

# Conodont- and Ostracode-Biostratigraphy of the Triassic in Israel

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(1 fig., 2 pls., 1 tab.)

## Abstract

Three conodont assemblage zones are recognised in the Lower and Middle Triassic of Israel; they may be used for correlation with the Alpine and Mediterranean Triassic. Ostracodes are successfully used in local biostratigraphical zonation; four main assemblage zones and one zonule are defined.

## Introduction

A 900 to 1000 m thick, mainly marine Triassic sequence is recognised in Southern Israel.

Lower Triassic is only known from drillings. Middle Triassic sections are exposed in the Ramon cirque (Central Negev), at Mount Arif (Central Negev) and at Gebel Arif e Naqa (Northern Sinai). Upper Triassic outcrops only in the Ramon cirque. Rich invertebrate-megafaunas occur in the Middle and Lower Upper Triassic of the exposed sections (BROTZEN, 1956; PARNES, 1962, 1965; LERMAN, 1960; KUMMEL, 1960). Microfaunas comprising mainly Conodonts and Ostracodes occur in both exposed and drilled sections of the Lower, Middle and Upper Triassic (GERRY, 1967; SOHN, 1968; HUDDLE, 1970; HIRSCH, 1972). Microfloras were only studied from drillings (GLICKSON, 1964; HOROWITZ, 1970).

Lithostratigraphy is according to ZAK (1963), DRUCKMAN (1967, 1969) and WEISSBROD (1969).

## I. Conodont—Biostratigraphy of the Lower and Middle Triassic of Israel (F. H.)

In the Triassic of Israel three Conodont-assemblage zones can be defined:

- *Hadrodontina-Pachycladina* assemblage zone of late Lower Scythian—early Upper Scythian age.
- *Pseudofurnishius* assemblage zone (HIRSCH, 1972) of Lower Ladinian to early Upper Ladinian age.
- *Pseudofurnishius murcianus*—*Epigondolella mungoensis* assemblage zone (HIRSCH, 1972) of Upper Ladinian age.

### *Hadrodontina-Pachycladina* assemblage Zone

In Makhtesh Qatan 2 Well (Northern Negev, Israel) an assemblage of *Pachycladina obliqua*, *P. symmetrica*, *P. tricuspidata*, *P. inclinata*, *P. longispinosa*, *Lonchodina nevadensis* and *Neohindeodella* cf. *N. nevadensis* is found in the lower part of the Zafir Formation (core 7) and *Hadrodontina* cf. *H. adunca* is found in the uppermost part of the Yamin Formation (core 8). BENDER (1968) reports a list of conodonts determined by STOPPEL from Wadi Zarqa Ma'in (Jordan): *Hadrodontina anceps*, *H. biserialis*, *Pachycladina inclinata*, *P. obliqua* and *P. symmetrica*.

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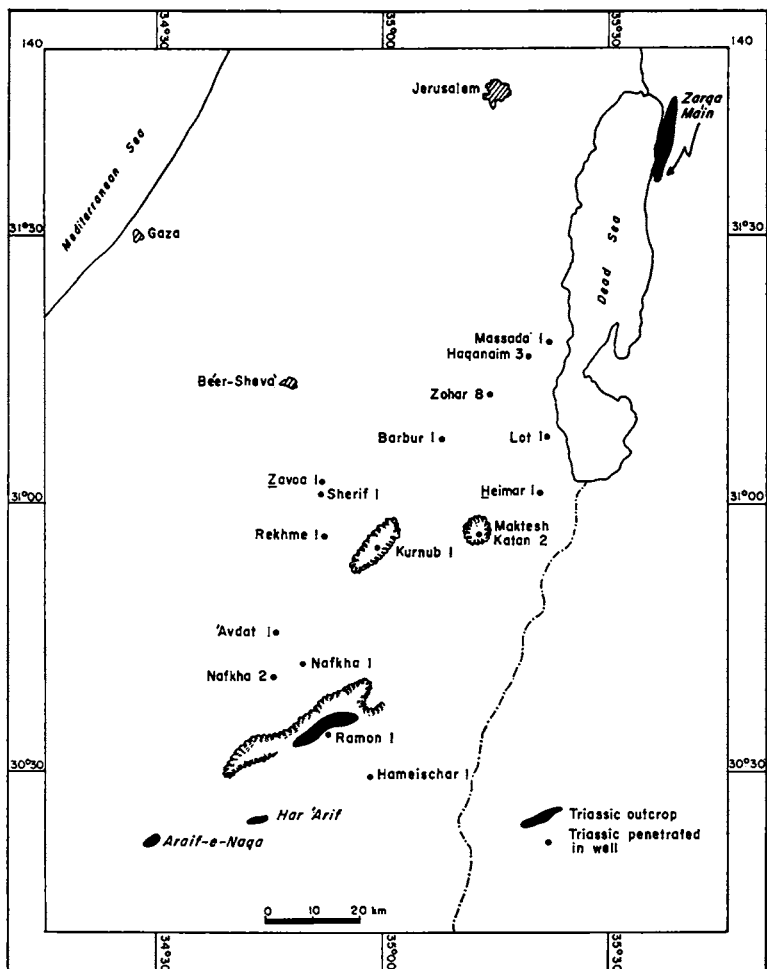


Fig. 1

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Species of *Pachycladina* and *Hadrodontina* were found in Italy in the upper Campil Beds, and species of *Hadrodontina* alone were found in the lower Campil and upper Seis Beds (STAESCHE, 1964). *Pachycladina*-like forms and *Lonchodina nevadensis* occur in layers of Smithian age in Nevada and Utah (MUELLER, 1956; CLARK, 1959).

Therefore an age ranging from late Lower to early Upper Scythian is suggested for the conodont-assemblages found in Israel and Jordan.

The Lower Triassic conodonts of the Levantine region belong faunally to the Alpine-Dinaric faunal Province, where a "Werfen"-like facies prevails. Already COX (1932) observed this on the basis of Bivalves such as *Claraia aurita*, *Anodontophora jassaensis* and *Myophoria praeorbicularis* from Wadi Zarqa Ma'in (JORDAN).

The *Hadrodontina* cf. *H. adunca*, considered to be not earlier than of late Lower Scythian age, is found in the uppermost part of the Yamin Formation in Maktesh

Qatan 2 Well. On the other hand *Lueckisporites virkikiae* found by HOROWITZ (1970) in the upper part of the Yamin Formation in Zohar 8 Well, is of Upper Permian age (BALME, 1970). It is possible therefore that late Lower Scythian beds overly directly Upper Permian.

#### *Pseudofurnishius murcianus* assemblage Zone (HIRSCH, 1972)

The assemblage of *Pseudofurnishius murcianus* is found in two horizons of the Ramon cirque (Central Negev, Israel). The lower horizon occurs in the uppermost part of the Fossiliferous Limestone member (member I) of the Saharonim Formation. The second horizon occurs in the middle part of the Limestone-Marl member (member II) of the Saharonim Formation. A rich assemblage of *Pseudofurnishius murcianus* is recorded from the bed with "*Ceratites*" gen. nov. sp. nov. (ZAK, 1963; PARNES, personal communication).

The ratio of mono-/biplatform specimens of *P. murcianus* is in both horizons of 10/1. Ammonites (*Protrachyceras curionii*, *P. wahrmanni* and *Israelites ramonensis*; PARNES, 1962) in the lower horizon; indicate a Lower Ladinian age. An Upper Ladinian age is suggested by PARNES (personal communication) for the new "*Ceratites*" gen. nov. sp. nov. in the upper horizon.

This assemblage Zone is also found in the provinces of Jaèn, Almeria, Murcia and Granada (Spain). At Cortijos Nuevos and Hornos (Jaèn) LOPEZ GARRIDO (1970) has found *Hungarites pradoi* and *Protrachyceras* cf. *hispanicum* in the conodont bearing layers.

Summing up it seems that a Lower to early Upper Ladinian age can be suggested for the *P. murcianus* assemblage zone.

#### *Pseudofurnishius murcianus*—*Epigondolella mungoensis* assemblage Zone (HIRSCH, 1972)

Abundant *Pseudofurnishius murcianus* and *Epigondolella mungoensis* are found in a ratio of ca 1/1, in the lowermost part of the Limestone-Gypsum member (member III) of the Saharonim Formation. The ratio of mono-/biplatform specimens of *P. murcianus* is approximately 1/1 (HUDDLE, 1970).

This assemblage also occur in the Sierra de Gador (Almeria, Spain) (BOOGAARD & SIMON, 1973) and in the Balearic islands Menorca and Mallorca.

Following MOSHER (1968) and SWEET & AL. (1971) an Upper Ladinian age is assumed for this assemblage zone comprising *Epigondolella mungoensis*.

It is noteworthy that in the Ramon cirque (Central Negev), *Clionites rarecostatus* of early Carnian age (PARNES, 1962) occurs some 40 m above the conodont bearing horizon.

The Conodont assemblages found in the Ladinian of the Levantine and Western Mediterranean regions belong to the "sephardic" mediterranean faunal subprovince (HIRSCH, 1972).

## II. Ostracode—Biostratigraphy of the Triassic in Southern Israel (E. G.)

In 12 wells drilled in the area ostracode biozones can easily be correlated. Four main assemblage Zones: *Simeonella brotzenorum* assemblage Zone of Upper Ladinian/Lower Carnian age, *Reubenella avimelechi* assemblage Zone of Anisian/Lower Ladinian age, *Triebacynthere* n. sp. assemblage Zone of probable late Upper Scythian age and ? *Mono-ceratina* sp. C. assemblage Zone of Upper Scythian age, and one Zonule: *Bisulcocyparis triassica* Zonule of Lower Anisian age, are defined.

Age determinations are based on occurrence in ammonite and/or conodont bearing beds.

Triassic ostracoda from Israel are described in detail in SOHN 1968, GERRY & OERTLI 1967, and are listed in unpublished reports by GERRY. A new species of the genus *Triebacythere* GRÜNDEL & KOZUR (type species *Monoceratina hartmanni* KOZUR 1968) will be described by KOZUR & GERRY.

#### *Simeonella brotzenorum* assemblage Zone

*Simeonella brotzenorum* SOHN was originally described from the limestone and the limestone-gypsum member of the Saharonim Formation (Upper Ladinian/Lower Carnian), Makhtesh Ramon. It was found in most of the wells drilled in the area as well as the Aref en Naqa outcrop in Northern Sinai. While in the lower part of the zone *S. brotzenorum* is found in association with marine forms (*Paracypris*, *Bairdia*, *Leviella*) as well as conodonts and foraminifera, towards the top of the zone it becomes monospecific, occurs in floods, pointing to a probable hypersaline environment.

#### *Reubenella avnimelechi* assemblage Zone

*Reubenella avnimelechi* SOHN and associated fauna: *Simeonella reissi*, *R. parnesi*, *R. picardi*, *Paracypris* sp. were originally described from the fossiliferous limestone member of the Saharonim Formation (Anisian/Lower Ladinian) of Makhtesh Ramon.

The assemblage, with conodonts and foraminifera, was found in most wells in the area. Environment of deposition is probably shallow warm marine.

#### *Bisulcoypris triassica* Zone

*Bisulcoypris triassica* GERRY & OERTLI was originally described from the Makhtesh Qatan 2 well, from sediments of Lower Anisian age. Some fragments of? *Darwinula* sp. were the only other form found. The fauna points to a freshwater to oligohaline environment of deposition. The assemblage was found in four wells only, in a sandy shaly facies of the Gevanim Formation.

#### *Triebacythere* n. sp. assemblage Zone

In earlier reports this was known as the "Ostracode OT 8 Zone". The assemblage is found in the uppermost beds of Zafir Formation. Age of this biozone is tentatively considered as being late Upper Scythian.

Several other undescribed marine forms were found in association with *Triebacythere* n. sp. Type material for this biozone will be described from the Zavoa 1 well.

#### ? *Monoceratina* sp. C assemblage Zone

Most of the fauna from this zone were found in limestone cuttings. The type ostracode has affinities to species known from Upper Paleozoic as well as Triassic (Dr. H. J. OERTLI, pers. comm.) Environment is definitely marine, age Upper Scythian. The assemblage is found in shales and limestones in the lower part of the Zafir Formation.

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Table I

## Biostratigraphy of the Triassic of Israel

Age	Formation <sup>1)</sup>	Member	Selected Megafossils <sup>2)</sup>	Conodonts & Ostracodes <sup>3)</sup>				
? Norian Carnian	Mohilla (ca. 200 m)	(III)	<i>Costatoria inaequicostata</i>					
		(II)	<i>Spiriferina lipoldi</i>					
		(I)						
Lower Carnian	Saharonim (ca. 160 m)	(IV)	<i>Lyriomyophoria woehrmanni</i>					
		(III)	<i>Clionites rarecostatus</i>					
Upper Ladinian		(II)	„ <i>Ceratites</i> “ gen. nov. sp. nov.					
Lower Ladinian		(I)	<i>Protrachyceras curionii</i>					
	<i>Israelites ramonensis</i>							
Upper Anisian	Gevanim (ca. 280 m)	(IV)	<i>Myalina ramanensis</i>					
		(III)	<i>Beneckeia levantina</i>					
		(II)	„ <i>Paraceratites</i> “ subgen. nov. sp. nov.					
Lower Anisian		(I)	<i>Trigonodus tenuidentatus</i>					
L. Anisian/ U. Scythian	Ra'af (ca. 100 m)		<i>Costatoria costata</i> <sup>4)</sup>					
			<i>Hungarites arifensis</i> <sup>4) 5)</sup>					
Upper Scythian	Zafir (ca. 250 m)							
Lower Scythian?	Yamin (upper 30 m)		<i>Claraia aurita</i> <sup>5)</sup>					

<sup>1)</sup> After ZAK (1963) and WEISSBROD (1969).

<sup>2)</sup> After PARNES (1962 & person. commun.) from Makhtesh Ramon (Central Negev).

<sup>3)</sup> Partly after GERRY (1967), GERRY & OERTLI (1967), SOHN (1968), HUDDLE (1970), HIRSCH (1972).

<sup>4)</sup> After PARNES (1962 and pers. com.) from Har Arif (Central Negev).

<sup>5)</sup> After COX (1932) from Wadi Zarqa Ma'in (Jordan).

<sup>6)</sup> After DRUCKMAN (1967) from Ramon 1 Well, core 1.

*Hadronotina* . . . . .  
*Pachycladina* . . . . .  
*Monoceratina* sp. C . . . . .  
*Tribrachythere* sp. nov. . . . .  
*Bisulcoocypris triassica* . . . . .  
*Reubenella avimelechi* . . . . .  
*Pseudofurnishius mauritanus*  
*Epigondolella mungoensis* . . . . .  
*Simeonella brotzenorum* . . . . .

## Plate 1

Fig. 1. *Epigondolella mungoensis* (DIEBEL). Upper Ladinian; Nivel con *Daonella lomelli*, Coll de Jou, Tarragona (Spain). 75 ×.

Fig. 2. *Pseudofurnishius murcianus* BOOGAARD. Lower Ladinian; Fossiliferous Limestone Member, Saharonim Formation, Har Gevanim, Makhtesh Ramon (Israel). 95 ×.

Fig. 3. *Pseudofurnishius murcianus* BOOGAARD. Late Lower Ladinian or base Upper Ladinian; Hornos-Siles Formation, Jaèn (Spain). 110 ×.

Fig. 4. *Pachycladina inclinata* STAESCHE. Upper Scythian; Zafir Formation, Makhtesh Qatan 2 Well, Negev (Israel). 40 ×.

Fig. 5. *Pachycladina longispinosa* STAESCHE. Upper Scythian; Zafir Formation, Makhtesh Qatan 2 Well, Negev (Israel). 60 ×.

Fig. 6. *Hadrodontina* cf. *H. adunca* STAESCHE. ? Late Lower Scythian; Yamin Formation, Makhtesh Qatan 2 Well, Negev (Israel). Lateral view. 60 ×.

Fig. 7. *Hadrodontina* cf. *H. adunca* STAESCHE. ? Late Lower Scythian; Yamin Formation, Makhtesh Qatan 2 Well, Negev (Israel). Aboral view. 60 ×.

Fig. 8. *Lonchodina nevadensis* MÜLLER. Upper Scythian; Zafir Formation, Makhtesh Qatan 2 Well, Negev (Israel). 80 ×.

Fig. 9. *Pachycladina symmetrica* STAESCHE. Upper Scythian; Zafir Formation, Makhtesh Qatan 2 Well, Negev (Israel). 40 ×.

Fig. 10. *Pachycladina obliqua* STAESCHE. Upper Scythian; Zafir Formation, Makhtesh Qatan 2 Well, Negev (Israel). 40 ×.

Fig. 11. *Pachycladina tricuspoidata* STAESCHE. Upper Scythian; Zafir Formation, Makhtesh Qatan 2 Well, Negev (Israel). 40 ×.

## Plate 2

(Scale = ca. 100 μ.)

Fig. 1. *Simeonella brotzenorum* SOHN. Lower Carnian; Limestone member (IV), Saharonim Formation, Har Gevanim, Makhtesh Ramon (Israel). Right view of carapace.

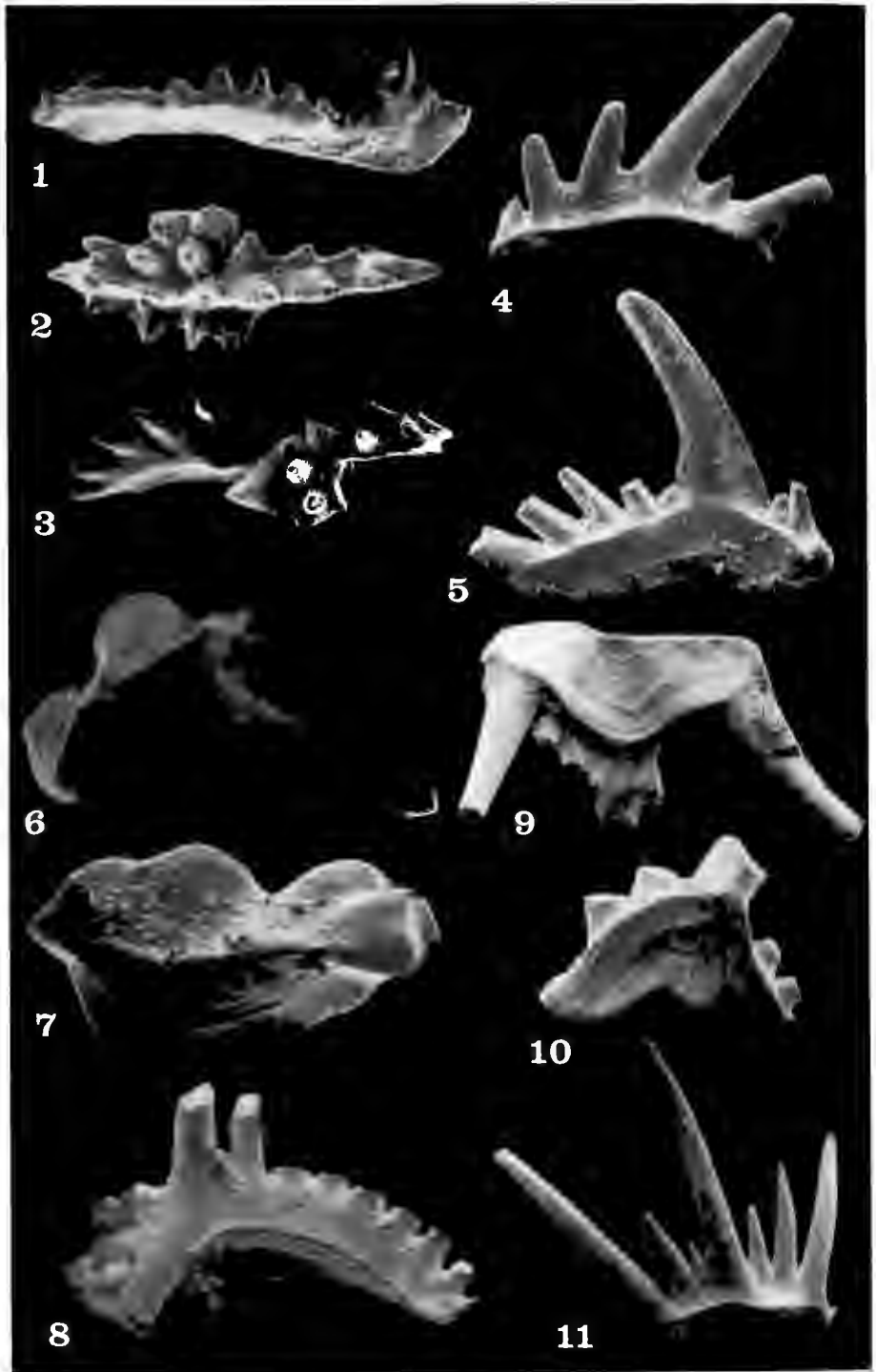
Fig. 2. *Simeonella brotzenorum* SOHN. Upper Ladinian; Limestone Gypsum member (III), Saharonim Formation, Har Gevanim, Makhtesh Ramon (Israel). Inside view of left valve.

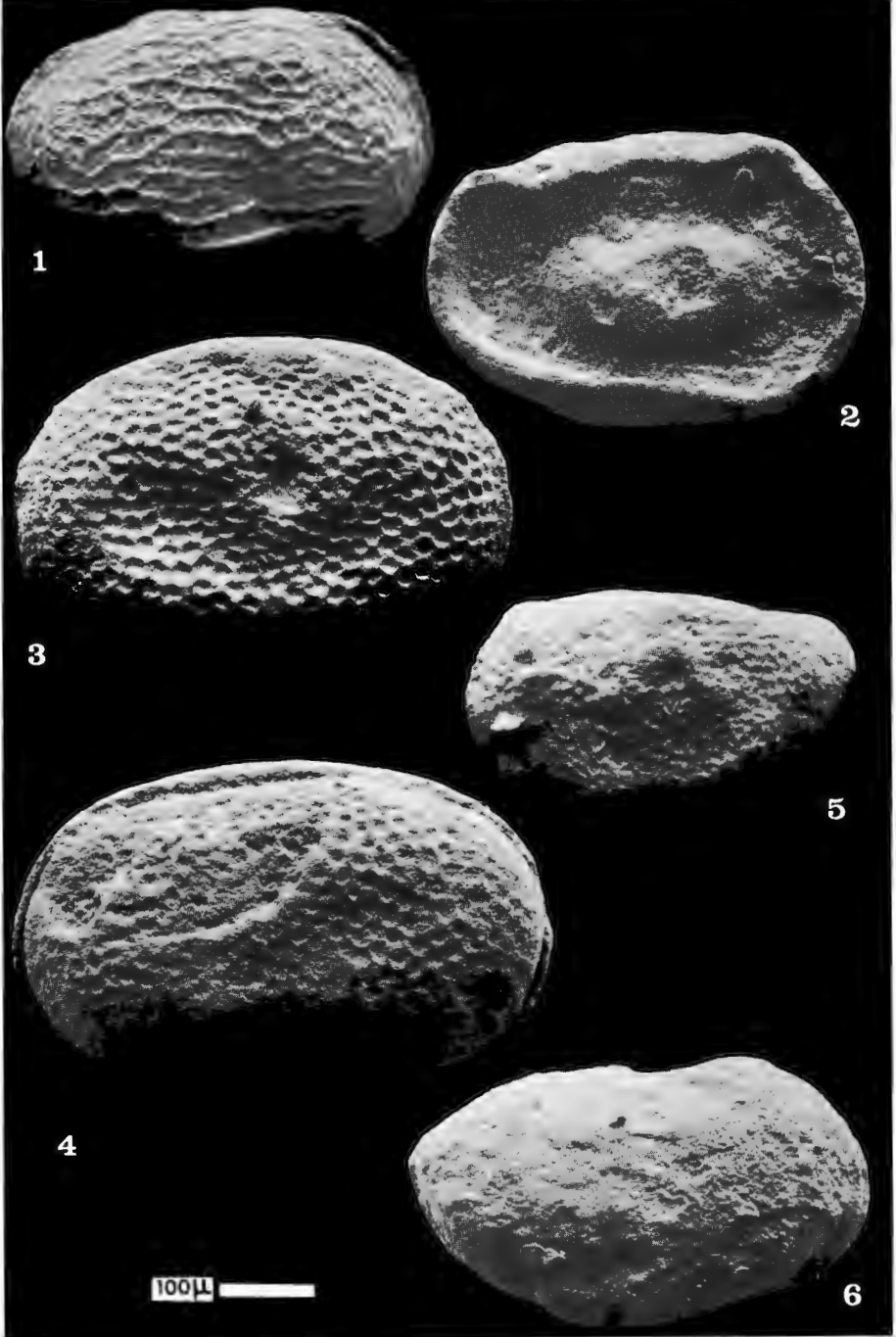
Fig. 3. *Reubenella avnimelechi* SOHN. Upper Anisian; Sandstone-“Reef” member (IV), Gevanim Formation, Har Gevanim, Makhtesh Ramon (Israel). Right view of carapace.

Fig. 4. *Reubenella avnimelechi* SOHN. Lower Ladinian; Fossiliferous Limestone member (I), Saharonim Formation, Har Gevanim, Makhtesh Ramon (Israel). Left view of carapace.

Fig. 5. *Triebacynthere* nov. spec. ? Late Upper Scythian. Zafir Formation, Zavoa 1 Well, Northern Negev (Israel). Left view of carapace.

Fig. 6. ? *Monoceratina* sp. C ? Upper Scythian. Zafir Formation, Ramon 1 Well, Negev (Israel). Right view of carapace.







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