830. PLEISTOCENE OSTRACODA FROM THE ATSUMI PENINSULA,
CENTRAL JAPAN*

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Abstract. Pleistocene Ostracoda occur abundantly in an excellent state of preservation from the Akazawa Silt Member and the Takamatsu Shell Sand of the Toshima Sand Member, both of the Tahara Formation exposed along the Pacific coast of the Atsumi Peninsula, central Japan. The ostracod assemblage found in the Akazawa Silt Member consists of embayment dwellers with a low species diversity. This assemblage is mixed with Zostera sand dwellers in the lower and middle parts of the Akazawa Silt Member. Ostracods are scanty in its upper part. The Takamatsu Shell Sand contains in its lower half a silty-bottom dweller assemblage with a low species diversity and in its upper half a mixture of offshore-sand, nearshore-sand and mud dweller assemblages with a very high species diversity. Ostracods are represented by 101 species belonging to 55 genera. Among them there proposed are one new genus, eight new species and 14 species in open nomenclature.

Introduction

Pleistocene strata, over 80 m thick, crop out along the Pacific coast of the Atsumi Peninsula, central Japan. They extend for about 50 km from Hamana-ko Lake (east end) to the Irako Cape (west end) (Figure 1). The strata dip very gently westward. Coastal cliff exposures enable us to trace lateral change of sedimentary facies over several kilometers. The Pleistocene strata (the Atsumi Group of Figure 2) directly overlie the so-called Chichibu System (Paleozoic blocks of various size embedded in Mesozoic sediments) and can be divided into the Tahara and Toyohashi Formations in ascending order. Abundant fossils of molluscs, ostracods and barnacles are well preserved in the Akazawa Silt Member and the the Takamatsu Shell Sand of the Toshima Sand Member, both of the Tahara Formation which are exposed in the Akazawa, Takamatsu, and Akabane areas (Figure 1).

Nannofossils indicate a Pleistocene age (N. Okada, personal communication, 1983). But the exact age of these strata is ambiguous because of the absence of a good age-indicator for assigning them to the subdivision of the Pleistocene. Correlating terrace deposits along the Pacific Coast of the Honshu Island is most helpful in determining the age of the Tahara Formation. An early Pleistocene age has been assigned to the Atsumi Group (Tsuchi, 1960).

The description of five new molluscan species from the Akazawa area by Yokoyama (1926) was the beginning of paleontological studies of the Atsumi area. He believed that the age of the formation is Pliocene based upon these molluscs. Oinnomikado (1933) distinguished Ostrea Bed and Corbicula Bed in the Akazawa Silt Member and Batillaria Bed, Dosinia Bed, Mya Bed, and Tonna Bed in ascending order in the Takamatsu Shell Sand. He concluded that the age of the formation is Pleistocene and that these molluscs belong to the Kuroshio (warm current) fauna. Hayasaka's (1961, 1962) work on the geology and paleontology of the Atsumi Peninsula was the most extensive in terms of the area covered and of giving a superb observation of sedimentary struc-
tures. Kuroda’s (1966, 1967) work on plant leaves provided additional knowledge on glacial and interglacial climatic changes of land area. A recent study by Honda (1975 MS) presented a good summary of the stratigraphy. Although opinions differ slightly among various authors with regard to stratigraphic assignment of terrace deposits, the overall stratigraphy of the Atsumi Group was established already by Kuroda and Honda. Furthermore, most of the molluscan fossils from the peninsula have also been described by Hayasaka (1961). However, ostracods of the Atsumi Group have not yet been described in spite of their abundant occurrence and excellent state of preservation. This study gives a full picture of warm-water ostracods that lived in a near-shore area influenced directly or indirectly by the Kuroshio Current flowing along the Pacific coast during the Pleistocene.

I am much indebted to Drs. Tetsuro Hanai and Itaru Hayami of the University of Tokyo, Dr. Noriyuki Ikeya of Shizuoka University, Dr. Kiyotaka Chinzei of the University of Kyoto, and Dr. Toshiyuki Yamaguchi of Chiba University and to Mr. Hiromi Honda of JAPEX for their advice during my field as well as laboratory work. Dr. Paul Frydl read and improved the manuscript, and I am thankful for his assistance.
Field observation

The following observations on lithofacies and molluscan biofacies clarify the environmental setting of the fossil ostracod assemblages.

1. Akazawa Silt Member

The Akazawa Silt Member is distributed from Shiroshita eastward to Hamana-ko Lake (Figures 1 and 3). Deposition begins with a cobble layer about 50 cm thick, which is characterized by flat pebbles and cobbles of limestone and chert. The boundary between the basal Ikobe Member and the Akazawa Silt Member is not exposed. The Ostrea Bed reported by Oinomikado (1933) and Hayasaka (1960) from Akazawa is now covered by coastal sand deposits.

The Akazawa Silt Member grades upward from the pebble-cobble bed to a micaceous, fine-sandy silt bed. The bed is 2 meters thick and contains besides pebbles and granules, aggregations of Corbicula japonica Prime. The bed probably corresponds to the Corbicula Bed of Oinomikado (1933). Associated molluscs are authochthonous, preserved in living position. Mya arenaria Linnaeus with their long-axis arranged vertically are often distributed at uniform intervals on one bedding plane, whereas Dosinia angulosa Philippi occurs sporadically. Abundant, partially interconnected burrows about 30 cm in length, penetrate nearly vertically into the bed. Since modern Corbicula japonica lives in lagoons, estuaries, and other brackish water environments, these Corbicula shells were probably transported together with pebbles from a brackish water environment to the shallow sandy silt bottom inhabited by Mya arenaria.

The upper part of the lower half of the Akazawa Silt Member consists of a sandy silt dominated by Dosinia angulosa, Raeta pulchera, Mya arenaria, and Corbicula japonica which occurs in an appreciably amount. Most of these molluscs appear to have been transported only for a short distance.

The upper part of the Akazawa Silt Member consists of a thick silt or clay layer of about 10 m in thickness. Raeta pulchella and Dosinia angulosa occur in a massive bluish gray micaceous silt with plant fragments. A laterally continuous, 10 cm thick pinky white tuffaceous band is present in the lower 1 or 2 meter level of the silt.

The Akazawa Silt Member consists of trans-
gressive deposits in its lower half and of stabilized embayment sediments in its upper half.

2. Takamatsu Shell Sand in the Toshima Sand Member

The Toshima Sand Member consists in general of shallow water sand. Well-developed cross lamination observable in the Higashikanbe area suggests deltaic deposition (Figure 2). The distribution of silty sediment is restricted to the Takamatsu and Ura areas. In the Takamatsu area, a lenticular body of silt of about 10 m in thickness and containing abundant molluscan fossils is traceable for more than 1 km along the coastal cliffs (Figure 4). Hayasaka (1961, 1962) named this sediment body the Takamatsu Shell Sand. Oinomikado (1933) distinguished four shell beds in this unit. The lowest Batillaria Bed is no longer exposed.

The lower Dosinia Bed, 1.2 m thick, consists of a silt with abundant burrows and is characterized by autochthonous assemblages of Dosinia angulosa and Barnea japonica. The silt is pierced by abundant, near-vertical branched burrows, reaching 2 cm in diameter and 30 cm in length.

The middle Mya Bed, 20 cm thick, consists of a sand and is packed densely with molluscs mostly transported from nearby areas. Mya arenaria dominates and some of the specimens still keep their living position.

The upper Tonna Bed, 2m to 6m thick, consists of a bluish gray micaceous silt with abundant molluscs and barnacles scattered throughout the bed. The fossil assemblage is dominated by Tonna luteostoma, Fulvia mutica, Solen grandis, and Balanus rosa. Although no appreciable vertical or horizontal variation in the number of species present exists, Solen grandis dominates the middle part and Tonna luteostoma and Fulvia mutica are most abundant in the upper part rather than the lower part of the Tonna Bed.

Analysis of sedimentary facies and molluscan and barnacle fossil assemblages suggests that early deposition of the Takamatsu Shell Sand took place in an embayment. Later, the embayment became open towards the off-shore and open coastal water deposition prevailed.

Figure 3. Stratigraphic succession at Akazawa. Large numerals represent locality numbers. Small numerals represent sample numbers. A: silt to clay, B: sandy silt, C: sand with gravel, D: tuff layer, E: ostracod sampling position, F: ostracods absent.
Ostracod fauna

Ostracods occur in the Akazawa Silt Member and in the Takamatsu Shell Sand of the Toshima Sand Member. Sediments containing ostracods are all mud-rich. The Terasawa Sandy Silt Member of the Toyohashi Formation is also high in mud content, but no ostracods have so far been recorded from the formation.

Sampling was designed in such a way as to elucidate horizontal and vertical changes of ostracod assemblages in the sediment. The following four assemblages were distinguished:

A: *Bicornucythere bisanensis*—*Aurila subconvexa* assemblage in the lower Akazawa Silt Member (*Corbicula Bed*)

B: *Bicornucythere bisanensis* assemblage in the upper Akazawa Silt Member (*Dosinia Bed*)

C: *Bicornucythere bisanensis*—*Neomonocera tina microreticulata* assemblage in the lower Takamatsu Shell Sand (*Dosinia Bed*)

D: *Pistocythereis bradyformis*—*Bythocythere ishizakii* assemblage in the middle and upper Takamatsu Shell Sand (*Mya Bed and Tonna Bed*)

A: *Bicornucythere bisanensis*—*Aurila subconvexa* assemblage

Samples obtained from the lower *Corbicula* Bed exposed along the cliff from locs. 16 to 30 were examined (Figure 3). No ostracods were found in samples from locs. 16, 17, 29, and 30. In general, ostracods are common in samples 1801, 1902, 2003, 2101, 2303, 2402, 2603, 2605, and 2801 except for sample 2605 (Table 1). Rarity of ostracods in sample 2605 seems to be a result of poor preservation state. No appreciable lateral change of combination of species is detectable throughout. This assemblage is characterized by the dominant occurrence of a mud dweller *Bicornucythere bisanensis* and by a low species diversity. A *Zostera* sand dweller, *Aurila subconvexa* is abundant and represented exclusively by adult specimens. The number of individuals of *A. subconvexa* exceeds that of *B. bisanensis* in sample 1801, and equals *B. bisa-
Table 1. Ostracoda from the Akazawa Silt. Sample number consists of four digits. The first two digits indicate the sampling locality, and the next two digits indicate the sample number in a descending sampling order.

<table>
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<th>2003</th>
<th>2101</th>
<th>2303</th>
<th>2402</th>
<th>2603</th>
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</table>

nensis in samples 1902, 2101, 2303, 2603, and 2605. Because all the species other than *A. subconvexa* are represented by both adult and immature specimens, selective transport of carapaces is the most likely cause of the occurrence of only adult carapaces of *A. subconvexa*. The *Zosteria* zone was probably located near a site of mud deposition. Associated species consist of mud dwellers, such as *Spinileberis quadriaculeata* (common), *Cytheromorpha acupunctata* (rare), and *Neomonoconarata micoreticulata* (only in sample 2003), sandy mud dwellers, such as *Trachyleberis scabrocuneata* and *T. sp.* (rare), and sand dwellers, such as *Loxoconcha tosaensis*, *Pontocythere japonica*, and *Parakrithella pseudadonta* (very rare).

*Bicornucythere bisanensis* and perhaps other mud dwellers are likely to be autochthonous, and other species are derived form nearby sites. In spite of the abundant occurrence of brackish water *Corbicula*, no brackish water ostracods have so far been found in the Akazawa Silt Member.

B. *Bicornucythere bisanensis* assemblage

A massive silt bed characterized by the occurrence of *Dosinia angulosa* and *Raeta pulchella* is exposed from loc. 15 eastwards to Hamana-ko Lake (Figure 3). Ostracods occur rarely in samples 2501 and 2701 (Table 1). No ostracods were found in samples 1501, 1502, 1901, 2301, 2401, 2601, and 2602. In general, ostracods are very rare in this silt bed. The only species found in abundance is *Bicornucythere bisanensis*. Species diversity is low. Other mud dwellers, *Spinileberis quadriaculeata* and *Cytheromorpha acupunctata*, occur very rarely. Other extremely rare species include *Trachyleberis scabrocuneata* derived from sandy mud bottom and *Loxoconcha tosaensis* from sand bottom of nearby areas.

Ostracod fauna endorses my field observations that the embayment become stabilized during deposition of the upper part of the Akazawa Silt Member.

C. *Bicornucythere bisanensis*–*Neomonoconarata micoreticulata* assemblage

Ostracods occur commonly form the *Dosinia* Bed of the Takamatsu Shell Sand extending over a distance of 700 m from loc. 1 to loc. 14 along the sea cliff (Figure 4 and Table 2). Species diversity of the assemblage is low except for samples 0302, 0402, 0803, and 1112. Among samples yielding high species diversity assemblages, samples 0302 and 0402 are a shell sand picked from
Table 2. Ostracoda from the Takamatsu Dosinia Bed.

<table>
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<td>Hanacrocythere nipponica, n. gen. et n. sp.</td>
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<td>159</td>
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<td>78</td>
<td>273</td>
<td>108</td>
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<td>159</td>
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the inside of burrows. Shallow water mud dwellers, Bicornechthys bisanensis and Neomonoceratina microreticulata, dominate the assemblage of low species diversity. Other mud bottom dwellers, Spinileberis quadriaculata and S. furu-yenensis, are rare and Cytheromorpha acupunctata has not yet been found. Rare species transported from nearby environments, probably after death, include sandy silt dwellers (Trachyleberis scabrocuneata and Pistoeythereis bradyformis), Zostera sand dwellers (Loxoconcha optima, L. uranouchiensis, Aurila subconvexa and A. uranouchiensis), and sand bottom dwellers (Pontoctythere spp., Callistocythere reticulata and Cythere omotenipponica). Very fragile, thin carapaces of intertidal species (Xestoleberis spp., Paradoxostoma spp., Cythereis sp., and Paracytheroma sp.) occur rarely but they are well preserved. Species composition seems uniform throughout the Dosinia Bed of the Takamatsu Shell Sand.

A bed equivalent to the Dosinia Bed is also exposed in the Ura area on the northern coast of the Atsumi Peninsula (loc. 31). Sediments consist of a bluish gray micaceous sandy silt, characterized by autochthonous Mya arenaria. The ostracod assemblage (sample 3101) is also dominated by Bicornechthys bisanensis and Neomonoceratina microreticulata.

D. Pistoeythereis bradyformis—Bythocythere ishizakii assemblage

Ostracods of a very high species diversity occur in the Mya Bed and Tonna Bed of the Takamatsu Shell Sand (Figure 4 and Tables 3, 4). The assemblage is dominated by a sandy silt dweller, Pistoeythereis bradyformis and is admixed with species from many different habitats as follows (cf. Hanai et al., 1977):


Shallow water sand dwellers: Pontoctythere japonica, P. miurensis, P. subjaponica, Callisto-

cythere reticulata, and Cythere omotenipponica.

Shallow water sandy silt dwellers: Pistoeythereis bradyformis (dominant), Trachyleberis scabrocuneata, T. sp., and Acanthocythereis? nitsumai.

Shallow water mud dwellers: Bicornechthys bisanensis, Neomonoceratina microreticulata and Spinileberis quadriaculata.

A species group of Anchistrocheles is newly described. Similar species were reported from subtropical, relatively deep water of the Indo-Pacific Oceans (Maddocks, 1969). Translucent, fragile carapaces of Paradoxostoma and Cythereis occur abundantly in an excellent state of preservation.

At loc. 11, samples were taken at vertical intervals of 50 cm to detect any vertical change in species composition. The following vertical changes were observed: In the Mya Bed, Pistoeythereis bradyformis, Bicornechthys bisanensis, and Neomonoceratina microreticulata dominate; Pistoeythereis bradyformis and Bythocythere ishizakii dominate in the lower part of the Tonna Bed; Pistoeythereis bradyformis and Loxoconcha optima dominate the middle part; and Pontoctythere subjaponica, P. miurensis, and P. japonica dominate the upper part. The vertical change in species composition results from a gradual increase of off-shore species in the assemblage.

A comparison of ostracod assemblage of the Takamatsu Shell Sand with those of F and G Members of the Kioroshi Formation, Boso Peninsula (Yajima, 1978), allows us to make the following two preliminary deductions concerning environments of ostracods living at the time of deposition of each bed.

1. The Dosinia Bed of the Takamatsu Shell Sand and F Member of the Kioroshi Formation both contain Bicornechthys bisanensis. However, the difference of associated species, Neomonoceratina microreticulata in the Takamatsu Shell Sand and Spinileberis quadriaculata and Cytheromorpha acupunctata in F Member of the Kioroshi Formation is indicative of a slight difference of environment. The former is interpreted to be a little closer to the bay mouth than the latter (cf. Ikeya and Hanai, 1982).
<table>
<thead>
<tr>
<th>Species</th>
<th>Sample number</th>
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<tbody>
<tr>
<td>Cytheluroidea munechiakai Ishizaki</td>
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<tr>
<td>Neonesidea hanaii, n. sp.</td>
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<tr>
<td>Anchistrecha elegansagrichii, n. sp.</td>
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<tr>
<td>Protopontocypris sp.</td>
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<tr>
<td>Neocytherididae aoi Yajima</td>
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<tr>
<td>Pontocythere japonica (Hani)</td>
<td></td>
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<tr>
<td>P. miyamori (Hani)</td>
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<tr>
<td>P. japonica (Hani)</td>
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<td>Munseyella japonica (Hani)</td>
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<td>Callistocythere reticulata Hanai</td>
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<tr>
<td>Cythere emomotipponica Hanai</td>
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<tr>
<td>Neomonoceratina microreticulata Kingma</td>
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<tr>
<td>Trachyleberis scabrocuta (Brady)</td>
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<tr>
<td>T. sp.</td>
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<tr>
<td>Acanthocytherei niitumai (Ishizaki)</td>
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<tr>
<td>Sinoeleberis tosaensis (Ishizaki)</td>
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<td>Plsotocythere bradyformis (Ishizaki)</td>
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<td>Eucythere bisansensis (Oktuba)</td>
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<td>Australoesele tomohoe (Ishizaki)</td>
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<td>Aurila subconica (Kajiyama)</td>
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<td>A. uranouchiensis Ishizaki</td>
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<td>Robustaurila ichikawai (Oktuba)</td>
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<td>Cornuoquimbata tosaensis (Ishizaki)</td>
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<td>Bythocythere ishikawii, n. sp.</td>
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<tr>
<td>B. matsukauxi Ikeya and Hanai</td>
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<td>Pseudocytherey fukidai Yajima</td>
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<td>Hemicytherea cuneata Hanai</td>
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<td>Paracythere boseniae (Oktuba)</td>
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<td>Loxoconcha optima Ishizaki</td>
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<td>L. uranouchiensis Ishizaki</td>
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<td>Nipponocythere bicarinata (Brady)</td>
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<td>Paradoxostoma elongatum Okubo</td>
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<td>Cythereis zosterae Schornikov</td>
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Table 4. Ostracoda from the Takamatsu Mya and Tonna Beds 2. Species occurred in fewer than 10 samples are listed. The list is arranged in three columns from left to right: species name, number of total individuals, and sample number and number of individuals from each sample in parentheses.

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<th>Species name</th>
<th>No. of total indiv.</th>
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<td>C. undata Hanai, 1957</td>
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<td>3, 1104 (1), 1107 (2)</td>
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<td>C. undulatifacialis Hanai, 1957</td>
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<td>C. sp. Schizocythere kishinouyei (Kajiyama, 1913)</td>
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<td>Hanaiborchella miurensis (Hanai, 1970)</td>
<td>8</td>
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<td>H. triangularis (Hanai, 1970)</td>
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<td>Spinileberis quadriaculeata (Brady, 1880)</td>
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<td>Actinocythereis kisarazuensis Yajima, 1978</td>
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<td>Pseudaurilia japonica (Ishizaki, 1968)</td>
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<td>Ambostacon ikeyai Yajima, 1978</td>
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<td>Cornucomiema rugosa Ikeya and Hanai, 1982</td>
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<td>Coquimba poga Hu, 1986</td>
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<td>Bythocythere alata, n. sp.</td>
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<td>Bythoceratina hanai Ishizaki, 1968</td>
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<td>P. sp. 2</td>
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<td>Hemicytherura tricarinata Hanai, 1957</td>
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<td>Semicytherura henryhousei Hanai and Ikeya, 1977</td>
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<td>S. tetragona (Hanai, 1957)</td>
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<td>9, 0601 (1), 0701 (1), 0901 (2), 1001 (1), 1101 (1), 1103 (1), 1107 (1), 1301 (1)</td>
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2. The Tonna Bed and Mya Bed of the Takamatsu Shell Sand and G Member of the Kioroshi Formation have certain species of Pontocythere, Loxoconcha and Aurila in common. However, among the associated species, Pistocythereis bradyformis and Bythocythere maisakensis dominate the Takamatsu Shell Sand, whereas Hemicytherura tricarinata and Callistocythere alata dominate G Member of the Kioroshi Formation. In addition to this difference of associated species, the occurrence of a relatively deep-water species of Cytherelloidea munechikai and Indo-Pacific tropical water species of Anchistrocheles suggests that the assemblage in the Takamatsu Shell Sand inhabited deeper and warmer waters than that of G Member.

**Systematic paleontology**

New species, species in open nomenclature, and some species with remarks if necessary, are described. In the case of species in open nomenclature, only remarks are given and description is omitted because of the lack of sufficient number of specimens to describe.

All the types and illustrated specimens are deposited in the collection of the University Museum, University of Tokyo (UMUT). Specimen numbers are prefixed with CA which stands for the Cenozoic Arthropoda.

The following abbreviations are used in the systematic section:
Sp: specimens measured (LV, RV, C, A-1 —

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<td>11</td>
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</table>
Michiko YAJIMA

A-5, for left valve, right valve, carapace, instar of adult minus one stage — minus five stage

Sa: sample number  
Me: measurements (L, H, W, for length, height, width)  
N: number of observations  
X: arithmetic mean (mm)  
Sd: standard deviation (mm)  
V: coefficient of variability  
OR: observed range (mm)

Subclass OSTRACODA Latreille, 1806
Order PODOCOPIDA Sars, 1866
Superfamily BAIRDIAECA Sars, 1888
Family Bairdiidae Sars, 1888
Subfamily Bairdiinae Sars, 1888
Genus Neonesidea Maddocks, 1969
Neonesidea hanaii, n. sp.
Figures 5-1—2, 11-1a, b, 2a, b.

Types:—Holotype, a left valve, UMMUT-CA 17979 (Figures 11-1a, b; Figures 5-1; L 0.745, H 0.413), from sample 1103, Takamatsu Tonna Bed. Illustrated specimens, a right valve, UMMUT-CA 17980 (Figures 11-2a, b; Figure 5-2; L 0.707, H 0.371) from sample 0802, Takamatsu Mya Bed.

Diagnosis:—Neonesidea with slender outline and muscle scars consisting of upper two, middle four, and lower two scars. Posterior scar in upper row long.

Description:—A trapezoidal carapace with broadly rounded anteroventral margin in left valve, and obliquely rounded with narrow dentate frill in right valve. Posterior margin more acutely projected than anterior margin. Dorsal margin generally rounded in left valve, and convexed in right valve. Ventral margin a little situated at middle in left valve and at anterior third in right valve. Left valve overlapping right valve. Surface smooth.

Marginal infold broad along anteroventral and posteroventral margins. Vestibule broad along anteroventral and posteroventral margins also.

Hinge lophodont. Muscle scars consisting of three horizontal rows of eight zigzag scars. The posterior scar of the upper row, long and overhung on anterior one. Two very small scars being anterior to central muscle scars.

Normal pores numerous and simple. Radial pore canals some, simple and short along posterior or margin. No eye tubercles on outer surface.

Dimensions:—Measurements of some pooled specimens of the Takamatsu Tonna Bed are as follows.

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<th>Sp</th>
<th>Sa</th>
<th>N</th>
<th>Me</th>
<th>OR</th>
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<tr>
<td>LV</td>
<td>0601</td>
<td>1</td>
<td>L</td>
<td>0.850</td>
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<td>0.466</td>
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<tr>
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<td>1</td>
<td>L</td>
<td>0.857</td>
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<td>0.430</td>
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<td>RV(A-1)</td>
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<td>0.415</td>
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<td>LV(A-1)</td>
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<td>L</td>
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<td>1</td>
<td>L</td>
<td>0.707</td>
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<tr>
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<td>0.398</td>
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<tr>
<td>RV(A-2)</td>
<td>2</td>
<td>L</td>
<td>0.538—0.550</td>
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<td>0.278—0.294</td>
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<tr>
<td>LV(A-3)</td>
<td>2</td>
<td>L</td>
<td>0.364—0.369</td>
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<td>0.200—0.205</td>
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Remarks:—As to the genus Neonesidea, only two species, N. oligodentata (Kajiyama, 1913) and N. mitsuensis (Ishizaki, 1971) have hitherto been reported although there are many different forms of Neonesidea in Recent and fossil sediments in Japan. One species in open nomenclature, Bairdia sp. was reported from the Setonai-kai (Recent) by Okubo (1975). N. hanaii, n. sp. is similar to Bairdia sp. in lateral outline and carapace size, but B. sp. was described so briefly that I could not identify N. hanaii with B. sp.

Occurrence:—Common in the Takamatsu Mya and Tonna Beds.

Subfamily Bythocypridinae Maddocks, 1969
Genus Anchistrocheles Brady and Norman, 1889
Anchistrocheles hondai, n. sp.
Figures 5-6, 11-5a, b.
Types:—Holotype, a right valve, UMMT-CA 17981 (Figures 5–6; Figures 11-5a, b; L 0.652, H 0.350), from sample 0501, Takamatsu Tonna Bed.

Diagnosis:—Anchistrocheles with three spines along anterior margin and seven small spines along posterior margin. Surface generally pitted with large punctations.

Description:—Carapace small, flat and trapezoidal. Anterodorsal margin broadly rounded. Anteroventral angle narrow with three spines. Posterodorsal margin truncated. Posteroventral margin broadly and obliquely rounded with seven small spines. Dorsal margin straight and a little bent toward anterior. Ventral margin deeplly sinuated at anterior third, but generally parallel to dorsal margin. Surface pitted with many large punctations.

Anterior inner margin running obliquely toward ventral inner margin. Vestibule broad anteroventrally and narrow posteroventrally. Line of concrescence parallel to anterior and posteroventral outer margins. Hingement lophodont. Muscle scars consisting of three rows of four large ones. Anterior one of four muscle scars longitudinal and posterior one vertical.

Figure 5. Internal views. Left row (odd number): left valves; right row (even number): right valves. x84. 1, 2. Neonesidea hanaii, n. sp. 1, holotype, CA 17979, sample 1103, Takamatsu Tonna Bed. 2, CA 17980, sample 0802, Takamatsu Mya Bed. 3, 4. Anchistrocheles yamaguchii, n. sp. 3, holotype, CA 17982. 4, CA 17983, sample 0602, Takamatsu Mya Bed. 5. Bythocystere angulata, n. sp., holotype, CA 17996, sample 1105, Takamatsu Tonna Bed. 6. Anchistrocheles hodai, n. sp., holotype, CA 17981, sample 0501, Takamatsu Tonna Bed.
Radial pore canals a few and straight. Normal pores simple. No eye tubercles.

**Dimensions:**—See *Types* and *Occurrences*.

**Remarks:**—This species is similar to *Anchistrocheles antemacella* Maddocks, 1969 from New Zealand in lateral outline and muscle scar pattern, but differs largely in armorment along the anteroventral and posteroventral margins. The marginal infold of *A. hondai* is narrower than that of *A. antemacella*. *A. hondai* is similar to *Bairdia* sp. aff. *angulata* Brady, 1870 from Australia reported by McKenzie (1974) in lateral outline and surface ornamentation, but *A. hondai* is flatter than *B. sp. aff. angulata*.

**Occurrence:**—There are only two specimens. One is the holotype and the other is a juvenile broken right valve (L 0.434, H 0.229) from sample 114, Takamatsu *Tonna* Bed.

*Anchistrocheles yamaguchi*, n. sp.

Figures 5-3, 4, 11-3a, b, 4a, b.

**Types:**—Holotype, a left valve, UMIT-CA 17982 (Figures 11-4a, b; Figure 5-3; L 0.743, H 0.376), from sample 0602, Takamatsu *Mya* Bed. Illustrated specimens, a broken right valve, UMIT-CA 17983 (Figures 11-3a, b; Figure 5-4; L 0.735, H 0.371), from the same sample as holotype.

**Diagnosis:**—A large *Anchistrocheles* with smooth surface. Anterior and posteroventral vestibules deep. Line of concrescence parallel to anterior and posteroventral margins.


Anterior and posteroventral inner margins parallel to outer margin. Anterior and posteroventral vestibules broad. Hingement lophodont with crenulated median element in left valve. Muscle scars consisting of four large scars.

Normal pores simple, many, and evenly distributed. Radial pore canals obscure in most specimens, but in a few specimens, short, straight and evenly spaced along anteroventral margin. No eye tubercles.

**Dimensions:**—Measurements of specimens from sample 0602, Takamatsu *Mya* Bed, are given below.

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<td>H</td>
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<td>RV</td>
<td>1</td>
<td>L</td>
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<td>L</td>
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<td>W</td>
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<td></td>
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<tr>
<td>RV(A-1)</td>
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<td>L</td>
<td>0.711</td>
<td>0.681-0.712</td>
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<td>H</td>
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<td>H</td>
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<td>H</td>
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**Remarks:**—This species is similar to *Anchistrocheles bradyi* Scott, 1905 reported form Nosy Be by Maddocks, 1969 in lateral outline and muscle scar pattern but anteroventral and posterior vestibules are not distinct in *A. yamaguchi*.

**Occurrence:**—Abundant in sample 0602, Takamatsu *Mya* Bed. Rare in all Takamatsu Shell Beds.

Superfamily CYPRIDACEA Baird, 1845
Family Paracyprididae Sars, 1923
Genus *Paracypris* Sars, 1866

*Paracypris?* sp.

Figures 6-2, 3.

Illustrated specimens:—A left valve, UMUT-CA 17984 (Figure 6-2; L 0.588, H 0.242), from sample 1203, Takamatsu *Mya* Bed, and a right valve, UMUT-CA 17985 (Figure 6-3; L 0.485, H 0.227), from sample 1109, Takamatsu *Tonna* Bed.

Remarks:—This species is similar to *Paracypris* sp. described by Yajima (1982, p. 183, 185, pl. 15, fig. 6, text-fig. 13-1) in lateral outline and in the shape of inner margin, but this species is short and small with a more arched ventral margin. Five adductor muscle scars are observed. Two illustrated specimens are different in size, but marginal infolds are developed in each of them.

Occurrence:—Very rare in Takamatsu *Mya* and *Tonna* Beds.

Genus *Aglaiocypris* Sylvester-Bradley, 1946

*Aglaiocypris nipponica* Okubo, 1980

Figure 6-1.

*Aglaiocypris nipponica* Okubo, 1980, p. 17–20, pl. 1, figs. e, f, text-fig. 1.

Illustrated specimen:—A left valve, UMUT-CA 17986 (Figure 6-1; L 0.555, H 0.227), from sample 1106, Takamatsu *Tonna* Bed.

Remarks:—Adductor scars composed of six small oval scars in a circular arrangement are observed. Two anteroventral scars are located horizontally and two posteroventral scars are vertically.

![Figure 6. Inner views. ×93. 1. Aglaiocypris nipponica Okubo, 1980, a left valve, CA 17986, sample 1106, Takamatsu Tonna Bed. 2, 3. Paracypris? sp. 2, a left valve, CA 17984 (sample 1203, Takamatsu Mya Bed). 3, a right valve, CA 17985 (sample 1109, Takamatsu Tonna Bed). 4, 5. Coquimba poga Hu, 1986. 4, a left falve, CA 17991. 5, a right valve, CA 17990 (sample 1203, Takamatsu Mya Bed).](image-url)
Michiko YAJIMA

*Occurrence:*—Rare in Takamatsu *Mya* and *Tonna* Beds.

Family Pontocyprididae G. W. Müller, 1894
Genus *Propontocypris* Sylvester-Bradley, 1947
*Propontocypris* sp.

*Propontocypris* (Propontocypris) sp., Yajima, 1982, p. 183, pl. 15, figs. 1, 2, 5.

*Remarks:*—All individuals are juveniles.
*Occurrence:*—Common from Takamatsu *Dosinia, Mya,* and *Tonna* Beds.

Superfamily CYTHERACEA Baird, 1850
Family Leptocytheridae Hanai, 1957
Genus *Callistocythere* Ruggieri, 1953
*Callistocythere* sp.

*Callistocythere* sp., Ikeya and Hanai, 1982, p. 45, 46, pl. 5, figs. 7a, b, 8, 9; Yajima, 1982, p. 192, pl. 11, figs. 8, 9.

*Occurrence:*—Very rare in Takamatsu *Mya* and *Tonna* Beds.

Family Trachyleberididae Sylvester-Bradley, 1948
Genus *Trachyleberis* Brady, 1898
*Trachyleberis* sp.

*Trachyleberis* sp., Yajima, 1978, p. 398, 399, pl. 49, figs. 1a, b; Ikeya and Hanai, 1982, p. 48, pl. 4, figs. 8a, b; Frydl, 1982, table 1; Yajima, 1982, p. 195, 196.

*Occurrence:*—Common in Takamatsu *Tonna* Bed. Rare in Takamatsu *Mya* and *Dosinia* Beds and Akazawa Silt Member.

Family Hemicytheridae Purli, 1953
Subfamily Coquimbinae Ohmert, 1968
Genus *Coquimba* Ohmert, 1968
*Coquimba ishizakii* Yajima, 1978
Figures 12-2, 3.

*“Hermanites”* sp. A, Ishizaki, 1968, p. 41, pl. 6, fig. 13.

*Coquimba* sp., Hanai, Ikeya and Ishizaki in Hanai et al., 1977, p. 48.

*Coquimba ishizakii* Yajima, 1978, p. 397, pl. 49, figs. 4a–c, text-figs. 7-3a, b; Frydl, 1982, tables 1, 2; Hu, 1982, p. 194, pl. 3, figs. 24, 28, 29; Hu, 1983, p. 152, pl. 1, figs. 21, 27, text-figs. 2; Hu, 1984, pl. 2, fig. 23; Hu, 1986, p. 121, pl. 3, figs. 4, 5, 7, 8, 10–12, 15.

*Illustrated specimens:*—A right male valve, UMUT-CA 17988 (Figure 12-2; L 0.531, H 0.252), from sample 0702, Takamatsu *Mya* Bed. A right female valve, UMUT-CA 17989 (Figure 12-3; L 0.535, H 0.262), sample 1105, Takamatsu *Tonna* Bed.

*Remarks:*—Although *C. ishizakii* was reported from the Holocene and Pleistocene sediments in Japan and Taiwan, there is no description of sexual dimorphism. In the Takamatsu Shell Sand, there are many specimens of *C. ishizakii*, and sexual dimorphism is observed. Female is shorter and higher than male. The specimens illustrated by Yajima (1978) are probably male.

It is worthwhile to describe that some false radial pore canals are developed along anterior margin, in considering the evolution of Coquimbinae in Japan.

*Occurrence:*—Rare in Takamatsu *Dosinia* Bed and common in *Mya* and *Tonna* Beds.

*Coquimba poga* Hu, 1986
Figures 6-4, 5, 11-8a–c, 9a, b.

*Illustrated specimens:*—A right valve, UMUT-CA 17990 (Figures 11-9a, b; Figure 6-5; L 0.604, H 0.315) and a left valve, UMUT-CA 17991 (Figures 11-8a–c; Figure 6-4; L 0.591, H 0.334) from sample 1203, Takamatsu *Mya* Bed.

*Remarks:*—This species resembles *Coquimba ishizakii* Yajima, 1978 in lateral outline, distinct subcentral tubercle, and posteroventral projection, but differs in its smooth surface and in having a large tubercle on posteroventral margin. The carapace size of this species is larger than that of *Coquimba ishizakii*. Japanese specimens are a little smaller than the specimens from the Tungshiao Formation of Taiwan.

*Occurrence:*—Rare in Takamatsu *Mya* and *Tonna* Beds.
Family Bythocytheridae Sars, 1926
Subfamily Bythocytherinae Sars, 1926
Genus *Bythocythere* Sars, 1866

*Bythocythere alata*, n. sp.
Figures 7-4, 11-10, 12-7a–c.

*Types:*—Holotype, a right valve, UMUT-CA 17992 (Figures 12-7a–c; Figure 7-4; L 0.517, H 0.244), from sample 1102, Takamatsu *Tonna* Bed. Illustrated specimen, a right valve, UMUT-CA 17993 (Figure 11-10; L 0.522, H 0.253) from sample 0701, Takamatsu *Tonna* Bed.

*Diagnosis:*—A small *Bythocythere* with weak dorsal keel and flattened ventral alae starting from anteroventral corner, pointing posteroverentral corner, and running toward posterodorsal caudal process, and with weak ridges along ventral margin.

*Description:*—Carapace small in lateral view. Anterior margin broadly rounded. Dorsal margin straight with weak ridges along its posterior two thirds. Posterior caudal process distinct at dorsal third, and flattened. Ventral margin straight and parallel to dorsal margin. Ventral alae starting from anteroventral corner, pointing at posteroverentral corner, and running toward posterodorsal caudal process, with weak ridges on the tip and three longitudinal ridges on dorsal side. Three weak ridges running along posteroverentral ridge. Anteroventral sulcus weak. Median sulcus not so distinct in lateral view.
Marginal infold broad anteroventrally and posterodorsally. Radial pore canals some, straight at anterior and posterior sides. Normal pores simple. Eye tubercle not so distinct. Hinge straight lophodont. Muscle scars consisting of a round frontal scar and a vertical row of five small round scars on inner wall of median sulcus.

**Dimensions:**—Measurements of pooled specimens are given below:

<table>
<thead>
<tr>
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<th>Me</th>
<th>OR</th>
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<tbody>
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<td>L</td>
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<td></td>
<td></td>
<td></td>
<td>H</td>
<td>0.217</td>
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<tr>
<td>RV</td>
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<td>1</td>
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<td>0.522</td>
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<td></td>
<td></td>
<td></td>
<td>H</td>
<td>0.253</td>
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<tr>
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<td>1102</td>
<td>2</td>
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<td>H</td>
<td>0.249</td>
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<tr>
<td>LV</td>
<td>1301</td>
<td>1</td>
<td>L</td>
<td>0.527</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>H</td>
<td>0.244</td>
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</tbody>
</table>

**Remarks:**—This species is similar to *Bythocythere ishizakii*, n. sp. in lateral outline, but is different in the shape of ventrolateral alae.

**Occurrence:**—Rare in Takamatsu *Tonna* Bed.

*Bythocythere ishizakii*, n. sp.

Figures 7-5, 6, 11-11, 12-8a, b, 9a, b.

**Types:**—Holotype, a left valve, UUMT-CA 17994 (Figure 11-11, Figures 12-9a, b; Figure 7-5; L 0.636, H 0.315), from sample 0501, Takamatsu *Tonna* Bed. Illustrated specimens, a right valve, UUMT-CA 17995 (Figures 12-8a, b; Figure 7-6; L 0.623, H 0.331), from the same sample as holotype.

**Diagnosis:**—*Bythocythere* with punctated surface with weak ridges on ventral side of lateral alae.

**Description:**—Carapace subrhomboidal in lateral view. Anterior margin broadly rounded, dorsal margin straight. Posterior caudal process locating above middle of posterior margin, triangular and flat. Posterodorsal margin very broadly and obliquely rounded. Ventral margin straight and parallel to dorsal margin.

Surface evenly pitted. Weak ridges running parallel to posterodorsal margin and ventral side of ventral alae. Anterodorsal ridge distinct and parallel to dorsal margin in left valve. Posterodorsal ridge also distinct and parallel to posterodorsal margin. Anterior margin having weak ridges. Median sulcus not so distinct in lateral view. Anterior half of median sulcus covered with weak reticulations.

Marginal infold moderate along anteroventral and posterior margins. Vestibule indistinct. Radial pore canals short, straight, and evenly arranged. Normal pores simple. Hinge straight type of lophodont. Muscle scars consisting of a vertical row of five adductor scars on inner wall of median sulcus in arched shape and a round frontal scar. A large scar above adductor scars and a small round scar below frontal scar observed.

**Dimensions:**—Measurements of specimens from sample 0501, Takamatsu *Tonna* Bed are given below.

<table>
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<th>Sp</th>
<th>N</th>
<th>Me</th>
<th>X</th>
<th>Sd</th>
<th>V</th>
<th>OR</th>
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<td>RV</td>
<td>5</td>
<td>L</td>
<td>0.613</td>
<td>0.007</td>
<td>0.012</td>
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<td>H</td>
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<td>0.011</td>
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<td>0.302–0.331</td>
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<tr>
<td>LV</td>
<td>3</td>
<td>L</td>
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<td>LV(A-1)</td>
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<td></td>
<td>H</td>
<td>0.257</td>
<td></td>
<td>0.256–0.258</td>
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</table>

**Remarks:**—*Bythocythere ishizakii* is similar to *B. maisakensis* Ikeya and Hanai, 1982 in lateral outline and carapace surface, but median sulcus of *B. ishizakii* is not so deep as *B. maisakensis*. The surface of *B. ishizakii* is smooth and has no distinct ridges. *B. ishizakii* is larger than *B. maisakensis*. *B. ishikai* is similar to *Bythocythere* sp. A Ishizaki, 1968 in lateral surface, but median sulcus is not so well developed.

**Occurrence:**—Rare in Takamatsu *Dosinia* Bed and common in Takamatsu *Mya* Bed and *Tonna* Bed.

**Genus Bythoceratina** Hornibrook, 1952

*Bythoceratina angulata*, n. sp.

Figures 5-5, 11-6a, b, 7a–c.
**Bythoceratina** sp., Yajima, 1982, p. 216, pl. 13, fig. 16.

**Types:**—Holotype, a left valve, UMUT-CA 17996 (Figure 11-7a–c; Figure 5-5; L 0.712, H 0.340), from sample 1105, Takamatsu *Tonna* Bed. Illustrated specimens, a right valve, UMUT-CA 17997 (Figures 11-6a, b; L 0.681, H 0.387), from sample 0801, Takamatsu *Tonna* Bed.

**Diagnosis:**—*Bythoceratina* with distinct lateral alae and anterodorsal lobe. A lateral alae starting from anteroventral area, running posteroventrally with distinct keel, and then turning to posterodorsal area with reticulation. Anterodorsal lobe with reticulation at anterodorsal slope.

**Description:**—In lateral view, anterior margin broadly and obliquely rounded. Dorsal margin straight with distinct dorsal ridge starting at anterior third, running a little dorsalward, and squarely shouldering. Ventral margin obscured by lateral alae, but nearly parallel to dorsal margin. Posterior caudal process distinct at dorsal part with weak reticulation. Anterior lobe, with reticulation at anterodorsal slope. Median sulcus distinct. Lateral alae starting at mid-height to anteroventral area, running posteroventrally with distinct keel, and then turning posterodorsal direction, forming angular tip of wing, and ending at posterior caudal process with reticulation. Surface evenly punctuated.

Marginal infold broad along anterior and posterior margins. Vestibule deep along anterior and posterior margins. Radial pore canals, several, short, and straight. Normal pores simple. Hinge straight type of lophodont. Muscle scars consisting of a frontal scar and a vertical row of five adductor scars on the inner wall of median sulcus.

**Dimensions:**—Measurements of pooled specimens are given below.

<table>
<thead>
<tr>
<th>Sp</th>
<th>Sa</th>
<th>N</th>
<th>Me</th>
<th>OR</th>
</tr>
</thead>
<tbody>
<tr>
<td>RV</td>
<td>0801</td>
<td>1</td>
<td>L 0.681</td>
<td>H 0.387</td>
</tr>
<tr>
<td>RV</td>
<td>1102</td>
<td>1</td>
<td>L 0.647</td>
<td>H 0.319</td>
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<td>LV (holotype)</td>
<td>1105</td>
<td>1</td>
<td>L 0.712</td>
<td>H 0.340</td>
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</table>

**Remarks:**—In 1982, I discussed this species to resemble *Bythoceratina* sp. (originally *Monoceratina* sp. A, Key [Koij], 1953) in lateral outline and surface ornamentation. But in *Bythoceratina* sp., two straight ridges run obliquely in anterodorsal area and the anterior marginal ridge is very distinct.

**Occurrence:**—Rare in Takamatsu *Tonna* Bed.

**Genus Pseudocythere** Sars, 1865

*Pseudocythere* sp. 1

Figures 7-1, 2.

**Illustrated specimens:**—A left valve, UMUT-CA 17998 (Figure 7-1; L 0.446, H 0.223), from sample 1103, Takamatsu *Tonna* Bed, and a left valve, UMUT-CA 17999 (Figure 7-2; L 0.385, H 0.188), from sample 1104, Takamatsu *Tonna* Bed.

**Remarks:**—This species is similar to *Pseudocythere similis* Müller, 1908 described by Schornikov (1982) in lateral outline, but the posteroventral marginal infold of this species is more strongly developed.

**Occurrence:**—Very rare in Takamatsu *Tonna* Bed.

*Pseudocythere* sp. 2

Figure 7-3.

**Illustrated specimen:**—A left valve, UMUT-CA 18000 (Figure 7-3; L 0.411, H 0.232) from sample 1301, Takamatsu *Tonna* Bed.

**Remarks:**—This species is very similar to *Pseudocythere* sp. 1 of this paper in lateral outline but has 10 to 12 horizontal ridges. The species is also similar to *Pseudocythere* sp. 1 described by Whatley and Downing (1982) from the Middle Miocene of Victoria, Australia in having the lateral parallel ribs extending from the anterior to posterior margins, but is distinguished in having no weak vertical ribs in anterior part.

**Occurrence:**—Very rare in Takamatsu *Tonna* Bed.

Family Cytheruridae G. W. Müller, 1894

Subfamily Cytherurinae G. W. Müller, 1894
Genus *Semicytherura* Wagner, 1957

*Semicytherura* sp. 1

Figures 12-10, 11.

**Illustrated specimen:**—A left juvenile valve, UUMT-CA 18001 (Figure 12-11; L 0.368, H 0.146), from sample 0702, Takamatsu *Mya* Bed, and also a left juvenile valve, UUMT-CA 18002 (Figure 12-10; L 0.354, H 0.145), from sample 0602, Takamatsu *Mya* Bed.

**Remarks:**—Comparing two specimens, difference of secondary surface ornamentation at the central part is noted, one being smooth, and the other punctate.

**Occurrence:**—Very rare in Takamatsu *Tonna* and *Mya* Beds.

*Semicytherura* sp. 2

Figure 12-6.

**Illustrated specimen:**—A left valve, UUMT-CA 18003 (Figure 12-6; L 0.333, H 0.164) from sample 0901, Takamatsu *Tonna* Bed.

**Remarks:**—This species is similar to *Semicytherura miurenensis* (Hanai, 1957) in lateral outline but smaller size and a median horizontal ridge characterize the Atsumi specimens.

**Occurrence:**—Very rare in Takamatsu *Tonna* Bed.

Family Paracytherideidae Puri, 1957

Genus *Paracytheridea* G. W. Müller, 1894

*Paracytheridea* sp.

Figures 12-12a, b.

**Illustrated specimens:**—A juvenile left valve, UUMT CA 18004 (Figures 12-12a, b; L 0.552, H 0.252), from sample 1110, Takamatsu *Tonna* Bed.

**Remarks:**—The ventral alae of this species are very protrudent with tubercle at posteroventral side of caudal projection. This species closely resembles *Paracytheridea polyspinosa* Hu and Cheng, 1977 described by Hu (1986, pl. 16, figs. 9, 10) in outline and surface ornamentation, but species identification is waived simply because those specimens from the Atsumi area are all of juvenile form.

**Occurrence:**—Very rare in Takamatsu *Tonna* Bed.

Family Paradoxostomatidae

Brady and Norman, 1889

Subfamily Paradoxostomatinae

Brady and Norman, 1889

Genus *Paradoxostoma* Fisher, 1855

*Paradoxostoma setosum* Okubo, 1977

Figure 9-2.


**Illustrated specimen:**—A right valve, UUMT-CA 18005 (Figure 9-2; L 0.500, H 0.277), sample 1105, Takamatsu *Tonna* Bed.

**Remarks:**—The illustrated specimen is very similar to the Recent specimen described by Okubo (1977) from the Setonaikai, except for the height of carapace. This specimen is a little higher.

**Occurrence:**—Very rare in Takamatsu *Mya* and *Tonna* Beds.

*Paradoxostoma* sp.

Figure 8-1.

*Paradoxostoma* sp. 2, Frydl, 1982, p. 136, text-fig. 32c.

**Illustrated specimen:**—A left valve, UUMT-CA 18006 (Figure 8-1; L 0.819, H 0.277), sample 1109, Takamatsu *Tonna* Bed.

**Remarks:**—The illustrated specimen has more numerous radial pore canals along the posterior and ventral margins than the specimen illustrated by Frydl (1982).

**Occurrence:**—Only one illustrated specimen.

Genus *Sclerochlorus* Sars, 1866

*Sclerochlorus* sp.

Figure 9-1.

*Sclerochlorus* sp. 1, Yajima, 1982, p. 226, pl. 15, fig. 10,
830. Pleistocene Ostracoda from Atsumi

Figure 8. Inner views, x75. 1. Paradoxostoma sp., a left valve, CA 18008 (sample 1109, Takamatsu Tonna Bed). 2. Xiphichilus sp., a left valve, CA 18008 (sample 0701, Takamatsu Tonna Bed).

text-fig. 17-5.

Illustrated specimen:—A right valve, UMUT-CA 18007 (Figure 9-1; L 0.431, H 0.254), sample 1109, Takamatsu Tonna Bed.

Remarks:—One available specimen has five large adductor scars attached to one another to form a circle, and inclined towards posterior, although Sclerochilus sp. 1 reported by Yajima (1982) has four adductor scars. The triangular lateral outline and straight ventral margin of this specimen may represent a new genus.

Recently, Schornikov (1982) proposed a new genus Convexochilus to include triangular Sclerochilus species, assigning the Antarctic species Sclerochilus meridionalis G. W. Müller, 1908 as the type species. The present species is very similar to Sclerochilus meridionalis in general shape, and may be included into the genus Convexochilus. However, this species is small in size and different slightly in its muscle scar patterns. Convexochilus is so far known only from around Antarctic sea.

Occurrence:—Very rare in Takamatsu Tonna Bed.

Genus Xiphichilus Brady, 1870

Xiphichilus sp.

Figure 8-2.

Illustrated specimen:—A left valve, UMUT-CA 18008 (Figure 8-2; L 0.946, H 0.281), from sample 0701, Takamatsu Tonna Bed.

Remarks:—This is the first report of Xiphichilus from Japan. This species is rather short in length among the genus Xiphichilus.

Occurrence:—Very rare in Takamatsu Tonna Bed.

Family Cytheromatidae Elfnson, 1939

Subfamily Cytheromatinae Elfnson, 1939

Genus Cytheroma G. W. Müller, 1894

Cytheroma? sp.

Cytheroma? sp., Ikeya and Hanai, 1982, p. 58, 59, pl. 6, fig. 1–4, text-fig. 20.

Occurrence:—Very rare in Takamatsu Dosinia and Tonna Beds.

Genus Paracytheroma Juday, 1907

Paracytheroma sp.

Occurrence:—Rare in Takamatsu *Dosinia* and *Tonna* Beds.

Family Microcytheridae Klie, 1938
Genus *Cobanocythere* Hartmann, 1959

*Cobanocythere? pulchra*, n. sp.

Figures 10-2, 3, 12-5a–c.

Types:—Holotype, a left valve, UMIT-CA 18009 (Figures 12-5a–c; Figure 10-3; L 0.479, H 0.201), from sample 0501, Takamatsu *Tonna* Bed. Illustrated specimen, a right valve, UMIT-CA 18010 (Figure 10-2; L 0.458, H 0.154), from sample 1112, Takamatsu *Dosinia* Bed.

Diagnosis:—*Cobanocythere* with a shallow hollow at anteromedian part of ventrolateral alae.


→ Figure 11. 1a, b, 2a, b. *Neonesidea hanai*, n. sp.
1a. Lateral view of left valve (holotype, CA 17979, sample 1103, Takamatsu *Tonna* Bed). x60. 1b. Inner view of right valve (CA 17979). x60. 2a. Lateral view of right valve (CA 17980, sample 0802, Takamatsu *Mya* Bed). x60.
2b. Inner view of right valve (CA 17980). x60.

3a, b, 4a, b. *Anchistrocheles yamaguchii*, n. sp.
4b. Inner view of left valve (CA 17982). x65.

5a, b. *Anchistrocheles hondai*, n. sp.
5a. Lateral view of right valve (holotype, CA 17981, sample 0501, Takamatsu *Tonna* Bed). x70. 5b. Inner view of right valve (CA 17981). x70.

6a, b, 7a–c. *Bythocythere angulata*, n. sp.
6a, b. Stereo pair of lateral view of right valve (CA 17997, sample 0801, Takamatsu *Tonna* Bed). x65. 7a, b. Stereo pair of lateral view of left valve (holotype, CA 17996, sample 1105, Takamatsu *Tonna* Bed). x65. 7c. Inner view of left valve (CA 17996). x65.

8a–c, 9a, b. *Coquimba poga* Hu, 1986
8a, b. Stereo pair of lateral view of left valve (CA 17991, sample 1203, Takamatsu *Tonna* Bed). x78. 8c, Inner view of left valve (CA 17991). x78. 9a, b. Stereo pair of lateral view of right valve (CA 17990, sample 1203, Takamatsu *Tonna* Bed). x78.

10. *Bythocythere alata*, n. sp.
Inner view of right valve (CA 17993, sample 0701, Takamatsu *Tonna* Bed). x80.

11. *Bythocythere ishizakii*, n. sp.
Inner view of left valve (holotype, CA 17994, sample 0501, Takamatsu *Tonna* Bed). x65.
Shallow small depression at anteromedian part of ventral alae.

Marginal infold broad anteriorly and posteriorly. Anterior and posterior inner margins nearly straight and vertical to ventral margin. Ventral inner margin running parallel to outer margin. Vestibule not distinct. Anterior radial pore canals short, two pseudoradial canals, and five finger-like ventral canals. Posterior radial pore canals several, short, straight and finger type at ventral part. Normal pores simple. Eye tubercles obscured.

Muscle scars consisting of two frontal scars and a row of four adductor scars. Hinge lophodont with distinct short bar as median element in right valve.

Dimensions:—Measurements of pooled specimens are given below.

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Remarks:—This species resembles Cobanocythere? japonica Schornikov, 1975 in lateral outline, marginal infold and radial pore canals, but Cobanocythere? japonica has three adductor scars and transversal elevation in inner view.

Occurrence:—Very rare in Takamatsu Dosinia and Tonna Beds.

Genus Hanaicythere, n. gen.

Type species:—Hanaicythere nipponica, n. sp.

Diagnosis:—Small trapezoidal carapace with distinct frill-like ventrolateral alae. Ventrolateral alae, ventrally flattened, starting from anteroventral corner, running parallel to dorsal margin and ending at posteroventral corner. Surface smooth. A shallow median sulcus on lateral side of ventrolateral alae.

Anteroventral, posteroventral and ventral marginal infold broad. Normal pore canals simple. Radial pore canals a few and straight. Eye tubercles obscured. Hinge lophodont with distinct bar as median element. Muscle scars consisting of a

Figure 12. 1a, b, 4a, b. Hanaicythere nipponica, n. gen. et n. sp.
1a, b. Stereo pair of lateral view of left valve (CA 18012, sample 1201, Takamatsu Tonna Bed). x100. 4a, b. Stereo pair of dorsal view of right valve (holotype, CA 18011, sample 1108, Takamatsu Tonna Bed). x100.
2, 3. Coquimba ishizakii Yajima, 1978
2. Lateral view of right male valve (CA 17988, sample 0702, Takamatsu Mya Bed). x78. 3. Lateral view of right female valve (CA 17989, sample 1105, Takamatsu Tonna Bed). x78.
5a–c. Cobanocythere? pulchra, n. sp.
5a, b. Stereo pair of lateral view of right valve (holotype, CA 18009, sample 0501, Takamatsu Tonna Bed). x78.
5c. Inner view of right valve (CA 18009). x100.
6. Semicytherura sp. 2
Lateral view of left valve (CA 18003, sample 0901, Takamatsu Tonna Bed). x140.
7a–c. Bythocythere alata, n. sp.
7a, b. Stereo pair of lateral view of right valve (holotype, CA 17992, sample 1102, Takamatsu Tonna Bed). x83.
7c. Inner view of right valve (CA 17992). x83.
8a, b, 9a, b. Bythocythere ishizakii, n. sp.
8a, b. Stereo pair of lateral view of right valve (CA 17995, sample 0501, Takamatsu Tonna Bed). x68. 9a, b. Stereo pair of lateral view of left valve (holotype, CA 17994, sample 0501, Takamatsu Tonna Bed). x68.
10, 11. Semicytherura sp. 1
10. Lateral view of left juvenile valve (CA 18002, sample 0602, Takamatsu Mya Bed). x140. 11. Lateral view of left juvenile valve (CA 18001, sample 0702, Takamatsu Mya Bed). x140.
12a, b. Paracytheridea sp.
Stereo pair of lateral view of juvenile valve (CA 18004, sample 1110, Takamatsu Tonna Bed). x83.
frontal scar and four adductor scars.

Remarks:—This genus resembles Cobanocythere Hartmann, 1959 in lateral outline and inner view, but the ventral alae of this genus are very distinct and are shaped like a frill.

Hanaicythere nipponica, n. sp.
Figures 10-1, 12-1a, b, 4a, b.

Types:—Holotype, a right valve, UMUT-CA 18011 (Figures 12-4a, b; Figure 10-1; L 0.473, H 0.131), from sample 118, Takamatsu Tonna Bed. Illustrated specimens, a left valve, UMUT-CA 18012 (Figure 12-1a, b; L 0.483, H 0.145, W 0.193), from sample 1201, Takamatsu Tonna Bed.

Diagnosis:—See diagnosis of the genus Hanaicythere.

Description:—Carapace small, fragile, and translucent. In dorsal view, carapace egg-shaped because of broadly rounded ventrolateral alae. Body cavity narrow. In lateral view, carapace trapezoidal. Anterior margin straight and oblique at dorsal part, and obliquely and narrowly rounded at ventral part. Dorsal margin straight. Ventral contact margin obscured by ventrolateral alae. Margin of ventrolateral alae projected laterally with two layers of prominent frills. A shallow hollow on the middle part of ventrolateral alae having two weak longitudinal ridges.

Ventral marginal infold broad. Anterior and posterior inner margins running vertically down to ventral margin. Anteroventral list folding inward before contacting to anteroventral corner. Marginal infold broad anteriorly and posteriorly. Radial pore canals several, short, and straight dorsally, but like finger-like ventrally. Opening of radial pore canals setting on each projection of ventrolateral frill. Normal pores simple.

For hinge and muscle scars see diagnosis of the genus.

Dimensions:—Measurements of pooled specimens are given below.

<table>
<thead>
<tr>
<th>Sp</th>
<th>Sa</th>
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<th>Me</th>
<th>OR</th>
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Remarks:—This species resembles Platymicrocythere tokioi Schornikov, 1975 in anterior inner view but differs in ventrolateral alae.

Occurrence:—Very rare in Takamatsu Dosinia and Tonna Beds.

References cited


Hartmann, G. (1959): Zur Kenntnis der lotischen


中部日本沿半島産更新世介形虫：日本の中央部沿半島の太平洋岸に沿って、更新統が連続して露出する。下部の赤沢シルト層と、中部の豊島砂層に含まれるレンズ状の高松砂質シルトには、保存の良い貝化石が大量に含まれており、介形虫も多産する。

赤沢シルト層は下部 1 m に厚く分布し、Corbicula japonica を多産し、種亜も多く見られる。介形虫は現生内湾泥底にすむ Bicornucythere bisanensis を多産し、アマモ場にすむ Armirila subconexa がまんどこんんでいる。赤沢シルト層の上部は 20 m の堆積シルト～粘土で、Dosinia angulosa と Reta pulchella が少量ながら自生の産状を示し、介形虫は Bicornucythere bisanensis のみが少量産出する。赤沢シルト層の堆積時の環境は、他所からの混入を含む内湾泥底から、混入の少ない安定した内湾泥底だったことを示す。

高松砂質シルトは直径 1 km 前後の、まわりを豊島砂層の砂で囲まれた小さなレンズ状のくぼみに堆積したもので、まず Dosinia angulosa の自生する泥、次に Mya arenaria を主体とする多くの貝の混入をもたらした層。そして最後に少し深くなり Tonna luteostoma 等のすむ砂質シルトが堆積するまでになっている。介形虫は Dosinia angulosa の自生する層には泥底にすむ Bicornucythere bisanensis～Neomonoceratina microreticulata で代表される種の多様性の低い群集がみられ、Mya arenaria や Tonna luteostoma を多産する層では種の多様性の高い、砂泥底にすむ Pliocythereis bradyformis～Bathyocythere ishikazii 群集化した。Mya arenaria 群集に伴う介形虫の群集と Tonna luteostoma 群集に伴う介形虫群集とは、差が明瞭ではない。

1 新属 Hanaicythere (Microcytheridae) と 8 新種を記載した。Anchistrocheles と Xiphichilus 属は日本で最初の報告である。