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8. CENOZOIC OSTRACODES FROM HOLE 628A, ODP LEG 101, BAHAMAS[1]

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ABSTRACT

The Oligocene to Pliocene section from Hole 628A supplied about 100 species of Tertiary ostracodes. Deep-sea psychrospheric? species (*Bradleya* cf. *dictyon, Agrenocythere* cf. *gosnoldia, Cardobairdia* spp., *Henryhowella* sp., *Cytheropteron* spp., etc.) are present throughout the section. Starting in the Miocene, neritic species (*Hulingsina* sp., *Puriana* spp., *Caudites* spp., *Loxoconcha fischeri, Cytherelloidea* sp., etc.) dominate. Redeposition of these species from the continental shelf seems to be penecontemporaneous with sedimentation. Variations in the assemblages indicate biostratigraphic position. Species having an ecologic or stratigraphic importance are discussed and illustrated.

INTRODUCTION

Five of the sites drilled during Leg 101 penetrated Oligocene (or older) sediments. However, only a small part of the Tertiary series was recovered at two sites (Holes 634A and 635A). Two other Leg 101 holes were difficult to interpret. Hole 627B was difficult because downhole contamination occurred during drilling; Hole 626D, because of downslope contamination by neritic sediments. Therefore, we present only results from Tertiary ostracodes of Hole 628A.

Hole 628A was located in a water depth of 966 m north of Little Bahama Bank (latitude 27°31.85′N; longitude, 78°18.95′N), about 15 km from the neritic platform (Fig. 1). Today, this platform belongs to the epibathyal zone. Drilling penetrated 298 m of unconsolidated or slightly lithified sediments and reached the upper Paleocene or the lower Eocene. Ostracodes occur above the base of the lower Oligocene. The lower and middle Miocene are missing from two sections (Austin, Schlager, et al., 1986).

PALEOENVIRONMENTAL INTERPRETATION

We identified about 100 ostracode species. Those species that occur in at least three samples and are represented by *more than five specimens* (having carapaces or single valves) are noted in Table 1. Most specimens cannot be assigned precisely to known species because many belong to faunas from deeper-water environments that have not been studied much. However, the specimens can be divided into three ecological groups:

1. Species of genera exclusively or mainly occurring in the modern neritic environment, such as *Cytherelloidea, Hulingsina, Jugosocythereis, Puriana, Loxoconcha*, and species of other genera with well-developed eye tubercles.
2. Species of genera exclusively or mainly occurring in the modern deep-sea environment (i.e., for some genera this is as shallow as the lower limit of the photic zone). These species include *Cardobairdia, Henryhowella, Krithe, Trachyleberidea, Agrenocythere, Poseidonamicus, Bythoceratina*, and *Pseudocythere*.
3. Species belonging to common genera that occur at nearly all depths from the infralittoral or mediolittoral range to the abyssal or bathyal zone, such as *Cytherella*, numerous Bairdiidea, *Echinocythereis, Pterygocythereis*.

Species of the first two groups are the most interesting for paleobathymetric reconstructions. However, note that (to the limits of our current knowledge of ostracode ecology) it is difficult to discriminate between the infraneritic (circalittoral) zone and the epibathyal one. In fact, below the lower limit of the infralittoral (50–100 m water depth, in clear, well-lighted water), the main zone of biological turnover is the thermocline separating the thermosphere from the psychrosphere.[3] The depth of the thermocline varies geographically, especially according to latitude, and probably changed during Cenozoic time. Around the Florida–Hatteras slope (the Straits of Florida and the Blake Plateau), the thermocline is a major barrier between shallow- and deep-water species, as shown by Cronin (1983).

In spite of these constraints, this change in ostracode assemblages from Oligocene to late Pliocene (Table 1) allows us to conclude the following:

1. The Oligocene from Hole 628A yielded rare ostracodes (60 specimens), which belong almost exclusively to common or deep-sea genera, including *Cytherella, Krithe, Agrenocythere, Henryhowella, Cardobairdia* and *"Bairdia,"* the most typical elements. We interpreted the occurrence of occasional abraded or broken valves of neritic genera (*Jugosocythereis, Pokornyella*, and *Paracytheridea*) as transportation of sediment from the continental shelf. This conclusion is also supported by the presence of lepidocycline foraminifers in our samples (Fourcade and Butterlin, this volume).
2. From the middle Miocene (N11 part/N13 part) to the upper Pliocene (the Pleistocene is represented in only one sample, by a single valve of *Cytherella*), ostracode assemblages contain many specimens and species of genera usually considered neritic, such as *Cytherelloidea, Hulingsina*, and *Puriana* (Hazel, 1970; Valentine, 1971; and others). These genera indicate temperate to subtropical marine climates. However, deep-sea genera (such as *Agrenocythere, Bradleya*, and *Bythoceratina*) are observed throughout the section. Although not indicated by the specimens that are well preserved and have asimilar sedimentary filling, logic suggests that the valves of neritic taxa were transported from the continental shelf. Since the Miocene, a small part of the infraneritic ostracode population could possibly have colonized the upper part of the continental slope. However, the concomitant presence of bathyal with neritic ostracodes may be attributed to the turbidites that occur in lithologic Unit II of Hole 628A (Austin, Schlager, et al., 1986).

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[3] For a discussion of these expressions and concepts see Bruun (1957) and Benson (1975a).

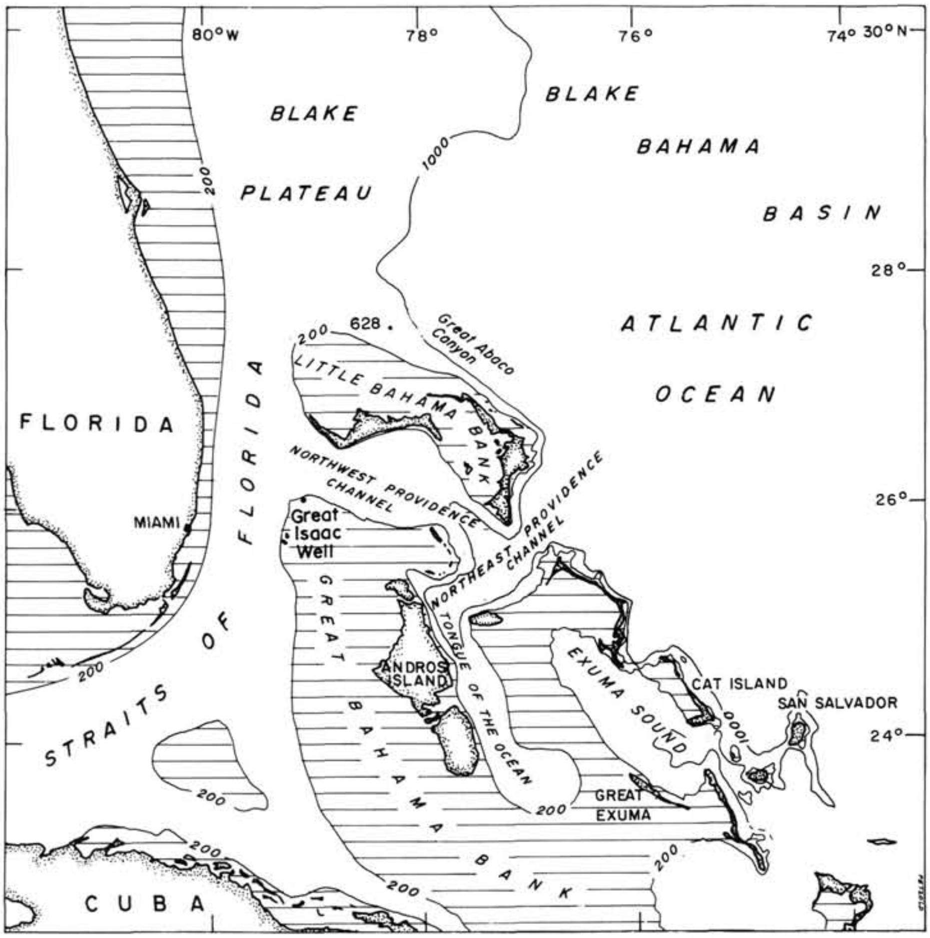


Figure 1. Location map showing Hole 628A from which samples containing Cenozoic ostracodes were studied.

Therefore, it appears that important events took place between the late Oligocene and the late middle Miocene; these events are responsible for the faunal break and the resedimentation of neritic ostracodes on the continental slope. These ostracodes suggest that most of the observed turbidites came from the infralittoral zone. Only those turbidites associated with large benthic foraminifers (Cores 101-628A-11H and 101-628A-12H) probably came from the shallow zones of the ancestral carbonate platform.

The change in specific composition of the ostracode assemblages through time is probably of biostratigraphic importance. The possible redeposition of the continental shelf seems to be penecontemporaneous with specimens indicating off-bank sedimentation. Note that with regard to the Eocene ostracode faunas from DSDP Site 390 (Guernet, 1982) and from Barbados (Steineck et al., 1984) species renewal is complete between the Eocene and the Oligocene, while at the generic level assemblages bear the same psychrospheric features. In contrast, the Oligocene–Miocene transition, despite the early and middle Miocene hiatus at Site 628, is characterized by the appearance of new species, rather than by extinctions. This "enrichment" continued during the late Miocene and the Pliocene. However, only further studies will enable us to determine if some appearances, such as *Hulingsina* sp. 1 (Core 101-628A-13H), *Gangamocytheridea* cf. *dictyon, Puriana* sp. 1 and *Cytherelloidea* sp. during the late Miocene (Cores 101-628A-11H and 101-628A-12H), *Semicytherura* sp. 1, *Hulingsina* cf. *tuberculata*, and *Ornatoleberis* sp. during the Pliocene (Cores 101-628A-8H through 101-628A-4H), which are well-represented in our samples, are biostratigraphically significant.

SYSTEMATIC PALEONTOLOGY

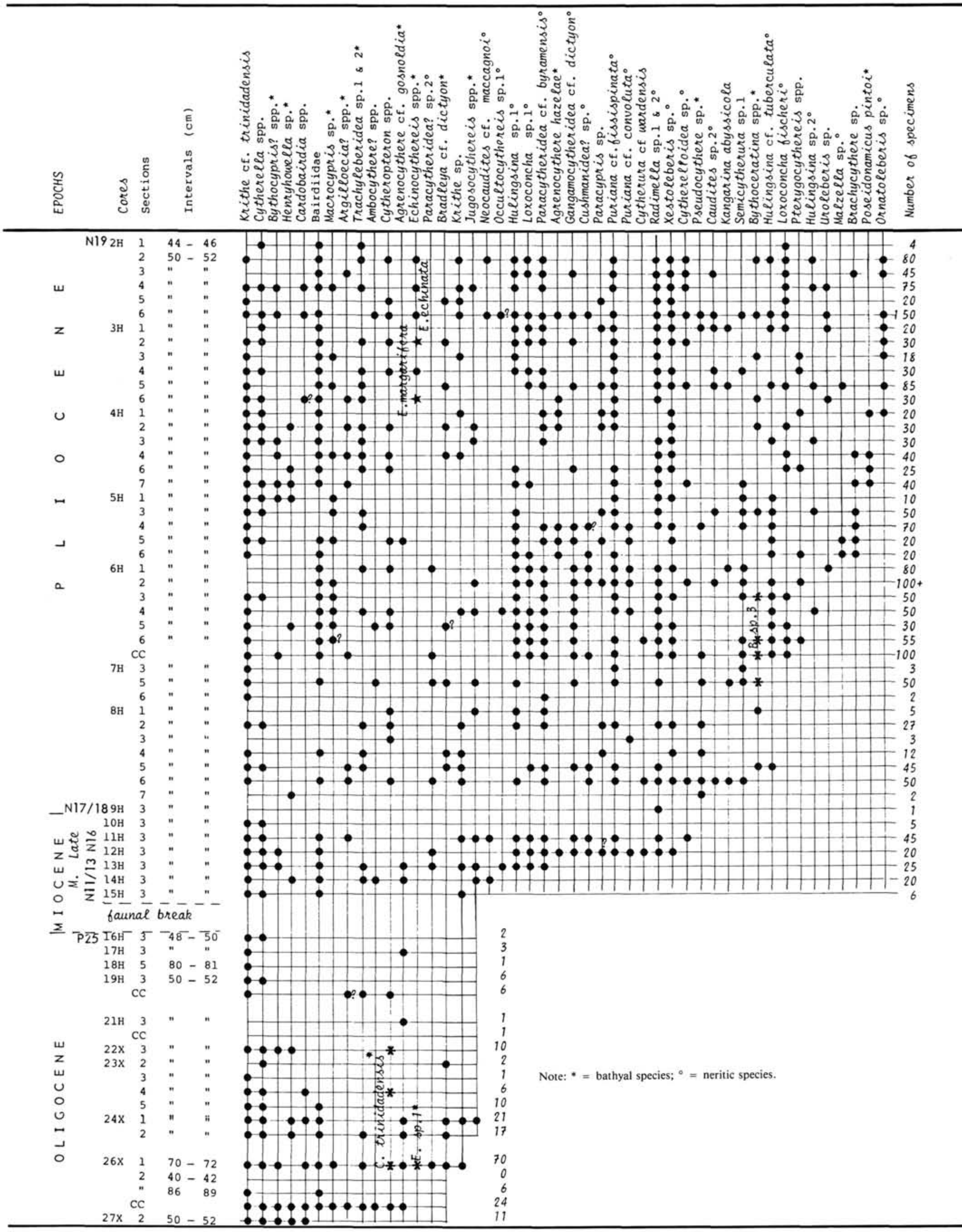
Among the 100 species observed, many occur as having only one or two valves. Their genetic significance (e.g., reworked specimen or downhole contamination) is particularly suspect. Consequently, these species are neither plotted in Table 1 nor illustrated in Plates 1 through 6. Species having easily identifiable features and ecologic or stratigraphic importance are discussed next. The systematics used here follow Hartmann and Puri (1974).

Order PODOCOPIDA Müller, 1894
Suborder PODOCOPA Sars, 1866
Superfamily CYTHERACEA Baird, 1850
Family CYTHERIDAE Baird, 1850
Genus *GANGAMOCYTHERIDEA* van den Bold, 1963

Gangamocytheridea cf. *dictyon* van den Bold, 1963
Pl. 5, Figs. 14 and 15

Remarks. The valves assigned to this species are abundant throughout the Neogene (Table 1) but seem to differ from those described by van den Bold (1963) by their more complex reticulation. *G. dictyon*, known in the Caribbean in the late Miocene, still lives "on the continental shelf north and east of Trinidad. The maximum depth at which the species has been observed is 30 fathoms" (van den Bold, 1963b). A closely related species, *G. reticulata* (van den Bold, 1957), occurs in the Miocene of Trinidad.

Table 1. Range chart for Tertiary ostracodes from Hole 628A.



Note: * = bathyal species; ° = neritic species.

Family CUSHMANIDEIDAE Puri, 1973

Remarks. The Cushmanideidae are absent in our Oligocene samples but do occur often in the Neogene samples. They are represented by *Cushmanidea*? sp. (Pl. 4, Fig. 8) and particularly by three species ascribed to the genus *Hulingsina* Puri, 1958: *H.* cf. *tuberculata* Puri, 1958 (Pl. 4, Fig. 9), *H.* sp. 1 (Pl. 4, Figs. 4 and 6), and *H.* sp. 2. This last species is coarsely punctate and related to *H. wilberti* (Puri, 1952). It occurs sporadically in the Pliocene samples. The known species of the genera *Cushmanidea* and *Hulingsina* are all neritic, and the genus *Hulingsina* seems to indicate warm temperate to subtropical climates (Hazel, 1970; Valentine, 1971).

Description. *Hulingsina* have a contraction of the posterior end of the carapace and an individualization (on one of the valves) of a kind of caudal process, which corresponds internally to a notch. The species may be a useful criterion for distinguishing *Hulingsina* from *Cushmanidea* and related genera (see Athersuch, 1982).

Family KRITHIDAE Mandelstam, 1960
Genus *KRITHE* Brady, Crosskey and Robertson, 1874

The genus *Krithe* is represented in all Cenozoic sediments from Hole 628A by at least two species.

Krithe cf. *trinidadensis* van den Bold, 1958
Pl. 1, Figs. 8 and 11

Description. Valves from Hole 628A present the following features, described by van den Bold for Oligocene and Miocene *Krithe* from Trinidad, that is, strong sexual dimorphism, anterodorsal inflection, posterior dorsal margin bent, and narrow vestibulum; however, Hole 628A specimens are more elongated (for size of the valves see Pl. 1, R.V. ♀ . L = 0.9 mm, h = 0.5 mm; R.V. ♂ , L = 1.1 mm, h = 0.49 mm).

Remarks. *K. trinidadensis* is a common species in deep-sea, middle Eocene and Oligocene deposits on Barbados (Steineck et al., 1984). It is probably *pro-parte* conspecific of *Krithe* sp. D of Peypouquet (1979) and particularly of *Krithe* sp. D12 of the Pliocene–Quaternary of DSDP Site 517 (Benson and Peypouquet, 1983). *K. trinidadensis* is similar to *K. morkhoveni* van den Bold, 1960, from the Miocene of Trinidad, but this latter species has a less sinuous inner lamella.

Krithe cf. *hiwanneensis* Howe and Law 1936
(Pl. 1, Figs. 14–15)

Remarks. The valves of this species are less common than those of the one previously described. They are tentatively assigned to *K. hiwanneensis*, which occurs in deep-sea Paleogene deposits from Barbados. Those found in Hole 628A, however, do not have a large vestibulum like the specimen illustrated by Steineck et al. (1984). Indeed, all the *Krithe* found in the Cenozoic of Hole 628A as well as those from the Oceanic Formation of Barbados have a constricted vestibulum. According to Peypouquet (1979), this feature corresponds to well-oxygenated waters. In general, the relative abundance of *Krithe* in our samples, particularly those from the Oligocene section, signified deep-water environments (Neale, 1985).

Families TRACHYLEBERIDIDAE Sylvester-Bradely, 1958
and HEMICYTHERIDAE Puri, 1953

Remarks. These families were not distinguished because of our difficulty in observing the internal features of the valves from Hole 628A.

Genus *PURIANA* Coryell and Fields, 1937

Remarks. Species attributed to *Puriana* are present in all Neogene sediments from Hole 628A. Two to five valves were recovered in most of the samples. Currently, the genus *Puriana* is represented by neritic and probably thermophilic species. However, Valentine (1971) reported the genus from modern assemblages occurring as deep as ~140 m offshore southern Virginia.

Puriana? cf. *fissispinata* Benson and Coleman, 1963
Pl. 5, Figs. 1 and 2

Description. The crests of these valves are narrower than those of *P. convoluta* Teeter, 1975 (see figure in Cronin and Hazel, 1979; Hazel, 1977, 1983). Their arrangement is also slightly different, and their valves are slimmer. They are probably instars of *P. fissispinata*, species that must perhaps be assigned to *Cornuquimba* Ohmert, 1968 (after T. M. Cronin, pers. comm., 1987). *Puriana*? cf. *fissispinata* is present in Core 101-628A-12H (i.e., as young as the late Miocene).

Genus *AGRENOCYTHERE* Benson, 1972

Agrenocythere cf. *gosnoldia* Benson, 1972
Pl. 2, Figs. 3 and 4

Remarks. Specimens from Hole 628A were differentiated from the Eocene species described by Benson (1972) by their elongated shape and details of their ornamentation. Valves of different instars and of different sexes were compared because each sample contains only one to three valves (except Sample 101-628A-26X-1, 70–72 cm, from which we extracted 10 or 11 valves corresponding to at least four molts).

Agrenocythere cf. *hazelae* (van den Bold), 1946
Pl. 2, Fig. 7

Description. Valves from Hole 628A are represented by early instars and are characterized by the division of their *pore-conuli* (especially on the occular ridge and on the dorsal spines). The caudal process is short and may be a larval feature.

Remarks. *A. hazelae* was described first from the lower Miocene of Cuba. The species still lives in the Carribean area and in the eastern Pacific (Benson, 1972). We observed it only in the Neogene of Hole 628A.

Genus *BRADLEYA* Hornibrook, 1952

Bradleya dictyon (Brady, 1880)
Pl. 2, Fig. 6

Remarks. This species is known in the Atlantic and the Southern Hemisphere from the lower Miocene to Holocene. It occurs sporadically in the Neogene from Hole 628A (Table 1). The Oligocene at this site contains several valves belonging to a new subspecies, or possibly a different species, that is similar, in its coarser reticulation, to *Bradleya johnsoni* Benson (in Benson and Peypouquet, 1983) of the lower Miocene from the South Atlantic.

The genera *Agrenocythere, Bradleya, Poseidonamicus* (*P. pintoi*, Pl. 3, Fig. 13), and *Trachyleberidea* are among the more characteristic of deep-water taxa. They are associated with widespread genera (*Krithe* and *Cytherella*) in the Oligocene from Hole 628A and are less numerous in the middle Miocene with respect to neritic genera.

Genus *ECHINOCYTHEREIS* Puri, 1952

Three species are ascribed to this genus. Only one bears eye tubercles.

Echinocythereis margaritifera (Brady, 1870)
Pl. 6, Fig. 3

Description. In a lateral view, the valves appear subquadrangular, with large *pore-conuli* and well-developed eye tubercles (perhaps an adaptation to a life in a shaded environment).

Remarks. Today, this tropical to cold temperate species is known from the shelf and upper slope of the Gulf of Mexico and Florida and from off Cape Hatteras down to a depth of 2000 m (Hazel, 1970).

Echinocythereis echinata (Sars, 1866)
Pl. 6, Fig. 1

Remarks. Valves from Hole 628A can be identified with Sars' species as illustrated by Benson et al. (1983). Today *E. echinata* seems to be a blind species, living in the cold, deep water of the Atlantic Ocean. Its valves and carapaces occur at depths greater than 3000 m. Its occurrence with *E. margaritifera* in the Pliocene from Hole 628A (unless it results from postmortem reworking) *points out an epi- or mesobathyal environment and a temperature of about 10°C.*

Echinocythereis sp. 1
Pl. 2, Fig. 2

Description. This species also lacks well-developed eye tubercles and is similar to *E. echinata* in the *pore-conuli* arrangement, although these specimens are much larger, except in the anterior, where they disappear. Their valves are more quadrangular than those of *E. echinata*, of which *E.* sp. 1 might be an ancestral form. They occur in only one of the Oligocene samples (Table 1) from Hole 628A.

Genus *NEOCAUDITES* Puri, 1960

Neocaudites aff. *maccagnoi* (Ciampo, 1971)
Pl. 4, Fig. 7

This neritic species, represented by a few valves in Neogene sediments from Hole 628A (Plate 1), is shorter than *N. maccagnoi* (see Bonaduce et al., 1980) from the Pleistocene or Holocene of the Mediterranean and Red seas, where the species is assigned to genus *Falsocythere* (Ruggieri, 1972). T. M. Cronin (pers. comm., 1987) discovered a species much like *N.* aff. *maccagnoi* in the western Pacific.

Family LOXOCONCHIDAE Sars, 1825
Genus *LOXOCONCHA* Sars, 1866

Loxoconcha fischeri (Brady, 1869)
Pl. 5, Fig. 5

Description. This species is distinguished by its general shape, its well-defined anteriodorsal angle, an anterior margin vertically "truncated," and its reticulation. Two ridges are developed anteriorly in a "V" shape. The species has posteriodorsal and posterioventral nodes.

Remarks. In the study area, *L. fischeri* occurs from the Miocene to the Holocene (van den Bold, 1957, 1963, 1966, 1969; Howe and van den Bold, 1975). Although never abundant (generally one or two valves occur), it is the most frequent *Loxoconcha* in the Pliocene of Hole 628A (Table 1).

Family PARACYTHERIDEIDAE Puri, 1957
Genus *PARACYTHERIDEA* Müller, 1894

Paracytheridea aff. *byramensis* Howe and Law, 1936
Pl. 6, Figs. 5 and 6

Remarks. By their carapace size, their proportion, and their ornamentation, valves from Hole 628A appear related to *P. byramensis* from the Oligocene of Mississippi (see Plate 10, Fig. 3 of Hazel et al., 1980). Hole 628A specimens lack eye tubercles and can be distinguished from *P. byramensis* by their less prominent anteriodorsal region. Probably, they are conspecific of *P.* sp. A of Colon Harbour (Panama) illustrated by van den Bold (1966). *P.* aff. *byramensis* is one of the Neogene species found most often in Hole 628A.

Family CYTHERURIDAE Müller, 1894
Genus *SEMICYTHERURA* Wagner, 1957

Semicytherura sp. 1
Pl. 5, Figs. 9 and 11

Remarks. This species is probably similar to *Semicytherura* sp. B of Hazel et al. (1980), mentioned as *S. byramensis* in the Glendon Formation (Oligocene) of Mississippi and Alabama; however, its caudal process is more triangular. It is similar to *Cytherura* sp. A from the Pleistocene of Virginia (Valentine, 1971). Beyond its general shape, *S.* sp. 1 is characterized by its ornamentation, including ventrolateral ridges and sockets settled in the mesh of the reticulum.

Family XESTOLEBERIDIDAE Sars, 1828
Genus *ORNATOLEBERIS* Keij, 1975

Ornatoleberis sp.
Pl. 6, Fig. 9

Description. This species is rare in the Pliocene of Hole 628A; however the species is interesting because of its similarity to *O. fortii* Bonaduce et al. (1980), which lives in the Red Sea to a depth of 25 m. Ornamentation and ventrolateral nodosity are similar, but the caudal appendix is better marked here.

Remarks. According to T. M. Cronin (pers. comm., 1987), *O.* aff. *fortii* also commonly occurs in the western Pacific. Has this species penetrated into the western Atlantic from the Mediterranean by way of the eastern Atlantic during the Neogene or from the Pacific (with *N.* aff. *maccagnoi*) through the Panamanian seaway?

SUMMARY AND CONCLUSIONS

The Tertiary of Hole 628A yielded about 100 species of ostracodes. Only those occurring in several samples were mentioned in Table 1 and illustrated in Plates 1 through 6.

We reached the following conclusions from our study:

1. During the Oligocene (Cores 101-628A-27X through 101-628A-16H) deep-sea or common species prevail, whereas from the middle Miocene onward (unfortunately, the lower Miocene is absent in Hole 628A), neritic species that were transported downslope from the continental shelf are more numerous. This change perhaps is the result of a late Oligocene-early Miocene eustatic event and/or of the progradation of the carbonate platform (Austin, Schlager, et al., 1986).
2. During the Neogene (Cores 101-628A-15H through 101-628A-2H), specific diversity increases. Most likely this change has biostratigraphic significance; however, it must be confirmed and documented by future investigations.

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APPENDIX
Systematic Listing of Cenozoic Species
Hole 628A

Cytherella sp. 1
Cytherella sp. 2 gr. *consueta* Deltel, 1961 (see Ducasse, 1981)
Cytherella sp. 3
Cytherelloidea sp.
Cardobairdia
 C. gr. *ovata* van den Bold, 1960: Sections 101-628A-27X-2, 101-628A-26X-CC, and 101-628A-24X-1.
 C. gr. *asymmetrica* (van den Bold, 1946): Section 101-628A-26X-1.
Paranesidea? sp. 1 and sp. 2.
Paranesidea cf. *cassida* (van den Bold, 1946) (see also Steineck, 1981); Section 101-628A-23X-5.
Neonesidea? sp.
Triebelina coronata (Brady, 1870); Section 101-628A-2H-4.
Bythocypris spp.
Gangamocytheridea cf. *dictyon* van den Bold, 1963a.
Eucythere sp.; Sections 101-628A-8H-5, 101-628A-8H-1, and 101-628A-7H-5.
Cushmanidea sp.
Hulingsina cf. *tuberculata* Puri, 1958.
Hulingsina sp. 1
Hulingsina sp. 2; Sections 101-628A-6H-6, 101-628A-5H-3, and 101-628A-2H-2.
Krithe cf. *trinidadensis* van den Bold, 1958.
Krithe cf. *hiwanneensis* Howe and Law, 1936 (see also Steineck et al., 1984).
Parakrithe sp.; Section 101-628A-1H-3.
Puriana cf. *convoluta* Teeter, 1975 (see also Hazel, 1983).
Puriana cf. *fissispinata* Benson and Coleman, 1963.
Trachyleberidea cf. *blanpiedi* Howe and Law, 1936.
Trachyleberidea cf. *mammidentata* van den Bold, 1981; Sections 101-628A-3H-5 and 101-628A-3H-6.
Agrenocythere gr. *gosnoldia* Benson, 1972.
Agrenocythere cf. *hazelae* (van den Bold, 1946) (see also van den Bold, 1957; Benson, 1972).
Pterygocythereis aff. *americana* Ulrich and Bassler, 1904 in Howe and van den Bold, 1975; Sections 101-628A-6H-2, 101-628A-3H-3 and 101-628A-3H-4.
Pterygocythereis sp. 2 = P. sp. 2 Howe and van den Bold, 1975; Sections 101-628A-6H-2 and 101-628A-3H-4.
Pterygocythereis sp.
Brachycythere sp.
Echinocythereis echinata (Sars, 1866).
Echinocythereis sp. I gr. *echinata*
Echinocythereis margaritifera (Brady, 1870) (see also Hazel, 1967, 1970).
Henryhowella sp.
Ambocythere spp.
Radimella sp. 1.
Radimella sp. 2.
Malzella sp.
Bradleya dictyon (Brady, 1880).
Poseidonamicus pintoi Benson, 1972.
Jugosocythereis spp. gr. *pannosa* (Brady, 1869).
Orionina sp.; Sections 101-628A-13H-3 and 101-628A-6H-1.
Caudites sp. 1; Sections 101-628A-13H-3 and 101-628A-8H-2.
Occultocythereis sp. 1
Neocaudites aff. *maccagnoi* (Ciampo, 1971) (see also Bonaduce et al., 1970).
Loxoconcha sp. 1
Loxoconcha fischeri (Brady, 1869).
Loxoconcha aff. *rugosa* van den Bold, 1946; Sections 101-628A-8H-5 and 101-628A-12H-03.
Paracytheridea aff. *byramensis* Howe and Law, 1936 (see also Hazel et al., 1980).

Paracytheridea sp. 1; Sections 101-628A-26X-2 and 101-628A-8H-6.
Paracytheridea sp. 2.
Cytherura cf. *wardensis* Howe and Brown, 1935 (in Valentine, 1974).
Cytherura cf. *hermesi* van den Bold, 1946; Sections 101-628A-8H-3 and 101-628A-6H-CC.
Hemicytherura sp.; Sections 101-628A-4H-4 and 101-628A-6H,CC.
Kangarina abyssicola (Müller, 1894) (see also Breman, 1976, van den Bold, 1963a, etc.)
Semicytherura sp. 1.
Cytheropteron trinidadensis van den Bold, 1960 = *Pelecocythere trinidadensis* (Pl. 1, Fig. 13).
Cytheropteron spp.
Xestoleberis sp.
Uroleberis sp.
Ornatoleberis sp.
Bythoceratina spp.
Pseudocythere sp.
Pellucistoma aff. *spurium* van den Bold, 1963a; Section 101-628A-11H-3.
Macrocypris sp.
Paracypris sp.
Argilloecia spp.

PLATES 1 THROUGH 6

All the illustrated valves or carapaces come from Hole 628A and, except for Pl. 2, Figs. 2 and 4, from intervals 50–52 cm; sections only are then indicated.

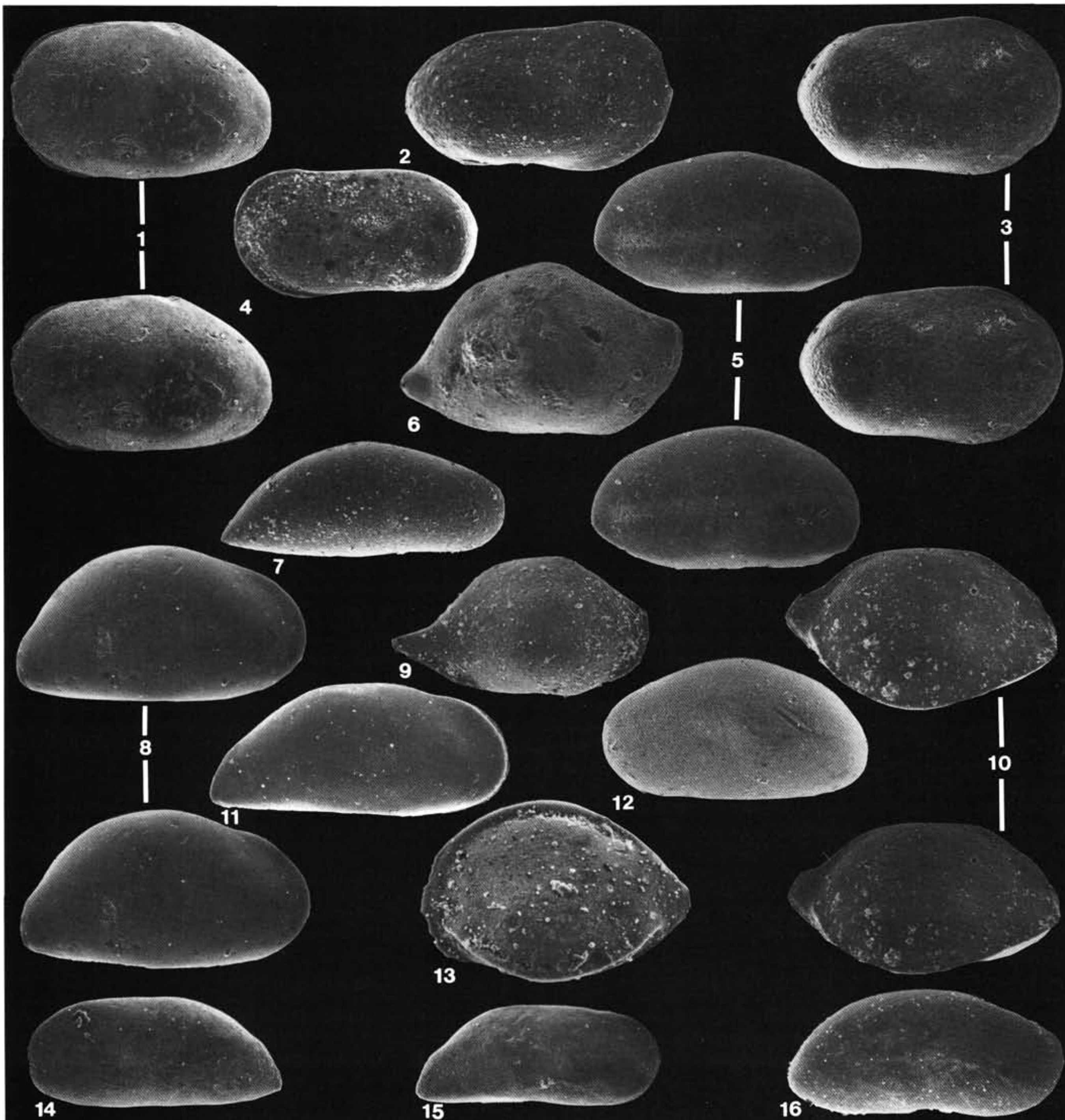

Plate 1. Oligocene ostracodes of Hole 628A, species belonging to common genera. **1.** *Cytherella* sp. 2 gr. *consueta*, L.V. ×47, Section 101-628A-24X-2. **2–3.** *Cytherella* sp. 1, R.V. ×63, Section 101-628A-27X-2. **4.** *Cytherella* sp. 3, L.V. ×55, Section 101-628A-19H-3. **5.** *Cardobairdia* gr. *ovata*, R.V. ×75, Section 101-628A-24X-1. **6.** *Paranesidea*? sp. 1, R.V. ×45, Section 101-628A-24X-2. **7.** *Macrocypris* sp., R.V. ×40, Section 101-628A-26X, CC. **8** and **11.** *Krithe* cf. *trinidadensis*, R.V. ♀ ×53, Section 101-628A-23X-4 and R.V. ♂ ×46, Section 101-628A-23X-4. **9.** *Paranesidea* cf. *cassida*, R.V. (larv.?) ×62, Section 101-628A-23X-5. **10.** *"Cytheropteron"* sp. 2, R.V. ×60, Section 101-628A-26X, CC. **12.** *Bythocypris*? sp., L.V. ×40, Section 101-628A-17H-3. **13.** *Pelecocythere trinidadensis* L.V. ×110, Section 101-628A-22X-3. **14–15.** *Krithe* cf. *hiwanneensis*, L. and R.V. (♂ ?) ×53, Section 101-628A-24X-1. **16.** *Bythocypris*? sp., R.V. ×48, Section 101-628A-27X-2.

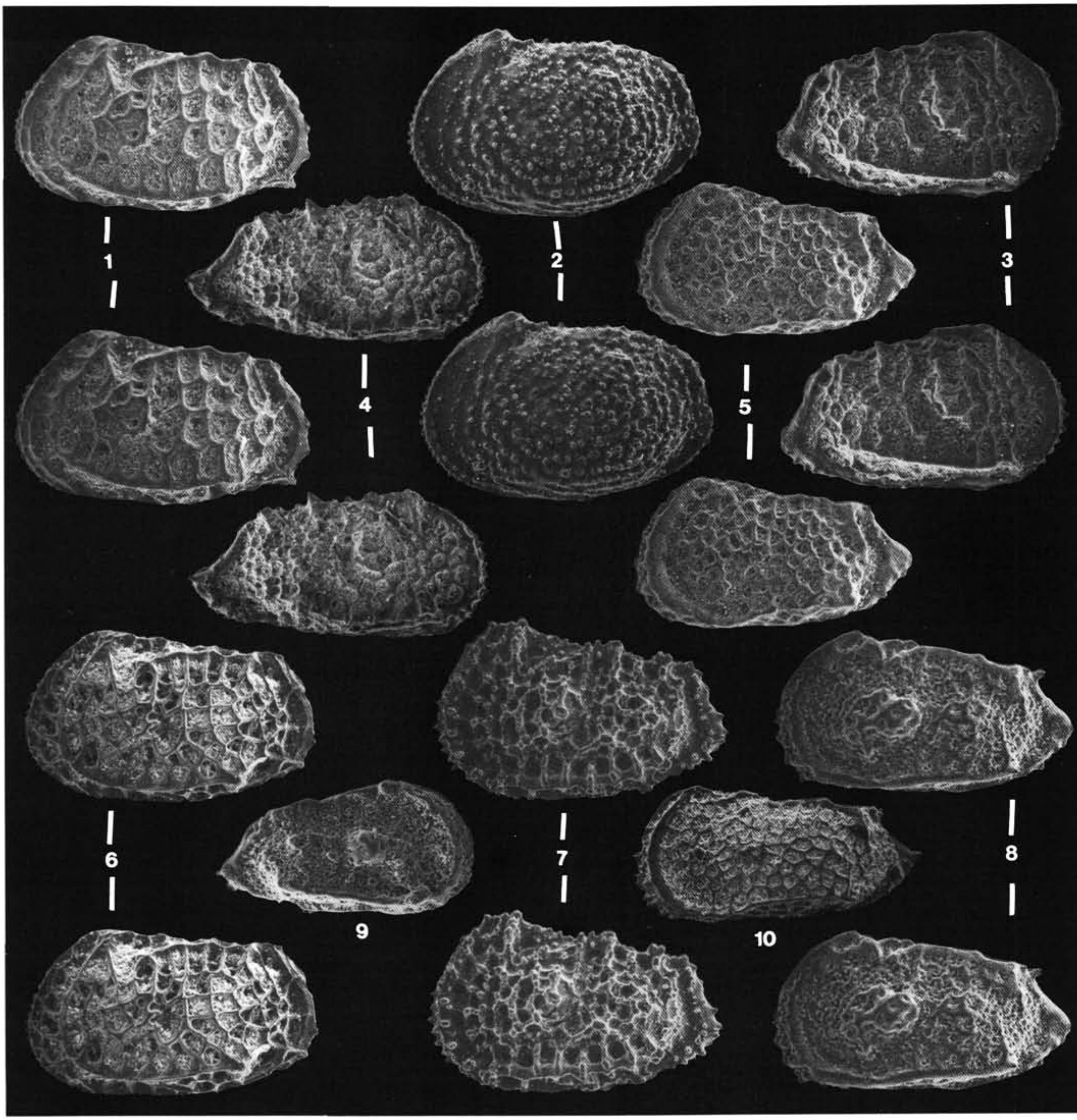

Plate 2. Cenozoic ostracodes (Trachyleberididae or Hemicytherididae) of Hole 628A, probably deep-sea species. **1.** *Bradleya* cf. *dictyon*, LV. (♀?) ×53, Section 101-628A-24X-2. **2.** *Echinocythereis* sp. 1, R.V. ×50, Sample 101-628A-26X-1, 70–72 cm. **3–4.** *Agrenocythere* cf. *gosnoldia*, larval R.V. ×63, Section 101-628-24X-2 and adult(?) R.V. ×35, Sample 101-628A-26X-1, 70–72 cm. **5.** *Trachyleberidea* sp. 1, L.V. (♀) ×55, Section 101-628A-24H-2. **6.** *Bradleya dictyon*, L.V. (♀?), ×50, Section 101-628A-8H-4. **7.** *Agrenocythere hazelae*, L.V. ×55, Section 101-628A-2H-6. **8.** *"Trachyleberidea" mammidentata*, L.V. ×65, Section 101-628A-3H-6. **9.** *Trachyleberidea* cf. *blanpiedi*, R.V. ×70, Section 101-628A-13H-3. **10.** *Trachyleberidea* sp. 1, L.V. (♂?) ×55, Section 101-628A-26X-1.

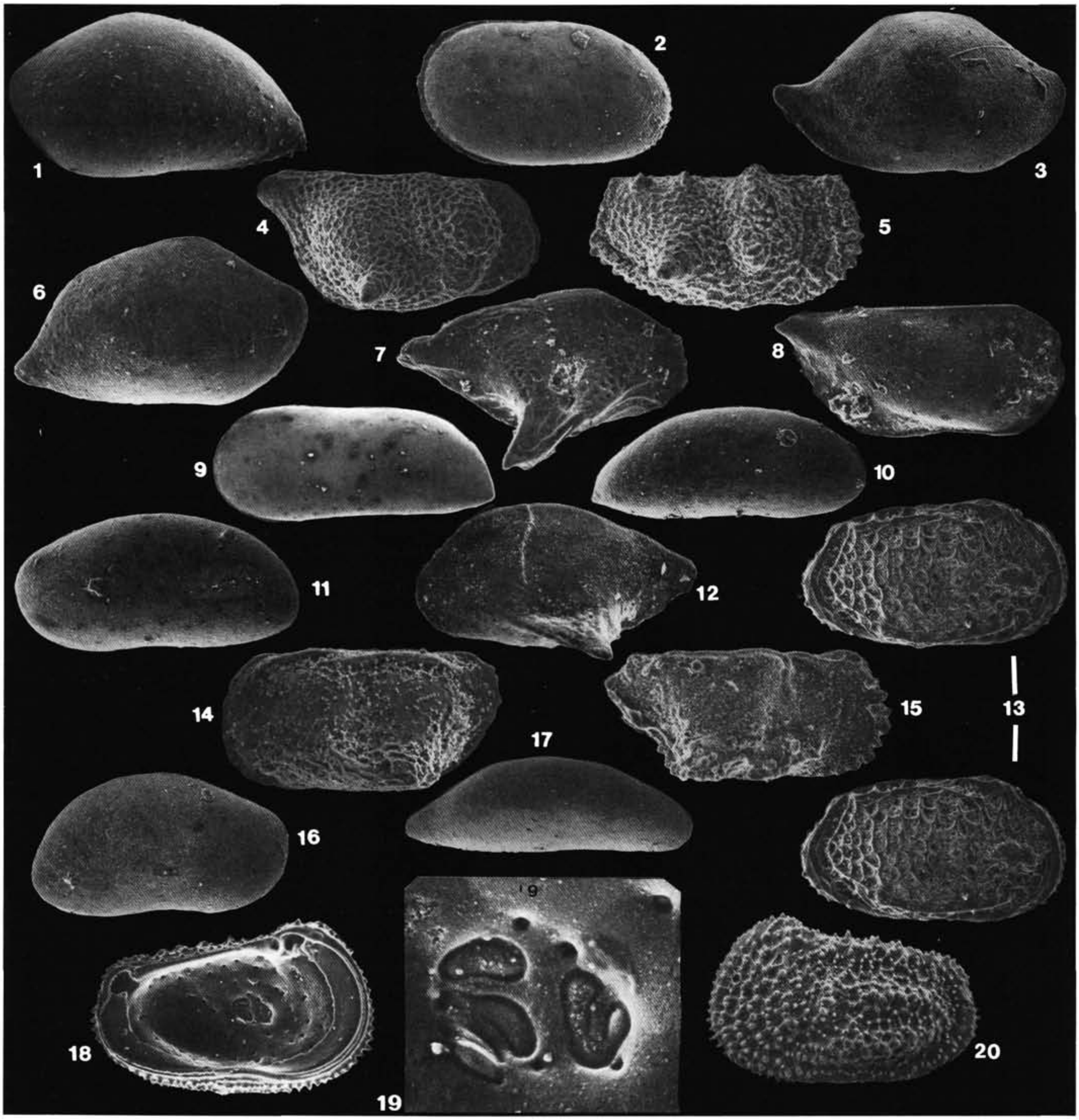

Plate 3. Neogene ostracodes of Hole 628A, probably deep-sea species. **1.** *Neonesidea*? *gerda*, L.V. (larv.?) ×100, Section 101-628A-12H-3. **2.** *Cytherella* gr. *consueta*, L.V. (♀?) ×55, Section 101-628A-15H-3. **3.** *Paranesidea*? sp. 2, R.V. ×38, Section 101-628A-24X-4. **4.** *Bythoceratina* sp. 5, R.V. ×63, Section 101-628A-3H-6. **5.** *Bythoceratina* sp. 2, R.V., broken posteriorly, ×55, Section 101-628A-4H-4. **6.** *Neonesidea*? *gerda*, R.V. ×70, Section 628A-2H-6. **7.** *Cytheropteron* sp. 4, R.V. ×125, Section 101-628A-6H-1. **8.** *Pseudocythere* sp. 2, R.V. (♀?) ×95, Section 101-628A-8H-7. **9.** *Krithe* sp. 2, L.V. (♂?) ×55, Section 101-628A-15H-3. **10.** *Cardobairdia* gr. *asymmetrica*, R.V. ×70, Section 101-628A-8H-6. **11.** *Bythocypris*? sp., L.V. ×50, Section 101-628A-12H-3. **12.** *Cytheropteron* sp. 3, L.V. ×115, Section 101-628A-8H-6. **13.** *Poseidonamicus pintoi*, R.V. ×50, Section 101-628A-4H-6. **14.** *Bythoceratina* sp. 1, L.V. ×100, Section 101-628A-8H-5. **15.** *Bythoceratina* sp. 3, R.V. ×105, Section 101-628-2H-6. **16.** *Bythocypris*? sp., R.V. ×50, Section 101-628A-3H-2. **17.** *Paracypris* sp., R.V. ×30, Section 101-628A-3H-2. **18–20.** *Henryhowella* cf. *evax*, int. and ext. view of a L.V. ×65, add. musc. ×200, Section 101-628A-5X-1.

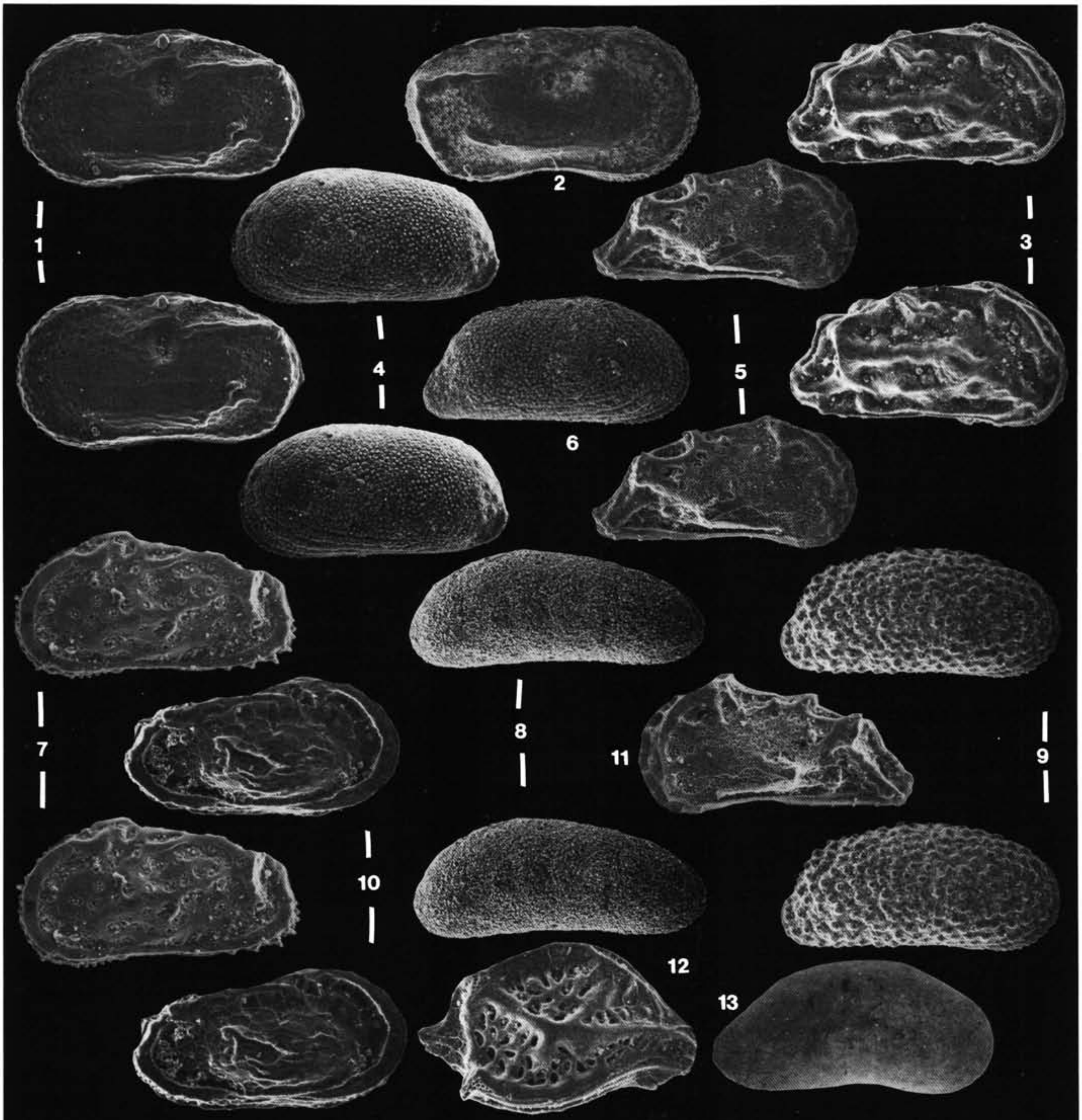

Plate 4. Neogene ostracodes of Hole 628A, probably neritic species (except 12 and 13). **1–2.** *Cytherelloidea* sp., L.V. ×80, Section 101-628A-2H-3 and R.V. ×75, Section 101-628A-2H-6. **3.** *Caudites* sp. 1., carapace ×80, Section 101-628A-13H-3. **4** and **6.** *Hulingsina*? sp. 1, L.V. ×80, Section 101-628A-6H, CC and R.V. ×85, Section 101-628A-6H-3. **5** and **11.** *Caudites* sp. 2, R. and L.V. ×80, Section 101-628A-6H, CC. **7.** *Neocaudites* aff. *maccagnoi*, L.V. ×95, Section 101-628A-11H-3. **8.** *Cushmanidea*? sp., R.V. ×85, Section 101-628A-2H-6. **9.** *Hulingsina* cf. *tuberculata*, R.V. ×95, Section 101-628A-6H, CC. **10.** *Occultocythereis*? sp. 1, carapace ×90, Section 101-628A-13H-3. **12.** *Kangarina abyssicola*, R.V. ×130, Section 101-628A-3H-5. **13.** *Bythocypris*? sp., R.V. ×35, Section 101-628A-2H-4.

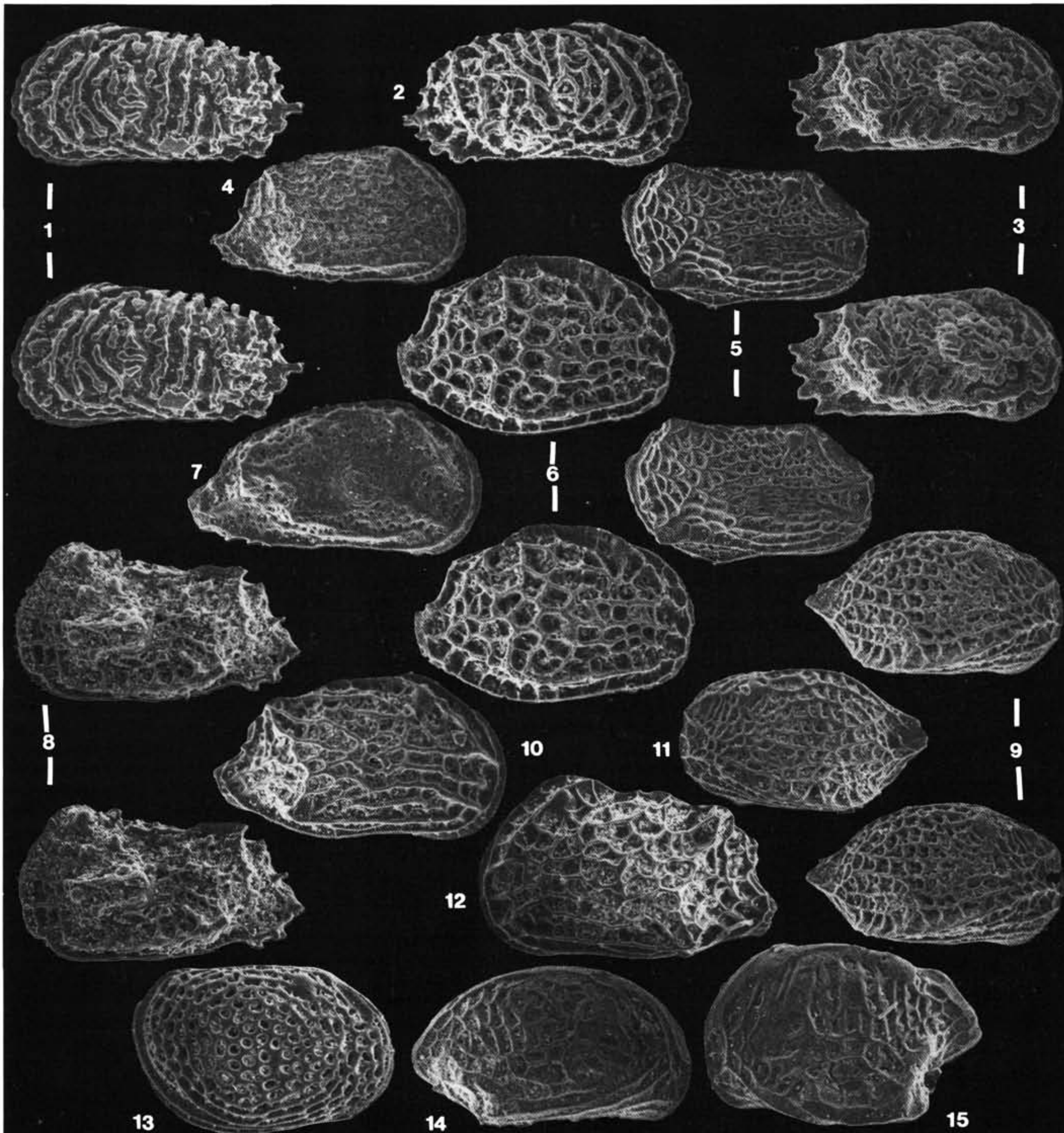

Plate 5. Neogene ostracodes of Hole 628A, probably neritic species. **1–2.** *Puriana* cf. *fissispinata*, L. and R.V. ×80, Section 101-628A-3H-5. **3.** *Puriana* cf. *convoluta*, R.V. ×75, Section 101-628A-5H-5. **4.** *Radimella* sp. 2, R.V. ×80, Section 101-628A-6H, CC. **5.** *Loxoconcha fischeri*, R.V. ×70, Section 101-628A-3H-5. **6.** *Malzella* sp., R.V. ×80, Section 101-628A-3H-5. **7.** Gen. sp., R.V. ×90, Section 101-628A-8H-5. **8.** *Jugosocythereis* sp. 2, L.V. ×70, Section 101-628A-4H-2. **9** and **11.** *Semicytherura* sp. 1, R.V. ×100 and L.V. ×90, Sections 101-628A-6H-2 and 101-628A-6H-1. **10** and **12.** *Radimella* sp. 1, R. and L.V. ×92, Section 101-628A-3H-3. **13.** *Loxoconcha* sp. 1, R.V. ×80, Section 101-628A-3H-5. **14–15.** *Gangamocytheridea* cf. *dictyon*, R.V. (♂ ?) ×115, Section 101-628A-13H-3 and L.V. (♀ ?) ×118, Section 101-628A-6H-2.

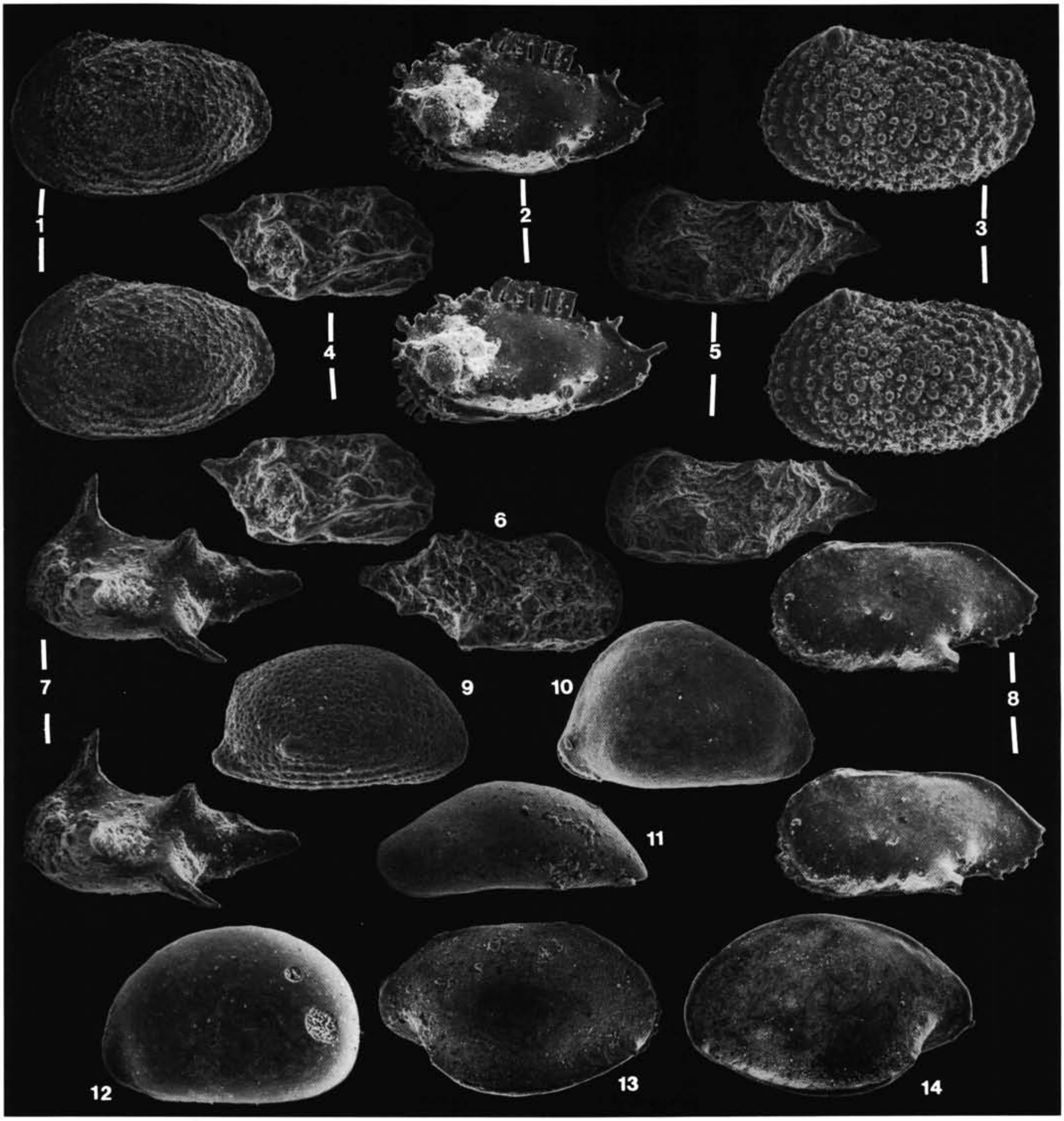

Plate 6. Neogene ostracodes of Hole 628A, neritic or deep-sea species. **1.** *Echinocythereis echinata*, L.V. ×50, Section 101-628A-3H-4. **2.** *Pterygocythereis* sp. 2, L.V. ×55, Section 101-628A-4H-2. **3.** *Echinocythereis margaritifera*, L.V. ×47, Section 101-628A-3H-2. **4.** *Paracytheridea*? sp., R.V. ×125, Section 101-628A-6H, CC. **5** and **6.** *Paracytheridea* aff. *byramensis*, L.V. (♂ ?) and R.V. (♀ ?) ×75, Section 101-628A-6H,CC. **7.** *Paracytheridea* sp. 2, L.V. ×80, Section 101-628A-8H-6. **8.** *Pterygocythereis* sp. 1, L.V. ×53, Section 101-628A-3H-3. **9.** *Ornatoleberis* sp., R.V. ×80, Section 101-628A-3H-5. **10.** *Uroleberis* sp., R.V. ×93, Section 101-628A-3H-1. **11.** *Paracypris*? sp., L.V. ×55, Section 101-628A-13H-3. **12.** *Xestoleberis* sp., V.D. ×90, Section 101-628A-3H-5. **13** and **14.** *Brachycythere* sp., R. and L.V. ×43, Section 101-628A-2H-3.