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THE ECHINOID FAUNA FROM JAPAN AND ADJACENT REGIONS

(ABSTRACT)

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I. INTRODUCTION AND GENERAL REVIEW

INTRODUCTION

The seas bordering Japan and the adjacent regions are diversified in biogeochemical conditions and the marine faunas therein, and have been known to zoologists for the rich yield of Echinoids and other marine invertedrates. The collections made by various surveying ships have given the proof that the Japanese seas, particularly the Sagami Sea and the adjacent areas, are in the richest in Echinoids in the world (and apparently also in the other classes of Echinoderms), as were the European seas in the Jurassic and Cretaceous Periods, and the Timor Sea in the western part of Arafura Sea in the Permian Period, and that they may be called "The Treasure Islands of Echinoderms".

The Echinoidea comprise a class of exclusively marine animals that are generally considered to have as vigorously flourished through the past geological ages down to the present time. Of the larger marine invertebrate fossils in Japan and the adjacent regions, the Echinoidea are ranked as a whole next to the Mollusca (the Pelecypoda, Gastropoda, and Cephalopoda) in scientific importance and stratigraphical significance.

The paleontological importance of the Echinoids rest upon their rather frequent occurrence as fossils, especially aggregated in rather limited places and horizons, and their complex morphology, which permits a fine discrimination of species and genera that are believed to have relatively short geological ranges. Thus they seem to prove to be valuable guides in stratigraphy, indicating definite geological ages, exhibiting weighty evidence for correlation of geological formations ; and they manifest valuable data of evolution, as they have recorded many and diverisified evolutionary changes. Owing to their relatively sedentary habits, their aversion to fresh water, the brevity of a free-swimming larval life, and the usually small bathymetrical range, the Echinoids provide remains that are remarkably suitable as bases for studying paleoecological and paleogeographical conditions through geological times. From another point of view, the Echinoids are especially interesting to zoologists (neontologists) ; as (1) material for anatomical and embryological studies of the Recent species and genera that throw much light on those of the past, as (2) the material to study the morphogenesis of the coronal plates, including

the ambulacra which are excellent examples of morphogenetic sequences ; (3) besides, morphologically they are the most complex encountered in invertebrates ; and (4) embryologically the material provides in the research, data to work out some problems in general zoology.

In the present article the writer intends to deal with almost all known Echinoids hitherto reported from the Japan and the adjacent regions. The present work is not complete because certain species and genera hitherto reported from these regions have been unfortunately inaccessible to the writer for study. However, the knowledge on the Echinoid fauna from these regions to date is exhaustively summarized in the present work ; and it is hoped that future workers would throw additional light by future discoveries of undescribed material and contribute to the progress of our knowledge by detailed studies along various lines. The writer has also given an almost equal space for the genera and species that are as yet not recognized in the fossil state in these regions, because there is a great possibility that many Recent Echinoidea of Japan and the adjacent regions might have their direct ancestors in the paleontological horizons of these same regions, or more or less remoted areas, and may be actually discovered by future collectors. There is no sharp taxonomical line between the Recent and fossil forms, a fact sometimes not fully considered by modern authors on neontology.

The purpose of the present work are, (1) to review (and sometimes to revise) the generic and other systematic nomenclature of the Echinoidea, (2) to make available a convenient catalogue of the known genera and species of the Echinoids from Japan and the adjacent regions, (3) to record some new forms, and (4) to redescribe by the new and more excellently preserved specimens the hitherto ill-defined or inaccurately described species.

The scope of the present work is to summarize our previous knowledge along all lines of research concerning the Echinoid fauna from Japan and the adjacent regions. It is also intended to give some remarks on morphological features which have hitherto been given but little attention, and to discuss the classification proposed in the present article. Discussions on some evolutionary trends and changes, periods of flourishing and of the maximum development, geographical-bathymetrical and geological distributions are also dealt with. Biostratigraphical and geological significance of the Echinoid fossil fauna from the present regions are touched upon with some remarks on the paleoecology and geology of their occurrences. And finally, as only to the descriptions of the forms concerned, but not as of a monographic style, on the Echinoid fauna from Japan and the adjacent regions, the present article is devoted.

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A BRIEF REVIEW ON THE SYSTEMATIC ARRANGEMENT OF THE ECHINOIDEA

In regard to the systematic arrangement of the Echinoidea, important studies have been done during the past one and half centuries by the following workers, namely, J. E. Gray (1626–55), L. Agassiz(1836–42), E. Desor (1855–58), A. Agassiz (1863–1904), G. H. Cotteau (1865–89), N. A. Pomel (1869–83), S. Lovén (1867–92), P. M. Duncan (1882–89), and J. W. Gregory (1892–1900). Among the monographic works together with the systematic arrangement of the genera and species made by various authors, the following ones are accounted for their importance, namely, A. d'Orbigny (1853–55), Th. Wright (1857–92), G. H. Cotteau (1861–89), and A. Agassiz (1872–74, 1881, 1904). M. Meissner (1904) fully reviewed the outline of systematic arrangement of the Echinoidea hitherto published until then, up to the end of the ninteenth century, and he also proposed a more or less revised arrangement.

Up to the present time, after the publication of Meissner's paper (1904), the more important works have been established by many authors. J. Lambert and P. Thiéry in their "Essai de nomenclature raisonnée des Échinides, (1909–1925)" enumerating a large number of species and genera, almost all of the known species at that time, and they arranged the Echinoidea of both Recent and fossil forms, as follows (only the ranks higher than taxa of the order-group cited).

Lambert and Thiéry (1909—1925)

Sous-Classe : GNATHOSTOMATA Pomel
  Ordre : PLAGIOCYSTA Lambert
    Sous-Ordre : CYSTOCIDAROIDA Zittel
  Ordre : ENDOCYSTA Lambert
    Section : HOMALOSTOMATA Lambert & Thiéry
      Sous-Ordre : BOTHRIOCIDAROIDA Zittel
      Sous-Ordre : PERISCHOECHINOIDA McCoy
      Sous-Ordre : CIDAROIDA Duncan
    Section : GLYPHOSTOMATA Pomel
      Sous-Ordre : STREPTOSOMATA Duncan
      Sous-Ordre : STEREOSTOMATA Duncan
  Ordre : EXOCYSTA Lambert
    Sous-Ordre : PILEATOIDA Lambert
    Sous-Ordre : CLYPEASTROIDA Agassiz
Sous-Classe : ATELOSTOMATA Pomel
  Ordre : BRACHYGNATHE Lambert
    Sous-Ordre : GLOBATOROIDA Lambert
  Ordre : NODOSTOMATA Lambert
    Sous-Ordre : PROCASSIDULOIDA Lambert
    Sous-Ordre : SPATANGOIDA Agassiz

This systematic arrangement has been followed by various authors, especially by paleontologists on the fossil Echinoidea; they changed a number of the old familiar names (e. g., *Echinarachnius* used for *Arachnoides* for instance), the result being a great confusion.

R. T. Jackson set forth in his monumental work "Phylogeny of the Echini, 1912" and "Echinoidea, in Eastman-Zittel, 1913" a new classificatory scheme, especially to devote to the systematic arrangement of the so-called Regular Echinoids based on their dental apparatus. His systematic arrangement of the Echinoidea is as follows (the ranks higher than taxa of the order-group cited).

Jackson (1912—1913)

Order 1 : BOTHRIOCIDAROIDA Duncan
Order 2 : CIDAROIDA Duncan
Order 3 : CENTRECHINOIDA Jackson
  Suborder A : AULODONTA Jackson
  Suborder B : STIRODONTA Jackson
  Suborder C : CAMARODONTA Jackson
Order 4 : EXOCYCLOIDA Jackson
  Suborder A : HOLECTYPINA
  Suborder B : CLYPEASTRINA Gregory
  Suborder C : SPATANGINA Jackson
Order 5 : PLESIOCIDAROIDA Jackson
Order 6 : ECHINOCYSTOIDA Jackson
Order 7 : PERISCHOECHINOIDA McCoy

In the great monographic work on the "Hawaiian and other Pacific Echini" by A.

Agassiz and H. L. Clark (1907–1909) and succeeded by H. L. Clark (1912–1917) are treated only the Recent species and genera in the systematic arrangement of the Echinoidea; the scheme followed in the main that of Jackson.

H. L. Hawkins in his studies in the interesting and primitive Irregular Echinoids, the Holectypoida and the allies (1909–1926), revised the systematic arrangement of the primitive Irregular Echinoidea, particularly in the Holectypoida, Cassiduloida, and Nucleolitoida (of his order, now united into the Cassiduloida). This classificatory scheme of the Irregular Echinoidea is followed principally by H. L. Clark (1925, 1946). His systematic arrangement of the Echinoidea on both the Recent and fossil forms, that combined with the scheme in the Regular Echinoidea of Jackson, is as follows (only the ranks higher than taxa of the order-group cited).

H. L. Clark (1925, 1946)

Order 1 : PERISCHOECHINOIDA McCoy
Order 2 : CIDAROIDA Duncan
Order 3 : DIADEMATOIDA Duncan(=Centrechinoida Jackson, 1912)
  Suborder A : AULODONTA Jackson
  Suborder B : STIRODONTA Jackson
  Suborder C : CAMARODONTA Jackson
Order 4 : EXOCYCLOIDA Jackson
  Suborder A : CLYPEASTRINA Gregory
  Suborder B : ECHINONEINA Hawkins
  Suborder C : NUCLEOLITINA Hawkins
  Suborder D : CASSIDULINA Hawkins
  Suborder E : URECHININA H. L. Clark
  Suborder F : SPATANGINA Jackson

Th. Mortensen, in his great and exhaustive work "A Monograph of the Echinoidea, 1928–1951", the greatest and most valuable monograph in the former half of the twentieth century, based on the very large amount of materials accumulated in a long time, the most experienced savant on the Echinoidea, with the deep and precise knowledge on the animals, describing the Recent forms to species, and fossil forms to genera, rearranged and reviewed the systematic arrangement of the Echinoidea and steadily made great strides in the science. Mortensen's classificatory scheme is as follows (only the ranks higher than taxa of the order-group cited).

Mortensen (1928–1951)

Subclass : REGULARIA Latreille, 1825
  Order : LEPIDOCENTROIDA Mortensen, 1934
  Order : MELONECHINOIDA Mortensen, 1934
  Order : CIDAROIDA Duncan, 1889
  Order : STIRODONTA Jackson, 1912
    Suborder A : CALYCINA Gregory, 1900
    Suborder B : PHYMOSOMINA Mortensen, 1934
  Order : AULODONTA Jackson, 1912
    Suborder A : ASPIDODIADEMINA Mortensen, 1939
    Suborder B : PEDININA Mortensen, 1939
    Suborder C : DIADEMINA Gregory, 1900

Order : CAMARODONTA Jackson, 1912
Suborder A : ORTHOPSINA Mortensen, 1942
Suborder B : TEMNOPLEURINA Mortensen, 1942
Suborder C : ECHININA Mortensen, 1942
Subclass : IRREGULARIA Latreille, 1825
Order : HOLECTYPOIDA Duncan, 1889
Suborder A : HOLECTYPINA Gregory, 1900
Suborder B : ECHINONEINA Hawkins, 1925
Order : CASSIDULOIDA Duncan, 1889
Suborder A : CASSIDULINA Delage & Hérouard, 1903
Suborder B : CONOCLYPINA Delage & Hérouard, 1903
Order : CLYPEASTROIDA (Agassiz & Desor) Duncan, 1889
Suborder A : CLYPEASTRINA Gregory, 1900
Suborder B : LAGANINA Desor, 1857
Order : SPATANGOIDA L. Agassiz, 1840
Suborder A : PROTOSTERNATA Mortensen, 1907
Suborder B : MERIDOSTERNATA (Lovén) Mortensen, 1907
Suborder C : AMPHISTERNATA (Lovén) Mortensen, 1907

In Th. Mortensen's systematic arrangement of the Echinoidea, as listed above, the following three points are important and noteworthy. 1. *Bothriocidaris* is neither an Echinoid as hitherto generally assumed nor the ancestor of all the Echinoids as had been considered by former writers. 2. Mortensen disregarded the sharp distinction between the multicolumnar Palaeozoic Echinoids and the post-Palaeozoic 20-columns Echinoids, the Subclass Palaechinoidea and Euechinoidea, hitherto generally accepted. The family Echinothuriidae, which have been hitherto classified into the Aulodonta, on account of the character of teeth, are regarded as the surviving member of the older Lepidocentroids ; but this procedure is open to later criticism. 3. Mortensen also pointed out a mistake of the sharp distinction between the oligoporous and the polyporous forms of the so-called Regular Echinoidea, the "Triplechinidae A. Agassiz" and "Echinometridae Gray" which has prevailed an important role in Echinoid classification, as seen in A. Agassiz, P. M. Duncan, J. W. Gregory, J. Lambert, and H. L. Clark.

An important work on the major classification of Echinoids was published by J. W. Durham and R. V. Melville (1957, pp. 242–272) after a great monograph of Mortensen had been completed. They critically reviewed and revised the classification of the class Echinoidea by Mortensen (1928–1951). Their systematic arrangement of the Echinoidea is as follows (only the ranks higher than taxa of the order-group cited).

Durham and Melville (1957)

Subclass : PERISCHOECHINOIDEA McCoy, 1849
Order : BOTHRIOCIDAROIDA Zittel, 1879
Order : ECHINOCYSTITOIDA Jackson, 1912
Order : PALAECHINOIDA Haeckel, 1886
Order : CIDAROIDA Claus, 1880
Subclass : EUECHINOIDEA Bronn, 1860
Superorder : DIADEMATACEA Duncan, 1889
Ordre : DIADEMATOIDA Duncan, 1889
Order : ECHINOTHURIOIDA Claus, 1880

Order : PYGASTEROIDA Durham & Melville, 1957
Superorder : ECHINACEA Claus, 1876
Order : HEMICIDAROIDA Beurlen, 1937
Order : PHYMOSOMATOIDA Mortensen, 1904
Order : ARBACIOIDA Gregory, 1900
Order : TEMNOPLEUROIDA Mortensen, 1942
Order : ECHINOIDA Claus, 1876
Superorder : GNATHOSTOMATA Zittel, 1879
Order : HOLECTYPOIDA Duncan, 1889
Suborder : HOLECTYPINA Duncan, 1889
Suborder : ECHINONEINA H. L. Clark, 1925
Suborder : CONOCLYPINA Zittel, 1879
Order : CLYPEASTEROIDA A. Agassiz, 1873
Suborder : CLYPEASTERINA A. Agassiz, 1873
Suborder : LAGANINA Mortensen, 1948
Suborder : SCUTELLINA Haeckel, 1896
Suborder : ROTULINA Durham, 1955
Superorder : ATELOSTOMATA Zittel, 1879
Order : NUCLEOLITOIDA Hawkins, 1920
Order : CASSIDULOIDA Claus, 1880
Order : HOLASTEROIDA Durham & Melville, 1957
Order : SPATANGOIDA Claus, 1876

In their systematic arrangement of the Echinoidea, the following results are important and noteworthy. 1. As for the position of *Bothriocidaris* they conceded, with three sound reasons, to the view that the genus, if it is ancestral or not, is a true Echinoid, contrasting to Mortensen's view that *Bothriocidaris* is not a true Echinoid, and it has no genetic connexion with the class. 2. They lumping together numerous and diverse forms of the Palaeozoic Lepidocentroids into a single family, and prefer to accept the family Echinocystitidae (Lepidocentridae as a senior subjective synonym) in the wide sense of Mortensen. 3. They expressively claim that the family of the Echinothuriids, which are regarded by Mortensen as the surviving member of the Palaeozoic Lepidocentroids, originated from some other contemporary and closely similar Pedinid stock than the Echinocystitids (Lepidocentrids) ; the authors classified the Echinothuriids with the Pedinids, by the evidence from the Jurassic *Pelanechinus*, the earliest echinothuriid, or from certain Recent forms. 4. They considered that the Pygasterids, which are referred by Mortensen to the primitive forms of the Holectypoids, should be regarded as a sterile offshoot of the Pedinids, associating the Pygasterids with the Diadematoids on the evidence derived from the general resemblance of the Pygasterids to the Pedinid genera. 5. The division of the Cassiduloids into two orders, the Cassiduloida and Nucleolitoida, as proposed by H. L. Hawkins, and followed by Druham and Melville (1957, pp. 259–260), is opposed by later writers such as P. M. Kier (1962) and G. M. Philip (1963, 1965). 6. They proposed (1957, pp. 209, 260, 266) the new order Holasteroida to embrace two suborders Protosternata and Meridosternata of Mortensen's usage, on the reasons that the characters of their apical system are of sufficient important to unite them in an order than to divide into two suborders.

G. M. Philip (1965, pp. 45–62) critically reviewed the classification of the class

Echinoidea proposed by Durham and Melville (1957). His systematic arrangement of the Echinoidea is as follows (only the ranks higher than taxa of the order-group cited).

Philip (1965)

Subclass : REGULARIA Latreille, 1825
Superorder : PSEUDOECHINACEA Mortensen, 1935
Order : BOTHRIOCIDAROIDA Zittel, 1879
Superorder : PERISCHOECHINACEA McCoy, 1849
Order : CIDAROIDA Claus, 1880
Order : LEPIDOCENTROIDA Mortensen, 1934
Suborder : LEPIDOCENTRINA Mortensen, 1934
Suborder : ECHINOTHURIINA Claus, 1874
Order : MELONECHINOIDA Gregory, 1900
Superorder : DIADEMATACEA Duncan, 1889
Order : AULODONTA Jackson, 1912
Suborder : ASPIDODIADEMINA Mortensen, 1939
Suborder : DIADEMINA Duncan, 1889
Suborder : PEDININA Mortensen, 1939
Order : STIRODONTA Jackson, 1912
Suborder : CALYCINA Gregory, 1900
Suborder : PHYMOSOMINA Mortensen, 1904
Suborder : ARBACIINA Gregory, 1900
Order : CAMARODONTA Jackson, 1912
Suborder : ORTHOPSINA Mortensen, 1942
Suborder : TEMNOPLEURINA Mortensen, 1942
Suborder : ECHININA Claus, 1876
Subclass : IRREGULARIA Latreille, 1825
Superorder : GNATHOSTOMATA Zittel, 1879
Order : HOLECTYPOIDA Duncan, 1889
Suborder : HOLECTYPINA Duncan, 1889
Suborder : ECHINONEINA H. L. Clark, 1925
Order : CLYPEASTEROIDA A. Agassiz, 1873
Suborder : CLYPEASTERINA A. Agassiz, 1873
Suborder : SCUTELLINA Heackel, 1896
Superorder : ATELOSTOMATA Zittel, 1879
Order : CASSIDULOIDA Claus, 1880
Suborder : CASSIDULINA Claus 1880
Suborder : CONOCLYPINA Zittel, 1879
Suborder : NEOLAMPADINA Philip, 1963
Order : SPTANGOIDA Claus, 1876
Suborder : PROTOSTERNINA Mortensen, 1907
Suborder : MERIDOSTERNINA Mortensen, 1907
Suborder : AMPHISTERNINA Mortensen, 1907
Incertae sedis
Order : MEGALOPODA MacBride & Spencer, 1938

This major classification of the Echinoidea approaches, in the main, that presented by Mortensen in his great monograph ((1928—1951). Philip regards the perplexing and much disputed family of the Echinothuriids were derived from the Palaeozoic Lepido-

centroids through progressive morphological changes, as originally considered by Mortensen, than from the contemporary Pedinids. Philip (1965, pp. 45–46) also abandoned the order Pygasteroida, proposed by Durham and Melville (1957, p. 253), and classified them into the Holectypoida. His procedure being on the basis of R. V. Melville's discovery (1961) that *Pygaster* possessed keeled teeth as in *Holectypus*, by which disproves the continued assumption that this genus possessed grooved teeth. The subdivision of the orders, Aulodonta, Camarodonta, and Spatangoida, agrees with that of Mortensen.

This brief rveiew should give an impression of how the systematic arrangement and the classification of the Echinoidea differ in various authors, and how different nomenclatures are devised for a group of different ranks.

A NOTE ON TAXA OE THE ORDER-GROUP AND THEIR NAMES

As listed above, so many different nomenclatures have been tried for a rank (group), particularly to an ordinal rank, of the Echinoidea by various authors, e. g., J. Lambert's both of Brachygnatha (order) and Globatoroida (suborder) approximately correspond to Th. Mortensen's Echinoneina H. L. Clark (suborder), that for the use of these nomenclatures must be paid much caution. The International Codes of Zoological Nomenclature have no codification on the nomenclature of ranks higher than the ordinal group. In considering the names to be used for order-group Durham and Melville (1957, pp. 262–270), bearing in mind the recommendations published in "Copenhagen Decision on Zoological Nomenclature", have approved to use uniform termination for ordinal and subordinal names. They have used "-oida", by addition to the stem (base) of the name of the type-genus, for ordinal and "-ina" for subordinal terminations, and systematically adjusted the ordinal names. The same format is already being used by the writer (S. Nisiyama, 1954, pp. 323–330) since several years.

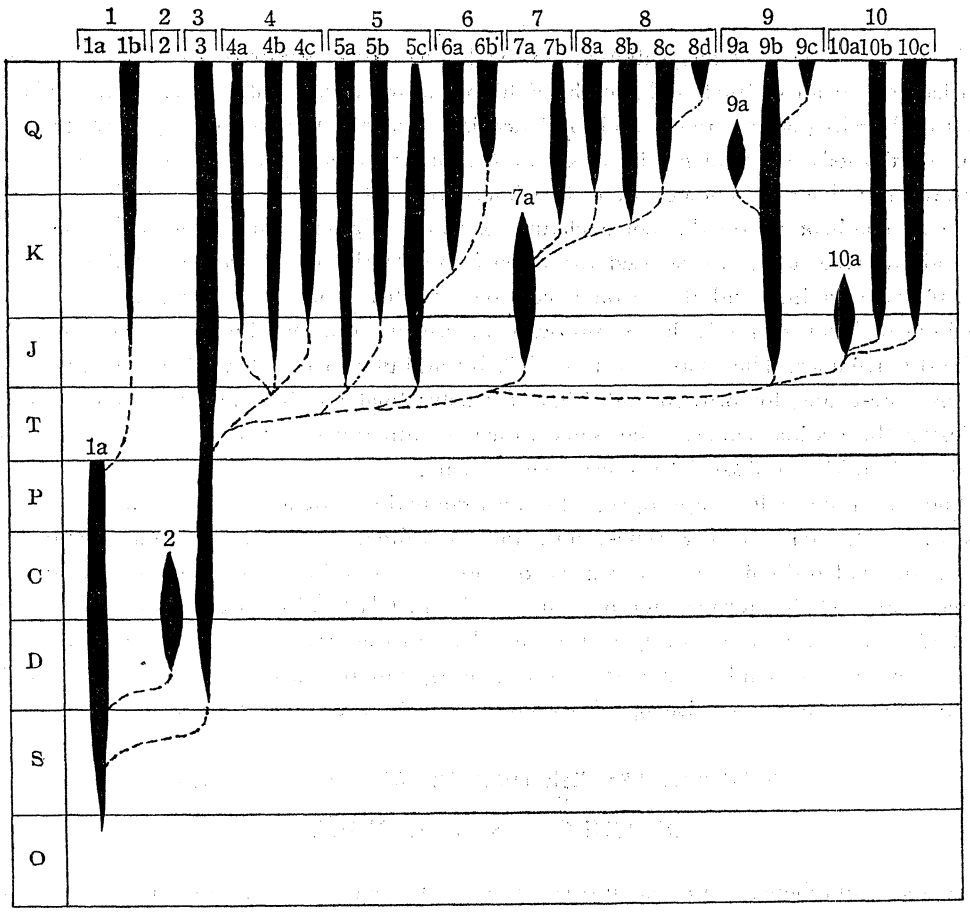
The writer has felt it appropriate to use termination "-oina", by addition to the stem (base) of the name of the type-genus, for subordinal rank, in accordance with the termination of ordinal rank as well as to show the inferior, not as in the termination "-ina" as used by former authors, such as H. L. Clark, Mortensen, and Durham and Melville. This format naturally causes the clear distinction between taxa of the order-group and of the family-group or of the genus-group (e. g., Cassiduloina Claus, 1880-Cassidulina Claus, 1880 (Delage & Hérouard, 1903), non d'Orbigny, 1826).

ON THE KEY TO THE ORDERS AND SUBORDERS OF THE CLASS ECHINOIDEA

In his comprehensive and exhaustive survey of the whole class, Mortensen recognized ten orders as listed above (except the Megalopoda MacBride & Spencer and Bothriocidaroida Zittel) grouped into two subclasses. Mortensen gave the excellent key to the orders of the class Echinoidea, through his sound judgement and his extensive knowledge of the class, three times in his great monograph ; the first in the second volume (1935, p. 26) he made a survey of key to all the orders so far as thought it possible at that time, before he had studied all of them throughly ; the second, in volume 4, part 1 (1948,

p. 8) a key to the orders of his Irregularia ; and the third, at the end of the Monograph (1951, p. 573) he gave a survey of the whole class. His key to the ten orders and to the suborders and furthermore to the families and the genera is excellent and sound, and shows considerable elaboration to guard against the perplexing groups.

In their "A Classifibation of Echinoids" Durham and Melville (1957) recognized seventeen orders (excepting the Bothriocidaroida and Megalopoda, but including two new) in the class Echinoidea ; and his "Classification of Echinoids" Philip recognized ten order (excepting the Bothriocidaroida and Megalopoda) in the class ; they gave no key to the orders and suborders, but from their excellent diagnoses given to each rank, the ordinal and subordinal characters are clearly discriminated. The author's own key to the orders and suborders of the class is not referred in this abstract (article).



TEXT - FIG. 1 — Broader aspects of the phylogeny of the class Echinoidea (excepting the BOTHRIOCIDAROIDA Zittel and MEGALOPODA MacBride & Spencer).
Q—Cenozoic (Quaternary and Tertiary) ; K—Cretaceous ; J—Jurassic ; T—Triassic ;P-Permian ; C—Carboniferous ; D—Devonian ; S—Silurian ; O—Ordovician.
1—Order LEPIDOCENTROIDA Mortensen, 1934 (ECHINOCYSTITOIDA Jackson, 1912), 1a—Suborder LEPIDOCENTROINA Mortensen, 1934, 1b—Suborder ECHINOTHURIOINA Claus,

1880 ; 2—Order MELONECHINOIDA Gregory, 1900 (PALAECHINOIDA Haeckel, 1866) ; 3—Order CIDAROIDA Claus, 1880 ; 4—Order DIADEMATOIDA Duncan, 1889, 4a—Suborder ASPIDODIADEMATOINA Mortensen, 1939, 4b—Suborder PEDINOINA Mortensen, 1939, 4c—Suborder DIADEMATOINA Duncan, 1889 ; 5—Order ARBACIOIDA Gregory, 1900, 5a—Suborder SALENIOINA Mortensen, 1903, 5b—Suborder ARBACIOINA Gregory, 1900, 5c—Suborder PHYMOSOMATOINA Mortensen, 1904 ; 6—Order ECHINOIDA Claus, 1876, 6a—Suborder TEMNOPLEUROINA Mortensen, 1942, 6b —Suborder ECHINOINA Claus, 1876 ; 7—Order HOLECTYPOIDA Duncan, 1889, 7a—Suborder HOLECTYPOINA Duncan, 1889, 7b—Suborder ECHINONEOINA H. L. Clark, 1925 ; 8—Order CLYPEASTEROIDA A. Agassiz, 1873 ; 8a—Suborder CLYPEASTEROINA A. Agassiz, 1873, 8b—Suborder LAGANOINA Mortensen, 1948, 8c—Suborder SCUTELLOINA Haeckel, 1896, 8d—Suborder ROTULOINA Durham, 1955 ; 9—Order CASSIDULOIDA Claus, 1880, 9a—Suborder CONOCLYPOINA Zittel, 1879, 9b—Suborder CASSIDULOINA Claus, 1880, 9c—Suborder NEOLAMPADOINA Philip, 1963 ; 10—Order SPATANGOIDA Claus, 1876, 10a—Suborder COLLYRITOINA Nisiyama, 1954, 10b—Suborder URECHINOINA H. L. Clark, 1925, 10c—Suborder SPATANGOINA Claus, 1876.

TYPES IN THE GENUS-GROUP

The kinds and their names of type-species (ICZN, 1961, p. 63), which the writer intends to use here, are followed, chiefly what have been used by the writer himself (Nisiyama, 1937) and T. Iredale (1939) : they are - *Orthotype.* —(ICZN, 1961, Article 68 (a))—(Type by original designation) ; *Haplotype.*—(ICZN, 1961, Article 68 (c))—(Type by monotypy at the time) ; *Tautotype.*—(ICZN, 1961 Article 68 (d))—(Type by absolute tautonomy) ; *Logotype.*—(ICZN, 1961, Article 69 (a))—(Type by subsequent designation - the designator is enclosed in brackets after the citation of type-species).

HISTORICAL SKETCH OF THE FOSSIL ECHINOIDS FROM JAPAN AND THE ADJACENT REGIONS

Although the number of fossil Echinoids hitherto described and illustrated from Japan and the adjacent regions is small, yet there are several interesting and important forms amongst them. Palaeontological studies on the fossils from these regions are considerably backward from the studies of the Recent forms, and it was probably not later than the later half of the ninteenth century that the fossils from these regions began to communicated by the scientists.

The species (and subspecies), which have been hitherto described and illustrated from Japan and the adjacent regions as fossil, attain about 150 in number, published in about 50 articles (1890—1964). The geological ages of the fossils range from the Jurassic to Pleistocene.

The species which have been reported from various localities and geological horizons in Japan and the adjacent regions, it may be noticed that many of the generic and specific names used by previous authors are very diverse and are in need of various changes, and they are made in the part of this article dealing with the descriptions of the species.

MATERIAL

The collections studied include the large number of specimens now stored in the Institute of Geology and Paleontology, Tohoku University, Sendai, the collection of the Department of Geology of the Saito Ho-on Kai Museum, Sendai, the collection of the Paleontological Branch of the National Science Museum, Tokyo, the specimens now stored in the Geological Department of the Shimane University, Matsue, and the specimens stored in the Seto Marine Biological Laboratory and the Laboratories of other Universities. Dr. C. W. Cooke's specimens and others in the collection of the United States National Museum, Washington, D. C., and a part of A. Agassiz's and H. L. Clark's collections in the Museum of Comparative Zoology at Harvard University, Cambridge, may be added to the material examined, as the writer had an opportunity to examine them through for a short time.

II. SYSTEMATIC DESCRIPTION

The species (and subspecies), from Japan and the adjacent regions as fossil described in this article, are given in the following systematic list together with their respective localities and geological ages. The geographical range is given in approximate degrees of north latitude and approximate degrees of east longitude of fossil locality, thus - (34° 139° ;) ; the geological range is given in the name of Epoch (or Period), thus—(; Miocene). (The descriptions of members of the orders, Cidaroida, Diadematoida, Arbacioida, Echinoida, and Holectypoida, are now in press : *indicates the living species).

Order CIDAROIDA Claus, 1880

Family MIOCIDARIDAE Durham & Melville, 1957

Miocidaris spinulifera Nisiyama, MS (35°30′ 136°30′ ; Mid. Permian) ; *M. platyacantha* Nisiyama, MS (35°30′ 136°30′ ; Mid. Permian).

Family CIDARIDAE Gray, 1825

Stereocidaris grandis fusana Nisiyama, MS (35° 140° ; Pliocene) ; *St. (Phalacrocidaris) japonica multipora* Nisiyama, MS (35° 140° ; Pliocene). **Prionocidaris baculosa annulifera* (Lamarck, 1816) (28° 130° ; Pleistocene) ; **Pr. bispinosa* (Lamarck, 1816) (28° 130° Pleistocene) ; *Balanocidaris japonica* Nisiyama, MS (33°30′ 132—133° ; Upp. Jura.) : *Firmacidaris neumayri* Nisiyama, MS (33°30′ 133° ; Upp. Jura.) ; ?*Eucidaris metularia* (Lamarck, 1816) (27° 128° ; Pliocene) ; *Chondrocidaris marianica* Nisiyama, MS (15° 145° ; Miocene) ; **Phyllacanthus imperialis* (Lamarck, 1816) (6° 131° ; Pleistocene) ; *Ph. cf. javanus* Martin, 1885 (15° 145° : Miocene).

Order DIADEMATOIDA Duncan, 1889

Suborder DIADEMATOINA Duncan, 1889

Family DIADEMATIDAE Gray, 1855

**Echinothrix calamaris* (Pallas, 1774) (27° 125° ; Pleistocene).

Order ARBACIOIDA Gregory, 1900

Suborder SALENIOINA Mortensen, 1903

Family SALENIIDAE L. Agassiz, 1838

Salenocidaris hakkaidoensis (de Loriol, 1902) (43°30′ 142° ; Miocnee?) ; *Salenia novemprovincialis* Nisiyama, MS (33° 129°30′ ; Oligocene).

Family HEMICIDARIDAE Wright, 1857

Pseudocidaris simulans Nisiyama, 1950 (40° 142° ; Aptian-Albian).

Suborder PHYMOSOMATOINA Mortensen, 1904

Family PHYMOSOMATIDAE Pomel, 1883

**Glyptocidaris crenularis* A. Agassiz, 1863 (35°30′ 140°30′ ; Pleistocene) ; *Gl. crenularis stenozona* Nisiyama, MS (35° 140° ; Pliocene) ; *Gl.* (*Eoglyptocidaris*) *arctina* Nisiyama, MS (44° 141° ; Oligocene).

Family STOMECHINIDAE Pomel, 1885[1)]

Stomopneustes antiquus Nisiyama, MS (27° 141° ; Eocene) ; *St.* species (15° 145° ; Miocene).

Suborder ARBACIOINA Gregory, 1900

Family ARBACIIDAE Gray, 1855

Goniopygus atavus Nisiyama, 1950 (40° 142° ; Aptian-Albian) ; *Coelopleurus singularis* Nisiyama, MS (35° 139° ; Miocene) ; **Co. maculatus* A. Agassiz & H. L. Clark, 1907 (35° 140° ; Pleistocene).

Order ECHINOIDA Claus, 1876

Suborder TEMNOPLEUROINA Mortensen, 1942

Family TEMNOPLEURIDAE A. Agassiz, 1872

**Temnopleurus toreumaticus* (Leske, 1778) (23—35° 121—135° ; Plio.-Pleistoc.) ; **Tem. hardwickii* (Gray, 1855) (36° 140° ; Pleistocene) ; **Tem.* (*Toreumatica*) *reevesii* (Gray, 1855) (35—36° 140° ; Pleistocene) ; *Salmaciella cf. dussumieri* (L. Agassiz, 1846) (27° 128° ; Pliocene) ; **Temnotrema sculptum* A. Agassiz, 1863 (35°30′ 140° ; Pleistocene) ; **Tem. rubrum* (Döderlein, 1885) (35°30′ 140° ; Pleistocene) ; *Erbechinus gratus* Nisiyama, MS (35° 139° ; Miocene) ; *Brochopleurus pulcherrimus* Nisiyama, MS (35° 140° ; Mio-Pliocene).

Family TOXOPNEUSTIDAE Troschel, 1872

Mirechinus mirabilis Nisiyama, MS (27° 141° ; Eocene) ; *Tripneustes magnificus* Nisiyama, MS (15° 145° ; Miocene) ; *Pseudocentrotus stenoporus* Nisiyama, MS (35° 139° ; Miocene).

Suborder ECHINOINA Claus, 1876

Family STRONGYLOCENTROTIDAE Gregory, 1892

**Strongylocentrotus intermedius* (A. Agassiz, 1863) (40—42° 140—141° ; Pliocene) ; **St. echinoides* A. Agassiz & H. L. Clark, 1907 (43° 140° ; Pliocene) ; *St. magistrus* Nisiyama, MS (37—43°

1) G. M. Philip (1965, pp. 57, 61) separates the family Stomopneustidae Meissner, 1904 (possessing the echinoid ambulacral compounding) from the family Stomechinidae Pomel, 1883 (with generally the diadematoid ambulacral compounding). The structure of ambulacral plates of the genus *Stomopneustes* differs distinctly from the typical echinoid structure of the ambulacral plates of the Echinids and Echinometrids, on the one hand, and also from the typical diadematoid structure of the genus *Stomechinus*, the primitive member of the Stomechinids, on the other.

137–140° ; Pliocene) ; *St. ? octoporus* Nisiyama, MS (40° 140–141° ; Mio-Pliocene) ; *Allocentrotus japonicus* Nisiyama, MS (35° 140° ; Pliocene).

Family PARASALENIIDAE Mortensen, 1903

Parasalenia marianae Cooke, 1957 (15° 145° ; Miocene).

Family ECHINOMETRIDAE Gray, 1855

**Echinostrephus aciculatum* A. Agassiz, 1863 (28° 128° ; Pleistocene) ; *Ech. saipanicum* Cooke, 1957 (15° 145° ; Miocene) ; *Anthocidaris*? sp. (15° 145° ; Miocene) ; *Echinometra hondoana* Nisiyama, MS (38° 141° ; Miocene) ; **Ech. mathaei* (de Blainville. 1825) (28° 128° ; Pleistocene).

Order HOLECTYPOIDA Duncan, 1889

Suborder HOLECYTPOINA Duncan, 1889

Family HOLECTYPIDAE Lambert, 1900

Caenholectypus peridoneus (Nisiyama, 1950) (40° 142° ; Aptian-Albian).

Suborder ECHINONEOINA H. L. Clark, 1925

Family ECHINONEIDAE Wright, 1857

**Echinoneus cyclostomus* Leske, 1778 (22–34° 121–135° ; Mioc.? -Pleistoc.)

Order CASSIDULOIDA Claus, 1880

Suborder CASSIDULOINA Claus, 1880

Family CASSIDULIDAE L. Agassiz & Desor, 1847

Procassidulus yoshiwarai (de Loriol, 1902) (27° 141° ; Eocene) ; *Studeria okinawa* (Cooke), 1954 (27° 128° ; Pliocene) ; *Gitolampas sendaica* Nisiyama, MS (38° 141° ; Miocene).

Family ECHINOLAMPADIDAE Gray, 1851

**Echinolampas alexandri* de Loriol, 1876 (28° 129° ; Pleistocene) ; *Ech. ovata jacquemonti* d' Archiac & Haime, 1853 (25° 122° ; Miocene) ; *Ech. yoshiwarai* de Loriol, 1902 (24–42° 122–141° ; Mioc.-Pliocene) ; *Ech. bombos* Nisiyama, MS (27° 141° ; Eocene).

Family CLYPEIDAE Lambert, 1898

Pygurus asiaticus Tokunaga, 1903 (33°30′ 133° ; Upp. Jura.)

Order CLYPEASTEROIDA A. Agassiz, 1873

Suborder CLYPEASTEROINA A. Agassiz, 1873

Family CLYPEASTERIDAE L. Agassiz, 1835

**Clypeaster japonicus* Döderlein, 1855 (22–28°120–128° ; Plioc.-Pleistoc.) ; **Cl. virescens* Döderlein, 1885 (24–36° 120–136° ; Plioc.-Pleistoc.) ; **Cl. humilis* (Leske, 1778) (24°30′ 121° ; Pliocene) ; **Cl. reticulatus* (Linnaeus, 1758) (28° 129° ; Pleistocene) ; *Cl. okinawa* Cooke, 1954 (27° 128° ; Pliocene) ; *Cl. saipanicus* Cooke, 1957 (15° 145° ; Miocene).

Suborder LAGANOINA Mortensen, 1948

Family FIBULARIIDAE Gray, 1855

**Echinocyamus crispus* Mazzetti, 1893 (30°30′ 131° ; Pleistocene) ; *Ech. prostratus* Nisiyama, MS (30°30′ 131° ; Pleistocene) ; **Fibularia cribellum* de Meijere, 1904 (30°30′ 131° ; Pleistocene)

Fib. (Fibularıella) acuta Yoshiwara, 1898 (36° 140° ; Pleistocene) ; *Sismondia convexa* Nisiyama, 1937 (27° 141° ; Miocene) ; *Sis. javana ladronensis* Nisiyama, MS (15° 145° ; Miocene).

Family LAGANIDAE Desor, 1858

**Peronella pellucida* Döderlein, 1885 (27−30°30′ 128°−131° ; Plioc.-Pleistoc.) ; *P. kamimura* Cooke, 1954 (27° 128° ; Pliocene) ; *P. motobu* Cooke, 1954 (27° 128° ; *Pliocene*) ; ?*P. merrilli* Israelsky, 1933 (27° 128° ; Pliocene) ; **P. japonica* Mortensen, 1948 (24?−36° 121?−140° ; Plioc.?-Pleistocene) ; **Laganum fudsiyama* Döderlein, 1885 (27−35° 128−139° ; Pliocene) ; *L. fudsiyama tokunagai* Otuka, 1938 (35° 138°30′ ; Miocene) ; *L. pachycraspedum* Nisiyama, MS (35° 139° ; Miocene) ; **L. depressum* Lesson, 1841 (24−30° 131−138° ; Plioc.-Pleistoc.).

Suborder SCUTELLOINA Haeckel, 1896

Family SCUTELLIDAE Gray, 1825

Kewia nipponica (Nagao, 1928) (34° 131° ; Oligocene) ; *K. parva* (Nisiyama, 1940) (47° 143° ; Oligocene) ; *K. elongata* (Nisiyama, 1940) (47°30′ 142° ; Miocene) ; *K. minoensis* (Morishita, 1953) (36° 131−138° ; Miocene) ; *K. ugoensis* Shibata, 1960 (40° 139°30′ ; Miocene) ; *K. minuta* Shibata, 1960 (36° 139°30′ ; Miocene) ; *Echinarachnius microthyroides* Nisiyama, 1940 (36−40° 138−140° ; Mio-Pliocene) ; *Ech. subtumidus* Nisiyama & Hashimoto, 1950 (44° 142° ; Miocene) ; *Ech. naganoensis* Morishita, 1953 (37° 138° ; Pliocene) ; *Ech. humilis* Nisiyama, MS (39°30′ 140° ; Pliocene) ; *Ech. ishioi* Morishita, 1950 (37° 137° ; Pliocene) ; *Ech. rumoensis* Hayasaka & Shibata, 1952 (44° 141° ; Miocene) ; *Ech. laganolithinus* Nisiyama, 1940 (40° 140° ; Pliocene) ; **Ech. cf. parma* (Lamarck, 1816) (37−53° 136−143° ; Pliocene) ; **Ech. cf. parma obesus* H. L. Clark, 1914 (38° 138° ; Pliocene) ; *Scaphechinus raritalis* (Nisiyama, 1951) (40° 140° ; Pliocene) ; *S. tsudai* (Morishita, 1950) (36° 137° ; Pliocene) ; **S. mirabilis* A. Agassiz, 1863 (24−40° 121−140° ; Plioc.-Pleistoc.) ; **S. mirabilis tenuis* (Yoshiwara, 1898) (36° 137° ; Pliocene) ; **S. griseus* (Mortensen, 1927) (35°30′−40° 140° ; Plioc.-Pleistocene) ; **S. brevis* (Ikeda, 1936) (36° 137° ; Pliocene) ; *Pseudoastrodapsis nipponicus* (Nisiyama, 1948) (40°30′ 141°30′ ; Mio-Pliocene) ; *Ps. intermedius* Nisiyama, MS (44° 142° ; Miocene) ; *Ps. nitidiusculus* Nisiyama, MS (43°30′ 142° ; Pliocene) ; *Allaster rotundatus* Nisiyama, MS (47°30′ 142° ; Oligoc.-Mioc.).

Family ASTRICLYPEIDAE Stefanini, 1911

Echinodiscus chikuzenensis Nagao, 1928 (33°30′ 131° ; Oligocene) ; *Ech. transiens* Nisiyama, MS (34° 131° ; Oligoc.-Mioc.) ; *Amphiope formosa* (Yoshiwara, 1901) (24−28° 121−130° ; Miocene) ; **Astriclypeus mannii* Verrill, 1867 (24°30′−33°30′ 121−134° ; Pliocene) ; *A. mannii integer* Yoshiwara, 1899 (35°30′ 139° ; Miocene) ; *A. mannii ambigenus* Nisiyama, 1935 (37−42°30′ 137−140° ; Miocene) ; *A. mannii minoensis* Morishita, 1952 (35° 132−137°30′ ; Miocene).

Order SPATANGOIDA Claus, 1876

Suborder URECHINOINA H. L. Clark, 1925

Family HOLASTERIDAE Pictet, 1857

Holaster clypeatulus Nisiyama, 1950 (40° 142° ; Aptian-Albian) ; *Cardiaster perorientalis* Nisiyama, MS (30° 133° ; Senonian).

Suborder SPATANGOINA Claus, 1876

Family PALAEOPNEUSTIDAE A. Agassiz, 1904

Palaeopneustes psoidoperiodus Nisiyama, MS (38° 141° ; Pliocene) ; *Pal. periturus* Nisiyama, MS (35° 140° ; Pliocene) ; *Pal. lepidus* Nisiyama, MS (37° 136° ; Mio-Pliocene) ; *Pal. (Oopneu-*

stes) *priscus* Nisiyama, MS (38° 136° ; Miocene) ; *Pharaonaster japonicus* (de Loriol, 1902) (45°30′ 142° ; Miocene) ; *Niponaster hokkaidensis* Lambert, 1924 (34−43° 135−142° ; Senonian) ; *Nip. nakaminatoensis* Saito, 1959 (36°30′ 140°30′ ; Senonian).

Family AEROPSIDAE Lambert, 1896

Cottreaucorys (*Cordastrum*) *sulcatus* Nisiyama, MS (33° 133° ; Senonian).

Family TOXASTERIDAE Lambert, 1920

Heterester (*Enallaster*) *nexilis* Nisiyama, 1950 (34° 134−136° ; Barremian) ; *H.* (*En.*) *yuasensis* (Tanaka & Okubo, 1954) (34° 135° ; Barremian) ; *H.* (*En.*) cf. *obliquatus* (W. B. Clark, 1893) (32°30′ 130°30′ ; Albian) ; *Paraheteraster macroholcus* (Nisiyama, 1950) (34° 135° ; Barremian) ; *Par. barremicus* (Tanaka & Okubo, 1954) (34° 135° ; Barremian) ; *Par. japonicus* (Tanaka & Okubo, 1954) (32°30′ 130°30′ ; Albian) ; *Allotoxaster tosaensis* (de Loriol, 1902) (33°30′ 133°30′ ; Upp. Jura.) ; *Aphelaster serotinus* Tanaka & Shibata, 1961 (32°30′−34° 130°30′−135° ; Barremian) ; *Palmeraster japonicus* Morishita, 1956 (34° 131° ; Oligocene).

Family HEMIASTERIDAE H. L. Clark, 1917

Hemiaster uwajimensis Morishita, 1962 (33° 133° ; Senonian).

Family SPATANGIDAE Gray, 1825

**Spatangus pallidus* H. L. Clark, 1908 (35°30′ 140° ; Pleistocene) ; *Sp.* species (35°30′ 131° ; Oligocene).

Family MARETIIDAE Lambert, 1905

**Maretia planulata* (Lamarck, 1816) (7° 134° ; Pleistocene) ; *Nudobrissus* sp. (33° 131° ; Oligocene).

Family LOVENIIDAE Lambert, 1905

Breynia carinata Haime, 1853 (25−27° 122−128° ; Mioc.-Plioc.) ; *Br. cordata* Hayasaka, 1947 (24°30′ 122° ; Pliocene) ; *Br. testudinaria* Hayasaka, 1947 (24°30′ 122° ; Pliocene) ; **Echinocardium cordatum* (Pennant, 1777) (24−40° 122−140° ; Pliocene).

Family SCHIZASTERIDAE Lambert, 1905

Prenaster boninensis de Loriol, 1902 (27° 141° ; Eocene) ; *Linthia nipponica* Yoshiwara, 1899 (36° 138−141° ; Pliocene) ; *L. tokunagai* Lambert, 1925 (36−40° 138−140° ; Mioc.-Pliocene) ; *L. praenipponica* Nagao, 1928 (33−34° 130−131° ; Oligocene) ; *L. yessoensis* Minato, 1950 (43°30′ 142° ; Oligocene) ; *L. boreasterina* Nisiyama, MS (47° 142° ; Oligocene) ; *L.? taiwanica* Hayasaka, 1948 (23° 121° ; Miocene) ; *Paraster nummuliticus* Tokunaga, 1903) (27° 141° ; Eocene) ; *Par. saipanicus* Cooke, 1957 (15° 145° ; Oligocene) ; **Brisaster owstoni* Mortensen, 1950 (35° 140° ; Pleistocene) ; *Cagaster recticanalis* (Yoshiwara, 1899) (36°30′ 136°30′ ; Miocene) ; *C.* species (23° 120° ; Pliocene) ; **Schizaster lacunosus* (Linnaeus, 1758) (35° 138° ; Pliocene) ; *Sch. kinasaensis* Morishita, 1953 (36°30′ 138° ; Pliocene) ; *Sch. miyasakiensis* Morishita, 1956 (32° 131° ; Miocene) ; *Sch.* species (33°30′ 137°30′ ; Miocene) ; *Aplospatangus taiwanicus* (Hayasaka, 1948) (25° 121°30′ ; Eocene) ; *Moira obesa* Nisiyama, 1935 (24−41° 121−140° ; Miocene) ; *M.* (*Moiropsis*) *depressa* (Hayasaka, 1948) (25° 121°30′ ; Miocene).

Family PERICOSMIDAE Lambert, 1905

Pericosmus magnificus Nisiyama, MS (38°30′ 141° ; Miocene) ; *P.* cf. *spatangoides* (Desor, 1858) (34°30′ 129°30′ ; Oligocene) ; *P.*? species (23° 121° ; Miocene).

Family BRISSIDAE Gray, 1855

**Brissopsis luzonica* (Gray, 1851) (35° 138° ; Pliocene) ; *Br. luzonica cosibensis* Nisiyama, MS

(35°30′ 139°30′ ; Pliocene) ; *Br. japonica* Nisiyama, MS (35° 140° ; Pliocene) ; *Br. makiyamai* Morishita, 1957 (34−40° 131−140° ; Miocene) ; *Br.* species (25° 121°30′ ; Eocene) ; *Plesiaster peini* (Coquand, 1862) (32° 130° ; Senonian) ; *Eupatagus nipponicus* Morishita, 1957 (36°30′ 137° ; Miocene) ; *Eu. marianensis* Nisiyama, MS (15° 145° ; Miocene) ; **Brissus latecarinatus* (Leske, 1778) (7°−27° 121−134° ; Plioc.-Pleistocene) ; **Metalia spataugus* (Linnaeus, 1758) (7° 134° ; Pleistocene) ; *M. pelagica* Nisiyama, MS (15° 145° ; Miocene).

III. CONCLUDITORY REMARKS

THE RECENT ECHINOID FAUNA OF JAPAN AND THE ADJACENT REGIONS

In the following lines, based upon the data now available, the writer wishes to give a systematic list of the geographical and bathymetrical distributions of the Recent Echinoids of Japan and the adjacent regions; the geographical range north of the equator is given in degrees of latitude following an index letter representing geographical region as indicated below :

P : The Pecific Coast area of Japan and the adjacent regions bordering or in the Pacitic Ocean ("−O−" indicates a range extending south of the equator, e. g., P : 35−0−).

J : The Japan Sea Coast, the regions (including the west coast of Sakhalin Island) bordering the Sea of Japan. For species that ranges southward outside the Sea of Japan into the Pacific region, only the northern limit of range is indicated (e. g., P : 35−0 − ; J : 36−).

Order LEPIDOCENTROIDA Mortensen, 1934
(ECHINOCYSTITOIDA Jackson, 1912)

Suborder ECHINOTHURIOINA Claus, 1880

Family ECHINOTHURIIDAE Wyv. Thomson, 1872

Phormosoma bursarium A. Agassiz, 1881 (P : 36−10− ; 170-2340 m) ; *Tromikosoma tenue* (A. Agassiz, 1879) (P : 34−32 ; 1530−3375 m) ; *Sperosoma quincuciale* de Meijere, 1904 (P : 34−0− ; 715−919 m) ; *Sp. giganteum* A. Agassiz & H. L. Clark, 1907 (P : 34 ; 1204 m) ; *Hygrosoma hoplacantha* (Wyv. Thomson, 1897) (P: 35−0− ; 360−2068 m) ; *Calveriosoma gracile* (A. Agassiz, 1881) (p : 35−0 ; 160−800 m) ; *Haplosoma gemmiferum* Mortensen, 1934 (P : 35−32 ; 185−400 m) ; *Araeosoma owstoni* Mortensen, 1904 (P : 35−33 ; 60−115 m) ; *Ar. owstoni bicolor* (A. Agassiz & H. L. Clark, 1907) (P : 31 ; 155 m) ; *Asthenosoma ijimai* Yoshiwara, 1897 (P : 35−34 ; J : 36−34 ; 20−120 m).

Order CIDAROIDA Claus, 1880

Family CIDARIDAE Gray, 1825

Histocidaris elegans (A. Agassiz, 1879) (P : 33−0− ; 200−1440 m) ; *H. misakiensis* (Yoshiwara, 1898) (P ; 35 ; 120 m) ; *H. carinata* Mortensen, 1928 (P : 32 ; 360 m) ; *Aporocidaris fragilis* A. Agassiz & H. L. Clark, 1907 (P : 65−55 ; 2800−3550 m) ; *Goniocidaris* (*Petalocidaris*) *biserialis* (Doderlein, 1885) (P : 35−32 ; J : 36− ; 80−360−500 m) ; *G.* (*Discocidaris*) *mikado* (Döderlein, 1885) (P : 35−32 ; 50−700 m) ; *G.* (*Aspidocidaris*) *clypeata* Döderlein, 1885 (P : 35−32 ; 100 −700 m) ; *G.* (*A.*) *alba* Mortensen, 1928 (P 32 ; 400 m) ; *Rhopalocidaris gracilis* (Döderlein,

1885) (P : 35 ; 180–700 m) ; *Rh. rosea* Mortensen, 1928 (P : 35–32 ; 180–700 m) ; *Stereocidaris grandis* (Döderlein, 1885) (P : 35–5 ; 70–200 m) ; *St. grandis hyatorina* Mortensen, 1928 (P : 35–32 ; 120–400 m) ; *St. indica philippinensis* Mortensen, 1928 (P : 32–0– ; 400 m) ; *St. sceptriferoides* Döderlein, 1887 (P : 35 ; 120–400 m) ; *St. sceptriferoides lanceolata* Mortensen, 1928 (P : 35 ; 700 m) ; *St. (Phalacrocidaris) japonica* (Döderlein, 1885) (P : 41–33 ; J : 41– ; 70–700 m) ; *Compsocidaris pyrsacantha* Ikeda, 1939 (P : 27 ; 100m) ; *Acanthocidaris maculicollis* (de Meijere, 1903) (P : 35–0 ; 40–225 m) ; *Stylocidaris reini* (Döderlein, 1887) (P : 35–0– ; 197–500 m) ; *St. reini cladothrix* Mortensen, 1927 (P : 35–0– ; 197–247 m) ; *St. maculosa* Mortensen, 1928 (P : 35–31 ; 90–700 m) ; *St.? fusispina* Mortensen, 1928 (P : 35–31 ; 100–185 m) ; *'Eucidaris' metularia* (Lamarck, 1816) (P : 34–30–0– ; 0–20–570 m) ; *Plococidaris verticillata* (Lamarck, 1816) (P : 35–27–0– ; 0–54 m) ; *Prionocidaris baculosa annulifera* (Lamarck, 1816) (P : 35–0– ; 0–250 m) ; *Pr. bispinosa* (Lamarck, 1816) (P : 20–0– ; 4–50 m) ; *Phyllacanthus imperialis* (Lamarck, 1816) (P : 27–0– ; 0–37 m) ; *Ph. dubius* Brandt, 1835 (P : 27 ; 0–5 m) ; *Chronocidaris micca* Ikeda, 1941 (P : 27 ; 100 m).

Family PSYCHOCIDARIDAE Ikeda, 1936

Psychocidaris ohshimai Ikeda, 1935 (P : 27 ; 100 m).

Order DIADEMATOIDA Duncan, 1889

Suborder ASPIDODIADEMATOINA Mortensen, 1939

Family ASPIDODIADEMATIDAE Duncan, 1889

Aspidodiadema tonsum A. Agassiz, 1879 (P : 34–0– ; 180–925 m).

Suborder PEDINOINA Mortensen, 1939

Family PEDINIDAE Pomel, 1883

Caenopedina mirabilis (Döderlein, 1885) (P : 42–31 ; J : 42– ; 20–80–360 m) ; *C. pulchella* (A. Agassiz & H. L. Clark, 1907) (P : 35? –20 ; 900 m).

Suborder DIADEMATOINA Duncan, 1889

Family DIADEMATIDAE Gray, 1855

Astropyga radiata (Leske, 1778) (P : 34–27–0– ; 2–6 m) ; *Chaetodiadema japonicum* Mortensen, 1904 (P : 35–33 ; 50–135 m) ; *Diadema setosum* (Leske, 1778) (P : 35–0– ; J : 36 – ; 0–70 m) ; *D. savignyi* (Audouin, 1826) (P : 34–32–0 ; J : 35– ; 0–60–70 m) ; *Echinothrix calamaris* (Pallas, 1774) (P : 34–27–0 ; 0–70 m) ; *Ech. diadema* (Linnaeus, 1758) (P : 34–15–0 ; 0–5 m).

Order ARBACIOIDA Gregory, 1900

Suborder SALENIOINA Mortensen, 1903

Family SALENIIDAE L. Agassiz, 1838

Salenocidaris pacifica (Döderlein, 1885) (P : 35 ; 200 m) ; *Sal. hastigera* (A. Agassiz, 1879) (P : 34– ; 360 m) ; *Salenia cincta* A. Agassiz & H. L. Clark, 1907 (P : 35–31–0– ; 170–520 m) ; *Sal. unicolor* Mortensen, 1934 (P : 35 ; 200 m).

Suborder PHYMOSOMATOINA Mortensen, 1904

Family PHYMOSOMATIDAE Pomel, 1883

Glyptocidaris crenularis A. Agassiz, 1863 (P : 43–37 ; J : 43–38 ; 10–150 m).

Family STOMECHINIDAE Pomel, 1883

Stomopneustes variolaris (Lamarck, 1816) (P : 34–27–0– ; 0–10 m).

Suborder ARBACIOINA Gregory, 1900

Family ARBACIIDAE Gray, 1825

Coelopleurus maculatus A. Agassiz & H. L. Clark, 1907 (P : 35–0– ; J : 34– ; 70–360 m) ; *C. undulatus* Mortensen, 1934 (P : 35 ; 400 m) ; *C. undulatus polymorphus* Mortensen, 1935 (P : 34 ; 135 m).

Order ECHINOIDA Claus, 1876

Suborder TEMNOPLEUROINA Mortensen, 1942

Family TEMNOPLEURIDAE A. Agassiz, 1872

Temnopleurus toreumaticus (Leske, 1778) (P : 35–27–0– ; J : 36– ; 0–45 m) ; *T. hardwickii* (Gray, 1855) (P : 42–35 ; J : 42–36 ; 5–35 m) ; *T. hardwickii impressus* Mortensen, 1942 (P : 23 ; 65 m) ; *T.* (*Toreumatica*) *reevesii* (Gray, 1855) (P : 35–32–0 ; J : 36– ; 0–45 m) ; *Prymnechinus apodus* (A. Agassiz & H. L. Clark, 1907) (P : 35–0– ; J : 34– ; 160–500 m) ; *Salmacis bicolor* L. Agassiz, 1841 (P : 34–0– ;0–72 m) ; *Salmaciella dussumieri* (L. Agassiz, 1846) (P : 34–32–0 ; 10–180 m) ; *Microcyphus olivaceus* (Döderlein, 1885) (P : 35–31 ; 70–170 m) ; *Opechinus variabilis* (Döderlein, 1885) (P : 35–33 ; J : 36–34 ; 100–550 m) ; *Mespilia globulus* (Linnaeus, 1758) (P : 35–31–0– ; J : 36– ; 0–60 m) ; *M. globulus pellocrica* H. L. Clark, 1912 (P : 27 ; 0–5 m) ; *M. globulus albida* H. L. Clark, 1925 (P : 34 –27– ? ; J : 35– ; 0–5 m) ; *Temnotrema sculptum* A. Agassiz, 1863 (P : 41–23 ; J : 42– ; 0–190–500 m) ; *T. rubrum* (Döderlein, 1885) (P : 35 ; 5–25 m) ; *T. maculatum* (Mortensen, 1904) (P : 22–0– ; 0–38 m) ; *Prionechinus forbesianus* (A. Agassiz, 1881) (P : 34–31–0– ; 260–1370 m) ; *Pr. agassizii* Wood-Mason & Alcock, 1891 (P : 34–31–0– ; 270–345–3310 m) ; *Desmechinus anomalus* H. L. Clark, 1923 (P : 22 ; 100 m) ; *Printechinus impressus* Koehler, 1927 (P : 26–0– ; 110–135 m) ; *Lamprechinus sculptus* Mortensen, 1942 (J : 34 ; 400 m).

Family TOXOPNEUSTIDAE Troschel, 1872

Nudechinus multicolor (Yoshiwara, 1898) (P : 33–0 ? – ; 120 m) ; *Toxopneustes pileolus* (Lamarck, 1816) (P : 35–27–0 ; J : 36– ; 0–90 m) ; *Tox. elegans* Döderlein, 1885 (P : 31–27 ; 0–20 m) ; *Tripneustes gratilla* (Linnaeus, 1758) (P : 34–27–0– ; 0–25 m) ; *Pseudoboletia maculata* Troschel, 1869 (P : 34–32–0– ; 20–70 m) ; *Pseudocentrotus depressus* (A. Agassiz, 1863) (P : 35–32 ; J : 36– ; 0–5 m).

Suborder ECHINOINA Claus, 1876

Family ECHINIDAE Gray, 1825

Echinus lucidus Döderlein, 1885 (P : 42–31 ; J : 42– ; 180–1750 m).

Family STRONGYLOCENTROTIDAE Gregory, 1892

Strongylocentrotus sachalinicus Döderlein, 1906 (P : 43–38 ; J : 43–40 ; 0 ? –1600 m) ; *St. echinoides* A. Agassiz & H. L. Clark, 1907 (P : 52–38 ; J : 52–40 ; 2–45–770 m) ; *St. polyacanthus* A. Agassiz & H. L. Clark, 1907 (P : 52 ; 0–25 m) ; *St. intermedius* (A. Agassiz, 1863) (P : 52–38 ; J : 52–40 ; 0–35 m) ; *St. pulchellus* A. Agassiz & H. L. Clark, 1907 (P : 53–48 ; J : 52–48 ; 8–225 m) ; *St. droebachiensis* (O. F. Müller, 1776) (P : 50 ; 0 ? –220 m) ; *St. nudus* (A. Agassiz, 1863) (P : 43–35 ; J : 44–35 ; 0–180 m) ; *St. franciscanus* (A. Agassiz, 1863) (P : 53–42 ; 0–125 m) ; *Hemicentrotus pulcherrimus* (A. Agassiz, 1863) (P

: 42–31 ; J : 43– ; 0–45 m).

Family PARASALENIIDAE Mortensen, 1903

Parasalenia gratiosa A. Agassiz, 1863 (P : 33–12–0– ; 0–70 m) ; *P. gratiosa boninensis* Mortensen, 1930 (P : 35–32–10– ; 0–5 m).

Family ECHINOMETRIDAE Gray, 1855

Echinostrephus aciculatum A. Agassiz, 1863 (P : 34–32–0– ; 0–50 m) ; *Ech. molare* (de Blainville, 1825) (P : 27 –0– ; 0–50 m) ; *Anthocidaris crassispina* (A. Agassiz, 1863) (P : 36–33–20 ; J : 37– ; 0–5 m) ; *Echinometra mathaei* (de Blainville, 1825) (P : 35–0 ; J : 34 ? – ; 0–5 m) ; *Ech. mathaei oblonga* (de Blainville, 1825) (P : 27–0 ; 0–5 m) ; *Heterocentrotus mammillatus* (Linnaeus, 1758) (P : 27–0– ; 0–25 m) ; *H. trigonarius* (Lamarck, 1816) (P : 20–0– ; 0–5 m) ; *Colobocentrotus mertensii* Brandt, 1835 (P : 33–27–20 ; 0–5 m).

Order HOLECTYPOIDA Duncan, 1889

Suborder ECHINONEOINA H. L. Clark, 1925

Family ECHINONEIDAE Wright, 1857

Echinoneus cyclostomus Leske, 1778 (P : 34–32–0– ; 0–120 m).

Order CASSIDULOIDA Claus, 1880

Suborder CASSIDULOINA Claus, 1880

Family CASSIDULIDAE L. Agassiz & Desor, 1847

Oligopodia epigona (v. Martens, 1865) (P : 28–0– ; 5–35–141–390 m).

Family ECHINOLAMPADIDAE Gray, 1851

Echinolampas koreana H. L. Clark, 1925 (J : 36–33 ; 72–120 m) ; *Ech. alexandri* de Loriol, 1876 (P : 21–0 – ; 8–365 m) ; *Planilampas sternopetala* (A. Agassiz & H. L. Clark, 1907) (P : 35–31 ; 150–500 m).

Suborder NEOLAMPADOINA Philip, 1963

Family NEOLAMPADIDAE Lambert, 1918

Anochanus sinensis Grube, 1868 (P : 22 ; 20 m).

Order CLYPEASTEROIDA A. Agassiz, 1873

Suborder CLYPEASTEROINA A. Agassiz, 1873

Family CLYPEASTERIDAE L. Agassiz, 1835

Clypeaster reticulatus (Linnaeus, 1758) (P : 34–22–0– ; 0–120 m) ; *Cl. fervens hiradicus* Mortensen, 1948 (J : 34 ; 120 m) ; *Cl. humilis* (Leske, 1778) (P : 22–0– ; 0–20 m) ; *Cl. virescens* Döderlein, 1885 (P : 35–31–0– ; J : 35– ; 100–300 m) ; *Cl. japonicus* Döderlein, 1885 (P : 35–31 ; J : 36– ; 1–75 m) ; *Cl. japonicus clypeus* Döderlein, 1885 (P : 31 ; 110 m) ; *Cl. ogasawarensis* (Yoshiwara, 1898) (P : 27 ; 5 m) ; *Cl. ohshimensis* Ikeda, 1935 (P : 29–0– ; 5 m).

Family ARACHNOIDIDAE Duncan, 1889

Arachnoides placenta (Linnaeus, 1758) (P : 26–22 –0– ; 0–45–57 m).

Suborder LAGANOINA Mortensen, 1948

Family FIBULARIIDAE Gray, 1855

Echinocyamus crispus Mazzetti, 1893 (P : 34−0− ; J : 33− ; 18−192 m) ; *Ech. provectus* de Meijere, 1903 (P : 22−0− ; 133−275 m) ; *Ech. megapetalus* H. L. Clark, 1914 (P : 20−0− ; 0−5 m) ; *Ech.* (*Mortonia*) *australis* (Desmoulins, 1837) (P : 20−0− ; 0−75 m) ; *Fibularia ovulum* Lamarck, 1816 (P : 20 ? −0− ; 0−385 m) ; *F. ovulum trigona* Lamarck, 1816 (J : 34 −0− ; 0−5 m) ; *F. volva* L. Agassiz, 1847 ? (J : 34 ? −0− ; 0−50 m) ; *F.* (*Fibulariella*) *acuta* Yoshiwara, 1898 (P : 35 −23 ; J : 36− ; 0−90 m) ; *F.* (*F.*) *acuta septemtrionalis* Nisiyama, MS (P : 40−37 ; J : 40− ; 0−50 m).

Family LAGANIDAE Desor, 1858

Peronella lesueuri (Valenciennes, 1841) (P : 22−10−0− ; 0−70 m) ; *P. rubra* Döderlein, 1885 (P : 42−35 ; J : 42− ; 5−60 m) ; *P. japonica* Mortensen, 1948 (P : 35−31 ; J : 36 − ; 0 −50 m) ; *P. pellucida* Döderlein, 1885 (P : 35−31−0 ; 75−550 m) ; *P. minuta* (de Meijere, 1904) (P : 34−5 ; 13−35 m) ; *P. orbicularis* (Leske, 1778) (P : 22−10−0 ; 5−70 m) ; *Laganum laganum* (Leske, 1778) (P : 20−0− ; 0−10 m) ; *L. depressum* Lesson, 1841 (P : 22 −10−0− ; 0−85−290 m) ; *L. putnami* A. Agassiz, 1863 (P : 28 ; 0−? m) ; *L. boninense* Mortensen, 1948 (P : 27; 120−220 m) ; *L. decagonale* (de Blainville, 1827) (P : 22−0− ; 0 −26−194 m) ; *L. fudsiyama* Döderlein, 1885 (P : 35−31−0; J : 34− ; 50−645 m).

Suborder SCUTELLOINA Haeckel, 1896

Family SCUTELLIDAE Gray, 1825

Echinarachnius parma obesus H. L. Clark, 1914 (P : 52 −41 ; J : 52− ; 50−120 m) ; *Ech. asiaticus* Michelin, 1859 (P : 52−48 ; 0 ? − ?) ; *Scaphechinus mirabilis* A. Agassiz, 1863 (P : 42−31 ; J : 42−32 ; 0−125 m) ; *S. mirabilis tenuis* (Yoshiwara, 1898) (P : 36−35 ; J : 36 −35 ; 0−12 m) ; *S. griseus* (Mortensen, 1927) (P : 50−41 ; J : 51−40 ? ; 7−10 m) ; *S. brevis* (Ikeda, 1936) (P : 42−36 ; J : 43−? ; 0−10 m).

Family ASTRICLYPEIDAE Stefanini, 1911

Echinodiscus auritus siamensis Mortensen, 1948 (P : 30−23−0− ; 0−50 m) ; *Ech. tenuissimus* (L. Agassiz, 1847) (31 ? −20−0− ; 0−20 m) ; *Astriclypeus mannii* Verrill, 1867 (P : 35−10 ; J : 36− ; 0−5 m).

Order SPATANGOIDA Claus, 1876

Suborder URECHINOINA H. L. Clark, 1925

Family HOLASTERIDAE Pictet, 1857

Stereopneustes relictus de Meijere, 1903 (P : 31−8 ; 250−900 m).

Family URECHINIDAE Duncan, 1889

Urechinus loveni (A. Agassiz, 1898) (P : 55−50 ; 3070−3610 m) ; *U. naresianus* A. Agassiz, 1879 (P : 60−45 ? ; 3020−3610 m).

Family POURTALESIIDAE A. Agassiz, 1881

Pourtalesia laguncula A. Agassiz, 1879 (P : 35−20−0 ; J : 34− ; 220−1370 m).

Suborder SPATANGOINA Claus, 1876

Family PALAEOPNEUSTIDAE A. Agassiz, 1904

Linopneustes murrayi (A. Agassiz, 1879) (P : 35−31−2− ; 620−1615 m) ; *L. fragilis* (de

Meijere, 1904) (P : 34–0– ; 560–1170 m) ; *Argopatagus vitreus* A. Agassiz, 1879 (P : 34–0– ; 700–1310 m) ; *A. planus* (A. Agassiz & H. L. Clark, 1907) (P : 31 ; 772 m) ; *Platybrissus roemeri* Grube, 1865 (J : 35–0– ; 100 m) ; *Palaeotrema loveni* (A. Agassiz, 1879) (P : 35–31–0– ; 176–251–400 m).

Family PALAEOSTOMATIDAE Lovén, 1867

Palaeostoma mirabile (Gray. 1851) (P : 27–0– ; 20–110 m).

Family AEROPSIDAE Lambert, 1896

Aceste ovata A. Agassiz & H. L. Clark, 1907 (P : 32–0– ; 435–4755 m).

Family HEMIASTERIDAE H. L. Clark, 1917

Hemiaster expergitus gibbosus A. Agassiz, 1881 (P : 35–32–0 ; J : 34– ; 445–1765 m) ; *H. clarki* Lambert, 1924 (J : 40–36 ; 140–145 m).

Family SPATANGIDAE Gray 1825

Spatangus luetkeni A. Agassiz, 1872 (P : 42–38 ; J : 42–? ; 80–200 m) ; *Sp. pallidus* H. L. Clark, 1908 (P : 35–32 ; J : ? ; 90–110 m) ; *Sp. altus* Lütken in Mortensen, 1907 (P : 26 ? ; 5–? m) ; *Sp.* (*Granopatagus*) *paucituberculatus* A. Agassiz & H. L. Clark, 1907 (P : 32–0 – ; 230–520 m).

Family MARETIIDAE Lambert, 1905

Maretia planulata (Lamarck, 1816) (P : 35–0– ; J : 36– ; 0–60 m) ; *M. tuberculata* A. Agassiz & H. L. Clark, 1907 (J : 34 ; 108 m) ; *Pseudomaretia alta* (A. Agassiz, 1863) (P : 35–0– ; J : 36– ; 1.5–62–204 m).

Family LOVENIIDAE Lambert, 1905

Lovenia elongata (Gray, 1945) (P : 35–0– ; J : 36– ; 0–90 m) ; *L. gregalis* Alcock, 1893 (P : 32–3 ; 275–930 m) ; *L. subcarinata* (Gray, 1945) (P : 31 ? –22–0– ; 10–35 m) ; *L. triforis* Koehler, 1914 (J : 32–0– ; 80–250 m) ; *Pseudolovenia hirsuta* A. Agassiz & H. L. Clark, 1907 (P : 32 ? –20 ; 350–1265 m) ; *Echinocardium cordatum* (Pennant, 1777) (P : 42 –32– ; J : 42– ; 2–230 m) ; *Ech. lymani* (Lambert, 1924) (P : 38–34 ; J : 40–? ; 195–350 m).

Family PERICOSMIDAE Lambert, 1905

Pericosmus cordatus Mortensen, 1950 (P : 32 ; 200 m) ; *P. melanostomus* Mortensen, 1948 (P : 22–0– ; 18–70 m).

Family SCHIZASTERIDAE Lambert, 1905

Linthia (?) species (J : 34 ; 135 m) ; *Faorina chinensis* Gray, 1851 (P : 22–8 ; 50–180 m) ; *Brisaster latifrons* (A. Agassiz, 1898) (P : 60–43 ; J : 52–44 ; 57–1800 m) ; *Br. owstoni* Mortensen, 1950 (P : 39–32 ; J : 40– ; 10–530 m) ; *Schizaster lacunosus* (Linnaeus, 1758) (P : 35–31– ; J : 36– ; 5–90 m) ; *Hypselaster fragilis* (A. Agassiz & H. L. Clark, 1907) (P : 32 ; 715 m) ; *Hy. pacificus* (Lambert, 1924) (P : 34–32 ; 71 m) ; *Moira lachesinella* Mortensen, 1930 (P : 35–33 ; J : 36–33 ; 0–5 m).

Family BRISSIDAE Gray, 1855

Brissopsis luzonica (Gray, 1851) (P : 35–31–0– ; J : 36– ; 10–744 m) ; *Br. oldhami* Alcock, 1893 (P : 33–0– ; 780–2140 m) ; *Br. bengalensis* Koehler, 1914 (P : 35–0– ; 130–2986 m) ; *Anametalia sternaloides* (Bolau, 1873) (P : 22–10 ; 24–47 m) ; *Rhinobrissus pyramidalis* A. Agassiz, 1872 (P : 22–10 ; 2–10 m) ; *Gymnopatagus magnus* A. Agassiz & H. L Clark, 1907 (P : 34–0– ; 780–1730 m) ; *Eupatagus micropetalus* (H. L. Clark, 1917) (P : 35 ; 145–270

m) ; *Brissus latecarinatus* (Leske, 1778) (P : 28−22−0− ; 0−45 m) ; *Br. agassizii* Döderlein, 1885 (P : 39−31 ; J : 40− ; 0−10 m) ; *Metalia sternalis* (Lamarck, 1816) (P : 33−27−0− ; 0−90 m) ; *M. spatangus* (Linnaeus, 1758) (P : 33−27−0−]; 0−130 m) ; *M. dicrana* H. L. Clark, 1917 (P : 27−0− ; 0−22 m).

As might be expected from the geographical position, the Recent Echinoid fauna of Japan and the adjacent regions is characterized by the mingling, though it is not completely mingle but has more or less certain limits, of the forms endemic to the Japanese region (including the Bonin Islands), the tropical or subtropical forms of the Malay region (comprising the whole Malay Archipelago), and the boreal forms of the North Pacitic region (and the Arctic region). Particularly, on the area covers the main islands of Japan, viz. Hokkaido, Honshu, Shikoku, and Kyushu, the warm Kuroshio current and the cold Oyashiro current exsert considerable influence on the littoral assemblage of Echinoids. Common and rather widely distributed tropical forms, and species more characterically found on the vicinity of coral reefs of the Malay, East Indian, and South Sea regions, thrive on the coasts of Formosa and Ryukyu Islands and to the Pacific coast of Japan proper as far north as latitude 35° north, and on the Japan Sea coast to latitude 36° north or a little more, or less. The typical boreal forms of the North Pacific region (and the Arctic region), such as the genera *Strongylocentrotus* and *Echinarachnius*, having spread from Alaskan Peninsula over the northern Asiatic coast (Kamchatka, Kurile Islands, Sakhalin, and Hokkaido), and some passed down into North Honshu. As for the characteristic forms of the Japanese region, the following genera and subgenera are to be mentioned : *Compsocidaris*, *Chronocidaris*, *Petalocidaris*, *Aspidocidaris*, *Phalacrocidaris*, *Psychocidaris*, *Glyptocidaris*, *Pseudocentrotus*, *Hemicentrotus*, *Anthocidaris*, *Colobocentrotus*, *Scaphechinus*, and *Astriclypeus*. The last genus continuing down into the northern part of the Malay region (Riam, Cambodia), but the center of present and past distributions of it falls in the Japanese region.

THE ECHINOID FAUNA OF JAPAN AND THE ADJACENT REGIONS

From the two foregoing lists, one is the list of the geographical and geological distributions of the fossil Echinoids from Japan and the adjacent regions, and the other of the geographical and bathymetrical distributions of the Recent Echinoids, it is noticed that the Recent Echinoid fauna comprises 188 living species (with several subspecies) and fossil Echinoid fauna 167 species. The sum of the both faunas becomes 355 species in total, but with the deduction of 43 species in common with both the living and fossil, the exact number of species of whole Echinoid fauna of Japan and the adjacent regions becomes 312. The total number of species of these regions decidedly exceeds the species of the Echinoid fauna of Australia (192 spp. −H. L. Clark, 1946, and plus ca. 40 spp., Philip and others). Among the species of these regions, the smaller part seems to have developed autochthonously in the Japanese region, particularly of the area covers the main islands of Japan, throughout geological ages, or improverished remnants of the predecessors, while the larger part may be regarded as immigrants (or descendants of immigrants) of their predecessors which have developed in other zoogeographical regions outside Japan in the geological ages.

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