

Ontogenesis and stratigraphy of the ostracod *Veeniacythereis jezzineensis* (Bischoff, 1963)

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ABSTRACT—*Veeniacythereis jezzineensis* (Bischoff, 1963) occurs in Israel throughout the Upper Albian–Cenomanian. It comprises continuously ornamented-variable forms, including A-3 to A molt stages. The ontogenetic lineages reveal a pre-adult sexual-dimorphism. It is suggested that *Cythereis magrebensis* Bassoulet & Damotte and *Cythereis stebolophata* Al-Abdul-Razzaq & Grosdidier are junior synonyms of *V. jezzineensis*.

INTRODUCTION

The history of the forms designated herein as *Veeniacythereis jezzineensis*, began in 1959, when Glintzboeckel & Magné illustrated their ostracods C1, C2 and C3 from East Algeria and Tunisia. Since then, these forms have been described and figured in a dozen publications (see synonymy) and their stratigraphy given. Unfortunately, there is no consensus about the taxonomy of these forms, and a variety of specific and subspecific names, as well as different generic definitions were attributed to these same forms. This has, of course, led to controversy concerning their stratigraphic position.

This group of ostracods has a wide geographic distribution, extending along the southern border of the Tethys from Algeria (Glintzboeckel & Magné, 1959; Bassoulet & Damotte, 1969) in the west, to Iran (Grosdidier, 1973) and Kuwait (Al-Abdul-Razzaq & Grosdidier, 1981) in the east. They occur in Upper Albian (Bischoff, 1963) to Cenomanian (Rosenfeld & Raab, 1974) sediments.

V. jezzineensis is very abundant throughout Israel, occurring from the uppermost Albian Hevyon Member to the Upper Cenomanian, Avnon Member of the Hazera Formation, and in the Moza Formation. (Rosenfeld & Raab, 1974). Several samples included rich assemblages of this species enabling a thorough systematic and ontogenetic study.

Veeniacythereis jezzineensis (Bischoff, 1963)
(Pl. 1, figs. 1–15, Pl. 2, figs. 1–13)

Material. About 40 washed samples from the Uppermost Albian to Cenomanian Judea Group in Israel were studied. However, three samples, each comprising more than a hundred specimens of *V. jezzineensis* were chosen to represent the material studied. Sample T-968 (Pl. 1) is from the Upper Cenomanian Moza Formation, in the

Qastel, Judea Mountains; sample T-420 (Pl. 2) is from the Upper Cenomanian Avnon Member of the Hazera Formation in Hamakhtesh Haqatan, Southern Israel; sample T-2294 (Pl. 2) is from the Albian to Lower Cenomanian Hevyon Member of the Hazera Formation, Massada-1 well, core 9, Northeastern Negev, Israel. Additional information on these samples is available in Rosenfeld & Raab (1974, pp. 39, 44, 52, Fig. 1). The material is stored in the Geological Survey of Israel.

Synonymy.

- V. jezzineensis* A♂
(Pl. 1, figs. 1–2, Pl. 2, figs. 1, 8)
- 1963 *Cythereis jezzineensis* Bischoff: 42, pl. 16; figs. 128 a–d.
- ?1968 *Veenia jezzineensis* (Bischoff); Koch: 699, pl. 62.
- 1973 *Cythereis jezzineensis* Bischoff; Grosdidier: 135, pl. 7, figs. 61 b–e.
- 1974 *Veeniacythereis jezzineensis* (Bischoff); Rosenfeld & Raab: 21, pl. 3, figs. 28–29.

V. jezzineensis A♀
(Pl. 2, figs. 2, 9)

- 1959 Ostracode C1 Glintzboeckel & Magné: pl. 3, fig. 33.
- 1963 *Cythereis jezzineensis* Bischoff: 42, pl. 16, figs. 129a–c, 130.
- 1969 *Cythereis magrebensis* Bassoulet & Damotte: 133, pl. 1, figs. 2a–e.
- 1973 *Cythereis jezzineensis* Bischoff; Grosdidier: 135, pl. 7, fig. 64a.
- 1974 *Veeniacythereis jezzineensis* (Bischoff); Rosenfeld & Raab: 21, pl. 3, fig. 30.
- 1975 *Cythereis jezzineensis* Bischoff, Colin & El-Dakkak: 56, pl. 1, figs. 11–12.

- 1981 *Veeniacythereis jezzineensis* (Bischoff); Al-Abdul-Razzaq & Grosdidier: 179, pl. 1, fig. 2.
- 1981 *Veeniacythereis maghrebensis* (Bassoullet & Damotte); Al-Abdul-Razzaq & Grosdidier: 182, pl. 1, fig. 3.
- 1981 *Veeniacythereis maghrebensis* (Bassoullet & Damotte); Bismuth *et al.*: 232, pl. 10, figs. 1–2.

V. jezzineensis A-1♂

(Pl. 1, figs. 3–4, Pl. 2, figs. 3–4, 10–11)

- 1959 Ostracode C3, Glintzboeckel & Magné: pl. 3, fig. 28.
- 1974 *Veeniacythereis jezzineensis* (Bischoff), juvenile; Rosenfeld & Raab: 21, pl. 3, fig. 32.
- 1975 *Cythereis jezzineensis* Bischoff, forme jeune, Colin & El-Dakkak: 56, pl. 2, figs. 1–2.
- 1981 *Cythereis streblolophata streblolophata* Al-Abdul-Razzaq & Grosdidier: 183, pl. 1, fig. 7.

V. jezzineensis A-1♀

(Pl. 2, figs. 5, 12)

- 1959 Ostracode C2 Glintzboeckel & Magné: pl. 3, fig. 27.
- 1969 Ostracode C2 Glintzboeckel & Magné; Grekoff: 232, pl. 1, figs. 5 a–b.
- 1973 *Cythereis IRE3* Grosdidier: 136, Pl. 8, figs. 67 a–c.
- 1981 *Cythereis streblolophata streblolophata* Al-Abdul-Razzaq & Grosdidier: 183, Pl. 1, figs. 8–10.
- 1981 *Cythereis streblolophata streblolophata* (Al-Abdul-Razzaq & Grosdidier); Bismuth *et al.*: 233, pl. 10, figs. 3–4.

V. jezzineensis A-2♂

(Pl. 1, figs. 5, 7, 8, 10; Pl. 2, fig. 6)

- 1973 *Cythereis IRC4* Grosdidier: p. 136, pl. 8, figs. 66 c–d.
- 1974 *Veeniacythereis jezzineensis* (Bischoff), juvenile; Rosenfeld & Raab: 21, pl. 3, figs. 31, 33.
- 1981 *Cythereis streblolophata schista* Al-Abdul-Razzaq & Grosdidier: 185, pl. 2, figs. 2, 4.
- 1981 *Veeniacythereis streblolophata schista* (Al-Abdul-Razzaq & Grosdidier); Bismuth *et al.*: 233, pl. 10, figs. 5–7.

V. jezzineensis A-2♀
(Pl. 1, figs. 6, 9, 11–13; Pl. 2, figs. 7, 13)

- 1973 *Cythereis IRC4* Grosdidier: 136, pl. 8, fig. 66 a.
- 1981 *Cythereis streblolophata schista* Al-Abdul-Razzaq & Grosdidier: 189, pl. 2, figs. 1, 3.

V. jezzineensis A-3
(Pl. 1, figs. 14–15)

- 1973 *Cythereis IRC4* Grosdidier: 136, pl. 8, fig. 66b (*non* fig. 66 a).

Dimensions.

In order to follow the ontogenetical series, the lengths and heights of some 170 specimens from 30 samples, and belonging to *V. jezzineensis* according to our concept, were measured and plotted (Fig. 1).

Fig. 1 shows clearly the discontinuous growth pattern of the molt stages and the distinct lineages of the males and females. Sexual dimorphism is observed relatively early in ontogeny, as early as stage A-2. This phenomenon of early sexual dimorphism in ostracods has been previously discussed in the literature (Rohr, 1979; Whatley & Stephens, 1977). Despite its inaccuracy, the plottings of the minimum and maximum range values of the lengths and heights of the original descriptions of *C. jezzineensis* Bischoff (1963, p. 43), and of *C. maghrebensis* Bassoullet & Damotte (1969, p. 133) fall well within our fields. The dimension ranges of *Cythereis streblolophata streblolophata* and *C. streblolophata schista* (Al-Abdul-Razzaq & Grosdidier, 1981, pp. 183, 185) fall within the fields of A-1 and A-2 stages with slight deviations.

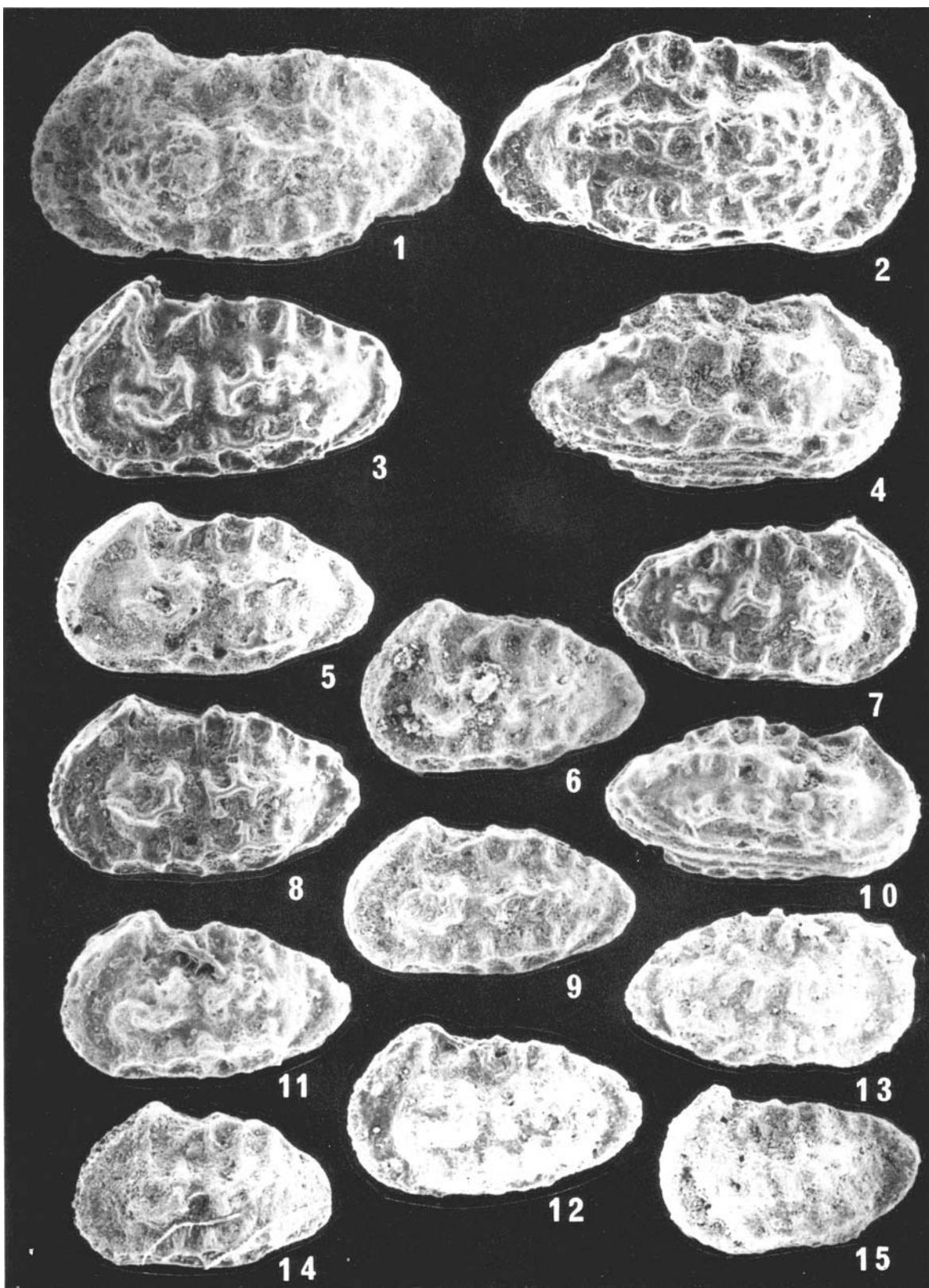
Ornamentation. There is no point in repeating the descriptions of the species, especially those features such as general shape, hinge ear, ridges etc., as they are commonly accepted. However, several points pertaining to the variability of ornament deserve consideration.

On the basis of observation of the numerous specimens it is obvious that the ornament is transitionally variable. The pattern of a median ridge accompanied by ventral and dorsal ridges exists in all the specimens, however, these ridges may vary in strength, from thin to very thick and prominent. Another variable feature is the cross ridglets, which may traverse continuously from the dorsal to the ventral ridges, or may be interrupted to various degrees. In addition, it could be observed that the transverse ridges are relatively few in early stages,

Explanation of Plate 1

All figures are × 80

Veeniacythereis jezzineensis (Bischoff): sample T-968, Qastel (coordinates 16377/13391), Moza Marl Formation, Lower part of Upper Cenomanian, *V. jezzineensis* zone (UC-3). Figs. 1, 2, A♂; figs. 3, 4, A-1♂; figs. 5, 7, 8, 10, A-2♂; figs. 6, 9, 11–13, A-2♀; figs. 14, 15, A-3.



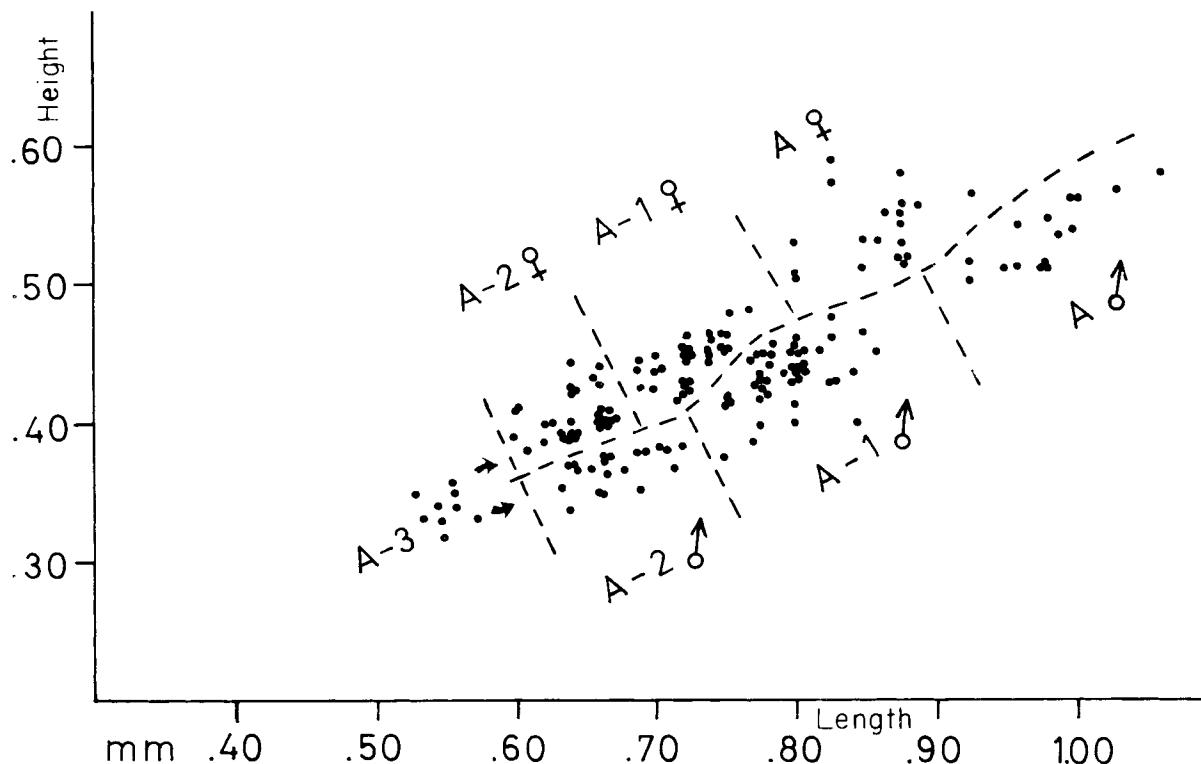


Fig. 1. Growth stages of *Veeniacythereis jezzineensis* (Bischoff). The figure is based on measurements of about 170 random specimens.

becoming more numerous towards the adult stage. (e.g. A-3: 4-5; A-2: 6; A: 7-8). The subcentral knob appears in earlier stages as a thickening on the rib, either connected to, or separated from the eye spot, becoming a thick, oval, reticulated knob in the adult. The reticulation exists only in the adult stage, which otherwise keeps all the above mentioned features.

REMARKS

The above mentioned synonymy includes all the available publications which, in our opinion, deal with *V.*

jezzineensis. These descriptions fall within one or other of the stages of this species, and completely agree with the descriptions of the respective stage. It seems that the variability in ornament, which accompanies the molt stages led several authors (e.g. Bassoulet & Damotte, 1969; Al-Abdul-Razzaq & Grosdidier, 1981; Bismuth *et al.*, 1981) to assign their specimens to different species and occasionally even genera.

In this connection it should be mentioned that the hinges shown by Al-Abdul-Razzaq & Grosdidier (1981, pl. 2, figs. 5-8) do not have any lobation or crenulation on the

Explanation of Plate 2

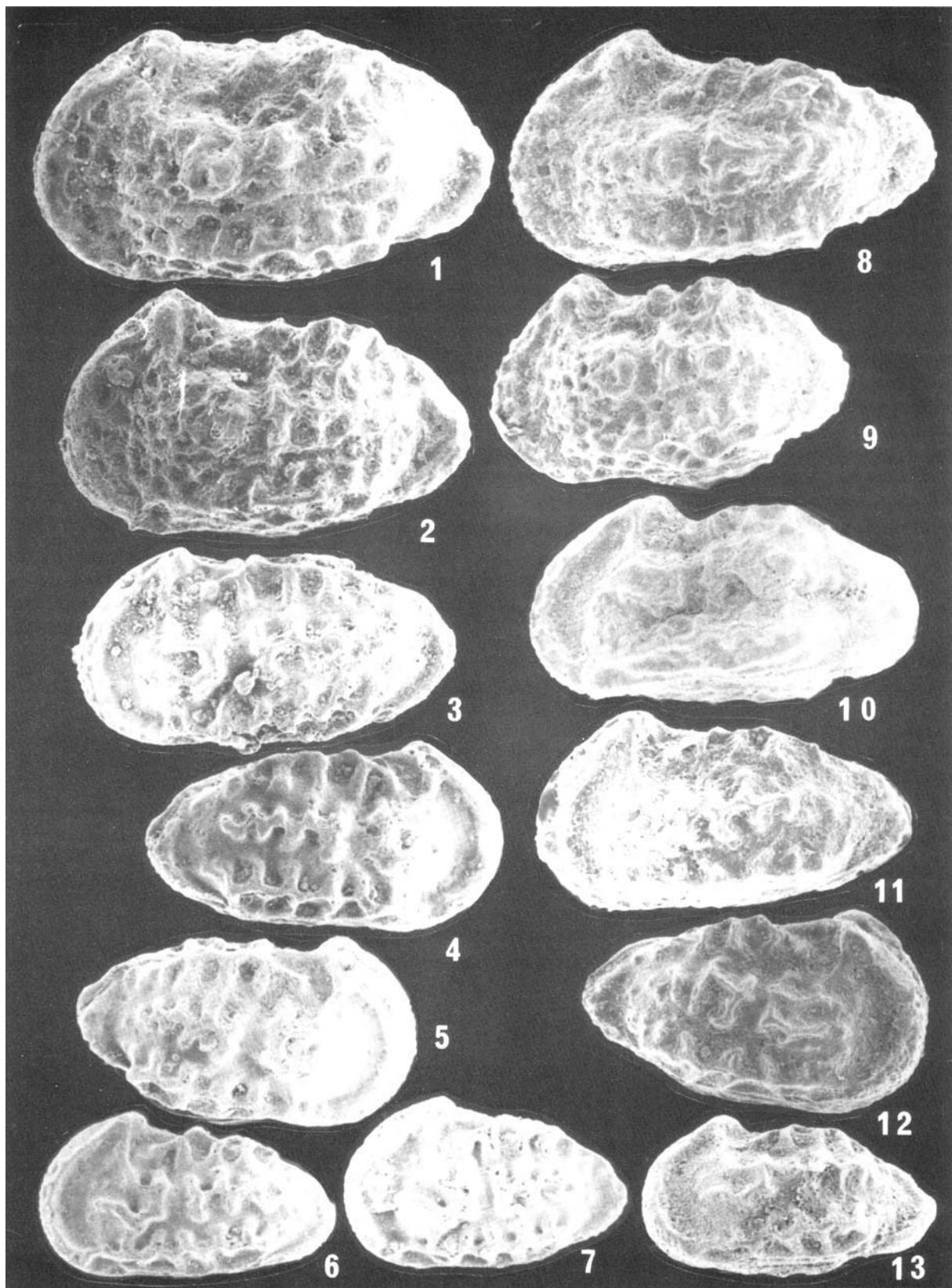
All figures are $\times 80$

Veeniacythereis jezzineensis (Bischoff):

Figs. 1-7, sample T-420, Hamakhtesh Haqatan (coordinates 1750/0420), Hazera Formation, Avnon Member, Upper Cenomanian, *Metacytheropteron berbericum* zone (UC-4).

Fig. 1, A ♂; fig. 2, A ♀; figs. 3, 4, A-1 ♂; fig. 5, A-1 ♀; fig. 6, A-2 ♂; fig. 7, A-2 ♀.

Figs. 8-13, sample T-2294, Massada-1 well, core No. 9 (coordinates 18410/08010), Hazera Formation, Hevyon Member, Upper Albian to Lowermost Cenomanian, *Neocythere? N. bisulcata* zone (UC-1). Fig. 8, A ♂; fig. 9, A ♀; figs. 10, 11, A-1 ♂; fig. 12, A-1 ♀; fig. 13, A-2 ♀.



anterior and posterior teeth whereas the median groove is crenulated. This hinge is typical of the amphidont/heterodont hinge of *Veenia* (and *Veeniacythereis* Gründel, 1974, p. 1469), rather than the amphidont/lobodont hinge of *Cythereis* (Van Morkhoven, 1962, p. 180). Unfortunately our samples contained very few single valves and these were very badly preserved. Therefore a thorough discussion on the hinge pattern of either juveniles or adults is impeded. However, to the best of our knowledge the hinge pattern in juveniles, and its ontogenetic development in the group of *Veeniacythereis* has not yet been thoroughly studied, and no conclusion can be categorically drawn, based on the stage of development of the hinge.

STRATIGRAPHIC NOTES

It should be stressed that all the different molts (A-3 to A) occur together in many of the samples studied. Moreover, they occur together throughout the Upper Albian to the Upper Cenomanian of Israel. This agrees with the observations of many other authors, namely:

Glintzboeckel & Magné, 1959, fig. 1 Ostracode C1, C2 and C3; Cenomanian (Tunisia, Algeria).

Bischoff, 1963, p. 43, fig. 2; *C. jezzineensis*; Upper Albian to Cenomanian (Lebanon).

Koch, 1968, fig. 62; *Veenia jezzineensis*; Cenomanian throughout (Jordan).

Bassoulet & Damotte, 1969, p. 133, *C. maghrebensis*; Upper Cenomanian throughout (Algeria and Tunisia).

Grosdidier, 1973 p. 154 and Distribution Chart; *Cythereis IRE3*; Albian-Lower Cenomanian; *Cythereis IRC4*; Cenomanian throughout; *C. jezzineensis* (IRC1); Lower-Middle Cenomanian (Iran).

Rosenfeld & Raab, 1974, p. 21, fig. 4, *V. jezzineensis*; Cenomanian throughout (Israel).

Colin & El-Dakkak, 1975, p. 56-57, *C. jezzineensis*; Cenomanian (horizons 1, 2, 3, 9) (Sinai).

The stratigraphic distribution of *V. jezzineensis* throughout the Cenomanian, seems to contradict the observations of Al-Abdul-Razzaq & Grosdidier (1981). They split *V. jezzineensis* into one additional species (*C. maghrebensis*) and two subspecies (*Cythereis stebolophata stebolophata* and *C. stebolophata schista*), assigning to them different stratigraphic levels (Upper Cenomanian, Upper Cenomanian and Lower Cenomanian respectively). The assignment of the Albian to Lower Cenomanian *Cythereis IRE3* (Grosdidier, *loc. cit.*), by Al-Abdul-Razzaq & Grosdidier *loc. citati*, to the Upper Cenomanian *C. stebolophata stebolophata*, and the Cenomanian (including Upper) *Cythereis IRC4* (Grosdidier, *loc. cit.*) to the Lower Cenomanian *C. stebolophata schista* seems odd.

Following the splitting by Al-Abdul-Razzaq & Grosdidier, Bismuth *et al.* (1981, p. 233) assigned an Albian age to *V. jezzineensis* although it was not recorded by them in their material. This was probably a result of the misinterpretation of the species. They did, however, assign a Lower Cenomanian to base Upper

Cenomanian age to their *V. stebolophata s.l.* Their conclusion that *V. stebolophata schista* and *V. stebolophata stebolophata* occur in a stratigraphic sequence (Lower Cenomanian and Middle to base Upper Cenomanian, respectively, p. 233 and Fig. 8) seems to contradict the coexistence of both subspecies in the lower unit of the Ben Younés sequence (p. 213).

CONCLUSIONS

1. The specimens defined from Israel as *Veeniacythereis jezzineensis* (Bischoff) comprising juveniles, show a continuously variable ornamentation, including passages from one form to the other, and can thus be regarded as belonging to the same species.

2. Length and height measurements of numerous specimens has resulted in the detection of A-3 to A molt stages, and enabled the plot of ontogenetic lineages for this species, for both sexes. These show the existence of preadult sexual dimorphism as early as A-2 molt stage.

3. The stratigraphic distribution of *V. jezzineensis*, in Israel is Upper Albian to Upper Cenomanian. The variously ornamented forms, as well as the different ontogenetic molt stages occur together throughout the section.

4. Careful examination of the available literature, in view of the above mentioned conclusions suggests that the following forms belong to *V. jezzineensis*: Ostracods C1, C2, C3 Glintzboeckel & Magné; *Cythereis maghrebensis* Bassoulet & Damotte; *Cythereis IRE3* and *IRC4* Grosdidier; *Cythereis stebolophata* Al-Abdul-Razzaq & Grosdidier (including spp. *stebolophata* and *schista*). It would appear that the finding of incomplete assemblages led to the erection of the synonymous new species and subspecies.

ACKNOWLEDGEMENTS

The authors wish to thank M. Dvorachek and R. Kenafo for the S.E.M. photography. Thanks are also due to Mrs. E. Halbersberg and D. Ashkenazi for their technical assistance.

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