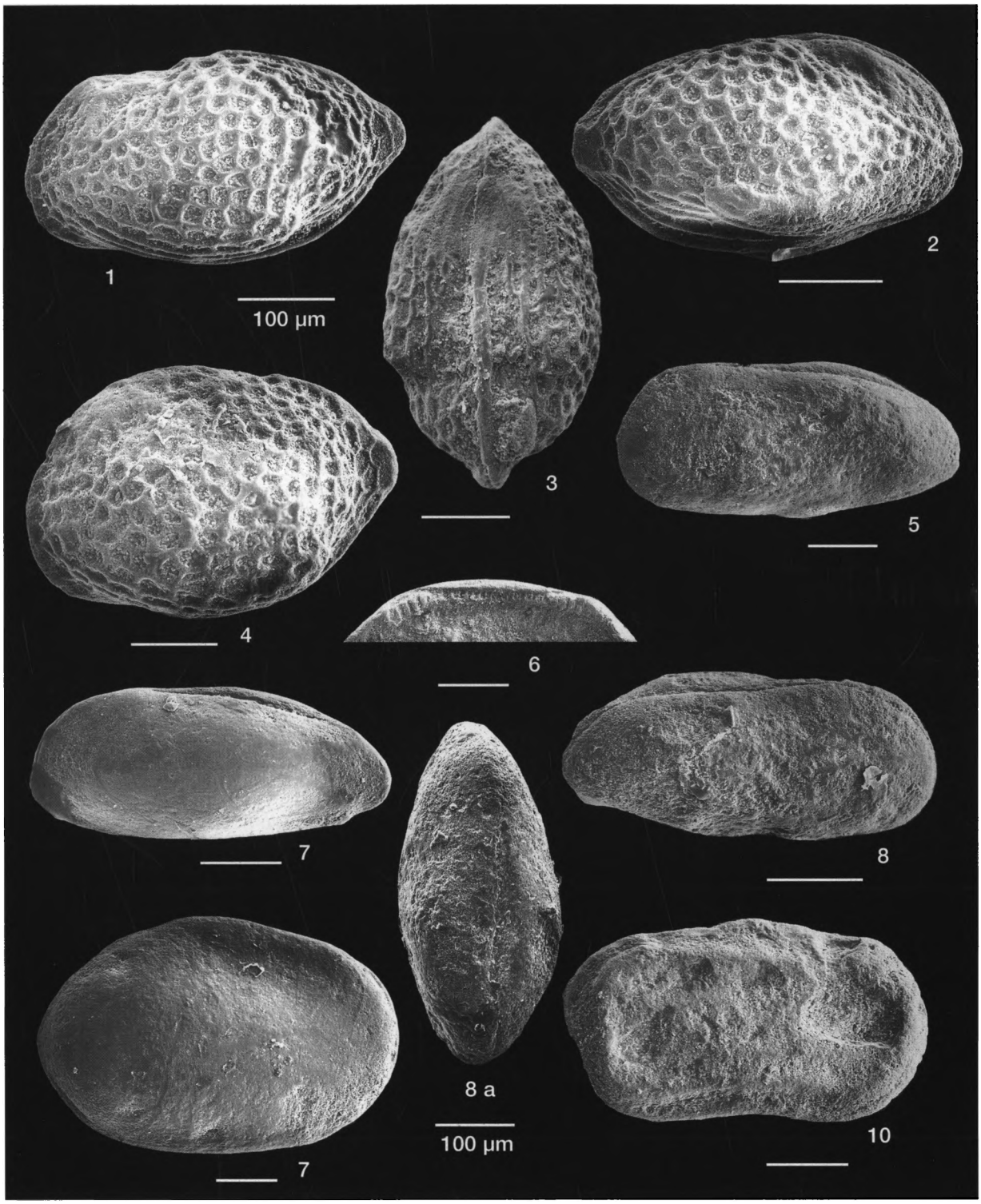

PLATE 3–*1, Micropneumatocythere haluzaensis* n. sp., paratype, left valve, Ein Qinya, sample AR-74/92. *2, Micropneumatocythere haluzaensis* n. sp., holotype, carapace, right valve, Ein Qinya, sample AR-77/92. *3, Micropneumatocythere haluzaensis* n. sp., carapace, ventral view, Ein Qinya, sample AR-38/89 (specimen lost after photograph). *4, Micropneumatocythere haluzaensis* n. sp., paratype, carapace, left valve, Ein Qinya, sample AR-76/92. *5, Galliaecytheridea micra* n. sp., holotype, carapace, left valve, Newe Ativ, sample 87/9/8/19. *6, Galliaecytheridea micra* n. sp., paratype, right valve, interior view (hinge), Ein Qinya, sample AR-36/89. *7, Galliaecytheridea micra* n. sp., paratype, carapace, left valve, Ein Qinya, sample AR-72/92. *8, Galliaecytheridea micra* n. sp., paratype, carapace, right valve, Newe Ativ, sample 87/9/8/19. *8a,* Same carapace, dorsal view. *9, Cytherella index* Oertli, carapace, right valve, Ein Qinya, sample AR-76/92. *10, Cytherelloidea* sp., carapace, right valve, Newe Ativ, sample 87/9/8/19.

and southern Israel. The assemblage consists of fourteen species, belonging to twelve genera. Only the genus *Schuleridea* is represented by three different species. The ostracodes are grouped into the *Hutsonia adunata* - (JJ-6) assemblage zone, named after this rather common and characteristic form. *Schuleridea bikfayaensis, S. bischoffi, Galliaecytheridea micra* and *Afrocytheridea faveolata* are other indicative and frequent species of this zone.

The age of the JJ-6 Zone in the Haluza Formation (in the Golan Heights also called Nahar Sa'ar Fm.) in Israel is given as Kimmeridgian, based on contemporaneous species, found in Lebanon (*S. bikfayaensis* and *H. adunata*). In addition, very similar taxa to our *Schuleridea* sp. and *S. bischoffi* were reported from Kimmeridgian strata of Lebanon. *Cytherelloidea* sp. resembles Kimmeridgian forms from Lebanon and Jordan. *Galliaecytheridea micra* shows close affinity to species, described from the Kimmeridgian of Tanzania. The ranges of *Cytherella index, Oligocythereis* aff. *fullonica, Ektyphocythere zoharensis* and *Afrocytheridea faveolata* are extended here from mainly Callovian-Oxfordian into the Kimmeridgian; their occurrence in sediments of the Haluza Formation in Israel represents their highest hitherto known stratigraphical level. All the species of the JJ-6 assemblage are restricted to Jurassic sediments only; they do not continue into Early Cretaceous ostracode zones of Israel.

The ostracode species indicate an open marine environment, based on relatively small forms and low eye swellings. The high percentage of open valves, especially among *Schuleridea*, points to an environment of high energy, caused probably by currents or post mortem redeposition of the valves along the nearby shore.

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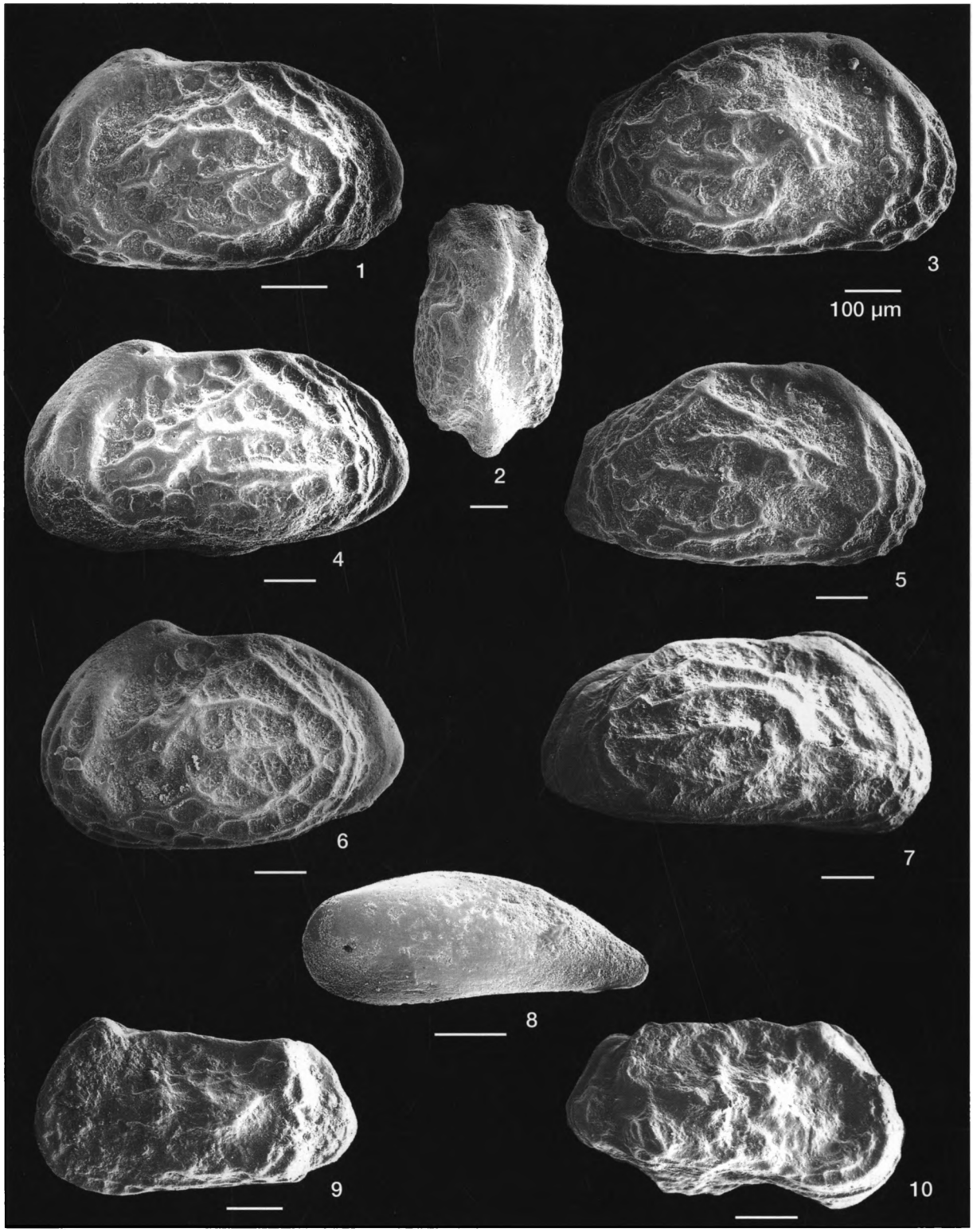

PLATE 4–*1, Afrocytheridea faveolata* Bate, carapace, left valve, Ein Qinya, sample AR-71/92. *2, Afrocytheridea faveolata* Bate, carapace, dorsal view, Ein Qinya, sample AR-75/92. *3, Afrocytheridea faveolata* Bate, right valve, Ein Qinya, sample AR-75/92. *4, Afrocytheridea faveolata* Bate, left valve, Ein Qinya, sample AR-76/92. *5, Afrocytheridea faveolata* Bate, right valve, Ein Qinya, sample AR-75/92. *6, Afrocytheridea faveolata* Bate, left valve, Ein Qinya, sample AR-35/89 (specimen lost after photograph). *7, Afrocytheridea faveolata* Bate, carapace, right valve, Qeren-1, core 3, 1216-1221 m. *8, Paracypris* sp., carapace, left valve, Ein Qinya, sample AR-70/92. *9, Oligocythereis* aff. *fullonica* (Jones and Sherborn), carapace, left valve, Beer Sheva-1, core 5, 1459 m. *10, Oligocythereis* aff. *fullonica* (Jones and Sherborn), carapace, right valve, Beer Sheva-1, core 5, 1459 m.