ON THE MYARIAN PELECYPODS OF JAPAN

Part II. Geological and geographical distribution of fossil and recent species, genus *Mya*.

By

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I. Introduction

Mya, the pelecypod genus is very widely distributed in the seas of the Northern Hemisphere. In many places myarian species are known in general as sea food.

The species belonging to the genus *Mya* are generally observed to live in very shallow seas, especially near the tidal zone. They are assumed to be well adapted to somewhat brackish-polyhalinic water. In general they are endobiotic, burrowing sub-upright burrows to a depth of some 15 to 30 cm in the sea bottom.

Hitherto, numerous species have been proposed by various scientists both in respect to fossil and recent forms.

Their oldest appearance is dated back to the early Palaeogene.

As their stenobathic, and stenohalinic nature in ecological condition, besides their special habitat of burrowing life is clearly known, myarian fossils can be assumed to give also good keys for the solution of various problems concerning palaeoecology.

Within such a wide scope, the author has long continued to study the myarian fossils of Japanese Tertiary including recent forms. In a former report (FUJIE, 1957) fossil and recent species have already been described in detail.

In this paper, various problems in respect to the geological and geographical

Part I. Summary of the Study of the Genus *Mya* from Hokkaido; Jour. Fac. Sci., Hokkaido Univ., Series IV, Vol. 9, No. 4.

distribution of myarian species will be briefly presented.

II. Taxonomical problem concerning the species, *Mya japonica* and *Mya japonica oonogai*

As far as the present author is concerned, there seems to be much confusion in the taxonomy of recent species of *Mya*.

The problem lies in whether or not there really exist one or more species besides *Mya truncata* and *Mya arenaria*.

Since 1856, there have been variously proposed new specific names. For instance, *Mya intermedia* (DALL, 1898) and *Mya japonica* (JAY, 1856) were proposed for the Pacific form, while *Mya truncata forma ovata* (JENSEN, 1901) and *Mya pseudoarenaria* (SCHLESCH, 1931) were also described respectively as names for the Atlantic form.

However there have remained ambiguities in the description, and illustrations when their specific names were first proposed, preventing any exact comparison with each other as well as with other known species. MACGNITIE, N. (1959) after detailed study recently expre ssed the view that *Mya truncata forma ovata* and *M. intermedia* are entirely and certainly synonymous with *Mya pseudoarenaria*. Further he regarded a certain species having been hitherto called *Mya japonica*, to be conspecific with *Mya arenaria*.

According to N. MACGNITIE, the following three specific names are accordingly valid for the living myarians: *Mya truncata* L. 1758, *M. arenaria* L. 1758 and *M. pseudoarenaria* (SCHLESCH) 1931.

The author, however believes in the specific validity of *Mya japonica*. The specimens collected from the sea of Tokyo Bay, and described as well as illustrated by N. MACGNITIE, (p. 187, pl. 19, fig. 8, 1959) are nothing but *Mya japonica oonogai*. In this regard, the author is perfectly in agreement with his views. The specimens of Tokyo Bay, just mentioned, are however quite distinct from the myarian species now living in "Volcano Bay" (=Funka wan) in southwestern Hokkaido, facing the Pacific, from which JAY (1856) first described *Mya japonica*.

There are indeed two species now living in Volcano bay. One of them is easily identifiable as *Mya japonica oonogai* while the other one is clearly distinct from *Mya japonica oonogai* in having thicker test, chalky grey in colour, and larger and stronger chondrophore of the left valve. JAY paid special attention to the three points above enumerated, when he proposed the new name "*japonica*" for the Japanese myarian form. The author also regards the above stated three criteria to be well justifying the specific distinction between *Mya japonica oonogai* and *M. japonica*.

Besides, the author has come to the conclusion that *Mya pseudoarenaria* is entirely conspecific with *Mya japonica*, after careful study. The synonymity between *Mya pseudoarenaria* and *M. intermedia*, *M. truncata forma ovata* is also indubitable, as MACGNITIE has already stated.

Another troublesome problem is in the taxonomic ambiguity concerning *Mya japonica oonogai* and *M. arenaria*.

As the author said in a former paper (p. 406, 1957), the synonymity seems almost indubitable between *Mya arenaria*, and the Japanese species *Mya japonica oonogai*. The latter species now lives in the sea around the Japanese islands; besides it has been not seldom found and described from the Miocene to Pleistocene deposits in the islands of Hokkaido and Honshū. As it has been repeatedly stated, all forms have been called *Mya japonica oonogai*, while indeed they closely resemble *Mya arenaria*.

The author has, however, unfortunately had no opportunity to examine and directly compare shells of *Mya arenaria* living now in the Atlantic, with the Japanese species *Mya japonica oonogai*. So he could not but help hesitating to call the Japanese species under the name *Mya arenaria*.

It is therefore with hesitation that the author treats the Japanese species, called *Mya japonica oonogai*, under such circumstances.

Therefore, the living species assignable into the genus *Mya* can be listed in the following:

Mya truncata L. 1758
M. arenaria L. 1758
(= *M. japonica oonogai*)
M. japonica JAY 1856
(= *M. intermedia*, *M. truncata forma ovata* and *M. pseudoarenaria*)

It is accepted that the genotype of the genus *Mya* is *Mya truncata* L. possessing shells posteriorly truncated, from which most fossils and living species greatly differ in respect to shell form. WINCKWORTH (1930), proposed accordingly the subgeneric name "*Arenomya*" for most species having shells to be posteriorly narrow, with rounded margin in distinguishment from *Mya truncata* in subgeneric name. MAKIYAMA (1934) and HABE (1952) accepted this classification.

As is recognized in general however, myarian shells individually show marked variations in their outer form, and the author believes now, such classification as the above to be not always tenable.

If the genus *Mya* must be divided into groups, it would be better classified into the following two species groups, based on the two distinct types of chondrophore, which the author described in detail in the former paper: the first group includes *Mya cuneiformis*, *M. truncata* and *M. japonica* whilst the second group consists of *Mya ezoensis*, *M. grewingki* and *M. japonica oonogai*.

III. Geological and geographical distribution (off Japanese islands and near-adjacent lands)

After long and continuous study, the geographical distribution for myarian species of Japan has become recently clear in detail to the writer, based on his

specific identification of the specimens stored at the Department of Geology and Mineralogy, Hokkaido University including the author's own material. Also description on myarian species, have been re-examined both in respect to fossil and recent forms. The results of such study are incorporation the accompanying maps. (Figs. 1 to 6)

Before going into an explanation of these maps, the author however believes it necessary to mention the following. First of all, the geological age is always of very long duration. Secondly, as fossils are only to be found on outcrops or in boring cores, so the precise extent of distribution of fossils is not always easy to estimate. The formations with myarian fossils are entirely covered with thick overlying rocks. Accordingly it is hard to learn the true distribution of the fossils. That is to say, there may be always left the possibility that the

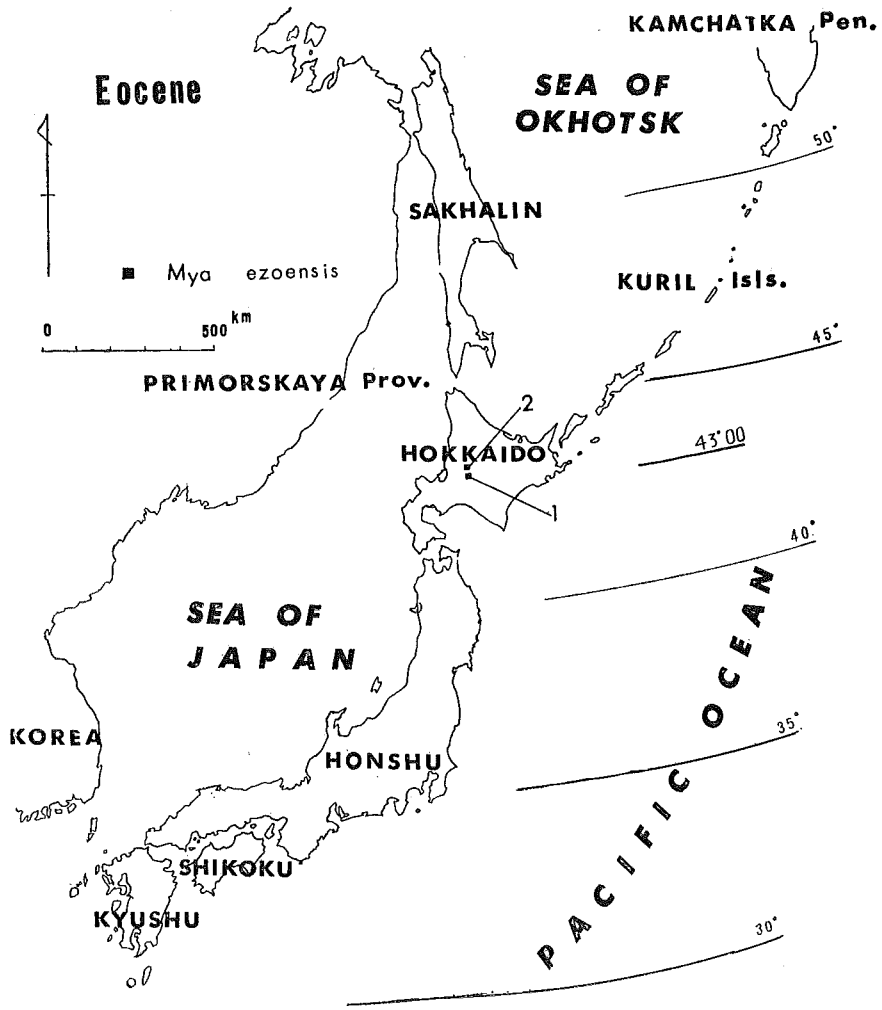


Fig. 1. Geographical distribution of fossil species *Mya* in Eocene age.

true extent of distribution is greater than that area observed. Thirdly shells are nearly always deposited after transportation from the original places of inhabitation of the animals, through long or short distance. Thus their place of deposition does not always show the place of inhabition. Besides attention must also be paid to the fact that in the case of recent myarian species they sometimes became locally extinct in as short a period as half a century; on the other hand, some are newly migrated, or may have been artifically transported from farm to farm for culture.

1) Eocene (Fig. 1)

In Japan, Eocene deposits are developed only in islands of Kyūshū and Hokkaido. The single species of *Mya ezoensis* has been known only from Hokkaido.

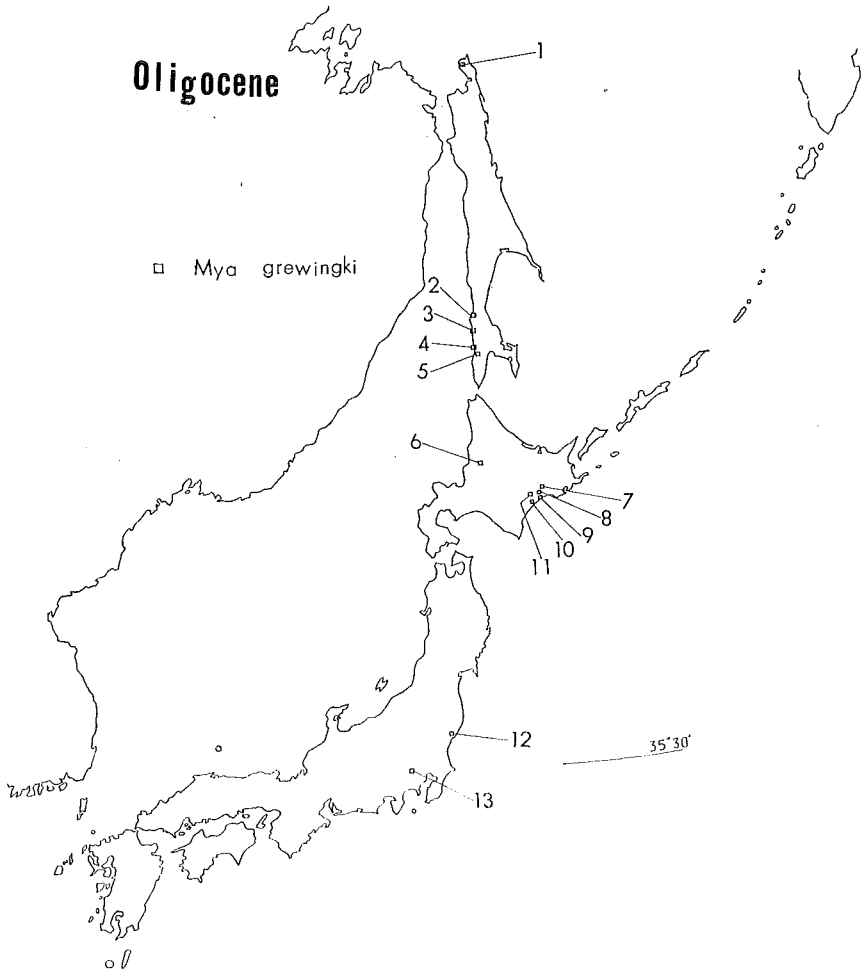


Fig. 2. Geographical distribution of fossil species *Mya* in Oligocene age.

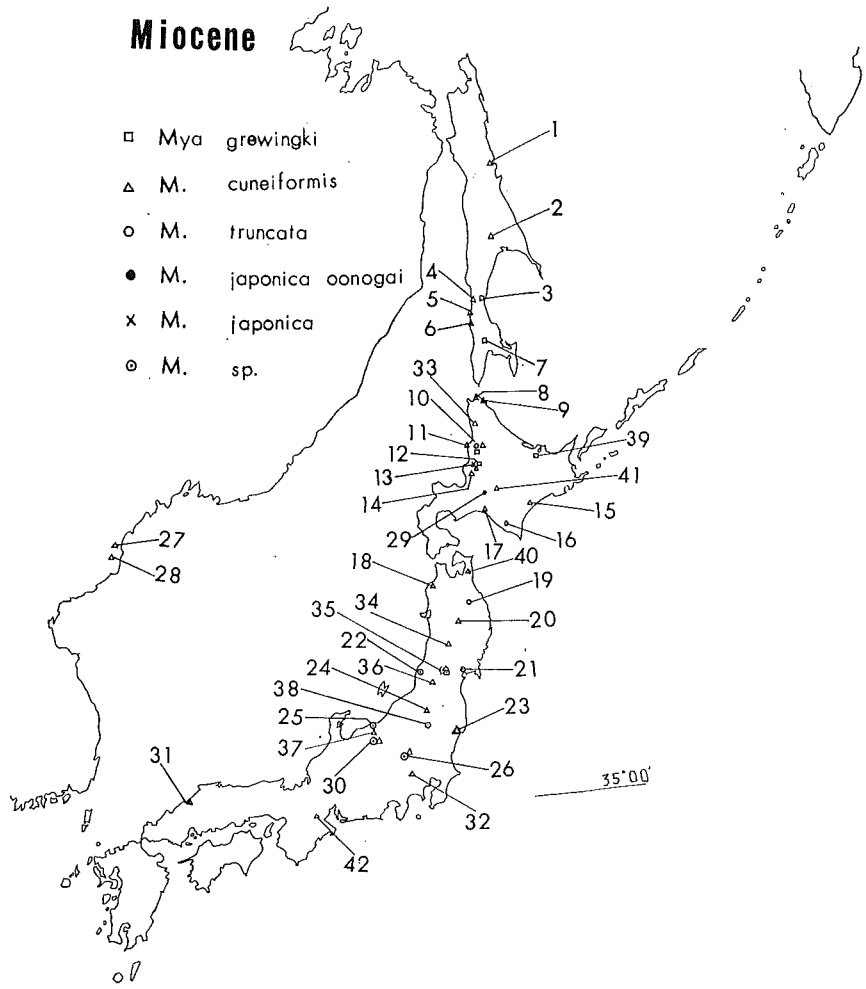


Fig. 3. Geographical distribution of fossil species *Mya* in Miocene age.

2) Oligocene (Fig. 2)

Mya grewingki shows very wide distribution ranging from North Sakhalin to the Chichibu basin of Kwanto district in the south. On the contrary, its varietal from, *M. grewingki* var. *elongata* has been known only to occur in Hokkaido and still farther northern districts.

3) Miocene (Fig. 3)

Very numerous species and varietal forms appeared after the dawn of this epoch: their distribution seems to have been much more extended than the species of the former age. Some of them (*Mya truncata*, *M. japonica* and *M. japonica oonogai*) are still alive in the sea around the Japanese islands. Next, the geographical distribution for each species will be briefly outlined.

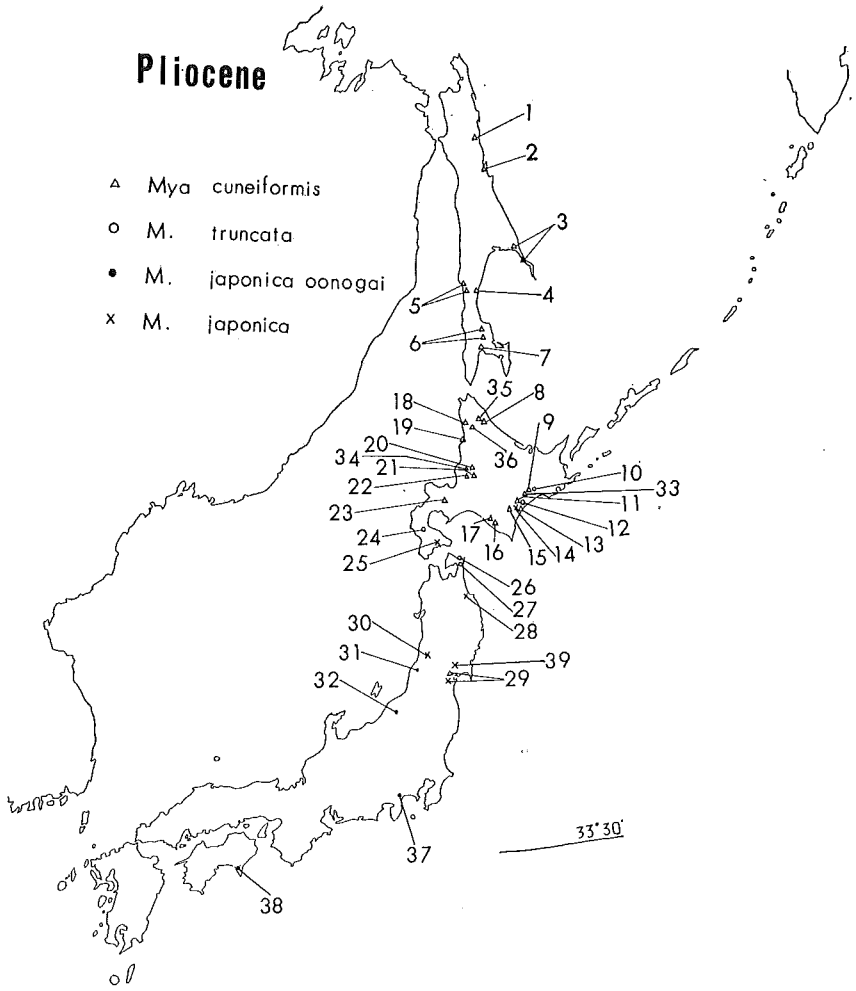


Fig. 4. Geographical distribution of fossil species *Mya* in Pliocene age.

First of all *Mya cuneiformis* shows specially wide distribution extending from south-western Honshū in the south, to Sakhalin in the north, besides the Kamchatka peninsula and Alaska.

Mya grewingki is still abundant especially in north central Hokkaido, although its southern limit of distribution seems to have been about 44 N. Lat., in those days. The southern limit of *Mya truncata* in respect to distribution lay at about 41 N. Lat., while the northern limit of *Mya japonica oonogai* might be at about 42 N. Lat.

4) Pliocene (Fig. 4)

In this age, *Mya cuneiformis* and *M. japonica oonogai* are characterised by their extensive geographical distribution. Of them, *Mya cuneiformis* are

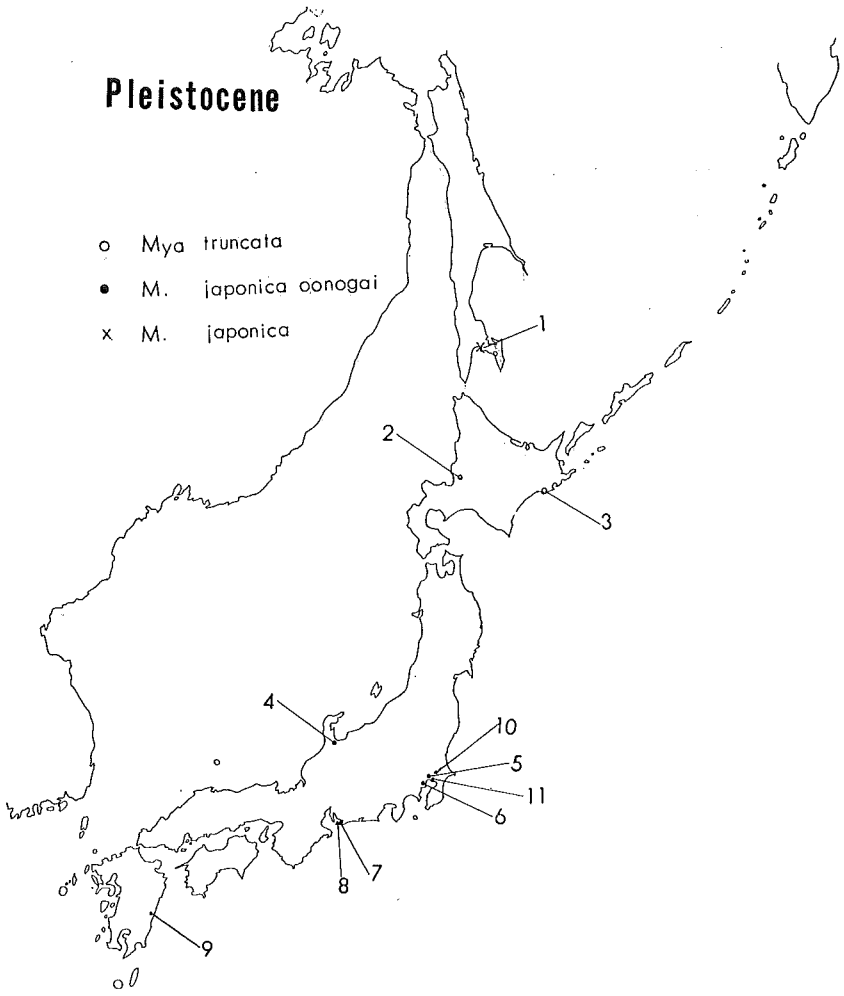


Fig. 5. Geographical distribution of fossil species *Mya* in Pleistocene age.

however more abundantly found in the northern region, differend to *Mya japonica oonogai* whose northern limit in distribution seems to lie far more southward than that of the former. Besides there are rarely found *Mya truncata* in the region farther north than North Honshū, whilst *Mya japonica* are known to be distributed in southwestern Hokkaido, and North Honshū.

5) Pleistocene (Fig. 5)

In the Japanese islands the Pleistocene fossils of marine origin are only sporadically distributed and little is known concerning the distribution of myarian species.

In the northern region, however, *Mya truncata* and *M. japonica* are to

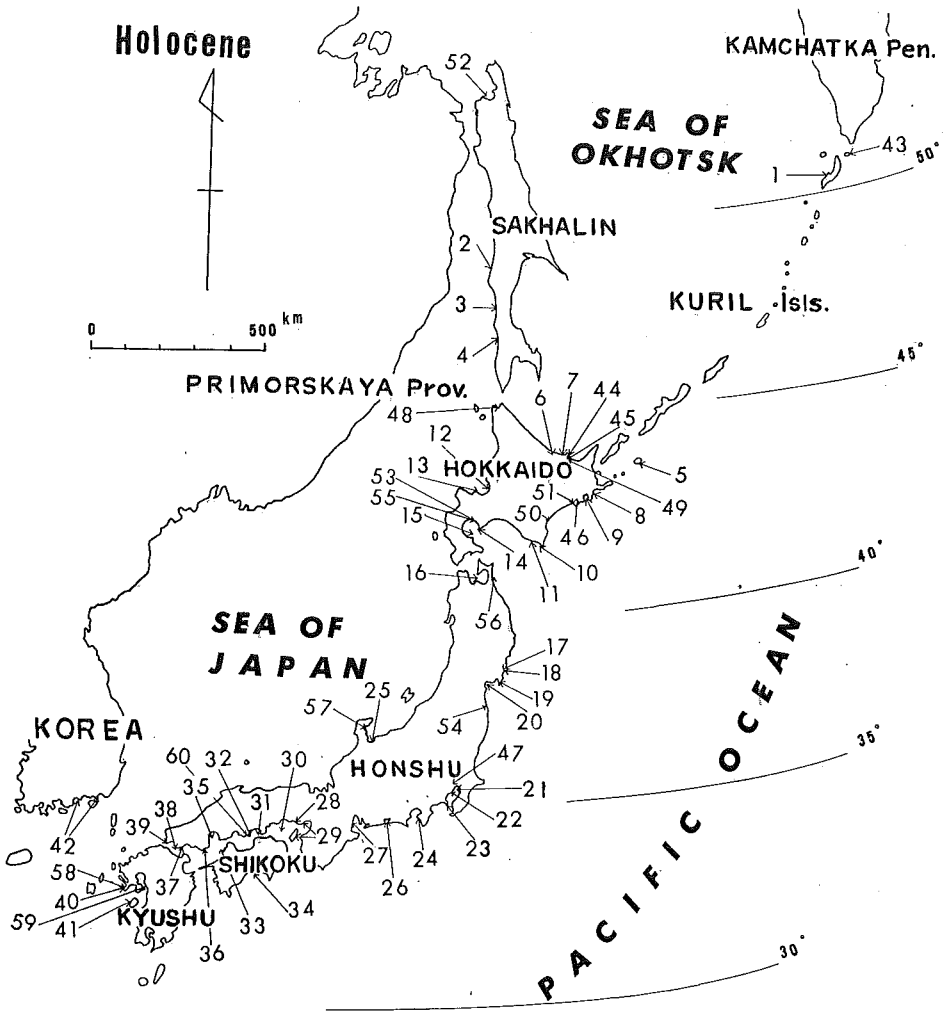


Fig. 6. Geographical distribution of species *Mya* in Holocene age.

be found, while *M. japonica oonogai* are recorded only in southern districts. The boundary line between those two seems to have been somewhere in a more southern region than the Hokkaido of the present.

6) Holocene (Fig. 6)

Taken into consideration are not only individuals inhabiting the present sea water, but also specimens from shell heaps with human remains of the Jōmon culture age, as well as shells found from the shell beds of early alluvial age, marine in origin.

The distribution of such specimens is naturally known quite in detail, in comparison with that of fossils. Of them, *Mya japonica oonogai* are particularly

abundantly found in such enclosed bays, lagoons or coastal lakes of brackish water as Lake Akkeshi in Hokkaido, Kesennuma and Matsushima bays of northern Honshū, Tokyo bay and on the northern coast of Seto-uchi Sea. Their northern limit of distribution lies at Wakkanai (46 N. Lat., 141 40′ E. Long.), Abashiri (44 15′ N. Lat., 143 45′ E. Long.), while the southern limit is near the Island of Amakusa, Kyūshū.

The northern limit for the distribution of *Mya japonica* lies in Mutsu bay, Northern Honshū, while that of *Mya truncata* has been generally belived to be Nemuro, Hokkaido (43 25′ N. Lat., 144 50′ E. Long.).

A dwarf form of *Mya truncata*, is however newly known to be rarely found on the coast of Hidaka, Hokkaido, facing southward to the Pacific. It must be worthy of note that all those three species above named have been little recorded from the Sea of Japan at least around the Japanese islands.

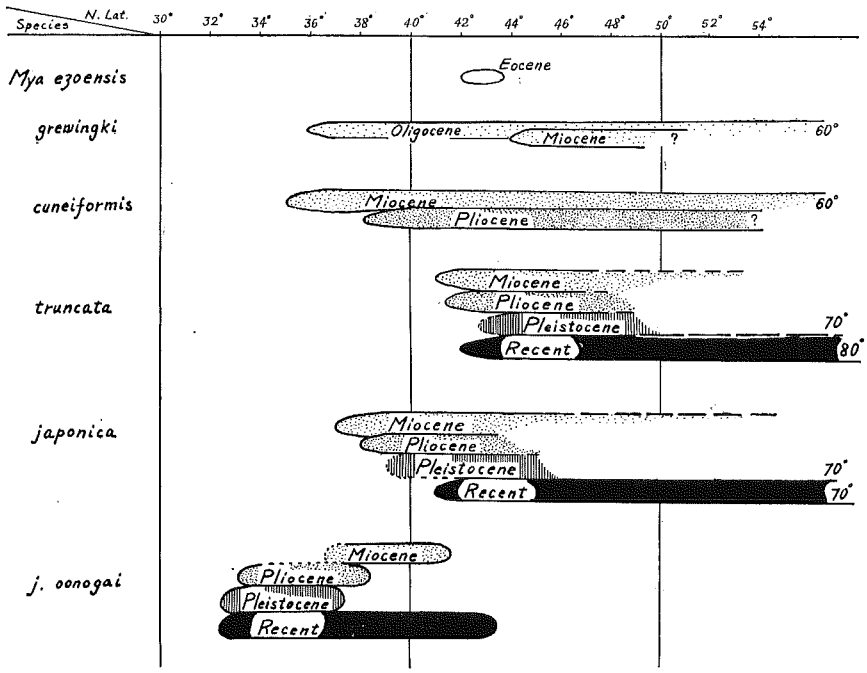


Fig. 7. Shows the known geographical distribution for each species from south to north. (off Japanese islands and near-adjacent lands)

Fig. 7 diagrammatically shows the known geographical distribution for each species from south to north.

1. Each myarian species shows fairly wide geographical distribution, excepting for the Eocene species, *Mya ezoensis*. Instead of it, the southern limit of distribution can always be ascertained with certainty for any species.

2. Only in the case of *Mya japonica oonogai*, its northern limit of distribution seems to be quite manifest.

3. Of species showing long geological range from early Miocene to the

present, *Mya japonica*, *M. japonica oonogai* and *M. truncata* seem to have abruptly changed their extension of geographical distribution between Pleistocene and Holocene.

All of them show very wide distribution in the Holocene in comparison with Pleistocene and Tertiary.

4. Geographical distribution for each species changes through geological ages: some species seem to have moved northwards, while others migrated toward the south.

For instance, *Mya grewingki* certainly migrated from south to north over a great distance between Oligocene to Miocene in age. Similar case can be induced for *Mya cuneiformis* to some extent between Miocene and Pliocene in age; at least, the southern limit of geogrphical distribution seems to have moved northwards.

Mya truncata and *M. japonica* also show similar inclination concerning the distribution through the geological ages ranging from Miocene to Pleistocene until the present day.

On the contrary, *Mya japonica oonogai* is an exception to all other species mentioned above. It seems evidently to have migrated from north to south since Miocene until Pleistocene age. So far as the southern limit is concerned, it is quite true, although *Mya japonica oonogai* is now geographically distributed somwhat more widely in the present seas.

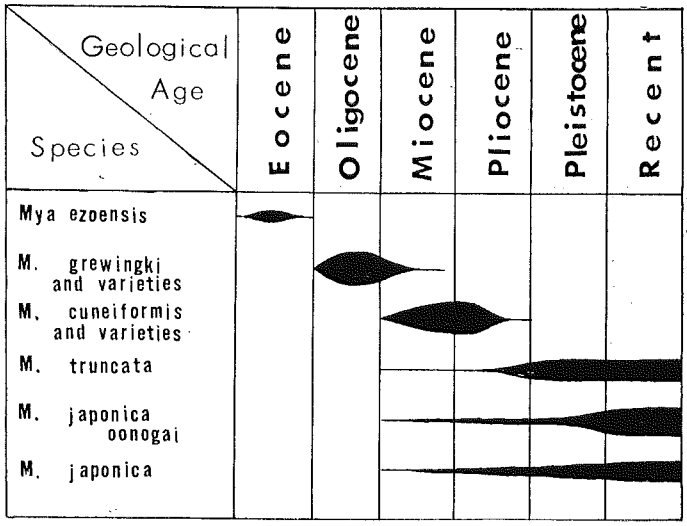
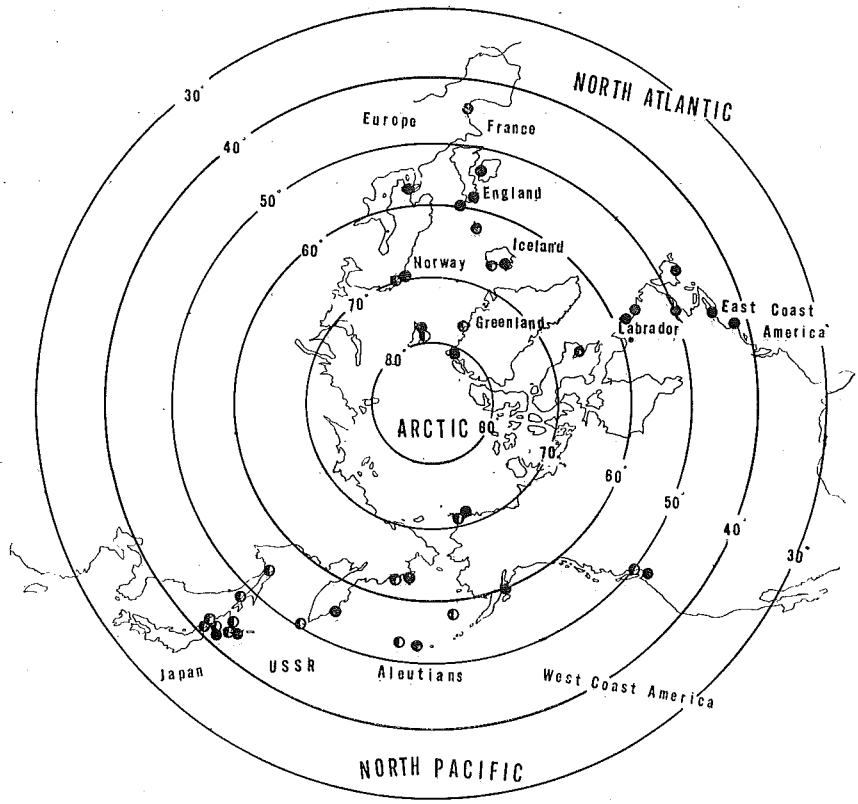


Fig. 8. Geological distribution (off Japanese islands and near-adjacent lands).

IV. Geological and geographical distribution in the Northern Hemisphere

Not a single record of the finding of myarian species is known to the present author from the Southern Hemisphere whether fossil or recent forms.



● *Mya truncata* L. ◐ *M. japonica* JAY

Fig. 9. Geographical distribution of living species, *Mya truncata* L. and *M. japonica* JAY.

The distribution of living species of myarian species may accordingly be diagrammatically shown as in figures 9 and 10.

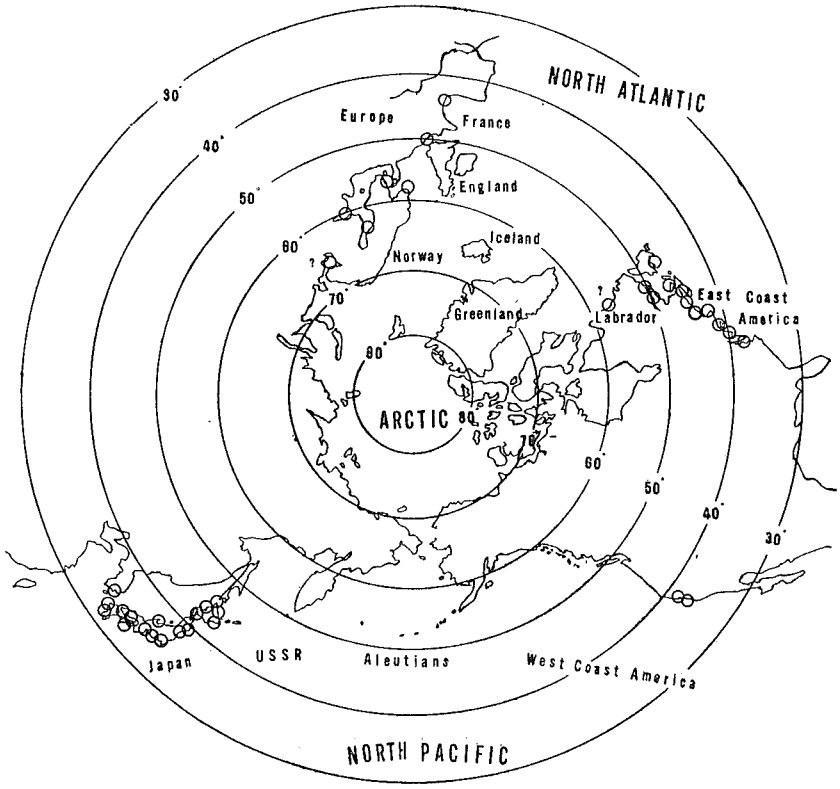
Next, the districts of their main distribution and notable localities of inhabitation of *Mya* will be listed in the following.

The range and distribution of recent species *Mya*.

Mya truncata L.

Range: 1. Arctic Ocean: Point Barrow.
2. Western Pacific: from Bering Sea to Hokkaido, Japan.
3. Eastern Pacific: from Alaska to Puget Sound, Washington.
4. Northern Atlantic: from Spitsbergen to Iceland.
5. Western Atlantic: from Baffin Bay to Massachusetts.
6. Eastern Atlantic: from Norway to Bay of Biscay, France.

Distribution
1. Point Barrow, Alaska.
2. Aleutians, Bering Sea, Kamchatka Peninsula and Kuril Islands. Off Nemuro and Cape Erimo, Hokkaido, Japan.



○ *Mya arenaria* L.

Fig. 10. Geographical distribution of living species, *Mya arenaria* L. The question marks deal with species whose specific identification seems to be somewhat doubtful, although they were named as *M. arenaria* L. Those questionable species are always to be found in far northern region than the general distribution of *M. arenaria*. The species now is question may with high probability be *Mya japonica*.

3. Afognak and Raspberry Islands, near Kodiak Island, Alaska. Puget Sound, Washington.
4. Northeast Greenland, Iceland and Spitzbergen.
5. Cumberland Gulf, Baffin. Cape Mumford to Hebron and Nain, Labrador, St. Lawrence Harbor and St. Anthony, Newfoundland. Little Metis, Quebec, Banquereau, Nova Scotia. Grand Manan, New Brunswick, Canada.
   Eastport, Boone Island, Maine. Middle Bank, Nahant, Revere Beach, Plymouth and Nantucket, Massachusetts, U.S.A.
6. Norway, Sweden. Faroe Islands, Shetland Islands, Western Scotland and Dublin Bay, Ireland, England. La Rochelle, Bay of Biscay, France.

Mya japonica JAY

Range: 1. Arctic Ocean: Point Barrow.

2. Western Pacific: from Bering Sea to Mutsu Bay, Japan.
3. Eastern Pacific: from Bering Sea to Bellingham, Washington.
4. Northern Atlantic: from Spitzbergen to Iceland.
5. Western Atlantic: unknown.
6. Eastern Atlantic: coast of Norway.

Distribution

1. Point Barrow, Alaska.
2. Kuril Islands. Saghalin Bay, North Sakhalin. West coast of South Sakhalin. Abashiri, Akkeshi, Hidaka and Volcano Bay, Hokkaido; Mutsu Bay, Aomori Prefecture, northern Honshū, Japan.
3. Probilof Island and Aleutians, Alaska.
   Gulf of Georgia, British Columbia, Canada.
   Bellingham, Washington, U.S.A.
4. Greenland, Iceland and Spitzbergen.
5. Unknown.
6. Coast of Norway.

Mya arenaria L.

Range: 1. Arctic Ocean: Unknown.
2. Western Pacific: from North Hokkaido to Amakusa Island, Kyūshū, Japan.
3. Eastern Pacific: San Francisco Bay and off Punct Ano Nueve, Central California, U.S.A.
4. Northern Atlantic: Uuknown.
5. Western Atlantic: from Nain, Labrador to Virginia Beach, Virginia, U.S.A.
6. Eastern Atlantic: from White Sea to Arcachon France.

Distribution

1. Absent.
2. Sea coast around Hokkaido, Kesennuma Bay, Matsushima Bay, Tokyo Bay, Suruga Bay, Lake Hamana, Ise Bay, Toyama Bay, sea coast of Seto-uchi Sea, Tosa Bay, Nagasaki and Amakusa, Japan.
   Chinhaeman Bay, South Korea.
3. San Francisco Bay and off Punct Ano Nuevo, Central California, U.S.A.
4. Absent.
5. Nain, Labrador. Cape Norman, Pilley's Islands and St. Pierre, Newfoundland. Seven Island and Little Metis, Quebec. Ellerslie, St. John, Grand manan and St. Andrews, New Brunswick, Canada. Eastport, Isle au Haut and Kennebunkport, Main. Hamptom Beach, New Hampshire. Ipswich, Atlantic, Duxbury, Province, Dennisport, Nantucket and Chelsea Beach, Massachusetts. Westerly,

Rhode Island, Stonington, Branford, Connecticut. Glencove, Staten Island, Brooklyn, New York. Atlantic City, New Jersey. Little Choptank River, Dorchester Co., Little Annemessex River, Chesapeake Bay, Maryland. Virginia Beach, Virginia, U.S.A.

6. White Sea, Coast of Norway and Baltic Sea. Walcheren Island, Holland. Great Britain Island and Arcachon, France.

To sum up descriptions in the foregoing pages, one may know that *Mya truncata* and *M. japonica* are now habitants of the waters of the North Pacific, North Atlantic and Arctic Ocean; on the contrary *Mya arenaria* is to be found only on the two sides of the North Atlantic, except on the coast off San Francisco, the Pacific.

The Japanese species (*Mya japonica oonogai*) being referable or conspecific with *Mya arenaria* is known to be inhabitating the sea along the Japanese islands.

Of them, *Mya arenaria* including the Japanese spcies *Mya japonica oonogai* is remarkable in showing the southern limit of distribution to lie much farther southward than that of the other two species.

The southern limit of distribution of *Mya truncata* nearly coincides with that of *Mya japonica*, although in geographical distribution they are somewhat different from each other.

As fossils, the species having been described from the Tertiary and Quaternary deposits in the regions along the Western Pacific is already briefly discussed in the foregoing pages. On the eastern side of the Pacific, some myarian species such as *Mya cuneiformis*, *M. truncata*, *M. japonica* and *M. arenaria* have been described from the Miocene and Pliocene developed in California and Alaska.

In the Atlantic, especially in the western region, *Mya truncata*, *M. japonica* and *M. arenaria* are known to have already appeard also in the Miocene age; they have been often recorded from Pliocene and Pleistocene deposits there; on the contrary on the eastern side, the same three species seem to have first oppeared in the Pliocene age and to have long lived there until the present.

Beyond this, their geographical distribution through geological ages in the Atlantic is unknown to the present author.

In this regard, however HESSLAND's description in the following paragraphs, is very interesting to the writer; it may be worth referring to here.

During the Pleistocene Ice Age, *Mya arenaria* became extinct in Europe, especially on the eastern coast of the Atlantic, which might have surely survived until the age, immediately before the Pleistocene Ice age, and *Mya truncata* only was existing there as a living myarian species.

After the last glaciation, according to HESSLAND (1946), *Mya arenaria* re-appeared on the eastern coast of the Atlantic and quickly spread as far as the Baltic, it was indeed just a few hundred years ago, most probably with

the aid of ships after America was discovered.

Further, *Mya arenaria* now living in San Francisco Bay is now believed in general to have been quickly spreading where in connection with the planting of Oyster from Virginia.

In the sea around the Japanese islands *Mya japonica oonogai* are abundantly living which may be probably conspecific with *M. arenaria* as has already been stated. In Japan, however, this species is to be found not only as a living species but also it is found from the geological formations, ranging from the Miocene, Pliocene, Pleistocene and Holocene; therefore it is improbable that it may be newly introduced from far distant seas. At least this seems true so far as most individuals are concerned, with exceptions which may unexpectedly have been transported by ships from America.

V. Localities for fossil and recent Myarian species

Eocene (Fig. 1)

1. Koguchi-no-sawa, a small tributary of the Panke river, Shimizusawa, Yūbari City, Central Hokkaido. Geological horizon: The lowest Wakkanabe Formation of the Ishikari Group. (NAGAO & INOUE 1941)
2. Sankō-no-sawa, Akabira City, C. Hok. (from the boring cores of the Sumitomo Coal Mining Co, Ltd.) Wakkanabe F. (FUJIE 1957)

Oligocene (Fig. 2)

1. Matchgar, Schmidtt Peninsula, North Saghalin, USSR. Beds of I-III and V. (MAKIYAMA 1934)
2. Neighbourhood of Oite-machi, Tomarioru-machi and Kushunnai-machi, Ujiro District, South Saghalin, USSR. Nissakutan F. (UWATOKO & TAKEDA 1938)
3. Rettan-gawa, Konotoro-machi, Noda District, S. Saghalin, USSR. Nissakutan F. (TAGAMI & ŌSUGI 1938)
4. Neighbourhood of Maoka-machi, District, S. Saghalin, USSR. Nissakutan F. (TAGAMI & TAKEDA 1937)
5. Upper stream of the Shiinai-gawa, Naihoro-machi, Honto District, S, Saghalin, USSR. Nissakutan F. (ISHIZAKI & SAKAKURA 1938)
6. Sōsyubetsu-zawa, Tappu-machi, Obira-mura, Rumoe District, Rumoe Province, N-W. Hok. Tappu F. (NAGAO & INOUE 1941; TSUSHIMA et al 1958)
7. Lower stream of the Pon-shitakara-gawa and the upper stream of the Shitakara river, Yūbetsu Coal Mine, Akan-machi, Akan District, Kushiro Prov., E. Hok. Shitakara F. (NAGAO & INOUE 1941; MATSUI et al. 1953; FUJIE 1957; MIZUNO & HYAKKOKU 1960)
8. Migi-nigō-zawa, a tributary of the Shoro river; lower stream of the Shikereppe-gawa and main stream of the Shoro river: Takinoue, Shiranuka-machi, Shiranuka District, Kushiro Prov., E. Hok. Shitakara F. (MITANI & FUJIE 1954)
9. Lowest stream of the Shoro river, Chinomi, Shoro, Shiranuka-machi, Shiranuka District, Kushiro Prov., E. Hok. Shitakara F. (FUJIE 1957)
10. Neighbourhood of Kamiatsunai Station, Urahoro-machi, Tokachi District, Tokachi Prov., E. Hok. Shitakara F. (ISHII 1957)
11. Niseikeshomanai-gawa, a tributary of the upper stream of the Honbetsu river, Honbetsu-machi, Nakagawa District, Tokachi Prov., E. Hok. Green Sandstone F. of the Onbetsu

Group. (MITANI et al. 1958)

12. Dainoyama, Yumoto City; Asamiyama and Okegasaku, Tsuzuura-machi, Uchigo City; Yamadakominato and the seaside of north Yotstkura-machi; in all Ishiki District: the entrance of a rail-way tunnel in the west side of the Higashi-Nihon Coal Mining Co. Ltd., Hirono-machi; Amaga-zawa, Koyamada; Shinyashiki; Oosa and Koosa, Oosa-mura; the Gokō of the Hirono Coal Mining Co. Ltd., Ōsaka; Yamadaoka; the entrance of a tunnel of the Tatta Coal Mining Co. Ltd., Tatta-mura; Naraba-machi; in all Futaba District: Fujiwara, Jōban City; Fukushima Prefecture. Asagai F. (YOKOYAMA 1924; MAKIYAMA 1934; NAGAO & INOUE 1941; HIRAYAMA 1955; FUJIE 1957)
13. Tomita, Chichibu City, Saitama Pref. Akabira F. (WATANABE et al. 1950)
14. Hotate-iwa, west side of Cape Shiriha, Akkeshi District, Kushiro Prov., E. Hok. The lower part of the Urahoro Group. (MINATO et al. 1952; MATSUI et al. 1953)

Miocene (Fig. 3)

1. Vicinity of Uengeri, east side of N. Saghalin, USSR. Okobikai and Dagi F. (KIRITANI 1936)
2. Aton-gawa, a west tributary of the Poronai river, Shikka District, S. Saghalin, USSR. Honto Group. (ŌISHI & MATSUMOTO 1938)
3. Upper stream of the Yamukai-gawa, Yamukai; upper stream of the Higashirebun-gawa, Higashirebun; upper stream of the Kashiho-gawa, Kashiho: Motodomari District, S. Saghalin, USSR. Honto Group. (ISHIZAKI 1937; NAGAO & INOUE 1941)
4. Raichishi-gawa, Raichishi; Chinnai-gawa, Chinnai; Ujiro District, S. Saghalin, USSR. Noda F. (UWATOKO & SONOKI 1937)
5. Neighbourhood of Kushunnai-machi, west coast of S. Saghalin, USSR. Kushunnai and Sandy shale F. (WATANABE 1936)
6. Oite-gawa, Oite-machi, Tomarioru District, S. Saghalin, USSR. Naihoro Coal bearing F. (UWATOKO & TAKEDA 1938)
7. Outcrop 1 km west of the Takinosawa tunnel, Toyoma rail-way; the confluence of the Shimizu-gawa and Nakano-gawa: Shimizu-mura, Maoka District, S. Saghalin, USSR. Shirahimeyama Sandstone and Upper Hachōrei hard shale F. (INAI & SEKI 1933)
8. A small river in vicinity of Tomiiso, eastern part of Wakkanai City, N. Hok. Onishibetsu F. (OSANAI et al. 1959)
9. Sea shore of Higashiura, eastern part of Wakkanai City, N. Hok. Magaribuchi and Onishibetsu F. (OSANAI et al. 1958)
10. Upper stream of the Haboro-gawa; upper stream of the Chikubetsu-gawa; main stream of the Chikubetsu-gawa of Chikubetsu Coal Mine; main stream of the Haboro-gawa in Haboro-machi: Haboro-machi, Tomamae District, Rumoe Prov., N-W. Hok. Chikubetsu F. (YOKOYAMA 1927 a; FUJIE 1957)
11. Sea side of west part of Kotanbetsu, Tomamae-machi, Tomamae District, Rumoe Prov., N-W. Hok. Chikubetsu F. (TSUSHIMA et al. 1954)
12. Shimokinebetsu-mura, Rumoe District, Rumoe Prov.; Horoshin-zawa, Horoshin, Numata-machi, Uryū District, Sorachi Prov., N-W. and C. Hok. Horoshin F. (NAGAO & INOUE 1941; FUJIE 1957)
13. Neighbourhood of the Ōwada Coal Mine, Rumoe City, N-W. Hok. Tōgeshita F. (FUJIE 1957)
14. Upper stream of the Pon-subetsu-gawa, Tsukigata-machi, Kabato District, Sorachi Prov., C. Hok. Pon-subetsu F. (KAKIMI & UEMURA 1958)
15. Atsunai, Urahoro-machi, Tokachi District, Tokachi Prov., E. Hok. Atsunai F. (MINATO

et al. 1957)

16. Gabari, Monbetsu-machi, Saru District, Hidaka Prov., S. Hok. "Oiwake F." (NAGAO & INOUE 1941)
17. Upper stream of the Monbetsu-gawa, Hirotomi, Monbetsu-machi; neighbourhood of Biratori-machi; Ussapu, Hidaka-mura: Saru District, Hidaka Prov.; Niwan, Hobetsu-mura, Yūfutsu District, Iburi Prov., S. Hok. Kawabata, Sakae and Furanui F. (NAGAO & INOUE 1941; IMAI & SUMI 1957; YOSHIDA et al. 1959)
18. Hotatebuchi, Hitotsumori and Akaishi, Ajigazawa-machi, Nishi-tsugaru District, Aomori Pref. Chiganoura F. (NOMURA 1935 a)
19. Anaushi and Koiwai, Kita-nisatsutai; Matsukura, Nisatsutai: Fukuoka-machi, Ninohe District, Iwate Pref. Yotsuyaku and Kadonosawa F. (CHINZEI 1958 b; HATAI 1940)
20. Vicinity of Shizukuishi-machi, Iwate District, Iwate Pref. Yamatsuda and Orose F. (KITAMURA 1958)
21. Nakanoshima and Ajiri, Shiogama City, Miyagi Pref. Chiganoura F. (NOMURA 1935)
22. Vicinity of Oguni-machi, Nishi-okitama District, Yamagata Pref. Sandy tuff F. (NOMURA & HATAI 1936)
23. Tōzenji, Yuami, Sekimoto-machi, Kitaibaragi City, Ibaragi Pref. Shirado F. (YOKOYAMA 1925 a)
24. Hagino, Takasato-mura, Kanuma District, Fukushima Pref. Hitosao F. (NOMURA 1934)
25. Nodani, Nō-machi, Nishi-kubiki District, Niigata Pref. A formation of Miocene age. (MORISHITA 1960)
26. Ichinokaya, Nishinomasa, Shimonida-machi, Kanra District, Gunma Pref. A formation of Miocene (?) age. (YOKOYAMA 1926 a)
27. Kantin and Kissyu, Myongchon, North Hamgyeng, N. Korea. Kantin shale and Heiroku F. (MAKIYAMA 1936; HATAI 1952)
28. Kilchu, North Hamgyeng, N. Korea. Kantin shale F. (MAKIYAMA 1936; HATAI 1952)
29. Takinoue, Yūbari City, C. Hok. Takinoue F. (MINATO et al. 1950; FUJIE 1957)
30. Hitaka, Sakaino-sawa, Ikari and Tsushiri-gawa, Nakajō-mura; Shigarami, Togakushi-mura; Iimori, Naniai-mura; Higashi-hosoo, Koshimichi, Shinshū-shin-machi; in entire Kamiminochi District: Nakano-sawa, Chimi, Miasa-mura, Kita-azumi District; Yasuga, Ōoka-mura, Sarashina District and Yamadanaka, Odagiri, Nagano City: throughout Nagano Pref. Ogawa F. (YOKOYAMA 1925 a; KURODA 1931; TANAKA 1960)
31. Akasaki, Nima-machi, Nima District, Shimane Pref. Kawai F. (MASUDA 1959)
32. Arakawa Bridge Arakawa-mura, Chichibu District, Saitama Pref. Matsuida F. (WATANABE et al. 1950)
33. Uttsu-gawa, Enbetsu-machi, Teshio District, Rumoe Prov., N-W. Hok. Wakkanai F. (YOKOYAMA 1926 b)
34. Outcrop 2 km southeast of Kamikurosawa, Sannai-mura, Hiraka District, Akita Pref. Kurosawa F. (OTUKA 1941)
35. Outcrop 1 km west of the Ginzan Hot spring; Yukizawa, Nobezawa and Wagō: Osarizawa City, Yamagata Pref. Yūhino-zawa, uppermost stream of the Narusa-gawa, Onoda-machi, Kami District, Miyagi Pref. Ginzan and Isozawa F. (SHŌJI 1954; TAGUCHI 1960)
36. A tributary of the Shira-kawa and the Utsu Pass, Iide-machi, Nishiokitama District, Yamagata Pref. Utsutōge F. (MINAGAWA 1959)
37. Wahei, Tsukioka and Sengokuzaki, Otari-mura, Kitaazumi District, Nagano Pref. Shigarami F. (Research Group for Himekawa Region 1958)
38. Shiobara, Shioya District, Tochigi Pref. Zones III and IV. (YOKOYAMA 1926 c)
39. Horonai-zawa, Tokoro-machi, Tokoro District, Abashiri Prov., N-E. Hok. Tokoro F.

(NAGAO & INOUE 1941; FUJIE 1957)

40. Muranokubo, Rokkashō-mura, Kamikita District, Aomori Pref. Takanoko F. (AOKI 1959 b)
41. Uppermost stream of the Pankemoyūparo-gawa, Yūbari City, Sorachi Prov., C. Hok. Ninyū Coal-bearing F. (OSANAI et al. 1958)
42. Road cutting about 700 meters from the entrance of Ago, Hisai-chō, Isshi District, Mie Pref. Kaisekizan F. (ARAKI 1960)

Pliocene (Fig. 4)

1. Neighbourhood of Chayuo Bay, Boatashin, east coast of N. Saghalin, USSR. Nuto F. (KIRITANI 1936)
2. Neighbourhood of Nuiuo Bay, Uini, east coast of N. Saghalin, USSR. Nuto F. (KIRITANI 1936)
3. Nitaki and Sane-zawa, Sane District, S. Saghalin, USSR. Nokoro and Mirukunai F. (SASA & NISHIDA 1937)
4. Lower stream of the Yamukae-gawa and Hokuenkotan-gawa, Motodomari District, S. Saghalin, USSR. Maruyama F. (ISHIZAKI 1937)
5. Sea side of Isara; Kotan-gawa and a tributary of the Chinnai-gawa: Ujiro District, S. Saghalin, USSR. Maruyama F. (UWATOKO & SONOKI 1937)
6. Kawakami Hot spring, Toyokita; Tomooka-gawa and Maruyama-gawa, a tributary of the Ootani-gawa, Hirono; Toyohara District, S. Saghalin, USSR. Maruyama F. (YOKOYAMA 1929; INAI 1937)
7. Daini-yayoi-bashi, Kamiotoyo; Kanenari-zawa, Kitatoyosakae: Rutaka-machi, Rutaka District and Ōurashima-zawa, Mizuho, Shimizu-mura, Maoka District, S. Saghalin, USSR. Maruyama F. (INAI & SEKI 1938)
8. The cliffs of the Tokushibetsu and Shibyūtan-gawa, Shibyūtan, Utanobori-mura, Esashi District, Sōya Prov., N. Hok. Shibyūtan F. (UOZUMI & FUJIE 1960)
9. Railway cut near Kotan station; Okiyokunnai-zawa, Yūbetsu Coal Mine: Akan-machi, Akan District, Kushiro Prov., E. Hok. Honbetsu F. (MATSUI et al. 1953; FUJIE 1957; MIZUNO & HYAKKOKU 1960)
10. Tributaries of left side of the Akubetsu-gawa; Upper and middle stream of Saienai-zawa; Upper stream of left side of the Akan river from Akubetsu to Saiyanai; the cliff at the confluence of the Akubetsu-gawa and the Akan river: Akubetsu, Akan-machi, Akan District, Kushiro Prov., E. Hok. Honbetsu F. (FUJIE 1957)
11. Main stream of the Urahoro-gawa in south Shimo-kawakami, Kiroroppe, Urahoro-machi, Tokachi District; a right tributary of the Honbetsu-gawa, Honbetsuzawa, Honbetsu-machi, Nakagawa District: Tokachi Prov., E. Hok. Rawan Aglomerate Sandstone F. of the Tokachi Group. (MITANI et al. 1959)

12 and 13. Kenebetsu-gawa, Ikeda-machi, Nakagawa District, Tokachi Prov., E. Hok. The Higashidai Group. (ODA et al. 1958)

14. Road side cutting along the Tokachi river, Kamishihoro, Otofuke-machi, Katō District, Tokachi Prov., E. Hok. Ikeda F. (NAGAO & INOUE 1941)
15. Onnekeruppuchi and Makubetsu Coal Mine, Makubetsu-machi, Nakagawa District, Tokachi Prov., E. Hok. Unknown. (may be Pliocene Age) (YOKOYAMA 1931)
16. Atsuga, Monbetsu-machi, Saru District, Hidaka Prov., S. Hok. Atsuga F. (MATSUNO & YAMAGUCHI 1958; YAMAGUCHI 1958)
17. 1.5 km northwest of Atsuga, Monbetsu-machi, Saru District, Hidaka Prov., S. Hok. Lower part of the Takigawa F. (NAGAO & INOUE 1941)

18. Vicinity of Enbetsu-machi, Teshio District, Teshio Prov., N. Hok. Bed A. (may be Yūchi F.) (YOKOYAMA 1926 b)
19. The sea side of Chikubetsu, Haboro-machi, Tomamae District, Rumoe Prov., N-W. Hok. Enbetsu F. (MATSUNO & YAMAGUCHI 1955)
20. Main stream of the Uryū-gawa, southwest of Tadoshi-machi, Uryū District, Sorachi Prov., C. Hok. Takigawa F. (NAGAO & INOUE 1941; SUZUKI 1953)
21. Cliffs of the Sorachi river, Naka-akabira, Akabira City, C. Hok. Takigawa or Horokura F. (YOKOYAMA 1931; NAGAO & INOUE 1941; FUJIE 1957; KOBAYASHI et al. 1957)
22. Hachigōsen-zawa, Shintotsukawa-mura, Kabato District, Sorachi Prov., C. Hok. The Fukagawa Group. (KOBAYASHI et al. 1957)
23. Cliff of the Shiribeshi river, about 1 km west of Konbu-machi, Abuta District, Shiribeshi Prov., W. Hok. Kuromatsunai (?) F. (ŌBA 1956; FUJIE 1960)
24. Main stream of the Toshibetsu-gawa, west of Pirika, Imagane-machi, Setana District, Hiyama Prov., S-W. Hok. Setana F. (NAGAO & INOUE 1941; FUJIE 1957)
25. The sea side of Tomikawa, Kamiiso-machi, Kamiiso District, Oshima Prov., S-W. Hok. Kamiiso F. (FUJIE 1957, 1960)
26. The sea side of Ishimochinaya, Higashidōri-mura, Shimokita District, Aomori Pref. Hamada F. (KUWANO 1957)
27. Sunakomata, Higashidōri-mura, Shimokita District, Aomori Pref. Sunakomata F. (KUWANO 1958)
28. Dōgamae, Gonohe-machi; Shimodera, Nagawa-machi, Sannohe District, Aomori Pref. Togawa F. (CHINZEI 1958 a)
29. Gōroku, Sendai City; Azukijima, Natori City: Miyagi Pref. Tatsunokuchi F. (MATSUMOTO 1930; NOMURA et HATAI 1936; NOMURA 1938)
30. Iguchi, Toyata, Sakegawa-mura, Mogami District, Yamagata Pref. Matsuzawa F. (NOMURA & ZINBŌ 1937)
31. Ōsawa, Hyūga, Atsumi-machi, Nishi-tagawa District, Yamagata Pref. Sandy shale Bed. (NOMURA 1937)
32. Kengazawa, Tochio and Urakara, Muika-machi, Minami-uonuma District, Niigata Pref. Kaizume F. (YOKOYAMA 1928)
33. Lower stream of the Chiroppu-gawa, west of Akan station, Akan-machi, Akan District, Kushiro Prov., E. Hok. Honbetsu F. (FUJIE 1960)
34. Main stream of the Horoshin-tachibetsu-gawa, about 2 km north of Hokuryū, Numata-machi, Uryū District, Sorachi Prov., C. Hok. Takigawa F. (FUJIE 1960)
35. The outcrop south west of Shōtonbetsu station, Nakatonbetsu-machi, Esashi District, Sōya Prov., N. Hok. "Takigawa F." (FUJIE 1960)
36. Yoshida-zawa, a tributary of the Paromauttsunai-gawa, Onuppunai, Horonobe-mura, Teshio District, Rumoe Prov., N-W. Hok. Yūchi F. (KANEHARA 1937)
37. Yagura-zawa, Jizōdō, Minami-shigara, Ashigarakami District, Kanagawa Pref. The Ashigara Group. (NOMURA & NIINO 1932)
38. Ōno, Yasuda-mura, Aki District, Kōchi Pref. Tonohama F. (YOKOYAMA 1926 d)
39. Aburajima, Hanaizumi-machi, Nishi-iwai District, Iwate Pref. Tatsunokuchi F. (HATAI & YAMAMOTO 1940)

Pleistocene (Fig. 5)

1. Sanno-sawa, Chitose-mura, Ōdomari District, S. Saghalin, USSR. Pleistocene F. (MURAYAMA 1933)
2. Shishinai, Tōbetsu-machi, Ishikari District. Ishikari Prov., C. Hok. Shishinai F. (ŌINO-

MIKADO 1937; NAGAO & INOUE 1941; FUJIE 1958; KAKIMI 1958)

3. Neighbourhood of Pleistocene tableland, suburbs of Kushiro City, E. Hok. Kushiro F. (NATORI 1958; FUJIE 1960)
4. Tsumuki, Akasaki, Himi City, Toyama Pref. Pleistocene F. (ŌTUKA 1935)
5. Kikuna, Ichikawa City, Chiba Pref. Pleistocene F. (YOKOYAMA 1927 c)
6. Kuruma-chō, Minato Ward, Tokyo City. Pleistocene F. (YOKOYAMA 1927 b)
7. Tonami and Ikobe, Toyohashi City, Aichi Pref. Pleistocene F. (YOKOYAMA 1926 e)
8. Takamatsu, Akabane-mura, Atsumi District, Aichi Pref. Pleistocene F. (ŌINOMIKADO 1934; MAKIYAMA & NAKAGAWA 1940)
9. Chūgenbaru, Sadowara-machi, Miyazaki District, Miyazaki Pref. Pleistocene F. (TAKEYAMA 1934)
10. Shironouchi, Inazai-machi, Inba District, Chiba Pref. Narita F. (KOJIMA 1958)
11. A drain of Shin-nakagawa, Isshiki-machi, Edogawa Ward, Tokyo City. Ichikawa shell F. (KOJIMA 1956)
12. Ishikawa, Tokumaruhon-machi, Itabashi Ward, Tokyo City. Tokumaru shell F. (FUKUDA & ANDŌ 1951)

Holocene (Fig. 6)

a) Alluvial deposits.

45. Ōmagari, north of Lake Abashiri, Abashiri City, N-E. Hok. (MINATO et al. 1953; FUJIE 1957)
54. St. 5, 6 and 10 of Nakanosu-jima, Matsukawa-Ura, Sōma City, Fukushima Pref. (KOTAKA et al. 1955)
58. Dejima, Nishihamano-machi and Takenokubo, Nagasaki City, Kyūshū. (KAMADA 1957)

b) Shell mounds.

43. Shumshu Island, northern part of Kurilskie Arch, USSR. (FUJIE 1957)
44. Moyoro shell mound, north of Abashiri City, N-E. Hok. (YONEMURA 1950)
46. and 51. Kushiro shell mound, Beppo, suburb of Kushiro City, E. Hok. (FUJIE 1960; OKAZAKI 1960)
47. Kudanshita, Chiyoda Ward, Tokyo City. (TSUKAMOTO 1936)

With the exception of above mentioned, the various localities are reported by MATSUSHIMA (1907) and SAKAZUME (1952) from Yokohama City and around Tokyo Bay.

53. Usu and Wakkaoi, Date-machi, Usu District, Iburi Province, S-W. Hok. (NATORI & MINEYAMA 1957)
60. Loc. No. 2, Yanaizu-machi, Matsunaga City, Hiroshima Pref. Shimoseko Shell mound. (YOSHIOKA 1960)

c) Recent.

1. Paramushir Island, northern part of the Kurilskie Arch, USSR. (FUJIE 1957)
2. The sea shore of Chelocgofuks, west coast of S. Saghalin, USSR. (NAGAO & INOUE 1941)
3. The sea shore of Kushunnai, west coast of S. Saghalin, USSR. (FUJIE 1957)
4. The sea shore of Holumusk, west coast of S. Saghalin, USSR. (FUJIE 1957)
5. Shikotan Island, southern part of the Kurilskie Arch, USSR. (FUJIE 1957); the sea shore Nemuro City, E. Hok., Japan. (HABE 1955)
6. Lake Saroma, Abashiri Prov., N-E. Hok. (KINOSHITA 1935)
7. The sea shore of Tokoro-machi, Tokoro District, Abashiri Prov., N-E. Hok. (FUJIE 1957)

8. Kojima, Kiritappu-mura, Akkeshi District, Kushiro Prov., E. Hok. (FUJIE 1957)
9. Shinryū, Akkeshi-machi, Akkeshi District, Kushiro Prov., E. Hok. (HABE 1955; FUJIE 1957)
10. The sea shore of Urakawa-machi, Urakawa District, Hidaka Prov., S. Hok. (FUJIE 1957)
11. The sea shore of Monbetsu-machi, Saru District, Hidaka Prov., S. Hok. (FUJIE 1957)
12. The sea shore of Mōrai, Atsuta District, Ishikari Prov., C. Hok. (FUJIE 1957)
13. The sea shore of Takashima, Otaru City, C. Hok. (KINOSHITA & ISAHAYA 1934)
14. Muroran Bay, Muroran City, S-W. Hok. (HABE 1953; FUJIE 1957)
15. The sea shore of Utsujiri-mura, Kayabe District, Oshima Prov., S-W. Hok. (KINOSHITA & ISAHAYA 1934)
16. The sea shore of Aburakawa, Yauchi, Yunoshima, Kamome-jima, Moura, Futago and Ōshima; the sea shore of Noheji-machi, Kamikita District: south of Mutsu Bay, Aomori Pref. (TAKATSUKI 1927; OTUKA 1935; YAMAMOTO & HABE 1959)
17. The sea shore of Tannōji, Hirota-machi, Rikuzen-takada City, Iwate Pref. (NOMURA & HATAI 1935)
18. The sea shore of Mawaridate of Ōshima and Iwaizaki, Kesennuma City, Miyagi Pref. (NOMURA & HATAI 1935; FUJIE 1957)
19. The sea shore of Mankokuura and Watanoha-machi, Ojika District, Miyagi Pref. (Miyagi Fish. Res. 1917)
20. Matsushima Bay, Miyagi District, Miyagi Pref. (Miyagi Fish. Res. 1917; OTUKA 1935; TANIDA et al. 1956)
21. The sea shore of Inage, Chiba City, Chiba Pref. (Chiba Fish. Res. 1952)
22. The sea shore of Ōmori, Shinagawa ward, Tokyo City. (MATSUSHIMA 1907 a); Shimoda-machi, Kanagawa Ward, Yokohama City. (SAKAZUME & SERIZAWA 1938)
23. The sea shore of Misaki City, Miura Peninsula, Kanagawa Pref. (MATSUSHIMA 1907 c); Kurihama Bay, Yokosuka City, Kanagawa Pref. (OKUTANI 1959)
24. Arari Bay, Kamo-machi, Kamo District, Shizuoka Pref. (TSUCHI 1959)
25. South coast of Toyama Bay, Toyama Pref. (OTUKA 1935)
26. Benten-jima, south of Lake Hamana, Hamana District, Shizuoka Pref. (OGURI 1932); St. 11, 13 and A, south of Hamana Lake, Shizuoka Pref. (TSUCHI 1957)
27. The sea shore of Toyatsu, Kawage-machi, Aki District, Mie Pref. (KANAMARU 1929)
28. The sea shore of Aboshi-machi, Himeji City, Hyōgo Pref. (ŌKAMI 1908)
29. The sea shore of Awaji-shima and Ōsaka Bay, Hyōgo and Ōsaka Pref. (YAGURA 1932)
30. The sea shore of Shōzu-jima, Kagawa Pref., Shikoku. (HATAKEDA 1936)
31. The sea shore from Takashima, Kojima City to Kurosaki, Tamashima City, Okayama Pref. (Okayama Fish. Exp. Sta. 1927; MIYAZAKI 1957)
32. The sea shore of Fukuyama City, Hiroshima Pref. (FUJIE 1957)
33. The sea shore of Niihama City, Ehime Pref. (HIRASE 1934; KURODA & HATAI 1952; MIYAZAKI 1957)
34. The sea shore of Tosa Bay, Kōchi Pref., Shikoku (MATSUSHIMA 1907 b)
35. The sea shore of Miya-jima, Itsuku-shima, Saeki District, Hiroshima Pref. (INABA 1941)
36. The sea shore of Yanai City, Yamaguchi Pref. (KAWAMOTO 1930)
37. The sea shore of Mitajiri and Murei, Bōfu City, Yamaguchi Pref. (INOUE & KAMIMATSU 1951)
38. The sea shore of Takadomari, west of Onoda City and the sea shore of Hani, Sanyō-machi, Asa District, Yamaguchi Pref. (NAGATOMI 1933; NAGAO & INOUE 1941; INOUE & KAMIMATSU 1951; INOUE 1953)
39. The sea shore of Shimonoseki City, Yamaguchi Pref. (INOUE & KAMIMATSU 1952)

40. The sea shore of Nagasaki City, Nagasaki Pref. (FUJIE 1957)
41. The sea shore of Tomioka, Reihoku-machi, Amakusa District, Kumamoto Pref., Kyūshū. (HABE & KIKUCHI 1960)
42. Chinhaeman Bay and the offing of the Somjin river, south Kyengsang, S. Korea. (YOSHIDA 1938)
48. The mouth of the Koitoi-gawa, Koitoi, Wakkanai City, N. Hok. (ASAHINA 1942)
49. Lake Mokoto, Abashiri City, N-E. Hok. (ASAHINA 1940)
50. Yūdō Lake, Toyokoro-mura, Nakagawa District, Tokachi Prov., E. Hok. (ASAHINA 1943)
52. Saghalin Bay, northern Saghalin, USSR. (MAKIYAMA 1935)
55. Usu Bay, Date-machi, Usu District, Iburi Province, S-W. Hok. (FUJIE 1960)
56. The sea shore of Ozame, Rokkasho-mura, Kamikita District, Aomori Pref. (AOKI 1959 a)
57. The sea shore of Wakura, south of Nanao Bay, Nanao City, Ishikawa Pref. (ITŌ 1954)
59. St. 18 of 10 km off Shimabara City, Ariake Bay, Kyūshū. (HABE & TANAKA 1959)

Locality numbers of recent species

Nos. 5 and 10 . . . . . *Mya truncata.*
Nos. 1 to 5, 7 to 11, 14, 16, 43, 52 and 55 . . . . *Mya japonica.*
Nos. 6, 7, 9, 12 to 15, 17 to 42, 44 to 51, 55 to 57 and 59 . . . . . *Mya japonica oonogai.*

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References

ABBOTT, R. T. (1954): *American Seashells*; D. Van Nostran Com. Ltd., pp. 454–5, pl. 32, figs. v and x.

AOKI, S. (1959 a): *Recent Molluscan Shells from the Shimokita Peninsula, Northern Honshū, Japan* (1); Miscellaneous Rep., Inst., Nat. Resources, No. 50, p. 36. (in Japanese)

——— (1959 b): *Miocene Mollusca form the Southern Part of the Shimokita Peninsula, Aomori Pref., Japan*; Sci. Rep., Tokyo Kyōiku Daigaku sec. C, No. 57, pp. 257 and 276, pl. 3, figs. 16, 17, 23 and 24.

ARAKI, Y. (1960): *Geology of the Tertiary Formations Developed in the Environs of Tsu City, Mie Pref., Japan*; Bull Lib. Arts Dep. Mie Univ., special volume, No. 1, pp. 102–3, pl. 8, figs. 3a–c.

ARNOLD, R. (1907): *New and Characteristic Species of Fossil Mollusks from the Oil-bearing Tertiary Formation of Southern California*; U.S. Geol. Surv., No. 309, p. 527, pl. 40, fig. 1.

——— (1909): *Paleontology of the Coalinga District Presno and Kings Co., California*; Bull. U.S. Geol. Surv., No. 396, p. 30, pl. 29, figs. 7, 8.

ASAHINA, E. (1940): *Bottom Fauna of a Brackish Water Lake, Mokoto-numa, Hokkaido*;

Jour. Zool. Soc., Japan, Vol. 52, No. 4, p. 162. (in Japanese)

——— (1942): *Ecological reconnaissance of the Brackish Waters of Northern Hokkaido*; Jap. Jour., Limnology, Vol. 12, No. 3, p. 105. (in Japanese)

——— (1943): *Bottom Animals of the Brackish Water Lakes in the Sea Coast of Tokachi, Hokkaido*; Jour. Zool. Soc., Japan, Vol. 55, No. 4, pp. 137–154. (in Japanese)

BELDING, D. L. (1931): *The Soft-shelled Clam Fishery of Massachusetts*; Marine Fish. Series No. 1, pp. 65.

Chiba Fish. Exp. Sta. (1952): *The list of Distributions of Mollusks from Chiba Prefecture*; Rep. Chiba Fish. Exp. Sta. (a mimeographic note)

CHINZEI, K. (1958 a): *Pliocene Stratigraphy of the Northern End of the Kitakami Mountains, North-eastern Japan (3)*; Jour. Geol. Soc., Japan, Vol. 64, No. 757, p. 532. (in Japanese)

——— (1958 b): *On the Neogene Formations in the Vicinity of Fukuoka-machi, Iwate Pref. (1)*; Jour. Geogr., Japan, Vol. 67, No. 707, p. 5. (in Japanese)

CLARK, B. L. (1915): *Fauna of the San Pablo group of Middle California*; Univ. Calif. Publ. Geol., Vol. 8, No. 478, pl. 63, figs. 3 and 4.

——— (1932): *Fauna of the Poul and Yakataga formations of Northern Alaska*; Bull. Geol. Sci., America, Vol. 43, p. 822, pl. 17, figs. 3, 4 and 8.

DALL, W. H. (1898): *Tertiary Fauna of Florida*; Tans. Wagner Free Inst. Sci., Phil., Vol. 3, pt. 4, pp. 857–8.

EKMAN, S. (1953): *Zoogeography of the Sea*; Text Books of Animal Biology, Sidgwick & Jackson Co. Ltd., London, pp. 107, 119, 127–8.

FEYLING-HANSSEN, R. W. (1955): *Stratigraphy of the Marine Late-Pleistocene of Billefjorden, Vestspitsbergen*; Norsk Polarinstitutt Skrifter, Nr. 107, pp. 185, pl. 25.

FIEDLER, R. H. (1938): *Fisheries Industries of the United States, 1936*; Bureau of Fish. Administrative Rep. No. 27.

FORBES, E. (1846): *Catalogue of species of Marine Animals, the remains of which are found Fossil in beds of the Glacial Epoch*; Mem. Geol. Surv., Great Britain Mus., Econ. Geol., Vol. 1, pp. 407.

FOSTER, R. W. (1946): *The Genus Mya in the Western Atlantic*; Johnsonia, Vol. 2, No. 20, pp. 29–35, 5. pls.

FUJIE, T. (1957): *On the Myarian Pelecypods of Japan (1)*; Jour. Fac. Sci., Hokkaido Univ., ser. 4, Vol. 9, No. 4, pp. 381–413, 8 pls.

——— (1958): *Pleistocene Molluscan Fossils (Pelecypod) from the Shishinai Formation, Hokkaido*; Cenozoic Res., No. 28, pp. 42–3, pl. 28, fig. 22. (in Japanese)

——— (1960): *Localities of genus Mya from Hokkaido and Others*; (Manuscript)

FUKUDA, O. and ANDŌ, Y. (1951): *On the Tokumaru Shell Bed*; Jour. Geol. Soc., Japan, Vol. 57, No. 670, p. 258. (in Japanese)

GANONG, W. F. (1889): *Economic Mollusca of Acadia*; Bull. Nat. Hist. Soc., New Brunswick, No. 8, pp. 97–104.

GRANT, U. S. and GALE, H. R. (1931): *Catalogue of the Marine Pliocene and Pleistocene Mollusca of California*; Mem. San Diego Soc., Nat. Hist., Vol. 1, pp. 412–5, pl. 21, fig. 13.

GREWINGKI, C. (1850): *Beitrag zur Kenntniss der oregraphischen und geognotischen Beschaffenheit der Nord-West-Küste Amerikas mit den anliegenden Inseln*; Vrhandlungen der Mineral. Gesellschaft zu St. Petersburg, für die Jahre 1848–1849, pp. 282–4, pl. 6, fig. 2 und 3.

HABE, T. (1952): *Genera of Japanese Shells, Pelecypoda*; Comm. Shell Literature Publ., No. 3, pp. 236–7, figs. 604, 605 and 612. (in Japanese)

——— (1953): *Sedimentation of Molluscan shells in Muroran Harbour and Volcano, Bay*; Cenozoic Res., No. 18, pp. 1–3. (in Japanese)

——— (1955): *Fauna of Akkeshi Bay*; Akkeshi Mar. Biol. Sta., No. 4, pp. 22–3, pl. 6, fig. 10 and 11, pl. 7, fig. 12.

——— and KIKUCHI, T. (1960): *Fauna and Flora of the Sea around the Amakusa Marine Biological Laboratory (1)*; Amakusa Mar. Biol. Lab., Kyūshū Univ., pp. 6 and 27.

——— and TANAKA, Y. (1959): *Molluscan Fauna of Ariake Bay*; Rep. Inv., Ariake Sea, No. 5, p. 14.

HATAI, K. (1940): *Oo Some Fossils from the Ninohe District, Mutsu Province, Northeast Honsyū, Japan*; Bull. Biogeogr. Soc., Japan, Vol. 10, No. 9, p. 131. pl. 1, fig. 9.

——— (1952): *On Some Lower Miocene Shells*; Short Papers, IGPS., No. 4, p. 72.

——— and YAMAMOTO, S. (1940): *Characteristic Features of the Yushima Molluscan Fauna*; Jour. Geol. Soc., Japan, Vol. 47, No. 566, p. 469.

HATAKEDA, K. (1936): *The Provincialism of Mollusca from the Shōzu Island*; Venus, Vol. 6, No. 2, p. 116. (in Japanese)

HESSLAND, I. (1946): *Arkiv för Zoologi, Stockholm*, Vol. 37, pt. 2, No. 8, pp. 1–51.

HIRASE, S. (1954): *A Handbook of Illustrated Shells*; Publ. Maruzen Co. Ltd., p. 122, pl. 52, fig. 7. (in Japanese)

HIRAYAMA, K. (1955): *The Asagai Formation and its Molluscan Fossils in the Northern Region, Jōban Coalfield, Fukushima Pref., Japan*; Sci. Rep. Tokyo Kyōiku Daigaku, sec. c, Vol. 4, No. 29, p. 108–9, pl. 3, figs. 21–4.

IMAI, I. and SUMI, H. (1957): *"Tomikawa" Explanatory Text Geol. Map of Japan*; Hokkaido Develop. Agency, p. 21. (in Japanese)

INABA, A. (1941): *Collections of Mollusca from Miya-jima, Hiroshima Pref.*; Venus, Vol. 10, Nos. 3–4, p. 188. (in Japanese)

INAI, Y. (1937): *Geology of the Region west of Toyohara*; Rep. Geol. Surv., Oil-field Karafuto, No. 4, pp. 113, 115–7. (in Japanese)

——— and SEKI, T. (1938): *Geology of the Rutaka river Area*; ibid., No. 5, pp. 112, 116 and 118. (in Japanese)

INOUE, Y. (1953): *Investigations on the Breeding in Shallow Water (3)*; Yamaguchi Inlands Sea Fish. Exp. Sta., Vol. 3, No. 2, p. 2. (in Japanese)

——— and KAMIMATSU, T. (1951): *Investigations on Breeding in Shallow Water (1)*; Yamaguchi Fish. Res. Inst., Vol. 3, No. 1, p. 8. (in Japanese)

——— (1952): ibid. *(2)*; Yamaguchi Inland Sea Fish. Exp. Sta., Vol. 3, No. 2, p. 2. (in Japanese)

ISHII, J. (1957): *Conglomerate of the Shitakara Formation in environs of Kamiatsunai, Ōtsu-mura, Tokachi Province in Hokkaido*; Bull. Geol. Comm., Hokkaido, No. 35, p. 9. (in Japanese)

ISHIZAKI, M. (1937): *Geology of Motodomari Region*; Rep. Geol. Surv., Oil-field Karafuto, No. 4, p. 81. (in Japanese)

——— and SAKAKURA, K. (1938): *Geology of the Region west of Notoro Peninsula*; ibid., No. 5, pp. 213–4. (in Japanese)

ITŌ, K. (1954): *A Catalogue of the marine Mollusca Shells collected on the coast of Wakura, Noto Peninsula*; Ann. Rep. Jap. Sea Regional Fish. Res. Lab., Vol. 1, No. 1, p. 103. (in Japanese)

JAY, J. C. (1856): *Report on the shells collected.····· together with a list of Japan shells*; M. C. PERRY's report on the United States Expedition to Japan, Vol. 2, p. 292, pl. 1, figs. 7 and 10.

JENSEN, A. S. (1901): *Studiew over nordiske Mollusker*; Medd. Naturh. Foren. København, pp. 139, 144, figs. 3–5, 6a–c.

KAKIMI, T. (1958): *"Ishikari" Explanatory Text Geol. Map of Japan*; Geol. Surv., Japan, p. 22. (in Japanese)

——— and UEMURA, T. (1958): *"Tsukigata" Explanatory Text Geol. Map of Japan*; Geol. Surv., Japan, p. 20. (in Japanese)

KAMADA, Y. (1957): *Molluscan Communities of the buried Recent Marine Deposits in Nagasaki City*; Bull., Fac. Lib. Arts Ed. Nagasaki Univ., No. 6, pp. 47–55.

KANAMARU, T. (1928): *Observations on the Coast of Ise Sea after a Storm*; Venus, Vol., 1. No. 5, p. 198. (in Japanese)

KANEHARA, K. (1937): *Pliocene Shells from the Teshio Oil Field, Hokkaido*; Jour. Palaeont. Soc., Japan, No. 41, p. 706.

KAWAMOTO, T. (1930): *The Previncialism of Mollusca from the Region East of Yamaguchi Pref.*; Venus, Vol. 2, No. 2, p. 94. (in Japanese)

KEEN, A. M. (1937): *An abridged Check List and Bibliography of west N. American marine Mollusca*; Stanford Univ., Press, p. 22.

KINOSHITA, T. (1935): *Molluscs of the Saroma Lake in Hokkaido*; Venus, Vol. 5, No. 1, p. 38. (in Japanese)

——— and ISAHAYA, T. (1934): *Catalogue of Mollusca in Hokkaido*; Rep. Fish. Exp., Hokkaido, No. 1, p. 18, pl. 14, fig. 103. (in Japanese)

KIRITANI, F. (1936): *On the stratigraphy of Oil Tertiary in North Saghalin (2)*; Jour. Jap. Assc., Petrol. Technol., Vol. 4, No. 1, pp. 18 and 29. (in Japanese)

KITAMURA, S. (1958): *On the Depositional Basin of Neogene Tertiary in Tōhoku Region, Japan*; Cenozoic Res. No. 26, p. 6. (in Japanese)

KOBAYASHI, I. et al. (1957): *"Takigawa" Explanatory Text Geol. Map of Japan*; Geol. Surv., Japan, pp. 21, 25 and 27. (in Japanese)

KOJIMA, N. (1956): *On the Ichikawa Shell Bed, Discovered in Ichikawa and Tokyo*; Jour. Geol. Soc., Japan, Vol. 62, No. 726, pp. 158–9. (in Japanese)

——— (1958): *On the Mode of Occurrence of Fossil Shells in the Narita Formation of the Kioroshi District, Chiba Pref., Japan (2)*; Jour. Geol. Soc., Japan, Vol. 64, No. 752, p. 216. (in Japanese)

KOTAKA, T., KAMADA, Y. and HAYASAKA, S. (1955): *Studies on the Ecology and Sedimentation of Matsukawa-Ura, Sōma City, Fukushima Pref.*; Inst. Geol. Paleont., Tōhoku Univ., No. 45, p. 62. (in Japanese)

KURODA, T. (1931): *Fossil Mollusca*; Geology of Central Shinano, pt. 4, pp. 63–5, pl. 8, fig. 55, pl. 9, figs. 57, 58 and 1 text fig. (in Japanese)

——— and HABE, T. (1952): *Check List and Bibliography of the Recent Marine Mollusca of Japan*; Publ. Hosokawa Print. Co. Ltd., p. 25.

KUWANO, Y. (1957): *Quaternary System of the Northern Part of Tanabu Lowland Area, Aomori Pref., Japan*; Miscellaneous Rep., Res. Inst., Nat. Resources, Nos. 43–4, p. 180. (in Japanese)

——— (1958): *Geology of the North-eastern Part of the Shimokita Peninsula*; ibid., Nos. 46–7, p. 33. (in Japanese)

MACGNITIE, N. (1959): *Marine Mollusca of Point Barrow, Alaska*; Proc. U.S. Nat. Mus., Vol. 109, No. 3412, pp. 184–8, pl. 25, figs. 1–5, pl. 19, figs. 6–8.

MACGNITIE, G. E. and MACGNITIE, N. (1949): *Natural History of Marine Animals*; McGraw-Hill Book Co. Ltd., pp. 330–1.

MACNEIL, F. S., MERTIE, J. B. and PILSBRY, H. A. (1943): *Marine invertebrate Faunas of the Buried Beach near Nome, Alaska*; Jour. Paleont., Vol. 17, No. 1, p. 93, pl. 16, fig. 3.

MAKIYAMA, J. (1934): *The Asagaian Mollusca of Yotukura and Matshgar*; Mem. Coll. Sci., Kyoto Imp. Univ., ser. B, Vol. 10, No. 2, pp. 156–9, pl. 7, figs. 50–3.

——— (1935): *The Fossils of genus Mya*; "Warera no Kōbutsu", Vol. 4, No. 3, pp. 135–9, 6 text figs. (in Japanese)

——— (1936): *The Meisen Miocene of North Korea*; Mem. Coll. Sci., Kyoto Imp. Univ., ser. B, Vol. 2, No. 4, pp. 200, 216 and 217.

——— and NAKAGAWA, T. (1940): *Pleistocene Foraminifera of Atsumi Peninsula*; Jour. Geol. Soc., Japan, Vol. 47, No. 564, p. 376. (in Japanese)

MASUDA, K. (1959): *Patinopecten imamurai Masuda N. Sp., from Shimane Pref., Japan*; Tras. Proc. Palaeont. Soc., Japan, N. S., No. 33, p. 8.

MATSUI, M., HURUHATA, Y. and FUJIE, T. (1953): *Geology of Yūbetsu Coal Mine, Kushiro Coal-Field, Hokkaido (1)*; Bull. Geol. Comm., Hokkaido, No. 22, pp. 1–29. (in Japanese)

MATSUMOTO, H. (1930): *On the Marine Fauna of Three fossil Zones of the Upper Miocene of Natori, Rikuzen*; Sci. Rep., Tōhoku Imp. Univ., ser. 2, Vol. 13. No. 3, p. 98, pl. 39, figs. 5–11.

MATSUNO, K. and YAMAGUCHI, S. (1955): *"Haboro" Explanatory Text Geol. Map of Japan*; Geol. Surv., Japan, p. 5. (in Japanese)

——— (1958): *"Shizunai" Explanatory Text Geol. Map of Japan*; ibid., p. 18. (in Japanese)

MATSUSHIMA, K. (1907 a): *List of Molluscs from Shinagawa*; Conch. Mag., Vol. 1, No. 3, p. 114. (in Japanese)

——— (1907 b): *Catalogue of Mollusca from Tosa*; ibid., Vol. 1, No. 5, p. 178. (in Japanese)

——— (1907 c): *Catalogue of Mollusca from Misaki*; ibid., Vol. 1, No. 9, p. 307, (in Japanese)

MINAKAWA, S. (1959): *Stratigraphical and Paleontological Studies on the Neogene Formations in the Surrounding Areas of the Yonezawa Basin (2)*; Jour. Geol. Soc., Japan, Vol. 65, No. 767, p. 490. (in Japanese)

MINATO, M., MATSUI, M. and UOZUMI, S. (1950): *On the Genus Mya from Hokkaido*; Cenozoic Research, No. 7, pp. 106–9, pl. 10. (in Japanese)

MINATO, M. et al. (1952): *Wann erschienen die Poronai-Faunen zum erstenmal?*; Proc. Japan Acad., Vol. 28, No. 7, p. 357.

———, KITAGAWA, Y., KUMANO, S. and SUGIYAMA, S. (1953): *Zur Entwicklung des Abashiri-Sees*; Jour. Fac. Sci., Hokkaido Univ., Vol. 8, No. 3, p. 260.

———, ISHII, J. and MATSUI, M. (1957): *On the Stratigraphical Positions of the Desmostylus-tooth found in Tokachi Province, Hokkaido*; Jour. Geol. Soc., Japan, Vol. 63, No. 740, p. 312. (in Japanese)

MITANI, K. and FUJIE, T. (1954): *Tertiary deposits of Takinoue Area, Shiranuka-gun, Kushiro Province*; Bull. Geol. Comm., Hokkaido, No. 27, pp. 7–9. (in Japanese)

———, OSANAI, H. and HASHIMOTO, W. (1958): *"Ashorobuto" Explanatory Text Geol. Map of Japan*; Hokkaido Develop. Agency, p. 14. (in Japanese)

MITANI, K. et al. (1959): *"Honbetsu" Explanatory Text Geol. Map of Japan*; ibid., pp.

46 and 47. (in Japanese)

Miyagi Fish. Exp. Sta. (1917): *Report on Spawning Season of Fish and Mollusca from Miyagi Pref.*; Rep. Miyagi Fish. Exp. Sta., pp. 128–30. (in Japanese)

MIYAZAKI, I. (1957): *The Breeding of Pelecypods*; Publ. Isana-Shobō, pp. 92–5, 1 text fig. (in Japanese)

MIZUNO, A. and HYAKKOKU, H. (1960): *"Yūbetsu" Explanatory Text Geol. Map of Japan*; Geol. Surv., Japan, pp. 20–1. (in Japanese)

MOFFIT, F. H. (1913): *Geology of the Nome and Grand Central Quadrangles, Alaska*; Bull. U. S. Geol. Surv., No. 533, pp. 45–6.

MORISHITA, A. (1960): *Biostratigraphy of Japanese Tertiary Echinoids*; Jour. Earth Sci. Nagoya Univ., Vol. 8, No. 1, p. 35.

MURAYAMA, K. (1933): *Geology of Ōdomari Region*; Rep. Geol. Surv., Oil-Field Karafuto, No. 2, p. 13. (in Japanese)

NAGAO, T. and INOUE, T. (1941): *Myarian Fossils from the Cenozoic deposits of Hokkaido and Karafuto*; Jour. Fac. Sci., Hokkaido Univ., Vol. 6, No. 273, pp. 143–158, 3 pls.

NAGATOMI, S. (1933): *Catalogue of Mollusca from Atsusa District, Yamaguchi Pref.*; "Yamaguchi-Ken-Kyōiku, No. 401, p. 5. (in Japanese)

NATORI, S. (1958): *Geology of Vicinity of Kushiro City*; A Graducation Thesis of Dept. of Geol. & Mineralogy Fac. Sci., Hokk. Univ., p. 35, (A Note in Japanese)

NATORI, T. and MINEYAMA, I. (1957): *Report of the Excavation of Wakkaoi Shell mound, Date-machi, Usu Disrict, Hokkaido*; Rep. Res. Northern Culture Hoppō-Bunka-Kenkyū), No. 12, p. 28. (in Japanese)

NEWCOMBE, C. L. (1935): *Growth of Mya arenaria in the Bay of Fundy Region*; Canadian Jour. Res., Vol. 13, No. 6, sec. D, pp. 97–137.

NOMURA, S. (1934): *Fossil Mollusca from the Vicinity of Ogino, Yama-gun, Fukushima-Ken*; Saitō Hō-on Kai Mus., Res. Bull., No. 5, p. 119, pl. 5, figs. 6 and 7.

——— (1935 a): *Miocene Mollusca from the Nishi-Tsugaru District, Aomori-Ken, Northeast Honshū, Japan*; ibid., No. 6, pp. 67–7.

——— (1935 b): *Miocene Mollusca from Shiogama, Northeast Honshū, Japan*; ibid., No. 6, p. 222, pl. 16, fig. 13.

——— (1937): *On Some Neogene Fossil Shells along the Upper Course of the Nikkogawa, Akumi-gun, Yamagata-Ken, Northeast Honshū, Japan*; ibid., No. 13, pp. 174–5.

——— (1938): *Molluscan Fossils from the Tatsunokuchi Shell Bed Exposed at Gōroku Cliff in the western Border of Sendai*; Sci. Rep., Tōhoku Imp. Univ., Vol. 19, No. 2, p. 266, pl. 35, figs. 14 and 15.

——— and HATAI, K. (1935): *Catalogue of the Shell bearing Mollusca Collected from the Kesen and Motoyosi District, Northeast Honshū, Japan, immediately after the Sanriku Tsunami, March 3, 1933, with Descriptions the Five New Species*; Saitō Hō-on Kai Mus., Res. Bull., No. 5, p. 19.

——— (1936): *Bathmetric Records of Marine Animals etc.*; ibid., No. 10, pp. 288–9 and 309.

——— and NIINO, H. (1932): *Fossil Mollusca from Izu and Hakone*; Sci. Rep. Tōhoku Imp. Univ., Vol. 15, No. 3, p. 187.

——— and ZINEŌ, K. (1937): *List of Neogene Mollusca Collected from the Vicinity of the Town Shinjō, Mogami*; Saitō Hō-on Kai Mus., Res. Bull. No. 13, p. 167, pl. 22, fig. 17.

ŌBA, Y. (1956): *Geology of Niseko Volcano, S-W. Hokkaido*; Graducation Thesis of Dept. of Geol. & Mineral., Fac. Sci., Hokkaido Univ. (A Note in Japanese)

ODA, S. et al. (1959): *"Tokomuro" Explanatory Text Geol. Map of Japan*; Geol. Surv., Japan, p. 28. (in Japanese)

OGURI, G. (1932): *Mollusca of the Hamana Lake*; "Seibutsu Kenkyū", No. 6, p. 28. (in Japanese)

ŌINOMIKADO, T. (1934): *Pleistocene Deposits of the Atsumi Peninsula*; "Chikyū", Vol. 20, No. 3, p. 168. (in Japanese)

——— (1937): *Molluscan Fossils from the Pleistocene Deposits of Shishinai in Tōbetsu-mura, Ishikari District, Hokkaido*; Jour. Geol. Soc., Japan, Vol. 44, No. 520, p. 66.

ŌISHI, S. and MATSUMOTO, T. (1938): *Geology of Keton Region*; Rep. Geol. Surv., Oil-Field Karafuto, No. 5, pp. 84 and 94. (in Japanese)

ŌKAMI, U. (1908): *Mollusca from Harima (3)*; Conch. Mag., Vol. 2, No. 10, p. 350. (in Japanese)

Okayama Fish. Exp. Sta. (1927): *Report of the Business in 1927*; Okayama Fish. Sta., pp. 112–6. (in Japanese)

OKAZAKI, Y. (1960): *Paleogeography of the Kushiro Plain, Hokkaido in the Alluvial Age*; Quat. Res., Vol. 1, No. 7, p. 259. (in Japanese)

OKUTANI, T. (1959): *Ecological Note on the Marine Shell-bearing Mollusks found in Kurihama Bay, Kanagawa Pref.*; Collection and Breeding (Saishū-to-Shiiku), Vol. 21, No. 7, p. 198. (in Japanese)

OLDROYD, I. S. (1924): *The Marine Shells of the West Coast of North America*; Stanford Univ., Publ. Geol., Vol. 1, pp. 197–9, 3 pls.

OSANAI, H. et al. (1958 a): *"Chiraibetsu" Explanatory Text Geol. Map of Japan*; Hokkaido Develop. Agency, pp. 16 and 23. (in Japanese)

——— (1958 b): *"Ishikarikanayama" Explanatory Text Geol. Map of Japan*; ibid., p. 43. (in Japanese)

——— (1959): *"Sōya and Sōya-misaki" Explanatory Text Geol. Map of Japan*; ibid., p. 25. (in Japanese)

OTUKA, Y. (1935): *The Oti Graben in southern Noto Peninsula, Japan*; Bull. Earthquake Res. Inst., Vol. 13, pt. 4, p. 900.

——— (1941): *On the Fauna of the Neogene Between Honzyō and Kurosawaziri*; Jour. Jap. Assoc., Petrol. Tech., Vol. 9, No. 2, p. 153, fig. 3.

ŌYAMA, K., MIZUNO, A. and SAKAMOTO, T. (1960): *Illustrated Handbook of Japanese Paleogene Molluscs*; Geol. Surv., Japan, special paper pp. 209–12. pls. 64 and 65.

PEARSE, A. S. et al. (1942): *Ecology of Sand Beaches at Beaufort, N. Carolina*; Ecol. Monogr., Vol. 12, p. 457.

Research Group for Himekawa Region (1958): *Tertiary Formations along the Northern Part of the Itoigawa-Shizuoka Tectooic Line*; Jour. Geol. Soc., Japan, Vol. 64, No. 756, p. 435. (in Japanese)

SAKAZUME, K. and SERIZAWA, Y. (1938): *Mollusca of the Shell Mound from Yokohama City*; Archaeological Soc., Japan, Vol. 28, No. 1, pp. 18–41. (in Japanese)

SASA, Y. and NISHIDA, S. (1937): *Geology of Sane Region*; Rep. Geol. Surv., Oil-Field Karafuto, No. 4, pp. 43 and 46. (in Japanese)

SCHLESCH, H. (1931): *Kleine Mitteilungen VII. Beitrag zor Kenntnis der marine Mollusken-Fauna Islands*; Arch. Moll., Vol. 63, p. 136, pl. 13. figs. 10–2.

SHIMER, H. W. and SHROCK, R. R. (1949): *Index Fossils of North America*; John Wiley & Sons, Inc., p. 431, pl. 173, figs. 4–6.

SHŌJI, R. (1954): *Geology of the Coal-Field in Sanbongi-machi* and *Mt. Yakurai, Miyagi Pref.*; Dept. Commerce and Industry, Miyagi Pref. (in Japanese)

STEARNS, R. (1881): *Mya arenaria in San Francisco Bay*; Amer. Natur., Vol. 15, pp. 362–366.

SUZUKI, J. (1953): *"Fukagawa" Explanatory Text Geol. Map of Japan*; Hokkaido Develop. Agency, pp. 22–3. (in Japanese)

SWAN, E. F. (1952): *The Growth of the clam Mya arenaria as affected by the Substratum*; Ecology, Vol. 33, No. 4, pp. 530–4.

TAGAMI, M. and ŌSUGI, T. (1938): *Geology of Maoka Region*; Rep. Geol. Surv., Oil-Field Karafuto, No. 5, p. 170. (in Japanese)

——— and TAKEDA, H. (1937): *Geology of Maoka and Honto Regions*; ibid., No. 4, p. 177. (in Japanese)

TAGUCHI, K. (1960): *Stratigraphical Studies of the Funagata Volcano (Neogene) in the Region Bordering Yamagata and Miyagi Prefectures (3)*; Jour. Geol. Soc., Japan, Vol. 66, No. 776, pp. 285–6. (in Japanese)

TAKATSUKI, S. (1927): *Report of the Biological Survey of Mutsu Bay, pt. 5*; Sci. Rep., Tōhoku Imp. Univ., 4 series, Vol. 3, No. 1, p. 26.

TAKEYAMA, T. (1934): *Marine Deposits (Pleistocene) of Chūgenbaru, Sadowara-machi, Miyazaki Pref.*, Kyūshū; "Chikyū", Vol. 21, No. 4, p. 285. (in Japanese)

TANAKA, K. (1960): *Some Observations on Anadara (s. s.) amicula (Yok.)*; Venus, Vol. 21, No. 1, p. 88. (in Japanese)

TANITA, S., YAMAMOTO, G. and SATŌ, S. (1956): *Fundamental Investigation on the Marine Resources of Matsushima Bay (3)*; Bull. Tōhoku Region Fish. Res. Lab., No. 6, p. 93. (in Japanese)

TREFETHEN, J. M. and DOW, R. L. (1960): *Some features of modern beach Sediments*; Jour. Sed. Pet., Vol. 30, No. 4, pp. 589–602, fig. 21.

TSUCHI, R. (1957): *Molluscs and Shell Remaine in the Brackish Lake "Hamana"*; Rep. Lib. Arts., Fac. Shizuoka Univ., Vol. 2, No. 1, pp. 33–4, pl. 1, fig. 25.

——— (1959): *Molluscs and Shell-Remains in Arari Bay and Heta Bay, West Coast of Izu Peninsula*; Rep. Liberal Arts & Sci. Fac. Shizuoka Univ., Vol. 2, No. 5, p. 222.

TSUKAMOTO, Y. (1936): *The Shell Mound of Kudan, Tokyo City*; Venus, Vol. 6, No. 2, p. 113. (in Japanese)

TSUSHIMA, K. et al. (1954): *"Tomamae" Explanatory Text Geol. Map of Japan*; Geol. Surv., Japan, p. 9. (in Japanese)

——— (1958): *"Tappu" Explanatory Text Geol. Map of Japan*; ibid., p. 49. (in Japanese)

TURNER, H. J. (1948): *Report on Investigations of the Progagation of the Soft-shell Clam, Mya arenaria*; Woods Hole Oceanogr. Inst., No. 462. pp. 1–61.

UOZUMI, S. and FUJIE, T. (1960): *Stratigraphy of Utanobori Region, Esashi District, Kitami Province, Hokkaido.* (Manuscript)

UWATOKO, K. and SONOKI, B. (1937): *Geology of Raichishi Lake Region*; Rep. Geol. Svrv., Oil-Field Karafuto; No. 4, pp. 141 and 144. (in Japanese)

——— and TAKEDA, H. (1938): *Geology of Kushunnai Region*; ibid., No. 5, pp. 134 and 141. (in Japanese)

WATANABE, S. (1936): *Geology of Middle Part of West Coast, Karafuto*; ibid., No. 3. p. 25. (in Japanese)

WATANABE, K. et al. (1950): *Tertiary Geology of the Chichibu Basin*; Bull. Chichibu

Mus., Nat. Hist., No. 1, p. 79, pl. 4, figs. 11–2.

——— (1956): *On the Akabira and Asagai stage in the Kwanto Region*; "Yūkōchū" (Foraminifera), No. 5 (1), pp. 29–34. (in Japanese)

WINCKWORTH, A. J. (1930): Proc. Malac. Soc., London, Vol. 19, p. 15.

YAGURA, W. (1932): *Catalogue of Mollusca from Hyōgo Pref.*; Publ. Kōnan-Kairui-Sō, p. 17. (in Japanese)

YAMAGUCHI, A. and YAMADA, M. (1955): *Marine Invertebrates in Northern Japan (1)*; Publ. Hokkai Kyōiku Hyōron Co. Ltd., p. 147. (in Japanese)

YAMAGUCHI, S. (1958): *"Monbetsu" Explanatory Text Geol. Map of Japan*; Geol. Surv., Japan, p. 12. (in Japanese)

YAMAMOTO, G. and HABE, T. (1959): *Fauna of Shell bearing Mollusks in Mutsu Bay, Lamellibranchia (2)*; Bull. Mar. Biol. Sta., Asamushi, Vol. 9, No. 3, p. 113, pl. 12, fig. 24.

YOKOYAMA, M. (1924): *Molluscan Remains from the Lowest Part of the Jōban Coal-Field*; Jour. Coll. Sci., Tokyo Imp. Univ., Vol. 45, Art. 3, pp. 12–3, pl. 1, figs. 11–6.

——— (1925 a): *Molluscan Remains from the Uppermost Part of the Jōban Coal-Field*; ibid., Vol. 45, Art. 5, p. 16–7, pl. 6, figs. 4 and 6.

——— (1925 b): *Tertiary Mollusca from Shinano and Echigo*; Jour. Fac. Sci., Imp. Univ., Tokyo, sec. 2, Vol. 1, pt. 1, p. 10, pl. 3. fig. 3.

——— (1926 a): *Neogene Shells from Kōzuke and other Provinces*; ibid., pt. 7, p. 232, pl. 29, figs. 6–8.

——— (1926 b): *Tertiary Mollusca from the Oil-Field of Enbetsu and Etaibetsu*; ibid., pt. 7, p. 241, pl. 30, fig. 1.

——— (1926 c): *Tertiary Mollusca from Shiobara in Shimotsuke*; ibid., sec. 2, Vol. 1, pt. 4, p. 132.

——— (1926 d): *Tertiary Shells from Tosa*; ibid., pt. 9, p. 365.

——— (1926 e): *Fossil Shells from the Atsumi Peninsula, Mikawa*; ibid., pt. 9, p. 370.

——— (1927 a): *Tertiary Shells from the Coal-Field of Haboro, Teshio*; ibid., Vol. 2, pt. 4, p. 198, pl. 51, fig. 2.

——— (1927 b): *Mollusca from the Upper Musashino of Tokyo and its Suburbs*; ibid., Vol. 2, pt. 10, p. 399.

——— (1927 c): *Mollusca from the Upper Musashino of Western Shimosa and Southern Musashi*; ibid., Vol. 2, pt. 10, p. 443.

——— (1928): *Neogene Shells from the Oil-Field of Higashiyama, Echigo*; ibid., Vol. 2, pt. 7, p. 353.,

——— (1929): *Molluscan Fossils from Karafuto*; ibid., pt. 9, pp. 379 and 385, pl. 74, fig. 3.

——— (1931): *Neogene Shells from Karafuto and Hokkaido*; ibid., Vol. 3, pt. 4, pp. 189–191.

YONEMURA, Y. (1950): *The Materials of Moyoro Shell Mound, Abashiri City*; Publ. Abashiri Mus., p. 28. (in Japanese)

YOSHIDA, H. (1938): *Notes on the Veligers and the Young Shells of Mya arenaria japonica Jay*; Venus, Vol. 8, No. 1, pp. 13–21, figs. 1–10. (in Japanese)

YOSHIDA, S. et al. (1959): *"Hiu" Explanatory Text Geol. Map of Japan*; Hokkaido Develop. Agency, p. 30. (in Japanese)

YOSHIOKA, I. (1960): *Mollusca of Shell mound, Bigo Province, (Hiroshima Pref.)*; "Chiribotan" Vol. 1, p. 25–6. (in Japanese)

YONGE, C. M. (1949): *The Sea Shore*; Publ. Collins Co. Ltd., pp. 245–7, figs. 76 and 77.