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By

Hisayoshi IGO, Hiroshi NODA and Harumi NISHIMURA

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*Number 1 (Issued September 25, 1951) Bibliography of Japanese Palaeontology and Related Sciences, 1941-1950 ..... Compiled by Riuji ENDO

*Number 2 (Issued March 1, 1954) Matajiro YOKOYAMA's Pliocene and Later Faunas from the Kwanto Region ..... Revised by Isao TAKI and Katura OYAMA

*Number 3 (Issued August 31, 1957) Matajiro YOKOYAMA's Tertiary Fossils from Various Localities in Japan, Part 1 ..... Revised by Jirô MAKIYAMA

*Number 4 (Issued June 30, 1958) Matajiro YOKOYAMA's Tertiary Fossils from Various Localities in Japan, Part 2 ..... Revised by Jirô MAKIYAMA

*Number 5 (Issued December 15, 1959) Matajiro YOKOYAMA's Tertiary Fossils from Various Localities in Japan, Part 3 ..... Revised by Jirô MAKIYAMA

*Number 6 (Issued July 25, 1960) Matajiro YOKOYAMA's Tertiary Fossils from Various Localities in Japan, Part 4 ..... Revised by Jirô MAKIYAMA

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Number 12 (Issued September 20, 1966) Posteranial Skeletons of Japanese Desmostylia ..... Tokio SHIKAMA

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*Number 14 (Issued November 25, 1969) Litho- and Bio-Facies of Carbonate Sedimentary Rocks —A Symposium— ..... Edited by Tatsuro MATSUMOTO

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Number 16 (Issued December 25, 1971) Tertiary Molluscan Fauna from the Yakataga District and Adjacent Areas of Southern Alaska ..... Saburo KANNO

Number 17 (Issued November 30, 1973) Revision of Matajiro YOKOYAMA's Type Mollusca from the Tertiary and Quaternary of the Kanto Area ..... Katura OYAMA

Number 18 (Issued November 30, 1974) Silurian Trilobites of Japan in Comparison with Asian, Pacific and Other Faunas ..... Teiichi KOBAYASHI and Takashi HAMADA

Number 19 (Issued February 10, 1976) Bivalve Faunas of the Cretaceous Himenoura Group in Kyushu ..... Masayuki TASHIRO

Number 20 (Issued January 31, 1977) Devonian Trilobites of Japan, in Comparison with Asian, Pacific and Other Faunas ..... Teiichi KOBAYASHI and Takashi HAMADA

*Number 21 (Issued May 10, 1977) Mid-Cretaceous Events—Hokkaido Symposium, 1976 ..... Organized by Tatsuro MATSUMOTO

Number 22 (Issued March 30, 1978) Bibliography of Palaeontology in Japan, 1961-1975 ..... Edited by Kametoshi KANMERA and Hiroshi UJIIE

Number 23 (Issued December 15, 1980) Carboniferous Trilobites of Japan, in Comparison with Asian, Pacific and Other Faunas ..... Teiichi KOBAYASHI and Takashi HAMADA

Number 24 (Issued December 15, 1981) Permian Conodont Biostratigraphy of Japan ..... Hisaharu IGO

(* Out of Stock)

Continued inside of back cover

Special Publications, Palaeontological Society of Japan

*Twenty-Fifth Anniversary Volume (Issued February 15, 1961) Catalogue of Type-Specimens of Fossils in Japan ..... Compiled by Shoshiro HANZAWA, Kiyoshi ASANO and Fuyuji TAKAI

*Twenty-Fifth Anniversary Volume (Issued September 16, 1963) A Survey of the Fossils from Japan Illustrated in Classical Monographs (Primarily a Nomenclatorial Revision) ..... Edited by Tatsuro MATSUMOTO

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Preface

The Palaeontological Society of Japan has published "Bibliography of Japanese Palaeontology and Related Sciences" for the periods of 1942-1950, 1951-1960, 1961-1975, 1976-1980 and 1981-1985 as its Special Papers nos. 1, 9, 22, 28, and 31, respectively. The present bibliography represents a sixth issue in this series and contains articles written during the five-year period of 1986-1990 by the authors restricted to one of the following categories;

1) Paleontological articles printed in the publications issued in Japan (includ-ing those written by foreign authors).
2) Paleontological articles treated material from Japan (including those printed in the publications issued in foreign countries and also written by foreign authors).
3) Articles treated the Recent material in relation to paleontology (excluding those references written by neontologists treated merely as living material).
4) Articles treated overseas material and written by Japanese paleontologists.

The data base for this bibliography was compiled from the following manner;

1) Publication lists made available by the authors at the request of the present editors.
2) The present editors searched as possible articles which are application to the above mentioned categories.

The numbers of articles listed through our own searching attain about two-thirds of a total number of listed articles. Owing to the rapid rise in numbers of publications, we are afraid that there are a number of omissions from the lists.

This volume includes Author Catalogue and three kinds of indices: the Co-Author (s), Geologic Age, and Taxa indices. The Author Catalogue, in which articles are arranged in alphabetical order by author name, gives full information about the titles and media of publication. Prefixed serial numbers are specific to respective articles and afford the only key for retrieval from the indices. The titles of articles written in Japanese , where not given in foreign languages, have been translated into English by the editors and put in space brackets. Articles written in Japanese, with the abstract or summary written in English, are indicated by abbreviation in parentheses (J.E.)

Author Catalogue is numbered consecutively. Articles searched out during editing were added in Supplemental Lists which are numbered with a prefix (s).

The present bibliography reflects directly on research activities of Japanese paleontologists, hence we compared tendency in the following points with that recognized in the previous volume (1981-1985).

1) Articles included in this volume rise the total to 1880 including supplemental lists. A total of 1446 articles were listed in the previous issue.

2) Articles written by pleural cooperative authors are increased in this volume.

3) Articles in the foreign publications are increased in both numbers of articles and publications.

4) Materials treated are graphically shown in Figs. 1-4 and Table 1.

Figs.1-2 show a change of percentage in numbers of articles classified them into three categories, animalia, vegetabilia, and the general in this volume and that in the previous one (1981-1985). This circle graph shows the increase of references treated the general and vegetabilia. Most of the paleontological papers in Japan were dealt with classification, systematic, and biostratigraphy but the increase of the general shows that Japanese paleontologists become interested in various fields of paleontology such as microstructure, evolution, paleoecology, taphonomy, functional morphology, and others.

Fig. 3 is a bar chart showing a change in numbers of articles classified into each taxon treated. Mollusca and Protozoa are main taxa in both volumes and attain up to more than 500 references. The increase of published references dealing with Protozoa in the present volume reflects the growth of radiolarian biostratigraphy in Japan. References dealing with Chordata are also increased and attain more than 200. This phenomenon indicates a recent rush of dinosaur discovery.

Fig. 4 is a bar chart showing a change in numbers of references classified into the geologic age of the studied material. This apparently reflects an area of the distribution of fossiliferous strata. The increase in numbers of published papers is not prominent between two volumes but the growth is recognized in references treated the Permian, Neogene, Quaternary, and Recent.

During the course of the present editing work, we are indebted very much to Drs. Kenshiro Ogasawara, Katsuo Sashida, Ken-ichiro Hisada, Shuko Adachi, Katsumi Ueno, Messers. Yoshibumi Kikuchi and Koichi Watase, all of Institute of Geoscience, the University of Tsukuba for collecting and editing the data of paleontological papers concerned herewith. Our deep appreciation is send to Mrs. Akiko Kawada for her computer works and preparation of data cards.

Table 1. Number of articles in taxa in periods of 1981–1985 and 1986–1990.

Taxa	1981-1985	1986-1990
General	37	101
Animalia	2	4
Trace fossils	5	29
Chordata	7	12
Mammalia	92	102
Primates	0	13
Proboscidea	8	24
Artiodactyla	4	5
Aves	4	3
Reptilia	18	27
Amphibia	3	2
Pisces	15	28
Osteichthyes	11	8
Chondrichthyes	27	19
Conodontchordata	44	29
Echinodermata	4	3
Holothuroidea	1	0
Echinoidea	15	10
Crinoidea	3	10
Brachiopoda	34	31
Bryozoa	10	14
Arthrozoa	0	1
Insecta	5	8
Crustacea	1	9
Malacostraca	4	5
Cirripedia	6	10
Ostracoda	49	49
Branchiopoda	3	1
Trilobita	25	32
Annelida	1	5
Mollusca	89	175
Cephalopoda	15	16
Coleoidea	4	1
Ammonoidea	109	77
Nautiloidea	32	25
Mollusca excl. Cephalopoda	14	25
Bivalvia	171	190
Scaphopoda	9	5
Gastropoda	82	80
Polyplacophora	0	1
Coelenterata	2	11
Anthozoa	3	7

Taxa	1981-1985	1986-1990
Zoantharia	3	1
Tabulata	6	8
Scleractinia	21	10
Tetracorallia	18	15
Stromatoporata	5	4
Hydrozoa	2	1
Porifera	2	9
Protozoa	0	1
Radiolaria	161	209
Rhizopoda	1	0
Foraminifera	60	135
Fusuline	23	39
Benthic Foraminifera	0	66
Larger Formainifera	15	10
Smaller Foraminifera	0	2
Benthic Smaller Foraminifera	46	21
Planktonic Foraminifera	50	59
Chitinozoa	0	1
Vegetabilia general	12	69
Palynology	58	98
Angiospermae	14	14
Dicotyledoneae	16	17
Gymnospermae	12	3
Coniferopsida	18	12
Ginkgopsida	3	4
Cycadopsida	9	3
Pteridospermopsida	4	1
Pteridophyta	0	2
Pteropsida	4	6
Articulatae	2	1
Tracheophyta	0	1
Non Tracheochyta	3	1
Charophyta	1	0
Lycophyta	0	1
Algae	0	1
Calcareous Algae	7	16
Coccolithophoridae	35	46
Dinoflagellata	10	10
Diatomae	73	94
Silicoflagellata	8	4
Total	1670	2202

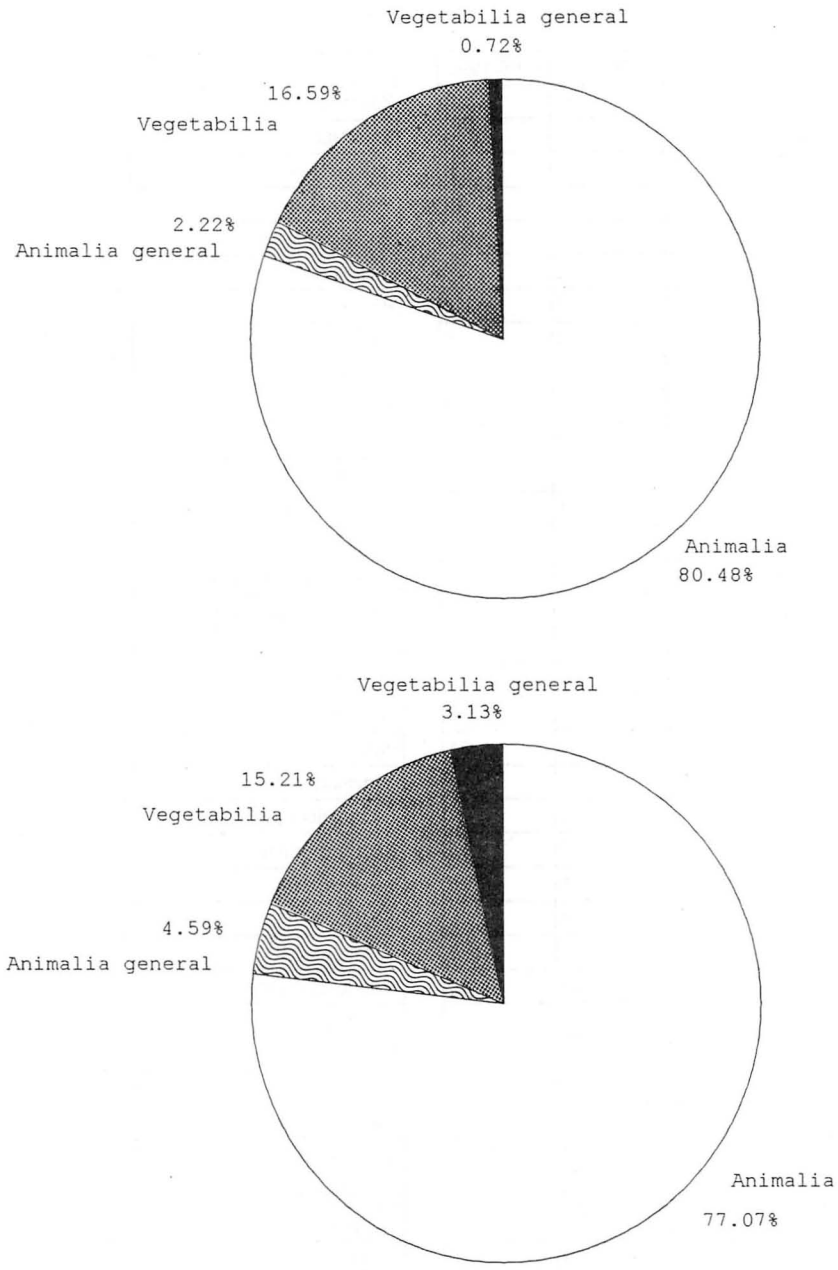

Figure 1. Percentage of articles in large taxonomic categories as animalia, vegetabilia and the general in period of 1981–1985 (above) and 1986–1990 (below).

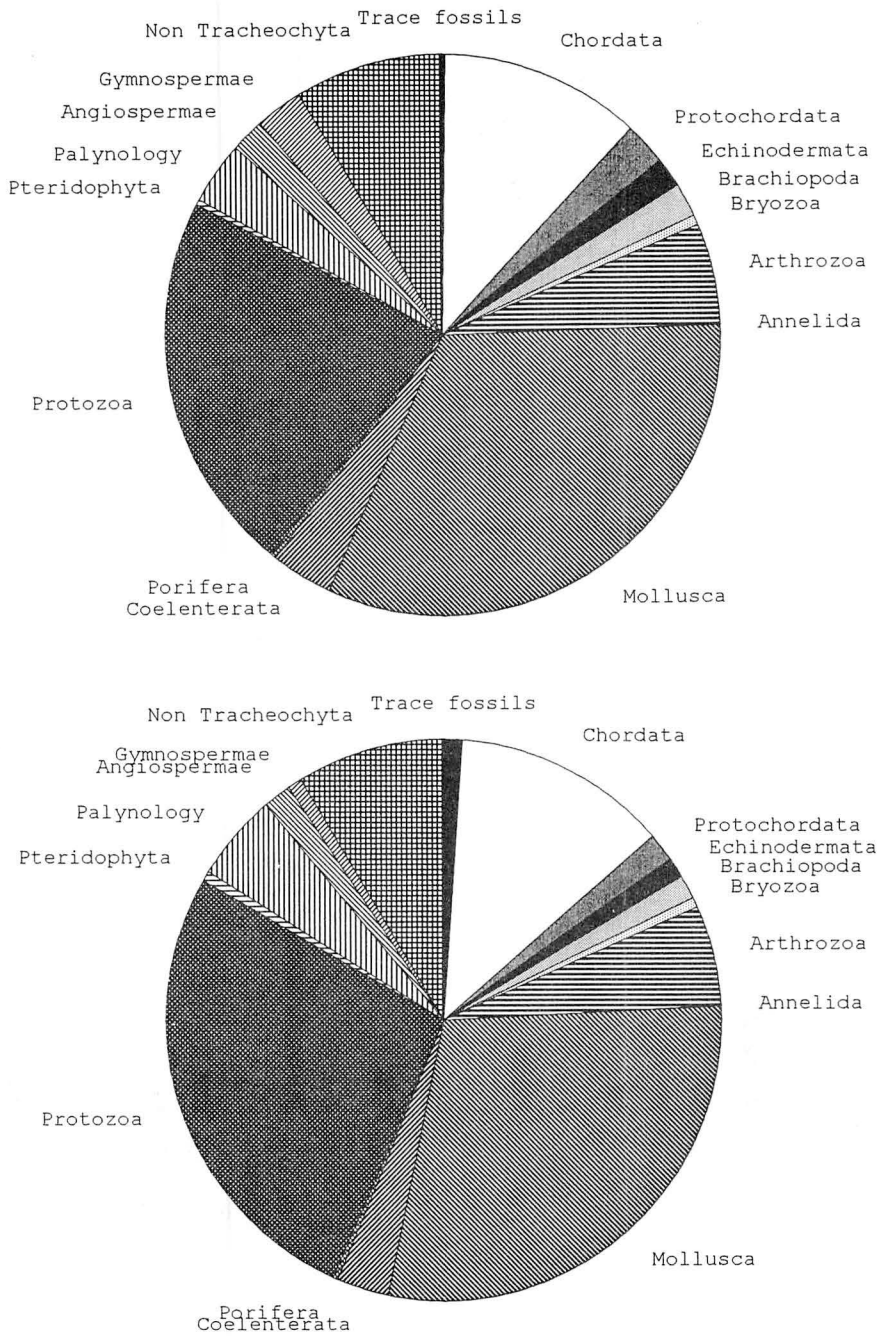

Figure 2. Percentage of articles in taxonomic categories in periods of 1981–1985 (above) and 1986–1990 (below).

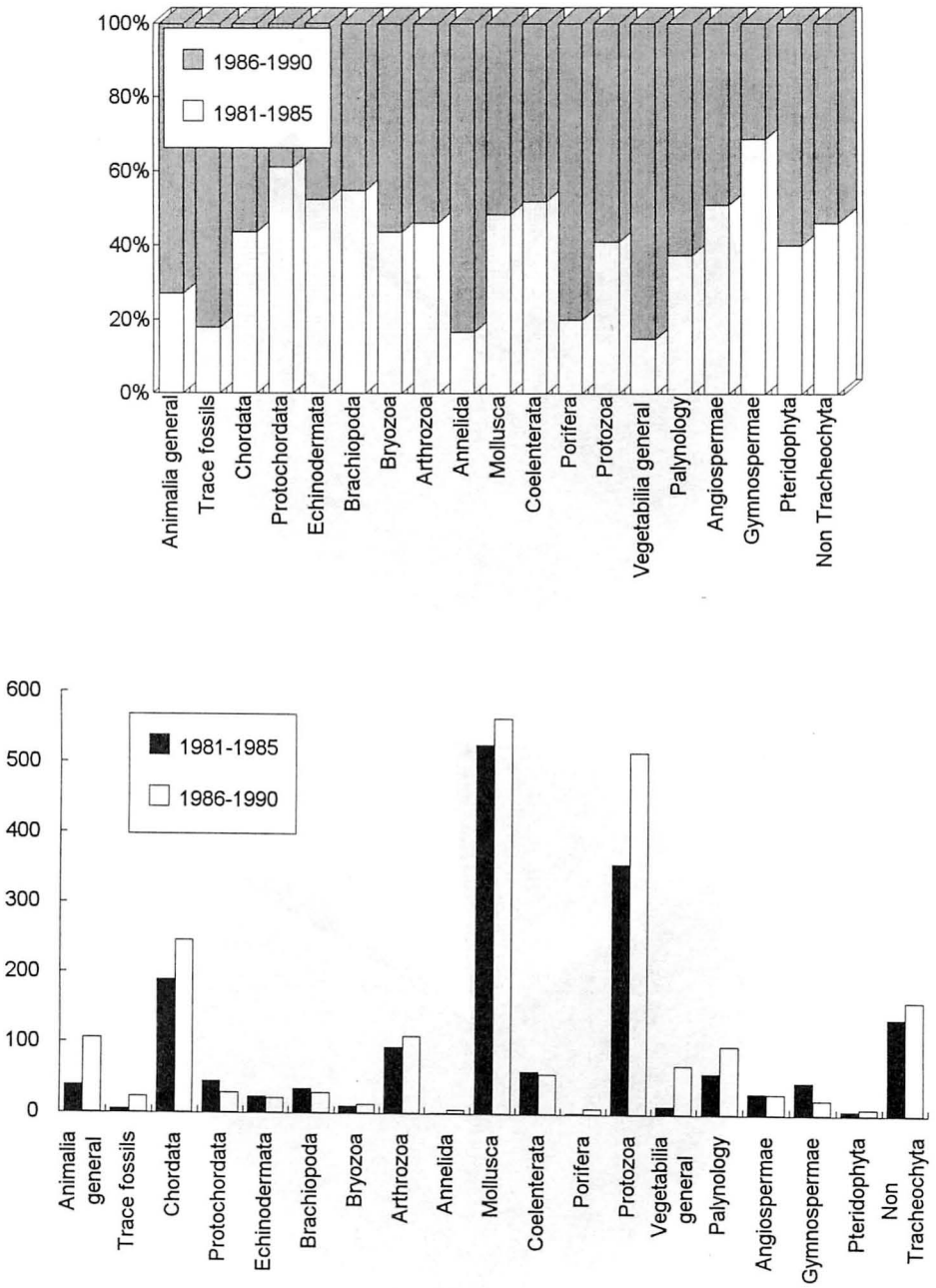

Figure 3. Percentage (above) and number (below) of articles in taxonomic categories in periods of 1981–1985 and 1986–1990.

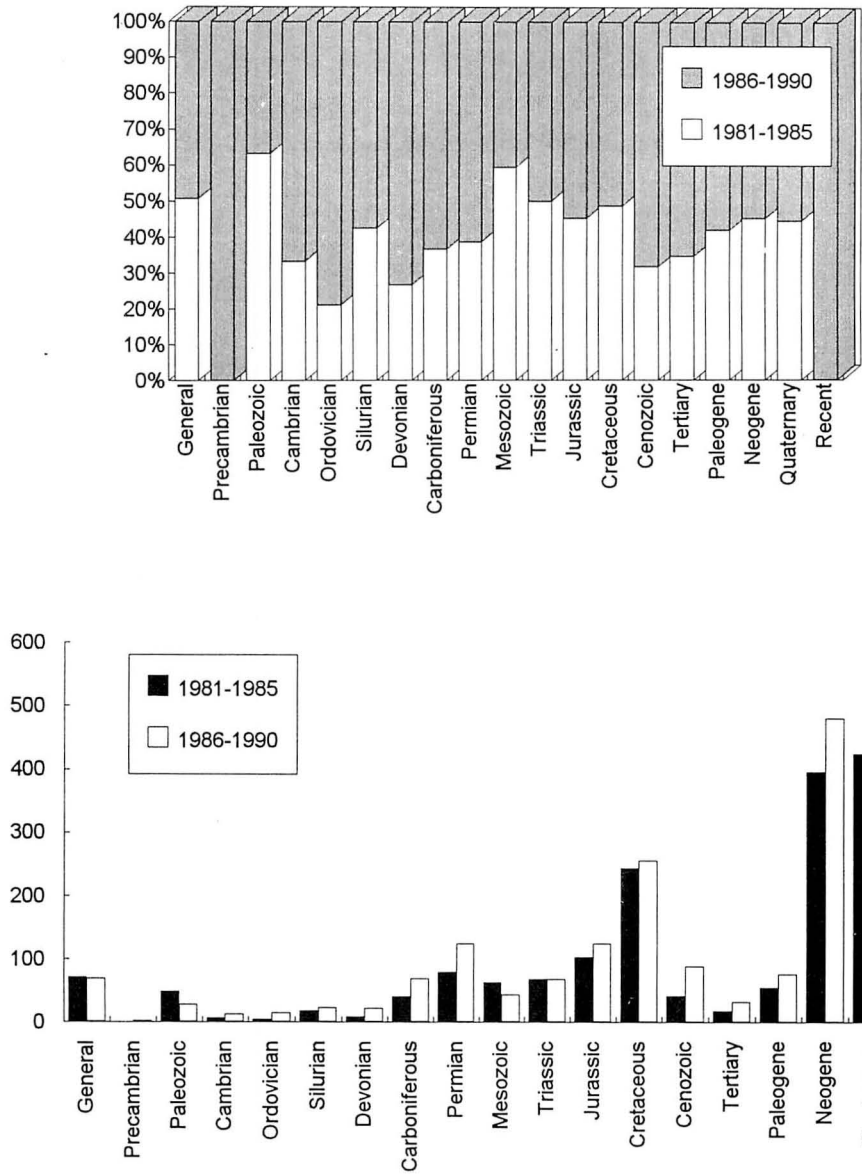

Figure 4. Percentage (above) and number (below) of articles in geological age in periods of 1981–1985 and 1986–1990.

ABBREVIATIONS AND PUBLISHERS OF THE PERIODICALS CITED

Abbreviations and Publishers of the Periodicals Cited

Acta Geol. Sinica
Acta Geologica Sinica, Peking

Acta Geol. Taiwanica
Acta Geologica Taiwanica, Taiwan

Anima
Anima, Magagine of Natural History, Heibonsha, Tokyo

Ann. Bull., Hiroshima Univ., Taishaku-kyo Site Res. Cent.
Annual Bulletin of Hiroshima University, Taishaku-kyo Sites Research Center, Hiroshima

Ann. Rep., Akita Pref. Mus.
Annual Report of Akita Prefectural Museum, Akita

Ann. Rep., Hist. Mus. Hokkaido
Annual Report of the Historical Museum, Hokkaido, Sapporo

Ann. Rep., Inst. Geosci., Univ. Tsukuba
Annual Report of the Institute of Geoscience, The University of Tsukuba, Tsukuba

Ann. Rep., Mar. Ecosyst. Res. Cent., Chiba Univ.
Annual Report of the Marine Ecosystem Research Center, Chiba University, Chiba

Ann. Rep., Ogasawara Res.
Annual Report of Ogasawara Research, Ogasawara Research Committee of Tokyo Metropolitan University, Tokyo

Ann. Rep., Synthetic Stud., Fukushima Univ., Nat. Lake Inawashiro
Annual Report of Synthetic Study, Fukushima University, Nature of Lake Inawashiro, Fukushima

Ann. Sci., Coll. Lib. Arts, Kanazawa Univ.
The Annals of Science, the College of Liberal Arts, Kanazawa University, Kanazawa

Aquabiology
Aquabiology (=Kaiyo to Seibutsu), Seibutsu Kenkyusha Co., Tokyo

Archiv. Conference on the Comp. Bio. Tooth Enamel, Japan
Archives of the Comparative Biology of Tooth Enamel in Japan, Yokohama

Asian Jour. Pl. Sci.

Asian Journal of Plant Science, India

Atlas, Japan. Foss.
Atlas of Japanses Fossils, Tsukiji Shokan, Tokyo

Benthos Res.
Benthos Research, Bulletin of Japanese Association of Benthology, Tomioka, Kumamoto

Biomechanisms
Biomechanism, International Society on Biomechanics, Basel

Biosystems
Biosystems, Elsevier Scientific Publishing Co., Ireland

Bone
The Bone, Medical Review Corporation, Osaka

Boreas
Boreas, An International Journal of Quaternary Research, Scandinavian University Press, Oslo-Stockholm

Bot. Gazzete
Botanical Gazzete, The University of Chicago Press, Chicago

Botan. Mag., Tokyo
Botanical Magazine, The Botanical Society of Japan, Tokyo

Bull. Aichi Univ. Educ., Nat. Sci.
Bulletin of Aichi University of Education, Natural Science, Kariya

Bull. Akiyoshi-dai Mus., Nat. Hist.
Bulletin of the Akiyoshi-dai Museum of Natural History, Shuho-cho, Yamaguchi

Bull. Amer. Paleontol.
Bulletins of American Paleontology, Paleontological Research Institutes, Ithaca, New York

Bull. Coll. Educ., Univ. Ryukyus
Bulletin of the College of Education, University of the Ryukyus, Nishihara, Okinawa

Bull. Coll. Sci., Univ. Ryukyus
Bulletin of the College of Science, University of the Ryukyus, Nishihara, Okinawa

Bull. Earthquake Res. Inst., Univ. Tokyo
Bulletin of the Earthquake Research Institute, University of Tokyo, Tokyo

Bull. Fac. Educ., Kagoshima Univ., Nat. Sci.
Bulletin of the Faculty of Education, Kagoshima University, Natural Science, Kagoshima

Bull. Fac. Educ., Kanazawa Univ., Nat. Sci.
Bulletin of the Faculty of Education, Kanazawa University, Natural Science, Kanazawa

Bull. Fac. Lib. Arts, Nagasaki Univ., Nat. Sci.
Bulletin of the Faculty of Liberal Arts, Nagasaki University, Natural Science, Nagasaki

Bull. Fukui Munic. Mus., Nat. Hist.
Bulletin of Fukui Municipal Museum of Natural History, Fukui

Bull. Fukui Pref. Mus.
Bulletin of the Fukui Prefectural Museum, Fukui

Bull. Fukuoka Univ. Educ.
Bulletin of Fukuoka University of Education, Akama, Fukuoka

Bull. Fukushima Pref. Mus.
Bulletin of the Fukushima Prefectural Museum, Fukushima

Bull. Geogr. Dept., Univ. Tokyo
Bulletin of the Geographical Department, The University of Tokyo, Tokyo

Bull. Geol. Soc. Amer.
Bulletin of the Geological Society of America, New York

Bull. Geol. Soc. Japan, Tohoku Branch
Bulletin of the Geological Society of Japan, Tohoku Branch, Sendai

Bull. Geol. Surv. Japan
Bulletin of the Geological Survey of Japan, Tsukuba

Bull. Gunma Pref. Mus. Hist.
Bulletin of the Gunma Prefectural Museum of History, Takasaki

Bull. Hobetsu Mus.
The Bulletin of the Hobetsu Museum, Hobetsu, Hokkaido

Bull. Hokkaido Tokai Univ.
Bulletin of the Hokkaido Tokai University, Hokkaido

Bull. Iwaki-shi Kyoiku Bunka Jigyodan
Bulletin of the Iwaki-shi Kyoiku Bunka Jigyoudan, Iwaki

Bull. Iwate Pref. Mus.
Bulletin of the Iwate Prefectural Museum, Morioka

Bull. Japan Sea Res. Inst., Kanazawa Univ.
Bulletin of the Japan Sea Research Institute, Kanazawa University, Kanazawa

Bull. Joetsu Univ. Educ.
Bulletin of Joetsu University of Education, Joetsu

Bull. Kanagawa Pref. Mus., Nat. Sci.
Bulletin of the Kanagawa Prefectural Museum, Natural Science, Yokohama

Bull. Kansai Nat. Reserv. Organization
Bulletin of Kansai Natural Reservation Organization (=Kansai Shizen Hogokikou Kaiho), Osaka

Bull. Kitakyushu Mus., Nat. Hist.
Bulletin of the Kitakyushu Museum of Natural History, Kitakyushu

Bull. Kushiro City Mus., Hokkaido
Bulletin of Kushiro City Museum, Kushiro, Hokkaido

Bull. Mar. Sci.
Bulletin of Marine Science, Coral Gables, Allen Press, Florida

Bull. Mizunami Fossil Mus.
Bulletin of the Mizunami Fossil Museum, Mizunami

Bull. Mukogawa Women's Univ. Educ.
Bulletin of the Mukogawa Women's University of Education, Mukogawa

Bull. Nagaoka Munic. Sci. Mus.
Bulletin of Nagaoka Municipal Science Museum, Nagaoka

Bull. Nara Univ. Educ.
Bulletin of Nara University of Education, Natural Science, Nara

Bull. Natn. Mus., Japan. Hist.
Bulletin of the National Museum of Japanese History, Sakura, Chiba

Bull. Natn. Mus., Nat. Sci.
Bulletin of National Museum of Natural Science, Taiwan

Bull. Natn. Sci. Mus., Tokyo, Ser. A
Bulletin of the National Science Museum, Series A, Tokyo

Bull. Natn. Sci. Mus., Tokyo, Ser. C
Bulletin of the National Science Museum, Series C, Tokyo

Bull. Osaka Mus., Nat. Hist.
Bulletin of the Osaka Museum of Natural History, Osaka

Bull. Plankton Soc. Japan
The Bulletin of Plankton Society of Japan, Tokyo

Bull. Saitama Mus., Nat. Hist.
Bulletin of the Saitama Museum of Natural History, Nagatoro, Saitama

Bull. Sci. & Eng. Res. Lab., Waseda Univ.
Bulletin of Science and Engineering Research Laboratory, Waseda University, Tokyo

Bull. Sugadaira Montane Res. Cent., Univ. Tsukuba
Bulletin of the Sugadaira Montane Research Center, The University of Tsukuba, Sugadaira, Nagano

Bull. Tochigi Pref. Mus.
Bulletin of Tochigi Prefectural Museum, Utsunomiya

Bull. Tokyo Gakugei Univ., Sec. 4
Bulletin of Tokyo Gakugei University, Section IV, Mathematics and Natural Sciences, Tokyo

Bull. Tokyo Seitoku Coll.
Bulletin of Tokyo Seitoku College, Tokyo

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Bulletin of Tsuyama Local Museum, Tsuyama

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The University Museum, The University of Tokyo, Bulletin, Tokyo

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Bulletin of the Yamagata Prefectural Museum, Yamagata

Bull. Yamagata Univ., Nat. Sci.
Bulletin of the Yamagata University, Natural Science, Yamagata

Bull. Yamaguchi Pref. Mus.
Bulletin of the Yamaguchi Prefectural Museum, Yamaguchi

Caldasia
Caldasia, Boletin del Instituto de Ciencias Naturals, Museo de Historia Natural, Fadultad de Ciencias de la Universidad Nacional de Columbia, Bogota

CCOP Tech. Bull.
Technical Bulletin, Committee for Co-Ordination of Joint Prospecting for Mineral Resources in Asian Offshore areas (CCOP), Geological Survey of Japan, Tsukuba

Chigaku Kenkyu
Chigaku Kenkyu (=Journal of the Society of Earth Scientists and Amateurs of Japan), Nippon Kobutsu Shumi-no-kai, Kyoto

Chiribotan
The Chiribotan, Newsletters of the Malacological Society of Japan, Tokyo

Chishitsu News
Chishitsu News, The Geological Survey of Japan, Tsukuba

Collect. & Breed.
Collecting and Breeding (=Saishu to Shiiku), The Japanese Association of Science, Tokyo

Compass
The Compass, Journal of the American Association of Social Work, New York

Contr. Inst. Geol. Paleont., Tohoku Univ.
Contributions from the Institute of Geology and Paleontology, Tohoku University, Sendai

Cour. Forschungsinst. Senkenb.
Courier Forschungsinstitut Senckenberg, Senckenbergische Naturforschende Gesellschaft, Frankfurt

Cretaceous Res.
Cretaceous Research, Academic Press, Ltd., London

Cruise Rep., Geol. Surv. Japan
Geological Survey of Japan, Cruise Report, Tsukuba

Cult. Prop. Rep., Nimomiya Town Educ. Commit.
Cultural Properties Reports, Ninomiya Town Educational Committee, Hiratsuka

Diatom Res.
Diatom Research, International Society for Diatome Research, Bristole

Dissert. Abstr. Internat.
Dissertarion Abstracts International, B. The Sciences and Engineering, University Microfilms International, Michigan

Earth Month.
Earth Monthly (=Gekkan Chikyu), Kaiyo Shuppan Co., Tokyo

Earth Sci.
Earth Science (=Chikyu Kagaku), The Journal of the Association for the Geological Collaboration in Japan, Chigaku Dantai Kenkyu-kai, Tokyo

Educ. Earth Sci.
Education of Earth Science (=Chigaku Kyoiku), Tokyo

Educ. Earth Sci. & Sci. Mov.
Education of Earth Science and Scientific Movement (=Chigaku Kyoiku to Kagaku Undou), Association for the Geological Collaboration in Japan, Tokyo

Episodes
Episodes, International Geoscience Newsmagazine, Herndon

Excavat. Rep., Archeol. Sites, Route Shikoku Transverse High Way
Excavation Report of Archaeological Sites on the Route of Shikoku Transverse High Way

Ezohelix
Sheller's Club Ezohelix, Wakkanai, Hokkaido

Facies
Facies, Institute fur Palaeontologie der Universitat Erlangen-Nuremberg

Fossils, Palaeont. Soc. Japan
Fossils (=Kaseki), Palaeontological Society of Japan, Tokyo

Fukushima Univ. Tokutei Kenkyu, [Inawashiro no Shizen] Kenkyu Hokoku
Fukushima University Tokutei Kenkyu, [Inawashiro no Shizen] Kenkyu Hokoku, Fukushima

Gakujyutsu Geppo
Gakujyutsu Geppo (=Japanese Scientific Monthly), The Japan Society for the Promotion of Science, Tokyo

Gakujutsu Kenkyu, Sch. Educ., Waseda Univ., Ser. Biol. & Geol.
Gakujyutsu Kenkyu (=Academic Studies), The School of Education, Waseda University, Seriese Biology and Geology, Tokyo

Geobios
Geobios, Paleontologie, Stratigraphie, Paleoecologie, Universite Claude, Bernard, Lyon

Geochemistry
Geochemistry (=Chikyukagaku), Geochemical Society of Japan, Tokyo

Geogr. Rev. Japan
Geographical Review of Japan (=Chirigaku Hyouron), Tokyo

Geology
Geology, Geological Society of America, Boulder

Geol. Jour.
Geological Journal, The Liverpool Geological Society, Liverpool

Geol. Palaeontol.
Geologica et Palaeontologica, Institute fur Geologie und Palaontologie der Philipps Universitat Marburg

Geol. Rep., Hiroshima Univ.
Geological Report of Hiroshima University, Hiroshima

Geol. Rep., Shimane Univ.
Geological Report of Shimane University, Matsue

Geophys. Monogr.
Geophysical Monographs, Washington, D. C.

Geosci. Rep., Shizuoka Univ.
Geoscience Reports of Shizuoka University, Shizuoka

Heredity
The Heredity (=Iden), Shokado Publishing Co., Tokyo

Hist. Biol.
Historical Biology, An International Journal of Paleobiology, Harwood Academic Publishers, Reading

Hokkaido no Shizen to Seibutsu
Hokkaido no Shizen to Seibutsu, Sapporo

Hum. Cult. Environ. Stud., N. Hokkaido, Univ. Tsukuba
Human Culture and Environmental Studies in Northern Hokkaido, The University of Tsukuba, Tsukuba

INA News Lett.
INA News Letter, International Nannoplankton Association, Hague

Indian Jour. Geol.
Indian Journal of Geology, India

Initial Rep., DSDP
Initial Reports of the Deep Sea Drilling Project, U.S. Science Foundation, Washington, D.C.

Int. Jour. Speleol.
International Journal of Speleology, Amsterdam

Iwaki-shi Maibotsubunka-zai Chosa Houkokusho
Iwaki-shi Maibotsubunka-zai Chosa Houkokusho, Iwaki City Educational Board, Iwaki

JAMSTECTR Deep Sea Res.
JAMSTECTR Deep Sea Research (="Shinkai 2000" Kenkyu Symposium Hokokusho), Yokosuka

Japan. Jour. Ecol.
Japanese Journal of Ecology (=Nihon Seitai Gakkai-shi), Ecological Society of Japan, Matsumoto

Japan. Jour. Hist. Bot.
Japanese Journal of Historical Botany (=Shokusei-shi Kenkyu), Tokyo

Japan. Jour. Oral Biol.
Japanese Journal of Oral Biology, Japanese Association for Oral Biology, Tokyo

Japan. Jour. Phycology
The Japanese Journal of Phycology, Japanese Society of Phycology, Tokyo

Jour. Afr. Stud.

Journal of African Studies, African Studies Center of the University of California, Berkeley, California

Jour. Anthropol. Soc. Nippon
Journal of Anthropological Society of Nippon (=Zinruigaku Zassi), Tokyo

Jour. Coll. Arts & Sci., Chiba Univ., B
Journal of the College of Arts and Sciences, Chiba University, B, Chiba

Jour. Coll. Lib. & Arts, Toyama Univ., Nat. Sci.
Journal of the College of Liberal and Arts, Toyama University, Natural Science, Toyama

Jour. Earth Sci., Nagoya Univ.
The Journal of Earth Sciences, Nagoya University, Nagoya

Jour. Fac. Lit., Kitakyushu Univ., Ser. B
Journal of the Faculty of Literature, Kitakyushu University, Series B, Kitakyushu

Jour. Fac. Sci., Hokkaido Univ., Ser. 4
Journal of the Faculty of Science, Hokkaido University, Series IV, Geology and Mineralogy, Sapporo

Jour. Fac. Sci., Univ. Tokyo, Sec. 2
Journal of the Faculty of Science, the University of Tokyo, Section II, Tokyo

Jour. Foram. Res.
Journal of Foraminiferal Research, The Cushman Foundation for Foraminiferal Research, Natural Museum of Natural History, Washington D. C.

Jour. Foss. Res.
Journal of Fossil Research (=Fossil Club Bulletin), Fossil Research Society of Japan, (=Kaseki Kenkyu-kai), Tokyo

Jour. Geogr.
Journal of Geography, Tokyo Geographical Society (=Tokyo Chigaku Kyokai), Tokyo

Jour. Geol.
Journal of Geology, The University of Chicago Press, Chicago

Jour. Geol. Soc. India
Journal of the Geological Society of India, Bangalore, India

Jour. Geol. Soc. Japan
The Journal of the Geological Society of Japan, Tokyo

Jour. Geol. Soc. Korea
Journal of the Geological Society of Korea, Seoul

Jour. Geol. Soc. Philippines
Journal of Geological Society of the Philippines, Manila

Jour. Geosci., Osaka City Univ.
Journal of Geosciences, Osaka City University, Osaka

Jour. Growth
Journal of Growth (=Seicho)

Jour. Hum. Evol.
Journal of Human Evolution, Academic Press, London

Jour. Japan. Assoc. Petrol. Tech.
Journal of the Japanese Association for Petroleum Technologists, Tokyo

Jour. Japan. Bot.
Journal of Japanese Botany, Tokyo

Jour. Japan Soc., Eng. Geol.
Journal of the Japan Society of Engineering Geology, Tokyo

Jour. Mammal.
Journal of Mammalogy, American Society of Mammalogists, Lawrence

Jour. Micropalaeont.
Journal of Micropalaeontology, The British Micropalaeontological Society, London

Jour. Nat. Hist. Mus. & Inst., Chiba
Journal of Natural History Museum and Institute, Chiba

Jour. Oceanogr. Soc. Japan
Journal of the Oceanographical Society of Japan, Tokyo

Jour. Paleont.
Journal of Paleontology, The Paleontological Society, Ithaca, New York

Jour. Paleontol. Soc. Korea
Journal of the Paleontological Society of Korea, Seoul

Jour. Plankton Res.
Journal of Plankton Research, IRL Press Limited, Oxford

Jour. Sci., Coll. Gen. Educ., Univ. Tokushima
Journal of Science, College of General Education, University of Tokushima, Tokushima

Jour. Sci., Hiroshima Univ., Ser. C
Journal of Science of the Hiroshima University, Series C, Geology and Mineralogy, Hiroshima

Jour. Southeast Asian Earth Sci.
Journal of Southeast Asian Earth Sciences, Pergamon Press, Oxford

Jour. Speleol. Soc. Japan
Journal of the Speleological Society of Japan, Kitakyushu

Jour. Theor. Biol.
Journal of Theoretical Biology, Academic Press Limited, London

Kagaku
Kagaku (=Science), Iwanami Publishing Co., Tokyo

Kagoshima-ken Chigaku-kaishi
Kagoshima-ken Chigaku-kaishi, Kagoshima

Kaiyo Month.
Kaiyo Monthly, Kaiyo-Shuppan, Co., Tokyo

Kaseki no Tomo
Kaseki no Tomo, Publication of the Tokai Fossil Society, Nagoya

Kikan Jinruigaku
Kikan Jinruigaku, Tokyo

Lethaia
Lethaia, An International Journal of Palaeontology and Stratigraphy, Norwegian University, Oslo

Life Sci.
Life Sciences, Pergamon Press, London

Limestone
Limestone, The Institute of Limestone Quarry, Tokyo

Malacologia
Malacologia, Institute of Malacology, The Academy of Natural Science of Philadelphia, Philadelphia

Mammal. Sci.
Mammalian Science (=Honyurui Kagaku), Tokyo

Mar. Ecol.
Marine Ecology, Paul Parey Scientific Publishers, Berlin

Mar. Ecol., Progress Ser.
Marine Ecology, Progress Series, Halstenleek

Mar. Geol.
Marine Geology, Elsevier Scientific Publishing Co., Amsterdam

Mar. Micropaleont.
Marine Micropaleontology, Elsevier Scientific Publishing Co., Amsterdam

Mar. Sci., Month.
Marine Science Monthly (=Kaiyo-Kagaku), Kaiyo Shuppan Co., Tokyo

Mem. Assoc. Australas. Palaeontol.
Memoir of the Association of Australasian Palaeontologists, Sydney

Mem. Fac. Educ., Ehime Univ. Ser. 3
Memoirs of the Faculty of Education, Ehime University, Series III, Natural Science, Matsuyama

Mem. Fac. Educ., Fukui Univ., Ser. 2
Memoirs of the Faculty of Education, Fukui University, Series II, Natural Science, Fukui

Mem. Fac. Educ., Kumamoto Univ.
The Memoirs of the Faculty of Education, Kumamoto University, Natural Scienece, Kumamoto

Mem. Fac. Educ., Shimane Univ.
Memoirs of the Faculty of Education, Shimane University, Matsue

Mem. Fac. Gen. Educ., Kumamoto Univ.
Memoirs of the Faculty of General Education, Kumamoto University, Natural Science, Kumamoto

Mem. Fac. Lib. Arts & Educ., Yamanashi Univ., Pt. 2
Memiors of the Faculty of Liberal Arts and Education, Yamanashi University, Part II (Mathematics and Natural Sciences), Kofu

Mem. Fac. Sci., Kochi Univ., Ser. E
Memoirs of the Faculty of Science, Kochi University, Series E, Geology, Kochi

Mem. Fac. Sci., Kyoto Univ., Ser. Geol. & Mineral.
Memoirs of the Faculty of Science, Kyoto University, Series of Geolog and Mineralogy, Kyoto

Mem. Fac. Sci., Kyushu Univ., Ser. D
Memoirs of the Faculty of Science, Kyushu University, Series D, Geology, Fukuoka

Mem. Fac. Sci., Shimane Univ.
Memoirs of the Faculty of Science, Shimane University, Matsue

Mem. Geol. Soc. Japan
Memoirs of the Geological Society of Japan, Tokyo

Mem. Hokkaigakuen Univ.
Memoirs of the Hokkaigakuen University, Sapporo

Mem. Inst., Field Educ., Yokohama Natn. Univ.
Memoirs of the Institute of Field Education, Yokohama National University, Yokohama

Mem. Natn. Inst. Polar Res., Spec. Issue
Memoirs of National Institute of Polar Research, Special Issue, Tokyo

Mem. Natn. Sci. Mus., Tokyo
Memoirs of the National Science Museum, Tokyo

Mem. Osaka Kyoiku Univ., Ser. 3
Memoirs of Osaka Kyoiku University, Series III, Natural Science and Applied Science, Osaka

Mem. Prefec. Office, Nemuro Munic. Mus.
The Memoirs of the Prefecture Office of Nemuro Municipal Museum, Nemuro

Mem. Tochigi Pref. Mus.
Memoirs of Tochigi Prefectural Museum, Utsunomiya

Micropaleontology
Micropaleontology, Micropaleontology Press, American Museum of Natural History, New York

Monogr. African Stud., Supplement. Issue
African Study Monographs, Supplementary Issue, Research Committee for African Area Studies, Kyoto University, Kyoto

Monogr. Assoc. Geol. Collab. Japan
The Association for the Geological Collaboration in Japan, Monograph, Tokyo

Monogr. Mizunami Fossil Mus.
Monograph of the Mizunami Fossil Museum, Mizunami

Nature
Nature, Macmillan Magazenes Ltd., London

Nat. & Cult., Univ. Mus., Univ. Tokyo
Nature and Culture, University Museum, the University of Tokyo, Tokyo

Nat. Hist. Rep. Kanagawa, Kanagawa Pref. Mus.
Natural History Report of Kanagawa, Kanagawa Prefectural Museum, Yokohama

Nat. Hist. Res., Nat. Hist. Mus. & Inst., Chiba
Natural Historical Research, Natural History Museum and Institute, Chiba

Naturl. Konstruct. Leichtbau Architekt. Nat.
Naturlische Konstructionen Leichtbau in Architektur und Natur, Stuttgart

NOM
News of Osaka Micropaleontologists, Osaka

NOM, Spec. Vol.
News of Osaka Micropaleontologists, Special Volume, Osaka

Occas. Pap., Kagoshima Univ. Res. Cent., South Pacific
Occasional Papers, Kagoshima University Research Center for the South Pacific, Kagoshima

Otolaryngol. Head & Neck Surg.
Otolaryngology-Haed and Neck Surgery, Tokyo

Overseas Res. Rep., New World Monkeys, Kyoto Univ.
Kyoto University Overseas Research Report of New World Monkeys, Kyoto

Pacific Sci.
Pacific Science, Biological and Physical Sciences of the Pacific Region, University of Hawaii, Honolulu

Palaeogeogr. Palaeoclimat. Palaeoecol.
Palaeogeography, Palaeoclimatology, Palaeoecology, Elsvier Scientific Publishing Co., Amsterdam

Palaeontogr., A
Palaeontographica, Beitrage zur Naturgeschichte der Vorzert, Abteilung A:Palaeo-zoologie-Stratigraphie, Stuttgart

Palaeontogr., B
Palaeontographica, Beitrage zur Naturgeschichte der Vorzert, Abteilung B:Paleao-phytologie, Stuttgart

Palaeontology
Palaeontology, The Paleontological Association, London

Palaontol. Z.
Palaontologische Zeitschrift, Herausgegeben von der Palaontologischen Gesellschaft, Stuttgart

Paleobiology
Paleobiology, The Paleontological Society, Ithaca, New York

Palynology
American Association of Stratigraphic Palynologists Foundation, Dallas, Texas

Pap. & Proc., Royal Soc. Tasumania
Papers and Proceedings of the Royal Society of Tasumania, Tasumania

Polar Res.
Polar Research, Norsk Polarinstitut, Oslo

Prelim. Rep. Hakuho-maru
Preliminary Report of the Hakuho Maru Cruise KH85-1, Ocean Research Institute, Tokyo

Primate Res.
Primate Research, Japan Monkey Center, Inuyama

Proc. 5th Int. Conf. Permafrost, Trondheim, Norway
Proceedings of the 5th International Conference on Permafrost, Trondheim, Norway

Proc. 6th Int. Coral Reef Symp., Townsville
Proceedings of the 6th International Coral Reef Symposium, Townsville

Proc. Geol. Assoc., U. K.
Proceedings of the Geologists' Association, The Geologist Association Publishing House, Bath

Proc. Inst. Nat. Sci., (Applied Earth Sci.), Inst. Nat. Sci., Nihon Univ.
Proceedings of the Institute of Natural Science, (Applied Earth Science), The Institute of Natural Science, Nihon University, Tokyo

Proc. Inst. Nat. Sci., Coll. Human. Sci., Nihon Univ., Earth Sci.
Proceedings of the Institute of the Natural Sciences, College of Humanities and Sciences, Nihon University, Earth Science, Tokyo

Proc. Japan Acad., Ser. B
Proceedings of the Japan Academy, Series B, Tokyo

Proc. Japan Assoc. Afr. Stud.
Proceedings of Japan Association for African Studies

Proc. Korean Acad., Nat. Sci.
Proceedings of the Korean Academy, Natural Sciences, Seoul

Proc. Natn. Inst., Polar Res. Symp., Polar Biol.
Proceedings of National Institute of Polar Research Symposium on Polar Biology, Tokyo

Proc. ODP, Sci. Results
Proceedings of the Ocean Drilling Program, Sceintific Results, Texas

Prom. Rep., 5th Sci. Surv., South Pacific, Kagoshima Univ. Res. Cent., South Pacific
Prompt Report of the 5th Scientific Survey of the South Pacific, Kagoshima University Research Center for the South Pacific, Kagoshima

Pub. Sado Mus.
Publications from the Sado Museum, Sado, Niigata

Quat. Res., Japan
The Quaternary Research, Japan, Association for the Quaternary Research, Tokyo

Quat. Sci. Rev.
Quaternary Science Review, Pergamon Press, Oxford and New York

Rec. Prog. Nat. Sci., Japan
Recent Progress in Natural Sciences in Japan, Science Council of Japan, Tokyo

Rep. Andean Stud., Shizuoka Univ.
Reports of Andean Studies, Shizuoka University, Shizuoka

Rep. Fac. Sci., Kagoshima Univ., Earth Sci. & Biol.
Reports of the Faculty of Science, Kagoshima University, Earth Sciences and Biology, Kagoshima

Rep. Fac. Sci., Shizuoka Univ.
Reports of the Faculty of Science, Shizuoka University, Shizuoka

Rep. Fukushima Pref. Mus.
Reports of the Fukushima Prefectural Museum, Aizuwakamatsu, Fukushima

Rep. Geol. Surv. Hokkaido
Report of the Geological Survey of Hokkaido, Sapporo

Rep. Geol. Surv. Japan
Report of the Geological Survey of Japan, Tsukuba

Rep. Japan. Group Elasmobranen Stud.
Report of Japanese Group for Elasmobranen Studies, Tokyo

Rep. Res. Inst., Nat. Resour., Min. Coll., Akita Univ.
Report of the Research Institute of Natural Resources, Mining College, Akita University, Akita

Res. Bull., Fac. Educ., Oita Univ.
The Research Bulletin of the Faculty of Education, Oita University, Oita

Res. Bull., Inst. Educ., Fukui Pref.
Research Bulletin, Institute of Education, Fukui Prefecture, Fukui

Res. Rep., Kochi Univ., Nat. Sci.
Research Reports of the Kochi University, Natural Science, Kochi

Res Rep., Tottori Educ. Train. Cent.
Research Reports of Tottori Educational Training Center, Tottori

Rev. Paleobiol., Vol. Spec.
Revue de Paleobiologie, Volume Special, No. 2, Benthos '86, Geneve

Rev. Palaeobot. & Palynol.
Review of Palaeobotany and Palynology, Elsevier Scientific Publishing Co., Amsterdam

Ritsumeikan Chirigaku
Ritsumeikan Chirigaku, The Jounal of Ritsumeikan Geographical Society, Kyoto

Saito Ho-on Kai Mus. Nat. Hist., Res. Bull.
Saito Ho-on Kai Museum of Natural History, Research Bulletin, Saito Gratitude Foundation, Sendai

Saito Ho-on Kai, Spec. Pub.
Saito Ho-on Kai, Special Publication, Saito Gratitude Foundation, Sendai

Sci. & Engin. Rev., Doshisha Univ.
Science and Engineering Review, Doshisha University, Kyoto

Sci. Pap., Coll. Arts & Sci., Univ. Tokyo
Scientific Papers of the College of Arts and Sciences, the University of Tokyo, Tokyo

Sci. Rep., Coll. Gen. Educ., Osaka Univ.
Science Reports, College of General Education, Osaka University, Osaka

Sci. Rep., Dept. Geol., Kyushu Univ.
Science Reports, Department of Geology, Kyushu University, Fukuoka

Sci. Rep., Fac. Educ., Fukushima Univ.
Science Reports of the Faculty of Education, Fukushima University, Fukushima

Sci. Rep., Fukuoka Univ.
Fukuoka University, Science Reports, Fukuoka

Sci. Rep., Inst. Geosci., Univ. Tsukuba, Sec. B
Science Reports of the Institute of Geoscience, The University of Tsukuba, Section B, Tsukuba

Sci. Rep., Kanazawa Univ.
The Science Reports of Kanazawa University, Kanazawa

Sci. Rep., Res. Inst., Evol. Biol.
Research Institute of Evolutionary Biology, Scientific Report

Sci. Rep., Tohoku Univ., 2nd Ser.
Science Reports of the Tohoku University, Second Series, Geology, Sendai

Sci. Rep., Yokohama Natn. Univ., Sec. 2
Science Reports of the Yokohama National University, Section II, Biological and Geological Science, Yokohama

Sci. Rep., Yokosuka City Mus.
Science Report of the Yokosuka City Museum, Yokosuka

Seibutsuchiri Kenkyukai News, Newsl. Biogeogr. Stud., Univ. Mus., Univ. Tokyo
Seibutsuchiri Kenkyukai News, Newsletter of Biogeographical Studies, University Museum, The University of Tokyo, Tokyo

Senckenberg. Biol.
Senckenbergiana Biologica, Frankfurt

Senckenberg. Lethaea
Senckenbergiana Lethaea, Frankfrut

South Pac. Stud., Kagoshima Univ. Res. Cent., South Pac.
South Pacific Study, Kagoshima University Research Center for the South Pacific, Kagoshima

Southwest. Nat.
The Southwestern Naturalist, Southwestern Association of Naturalists, Southwest Texas State University, Biology Department, Texas

Spec. Pap., Palaeontol. Soc. Japan
Palaeontological Society of Japan, Special Papers, Tokyo

Spec. Pub. Num., Natn. Mus. Nat. Sci.
National Museum of Natural Science, Special Publication Number, Tokyo

Spec. Pub., Osaka Mus. Nat. Hist.
Special Publication, the Osaka Museum of Natural History, Osaka

Spec. Rep., Bull. Nagoya Univ. Mus., Furukawa Mus.
Bulletin of the Nagoya University Museum, Furukawa Museum, Special Report, Nagoya

St. Paul's Rev. Sci.
St. Paul's Review of Science, (Rikkyo University), Tokyo

Stereo-Atlas, Ostracod Shells
Stereo-Atlas of Ostracod Shells, The British Micropalaeontological Society, London

Stockholm Contrib. Geol.
Stockholm Contributions in Geology, Stockholm

Struct. Geol.
Structural Geology (=Kozo Chishitsu), Tectonics Research of Japan, Tsukuba

Stud. Lib. Arts & Sci., Sci. Univ. Tokyo
Studies in Liberal Arts and Science, Science University of Tokyo, Noda

Stud. San'in Reg., Nat. Environ., Shimane Univ.
Studies of the San'in Region, Natural Environment, Shimane University, Matsue

Tectonophysics
Tectonophysics, International Journal of Geotectonics and Geology and Physics of the Interior of the Earth, Elsevier Science Publishers, Amsterdam

Tectonics
Tectonics, The American Geophysical Union and the European Geophysical Society, Washigton

Trans. Proc. Palaeont. Soc. Japan, N. S.
Transactions and Proceedings of the Palaeontological Society of Japan, New Series, Tokyo

Tsukuba Environ. Stud.
Tsukuba Environmental Studies, The University of Tsukuba, Tsukuba

Venus, Japan. Jour. Malacol.
Venus, Japanese Journal of Malacology, Malacological Society of Japan, Tokyo

Yukochu Kenkyu (=Stud. Foraminifera)
Yukochu Kenkyu (=Studies in Foraminifera), Sendai

AUTHOR CATALOGUE

A

1 **ABE Katsumi** (1988): Speciation completed? in *Keijella* species group. In T. Hanai, N. Ikeya and K. Ishizaki (eds.): Evolutionary biology of Ostracoda, its fundamentals and applications. Kodansha/Elsevier, Tokyo/Amsterdam, 919-925, pl. 1, figs. 1-2.

2 ABE Katsumi (1990): What the sex ratio tells us: A case from marine ostracods. In R. Whatley and C. Maybury (eds.): Ostracoda and global events. Chapman and Hall, London, 175-185, figs. 1-4.

3 ABE Katsumi and CHOE Kae-lim (1988): Variation of *Pistocythereis* and *Keijella* species in Gamagyang Bay, south coast of Korea. In T. Hanai, N. Ikeya and K. Ishizaki (eds.): Evolutionary biology of Ostracoda, its fundamentals and applications. Kodansha/Elsevier, Tokyo/Amsterdam, 367-373, pl. 1, figs. 1-5.

4 **ADACHI Mamoru** (1988): Further study on the Sakahogi Conglomerate and surrounding Mesozoic strata in the southern Mino terrane, Japan. *Bull. Mizunami Fossil Meseum*, (14):113-132, pls. 22-31, figs. 1-4, tabs. 1-4. (坂祝礫岩とその近傍の中生層の再検討) (J.E.)

5 ADACHI Mamoru (1988): Study of Permian radiolarian-bearing cherts from the Marble Bay area, North Island, New Zealand. *Jour. Geogr.*, 97(6):632-634, fig. 1. (ニュージーランド北島マーブルベイ地域の含二畳紀放散虫チャート) (J.)

6 ADACHI Mamoru (1989): Discovery of late Triassic radiolarians from the Ino Formation, central Shikoku. *Jour. Geol. Soc. Japan*, 95(1):81-83, pl. 1, fig. 1. (四国中央部伊野層より後期三畳紀放散虫化石の発見) (J.)

7 **ADACHI Shuko** (1989): Ostracodes from the Ichinotani Formation (Carboniferous and Permian), Fukuji, Hida massif, central Japan. 11^{e} Congres International de Stratigraphie et de Geologie du Carbonifere, Beijing 1987, Compte Rendu, Beijing, 3:1-5, figs. 1-2.

8 **ADAMS Geoffrey C.** (1989): Foraminifera as indicators of geological events. *Proc. Geol. Assoc., U. K.*, 100(3):297-311, figs. 1-3.

9 **AITA Yoshiaki** (1987): Middle Jurassic to Lower Cretaceous radiolarian biostratigraphy of Shikoku with reference to selected sections in Lombary basin and Sicily. *Sci. Rep., Tohoku Univ., 2nd Ser.*, 58(1):1-91, pls. 1-14, figs. 1-37, appends. 1-9.

10 AITA Yoshiaki and OKADA Hisatake (1986): Radiolarians and calcareous nannofossils from the uppermost Jurassic and Lower Cretaceous strata of Japan and Tethyan regions. *Micropaleontology*, 32(2):97-128, pls. 1-8, figs. 1-5, tabs. 1-4.

11 AITA Yoshiaki (1988): Neogene planktonic Foraminifera from the Kubota Formation, Tanagura area, northeast Honshu, Japan. *Bull. Fukushima Mus.*, (2): 13-27. (福島県棚倉地域の久保田層より産する新第三紀浮遊性有孔虫化石) (J.E.)

12 **AKAMATSU Morio** (1987): Stratigraphic position and faunal characteristics of middle Pleistocene warm-water extralimital molluscan fossils from the hill around the Ishikari Lowland, Hokkaido. *Jour. Geol. Soc. Japan*, 93 (11):809-821, pl. 1, figs. 1-6, tabs. 1-3. (石狩低地帯周辺丘陵の更新世温

暖水系貝化石群集の層準とその特性) (J.E.)

13 AKAMATSU Morio (1988): The salty river (the Tsugaru straits) and migration of wooly mammoths. *Collect. & Breed.*, 50(2):72-75, figs. 1-3. ("しょっぱい川"とマンモスゾウ－津軽海峡の変遷とゾウ化石) (J.)

14 AKAMATSU Morio (1988): Middle Pleistocene marine transgression and its significance in Hokkaido. *Jour. Geol. Soc. Japan*, 94(3):173-186, pl. 1, figs. 1-8, tabs. 1-2. (北海道における中期更新世海進とその背景) (J.E.)

15 AKAMATSU Morio (1989): History and significance of the late Cenozoic molluscan faunas in Hokkaido. *Ann. Rep., Hist. Mus. Hokkaido*, (17):45-50, pls. 1-2, figs. 1-6.

16 AKAMATSU Morio and SUZUKI Akihiko (1990): Pleistocene molluscan faunas in central and southwestern Hokkaido. *Jour. Fac. Sci., Hokkaido Univ., Ser. 4*, 22(4):529-552, pls. 1-5, figs. 1-8.

17 **AKIBA Fumio** (1986): Middle Miocene to Quaternary diatom biostratigraphy in the Nankai Trough and Japan Trench, and modified Lower Miocene through Quaternary diatom zones for middle-to-high latitudes of the North Pacific. In H. Kagami, D. E. Karig, W. T. Coulbourn et al. (eds.): *Initial Rep., DSDP*, 87:393-481, pls. 1-30, figs. 1-11, tabs. 1-12.

18 AKIBA Fumio (1987a): *Azpeitia komurae* n. sp., a biostratigraphically useful diatom from the Neogene of Japan. *Bull. Natn. Sci. Mus., Tokyo, Ser. C*, 13(4):157-170, pls. 1-2, figs. 1-2, tab. 1.

19 AKIBA Fumio (1978b): Neogene diatom biostratigraphy of the Nakayama-Toge section, Sado Island, Japan, and its relation to the Funakawa floral change plane by Yamanoi (1978b). *Pub. Sado Mus.*, (9):85-110, pls. 1-2, figs. 1-5, tabs. 1-2. (佐渡島中山峠セクションの新第三系珪藻化石層序および「船川遷移面」(山野井, 1978) との関係) (J.E.)

20 AKIBA Fumio, SASAKI Eiichi and SAGA Hajime (1987): Note on sandstone development of the Shiiya-Nishiyama Stages around the Shiunji gas field, Kita-kanbara Plain. *Jour. Japan. Assoc. Petrol. Tech.*, 52(1):48-57. (北蒲原平野紫雲寺ガス田周辺における椎谷・西山階の砂岩層の発達過程について) (J.E.)

21 AKIBA Fumio and YANAGISAWA Yukio (1985): Taxonomy, morphology and phylogeny of the Neogene diatom zonal marker species in the middle-to-high latitudes of the North Pacific. In H. Kagami, D. E. Karig, W. T. Coulbourn et al. (eds.): *Initial Rep., DSDP*, 87:483-554, pls. 1-53, figs. 1-3.

22 **AKIMOTO Kazumi** (1989): Recenet Foraminifera from Enshunada. In Y. Takayanagi and K. Ishizaki (eds.): Collected papers on Foraminifera from the Japanese Islands, Toko Print., Pub. Dept., Sendai, 93-104. (遠州灘周辺海域の現世有孔虫フォーナ) (J.E.)

23 AKIMOTO Kazumi (1990): Distribution of Recent benthic foraminiferal faunas in the Pacific off southwest Japan and around Hachijojima Island. *Sci. Rep., Tohoku Univ., 2nd Ser.*, 60(2):139-223, pls. 11-24, figs. 1-36.

24 AKIMOTO Kazumi and HASEGAWA Shiro (1989): Bathymetric distribution of the Recent benthic foraminifers around Japan - As a contribution to the new paleobathymetric scale -. *Mem. Geol. Soc. Japan*, (32):229-240, fig. 1, tabs. 1-2. (日本近海における現生底生有孔虫の深度分布－古水深尺度の確立に向けて－) (J.E.)

25 **AKIYAMA Masahiko**, KAMEI Tadao and NAKAI Nobuyuki (1988): ^{14}C ages of Naumann's elephant *Palaeoloxodon naumanni* (Makiyama) from the sea bottom off the San'in district in the Sea of Japan by accelerator mass spectrometry -^{14}C age of the Quaternary deposits in Japan (168)-. *Earth Sci.*, 42(1):29-31, fig. 1. (日本海山陰沖海底産ナウマンゾウの加速器質量分析計による ^{14}C年代－日本の第四紀層の ^{14}C年代(168)－) (J.)

26 **AKUTSU Jun** (1987): On the fossil diatom assemblages of the core-samples drilled at Noguchi-Hideyo Memorial Museum, Inawashiro, Fukushima Prefecture. Fukushima Univ., Tokutei Kenkyu [Inawashiro no Shizen], Kenkyu Houkoku, (4):57-63, figs. 1-2. (野口英世記念館ボーリング試料の珪藻分析について) (J.)

27 AKUTSU Jun (1987): On the diatom assemblages of the Arakawa Group (Miocene), Tochigi Prefecture, Japan (Preliminary report). *Mem. Tochigi Pref. Mus.* (5), Geology of Yamizo Mountains, 1-35, pls. 1-12, figs. 1-3, tab. 1. (荒川層群（中新統）の珪藻群集について予報) (J.E.)

28 **AMANO Kazuo**, KOSHIYA Shin, TAKAHASHI Haruyuki, NODA Hiroshi and YAGISHITA Kouji (1989): Tectonic movement and sedimentation in Tanakura sheared zone. Guidebook of the Geological Society of Japan, 55-86, pl. 1, figs. 1-36. (棚倉破砕帯の構造運動と堆積作用) (J.)

29 **AMANO Kazutaka** (1986): Age and characteristics of the so-called "Atsunai-Togeshita fauna" in Hokkaido. *Spec. Pap., Palaeont. Soc. Japan*, (29): 187-198, pl. 18.

30 AMANO Kazutaka (1986): Change of community structure of molluscan fossils from bay to shallow open sea -Lower Togeshita fauna (Miocene) in the Rumoi district, Hokkaido-. *Bull. Joetsu Univ. Educ., 5, Sec. 3,* 209-224. (貝化石群集の内湾から外洋浅海にかけての構造変化－北海道留萌地域の下部峠下動物群（中新世）－) (J.E.)

31 AMANO Kazutaka, ICHIKAWA Atsuko and KOGANEZAWA Satsuki (1988): Molluscan fauna from the Nadachi Formation around Osuga Bridge in Nadachi Town, Nishikubiki-gun -Studies on the molluscan fossils from the western part of Joetsu district, Niigata Prefecture (Part 3)-. *Bull. Joetsu Univ. Educ., 7, Sec. 3,* 63-71, pls. 1-2. (西頸城郡名立町大菅橋周辺の名立層産軟体動物群－新潟県上越地域西部の軟体動物化石の研究(その３)－) (J.E.)

32 AMANO Kazutaka and Kaetsu Group of Society for Earth Science Education of Niigata Prefecture (1989): Pliocene molluscan fauna from Asahi-mura, Iwafune-gun, Niigata Prefecture. *Bull. Mizunami Fossil Mus.*, (16):109-115, pl. 20. (新潟県岩船郡朝日村から得られた鮮新世軟体動物群) (J.E.)

33 AMANO Kazutaka, KANNO Saburo, ICHIKAWA Atsuko and YANAGISAWA Yukio (1987): Molluscan fauna from the Tanihama Formation in the western part of Joetsu City -Studies on the molluscan fossils from the western part of Joetsu district, Niigata Prefecture (Part 2)-. *Bull. Joetsu Univ. Educ.*, 6, *Sec. 3,* 157-170, pls. 1-2. (上越市西部の谷浜層軟体動物群－新潟県上越地域西部の軟体動物化石の研究（その２）－) (J.E.)

34 AMANO Kazutaka, KANNO Saburo, NAGAI Hiroshi, SASABE Noriko and BAN Hiromitsu (1990): Molluscan fauna from the Kawazume Formation in the western part of Joetsu City -Studies on the molluscan fossils from the western part of Joetsu discrict, Niigata Prefecture (Part 5)-. *Bull. Joetsu Univ. Educ.* 9, *Sec. 3,* 67-75, pl. 1. (上越市西部の川詰層産軟体動物群. －新潟県上越地域西部の軟体動物化石の研究（その５）－) (J.E.)

35 AMANO Kazutaka and KARASAWA Shigeru (1986): A new subspecies of *Chlamys lioica* (Dall) from the Pliocene Shigarami Formation developed in the environs of Nagano City, central Japan. *Monog. Mizunami Fossil Mus.*, (6):41-47, pl. 4.

36 AMANO Kazutaka and KARASAWA Shigeru (1988): *Yabepecten* and *Pseudamiantis* from the Shigarami Formation in Nagano Prefecture, central Japan. *Saito Ho-on Kai, Spec. Pub. (Prof. T. Kotaka Commem. Vol.)*, (3):505-517, pls. 1-2.

37 AMANO Kazutaka and OHNO Yuriko (1988): *Pecten (Pecten) byoritsuensis* Nomura from the Pleistocene Omma Formation in Ishikawa Prefecture, central Japan. *Venus, Japan. Jour. Malacol.*, 47(1):37-49, pls. 1-2.

38 ANDO Hisao (1986): On the Upper Triassic Saragai Group in the Utatsu area of Miyagi Prefecture, northeast Japan. *Gakujutsu Kenkyu, Sch. Educ., Waseda Univ., Ser. Biol. & Geol.*, 35:35-49, figs. 1-8, tab 1. (宮城県歌津地域の上部三畳系皿貝層群について) (J.E.)

39 ANDO Hisao (1987): Evolution and paleobiogeography of Late Triassic bivalve *Monotis* from Japan. In K. G. McKENZIE (ed.): Proceeding of the International Symposium on Shallow Tethys 2, Wagga Wagga, Australia, 233-246, figs. 1-6.

40 ANDO Hisao (1987): Paleobiological study of the Triassic bivalve *Monotis* from Japan. *Bull. Univ. Mus., Univ. Tokyo*, (30):1-110, pls. 1-15, figs. 1-38, tabs. 1-8.

41 ANDO Hisao (1988): Mode of occurrence of *Otapiria dubia* (Bivalvia) from the Upper Triassic of west Kyushu, southwest Japan. *Saito Ho-on Kai, Spec. Pub. (Prof. T. Kotaka Commem. Vol.)*, 265-279, pls. 1-2, figs. 1-5, tabs. 1-3.

42 ANDO Hisao, NODA Masayuki and SATO Yuichiro (1987): Discovery and its significance of the Upper Triassic *Monotis* bed from the Kurosegawa Terrain in east Kyushu. *Jour. Geogr.*, 96(3):163-167, figs. 1-3. (九州東部黒瀬川帯からの上部三畳系*Monotis* 層の発見とその意義) (J.E.)

43 ANDO Kazuo (1986): Holocene paleoenvironments and highest sea-level based on the diatom assemblages in Minuma Lowland, Saitama Prefecture. *Quat. Res., Japan*, 25(3):165-176, pls. 1-2, figs. 1-7, tabs. 1-2. (珪藻群集から見た埼玉県見沼低地の古環境の変遷と完新世最高海水準) (J.E.)

44 ANDO Kazuo and FUJIMOTO Kiyoshi (1990): Paleo-environmental history and sea-level records based on the diatom assemblage in the middle part of the Arakawa Lowland, central Japan. *Quat. Res., Japan*, 29(5):427-437, figs. 1-3, tabs. 1-2. (珪藻群集から見た埼玉県荒川低地中流域における古環境の変遷と旧海水準) (J.)

45 ANDO Kazuo, WADA Makoto and TAKANO Tsukasa (1987): On paleoenvironments based on the diatom assemblages in the Arakawa Lowland, Saitama Prefecture. *Quat. Res., Japan*, 26(2):111-127, pl. 1, figs. 1-5, tabs. 1-3. (珪藻群集からみた埼玉県荒川低地の古環境の検討) (J.E.)

46 ANDO Kenzo (1986): *Scacchinella* sp. from the Permian of Kinshou-zan, with special reference to its shell closing mechanism. *Chigaku Kenkyu*, 37(10/12):213-224, figs. 1-13, tab. 1. (金生山から産出した奇形腕足類スカチネラ、特にその開閉機構について) (J.)

47 Anthropology and Archaeology Research Group for Nojiri-ko Excavation (1990): Palaeolithic bone tools from the 10th excavation season at Tate-

gahana, Lake Nojiri, central north Japan. *Quat. Res.*, 29(2):89-103, pl. 1, figs. 1-8. (野尻湖立が鼻遺跡第１０次発掘出土の骨器) (J.E.)

48 AOKI Naoaki (1988): *Pseudononion japonicum* Asano (Foraminifera) from the Pleistocene Naganuma Formation at Watauchi, south of Yokohama, central Japan. *Ann. Rep., Inst. Geosci., Univ. Tsukuba*, (14):34-38, figs. 1-5, tab. 1.

49 AOKI Naoaki (1989): Benthic foraminiferal assemblages of the Kazusa Group in Yokohama, central Japan. In Y. Takayanagi and K. Ishizaki (eds.): Collected papers on Foraminifera from the Japanese Islands, Toko Print., Pub. Dept., Sendai, 77-81. (横浜地域の上総層群の底棲有孔虫群) (J.)

50 AOKI Naoaki and BABA Katsuyoshi (1987): Correlation of the subsurface Pleistocene Kazusa Group, central Kwanto Plain, by means of molluscan fossils. *Tsukuba Environ. Stud.*, (10): 91-96, fig. 1. (関東平野中央部地下の上総層群の貝化石による対比) (J.E.)

51 AOKI Naoaki and BABA Katsuyoshi (1987): Molluscan fossils from the Tsukuba University observation well (suppliment). *Tsukuba Environ. Stud.*, (10):61-65, pl. 1, tab. 1. (筑波大学ボーリングからの貝化石(つづき)) (J.E.)

52 AOKI Naoaki and BABA Katsuyoshi (1987): Pollen analysis of the Tsukuba University observation well. *Tsukuba Environ. Stud.*, (10):73-77, fig. 1, tab. 1. (筑波大学ボーリングの花粉分析) (J.E.)

53 AOKI Naoaki and BABA Katsuyoshi (1987): A *Psammotreta* (*Tellinimactra*) species from the Narita Formation, Shimotsuma, southern Ibaraki, central Japan. *Ann. Rep., Inst. Geosci., Univ. Tsukuba*, (13):74-79, figs. 1-7, tab. 1.

54 AOSHIMA Mutsuharu (1986): Foraminiferal fossils from the Momiyama Sandstone. *Bull. Tochigi Pref. Mus.*, (3):39-46, pls. 1-2. (樅山層の有孔虫化石) (J.E.)

55 AOSHIMA Mutsuharu (1987): Foraminiferal fossils from the Arakawa Group (1). *Mem. Tochigi Pref. Mus.*, (5):37-55, pls. 1-2. (荒川層群の有孔虫化石(1)) (J.E.)

56 ASADA Tadashi and OKAMOTO Masatoyo (1987): A pearl from fossil *Panopea*. *Chiribotan*, 18(2):58-60, fig. 1. (化石ナミガイの大形真珠) (J.)

57 ASAI Akito and HIRANO Hiromichi (1990): Stratigraphy of the Upper Cretaceous in the Obira area, northwestern Hokkaido. *Gakujutsu-Kenkyu, Fac. Educ., Waseda Univ., Ser. Biol. Geol.*, (39):37-50, figs. 1-6, tabs. 1-3.

58 ASAMA Kazuo (1986): Is the origin of land plants monophyletic or polyphyletic? In H. Nakagawa, T. Kotaka and Y. Takayanagi (eds.): Essays in geology. Prof. N. Kitamura Commem. Vol., 37-46, figs. 1-5. (陸上植物の起源は単系か多系か) (J.E.)

59 ASAMA Kazuo (1986): [Some problems in Darwinism]. Kappa Science, 1-255, figs. 1-31, tab. 1. (ダーウィン進化論を解体する) (J.)

60 ASAMA Kazuo (1987): [Re-examination of Lamarckism -Anthropologist should be Lamarckist-]. Biological Science, Tokyo, 39(1):21-27. (ラマルク進化論の再評価 －人類学者こそラマルキストであるべきだ－) (J.)

61 ASAMA Kazuo (1988): On some problems of paleogeography inferred from the Permian floras of northeast Japan. *Earth Science*, 42(4):202-211, figs. 1-5. (東北日本の二畳紀植物群より推定される古地理上の諸問題) (J.E.)

62 ASAMA Kazuo (1989): Permian plants from Maiya, Japan, 3. Pteridophylls. *Bull. Natn. Sci. Mus., Tokyo, Ser. C*, 15(2):39-51, pls. 1-5.

63 AZUMA Yoichi (1989): Outline and significance of the first systematic excavation of dinosaur fossils in Japan. *Collect. & Breed.*, 51(12):528-531, figs. 1-3. (日本初の組織的恐竜化石発掘 －その経緯と意義－) (J.)

64 AZUMA Yoichi (1989): Fossil tooth of the lamnoid shark, *Carcharodon megalodon* from the Kita-oki bank, Japan Sea floor. *Bull. Fukui Pref. Mus*, (3): 1-7, pl. 1, figs. 1-3.

65 AZUMA Yoshio and AZUMA Masao (1990): Fossil land molluscan fauna of Yoron Island, the northeastern Okinawa, Japan, with description of two new taxa. *Venus, Japan. Jour. Malacol.*, 49(3):198-204, figs. 1-3, tab. 1. (与論島の化石陸産貝類相) (J.E.)

B

66 BABA Hisao, SAKURA Hajime, GI Norikazu and TOMI Etsuhiro (1990): Child skeleton from Yowoki shelter in Tokunoshima Island, southwest Japan. *Mem. Natn. Sci. Mus., Tokyo*, (23):197-209, figs. 1-7, tabs. 1-4. (徳之島ヨヲキ洞穴前岩蔭出土小児人骨) (J.)

67 BACKMAN Jan, SCHNEIDER David A., RIO Domenico and OKADA Hisatake (1990): Neogene low-latitude magnetostratigraphy from ODP Site 710 and revised age estimates of Miocene nannofossil datum events. *Proc. ODP. Sci. Results*, 115:271-276, figs. 1-2, tab. 1.

68 BANDO Yuji, SATO Tadashi and MATSUMOTO Tatsuro (1987): Palaeobiogeography of the Mesozoic Ammonoidea, with special reference to Asia and the Pacific. In A. Taira and M. Tashiro (eds.): Historical biogeography and plate tectonic evolution of Japan and eastern Asia, Terra Pub., Tokyo, 65-95, figs. 1-11.

69 BEAUVAIS Louise and MORI Kei (1988): *Amphimeandra*, a new genus in the family Amphiastraeidae (Mesozoic Scleractinia). *Geobios*, (21):103-108, pl. 1, fig. 1.

70 BEU Alan G. (1988): Taxonomy of gastropods of the families Ranellidae (=Cymatiidae) and Bursidae. Part 5. Early history of the families, with four new genera and recognition of the Personidae. *Saito Ho-on Kai, Spec. Publ.* (*Prof. T. Kotaka Commem. Vol.*), (3):69-96, pls. 1-4, figs. 1-2.

71 BODERGAT A. and IKEYA Noriyuki (1988): Distribution of Recent Ostracoda in Ise and Mikawa Bays, Pacific coast of central Japan. In T. Hanai (ed.): Developments in palaeontology and stratigraphy, 11. Evolutionary biology of Ostracoda, its foundamentals and applications. Kodansha/Elsevier, Tokyo/Amsterdam, 413-428, figs. 1-7.

C

72 CARIDROIT Martial and DE WEVER Patrick (1986): Some Late Permian radiolarians from pelitic rocks of the Tatsuno Formation (Hyogo Prefecture), southwest Japan. *Mar. Micropaleont.*, 11:55-90, pls. 1-5, figs. 1-23.

73 **CHANG Ki-hong**, WOO Byung-geol, LEE Jin-hyung, PARK Soon-ok and YAO Akira (1990): Cretaceous and early Cenozoic stratigraphy and history of eastern Kyongsang basin, S. Korea. *Jour. Geol. Soc. Korea*, 26(5):471-487, pl. 1, figs. 1-5, tabs. 1-3.

74 **CHENG Yen-nien** (1986): Taxonomic studies on upper Paleozoic Radiolaria. *Natl. Mus. Nat. Sci., Taiwan, Spec. Publ.*, (1):1-311, pls. 1-41.

75 CHENG Yen-nien (1989): Upper Paleozoic and lower Mesozoic radiolarian assemblages from the Busuanga Islands, north Palawan block, Philippines. *Bull. Natn. Mus. Nat. Sci.*, (1):129-175, pls. 1-11, figs. 1-3.

76 CHENG Yen-nien and YEH Kuei-yu (1989): Radiolaria in surface sediments from west central Pacific near Taiwan (1). *Bull. Natn. Mus. Nat. Sci.*, (1):177-211, pls. 1-11, figs. 1-2.

77 **CHIBA Satoshi** (1988): [*Mandarina* in Ani-jima, the Ogasawara Islands]. Annual Report of Ogasawara Research, Ogasawara Research Committee of Tokyo Metropolitan University, Tokyo, 12:49-55, figs. 1-2. (小笠原諸島のカタマイマイ属) (J.)

78 CHIBA Satoshi (1989): Taxonomy and morphologic diversity of *Mandarina* (Pulmonata) in the Bonin Islands. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (155):218-251, figs. 1-17.

79 **CHIJI Manzo** (1986): [Some problems on the formation of the Japan Sea and related events]. *Mar. Sci. Month.*, 18(3):188-191. (日本海の形成とそれに伴う地史的事件に関する２、３の問題) (J.)

80 CHIJI Manzo, TSUCHI Ryuichi and IGCP-246 National Working Group (1989): [Reconstruction of paleogeography and paleoenvironment of the Japan Sea]. In M. Chiji and R. Tsuchi (eds.): [Neogene events of the Japan Sea], IGCP-246 Kyoto Shizuoka, 57-70. (日本海形成に伴う古地理・古環境の復元. 日本海の形成とそれに伴う新第三紀地史的事件) (J.)

81 **CHINZEI Kiyotaka** (1986): [Marine environmental chages in Miocene and the opening of the Japan Sea]. *Mar. Sci. Month.*, 18(3):181-187, figs. 1-2. (中新世における日本海域の海洋環境の変化と日本海の拡大) (J.)

82 CHINZEI Kiyotaka (1986): Faunal succession and geographic distribution of Neogene molluscan faunas in Japan. In T. Kotaka (ed.), Japanese Cenozoic molluscs -Their origin and migration-. *Spec. Pap., Palaeont. Soc. Japan,* (29):17-32, figs. 1-3.

83 CHINZEI Kiyotaka (1986): Marine biogeography in northern Japan during the early Middle Miocene as viewed from benthic molluscs. In T. Kotaka (ed.), Japanese Cenozoic molluscs -Their origin and migration-. *Spec. Pap., Palaeont. Soc. Japan,* (29):161-171, figs. 1-5.

84 CHINZEI Kiyotaka (1986): Opening of the Japan Sea and marine biogeography during the Miocene. *Jour. Geomag. Geoelectr.*, 1(38):487-494, figs. 1-2.

85 CHINZEI Kiyotaka (1986): Shell structure, growth, and functional morphology of an elongate Cretaceous oyster. *Palaeontology*, 29(1):139-154, pl. 18, figs. 1-7.

86 CHINZEI Kiyotaka (1987): Faunal succession and geographic distribution of Neogene molluscan faunas in Japan. In 4th International Congress, Pacific Neogene stratigraphy, Berkeley, RCPNS, Abstr. Vol., 14.

87 CHINZEI Kiyotaka, FUJIOKA Kantaro, KITAZATO Hiroshi, KOIZUMI Itaru, OBA Tadamichi, ODA Motoyoshi, OKADA Hisatake, SAKAI Toyosaburo and TANIMURA Yoshihiro (1987): Postglacial environmental change of the Pacific Ocean off the coasts of central Japan. *Mar. Micropaleont.*, 11(2):273-291, figs. 1-12.

88 CHINZEI Kiyotaka and HIRAMATSU Chikara (1988): First occurrence of Pliocene *Fortipecten* from the Japan Sea area of northern Honshu. *Saito Ho-on Kai, Spec. Pub. (Prof. T. Kotaka Commem. Vol.)*, (3):469-476, pl. 1, figs. 1-2.

89 CHINZEI Kiyotaka, KOIKE Hiroko, OBA Tadamichi, MATSUSHIMA Yoshiaki and KITAZATO Hiroshi (1987): Secular changes in the oxygen isotope ratios of mollusc shells during the Holocene of central Japan. *Palaeogeogr. Palaeoclimatol. Palaeoecol.*, 61(3-4):155-166, figs. 1-5.

90 CHINZEI Kiyotaka and MATSUSHIMA Yoshiaki (1987): Molluscan faunas in the south Fossa-Magna region. *Fossils, Palaeont. Soc. Japan,* (43):15-17, figs. 1-2. (南部フォッサマグナ地域の新第三紀貝化石群) (J.)

91 CHINZEI Kiyotaka and OBA Tadamichi (1986): Oxygen isotope studies of the deep sea sediments around Japan. *Recent Prog. Nat. Sci., Japan,* 11:35-43, figs. 1-3.

92 CHITOKU Tsutomu (1987): Occurrence of microfossils in some calcareous rocks and their preservation -Preparatory study for the micro-biostratigraphy-. *Bull. Hobetsu Mus.*, (4):1-9, pls. 1-4, fig. 1, tabs. 1-2. (石灰質岩石からの微化石の産出とその保存状態－微化石層序のための予備的研究－) (J.E.)

93 CHITOKU Tsutomu (1990): On some vertebrate fossils collected by the Hobetsu Museum. *Bull. Hobetsu Mus.*, (6):25-35, tabs. 1-5. (穂別町立博物館所蔵の脊椎動物化石について) (J.)

94 Collaborative Research Group on "Lebensspuren", the Association for the Geological Collaboration in Japan (1989): Fossil and Recent burrows. An introduction to the study of "Lebensspuren". *Monogr. Assoc. Geol. Collab. Japan,* (35):1-131, pls. 1-14, figs. 1.1-4.16, tabs. 1-10. (現生および化石の巣穴－生痕研究序説－) (J.E.)

95 CRONIN Tom, M. and IKEYA Noriyuki (1987): The Omma-Manganji Ostracoda fauna (Plio-Pleistocene) of Japan and the zoogeography of circumpolar species. *Micropaleont.*, 6(2):65-88.

96 CRONIN Tom, M. and IKEYA Noriyuki (1990): Tectonic events and climatic change: Opportunities for speciation in Cenozoic marine Ostracoda. In R. M. Ross and W. D. Allmon (eds.): Causes of evolution -A paleontological perspective. Univ. Chicago Press, Chicago & London, 210-248.

D

97 DAGYS Algirdas, S., LEHNANN Ulrich, BANDEL Klaus, TANABE Kazushige and WEITSCHAT Wolfgang (1989): The jaw apparati of ectocochleate cephalopods. *Palaeontol. Z.*, 63(1/2):41-53, figs. 1-9.

98 Diatom Research Group for Nojiri-ko Excavation (1987): Diatom thanatocoenosis of the samples from the 9th Nojiri-ko excavation and the 4th hill site excavation. *Monogr. Assoc. Geol. Collab. Japan,* (32):57-71, pls. 5.1-5.2, figs. 5.1-5.5, tabs. 5.1.a-5.1.b. (第９次野尻湖発掘および第４回陸上発掘における野尻湖層の珪藻骨髄群集) (J.E.)

E

99 **Ecology and Burrowing Research Group for Nojiri-ko Excavation** (1987): Trace fossils from the Nojiri-ko Formation found at the 9th Nojiri-ko excavation. *Monogr. Assoc. Geol. Collab. Japan,* (32):159-178, pls. 11.1-11.4, figs. 11.1-11.2, tabs. 11.1.a-11.1.b. (第９次発掘で産出した野尻湖層の生痕化石) (J.E.)

100 **EHIRO Masayuki** (1987): Permian ammonoids of the southern Kitakami massif, northeast Japan -Their stratigraphic distribution and zonation of the Permian-. *Jour. Geol. Soc. Japan,* 93(11):823-832, fig. 1, tabs. 1-2. (南部北上山地のペルム紀アンモナイト類－その層位的分布とペルム系の分帯－) (J.E.)

101 EHIRO Masayuki, SHIMOYAMA Shoichi and MURATA Masafumi (1986): Some Permian Cyclolobaceae from the southern Kitakami massif, northeast Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (142):400-408, pls. 79-80, figs. 1-4.

102 EHIRO Masayuki and TAKIZAWA Fuminori (1989): *Foodiceras* and *Domatoceras* (Nautiloid cephalopods) from the Upper Permian Toyoma Formation, southern Kitakami massif, northeast Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (155):212-217, figs. 1-2.

103 EHIRO Masayuki, TAZAWA Jun-ichi, OISHI Masayuki and OKAMI Kazuyoshi (1986): Discovery of *Trimerella* (Silurian Brachiopoda) from the Odagoe Formation, south of Mt. Hayachine in the Kitakami massif, northeast Japan and its significance. *Jour. Geol. Soc. Japan,* 92(10):753-756, figs. 1-3. (北上山地，早池峰山南方の小田越層（新称）よりシルル紀腕足類*Trimerella* の発見とその意義) (J.)

104 **ENDO Kazuyoshi** (1986): Mode of occurrence and significance of warm-water fauna in the Sawane Formation, Sado Island. *Jour. Geol. Soc. Japan,* 92(1):77-80, figs. 1-2, tab. 1. (佐渡の沢根層における暖流系動物群の産状と意義) (J.)

105 ENDO Kazuyoshi (1987): Life habit and relative growth of some laqueid brachiopods from Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (147): 180-194, figs. 1-2.

106 ENDO Kazuyoshi (1989): Growth and life mode of a Pleistocene brachiopod, *Kikaithyris hanzawai* (Yabe). *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (156):286-290, figs. 1-4.

107 **ENDO Kunihiko**, KOSUGI Masato, MATSUSHITA Mariko, MIYAJIMA Naomichi, HISHIDA Ryo and TAKANO Tsukasa (1989): Holocene environmental history in and around the Paleo-Nagareyama Bay, central Kanto Plain. *Quat. Res., Japan,* 28(2):61-77, figs. 1-8, tabs. 1-3. (千葉県古流山湾周辺域における完新世の環境変遷史とその意義) (J.E.)

108 ENDO Kunihiko, KOSUGI Masato, SUZUKI Shigeru and HISHIDA Ryo (1987): Paleoenvironments after the Jomon Transgression around Souka City, Kanto, Japan. *Proc. Inst. Nat. Sci., Nihon Univ., Applied Earth Sci.*, (22):47-56, pls. 1-2, figs. 1-7. (草加市周辺の縄文海進期後の沖積層層序と古環境) (J.E.)

109 **ENDO Mitsuhisa**, TAKEDA Junko, TANAKA Tsutomu and KOBAYASHI Iwao (1987): Neogene stratigraphy and planktonic foraminiferal assemblage in the north-eastern area of the Kuninaka Plain, Sado Island, central Japan. *Pub.*

Sado Mus., (9):117-126, figs. 1-6, tabs. 1-2. (佐渡国中平野北西部の地質と微化石群集) (J.E.)

110 ETO Tetsuto, ODA Motoyoshi, HASEGAWA Shiro, HONDA Nobuyuki and FUNAYAMA Masaaki (1987): Geologic age and paleoenvironment based upon microfossils of the Cenozoic sequence in the middle and northern parts of the Miura Peninsula. *Sci. Rep., Yokohama Natn. Univ., Sec. 2*, (34):41-57. (三浦半島中・北部の新生界の微化石生層序年代と古環境) (J.E.)

111 ETO Tetsuto and TANAKA Yuichiro (1990): The origin of the debris flow deposits interbedded with the Ikego Formation of the Miura Group in the Miura Peninsula. *Sci. Rep., Yokohama Natn. Univ., Sec. 2*, (37):65-71, figs. 1-3, tab. 1. (三浦層群池子層中の土石流堆積物の供給源について) (J.E.)

112 EZAKI Yoichi (1989): Morphological and phylogenetic characteristics of late Permian rugose corals in Iran. *Mem. Assoc. Australas. Palaeont.*, 8:275-281, pls. 1-3, fig. 1.

113 EZAKI Yoichi and KATO Makoto (1989): Growth bands in a Permian coral. *Mem. Assoc. Australas. Palaeont.*, 8:83-90, pls. 1-3.

F

114 FAURE Michel and ISHIDA Keisuke (1990): The mid-upper Jurassic olistostrome of the west Philippines: A distinctive key-maker for the north Palawan block. *Jour. Southeast Asian Earth Sci.*, 4(1):61-67, figs. 1-5, tab. 1.

115 Fossil Insect Research Group for Nojiri-ko Excavation and AKAGI Saburo (1986): Late Miocene to Pliocene insect fossils from the Hogi Lignite Formation of Ketaka-cho, Tottori Prefecture, Japan (1). *Bull. Osaka Mus., Nat. Hist.*, (40):31-58, pls. 5-6, figs. 1-16, tabs. 1-2. (鳥取県気高町の宝木亜炭層から産出した後期中新世～鮮新世の昆虫化石(1)) (J.E.)

116 Fossil Mammal Research Group for Nojiri-ko Excavation (1987): Vertebrate fossils from the Nojiri-ko Formation in the Lake Nojiri excavation (1984-1986). *Monogr., Assoc. Geol. Collab. Japan*, (32):137-158, pls. 10.1-10.5, figs. 10.1-10.4, tabs. 10.1-10.7. (野尻湖層産の脊椎動物化石(1984-1986)) (J.E.)

117 Fossil Mammal Research Group for Nojiri-ko Excavation (1990): Vertebrate fossils from the Nojiri-ko Formation during the Lake Nojiri excavation (1987-1989). *Monogr., Assoc. Geol. Collab. Japan*, (37):111-134, pls. 11.1-11.4, figs. 11.1-11.2, tabs. 11.1-11.10. (野尻湖層産の脊椎動物化石(1987-1989)) (J.E.)

118 Fossil Mollusc Research Group for the Nojiri-ko Excavation (1990): Freshwater Molluscs from the Pleistocene Nojiri-ko Formation (Part 5). *Monogr., Assoc. Geol. Collab. Japan*, (37):85-92, figs. 1-5. (野尻湖層産の淡水貝類化石 (その5)) (J.)

119 Fossil Plant Research Group for Nojiri-ko Excavation (1987): Plant remains from the Nojiri-ko Formation. *Monogr., Assoc. Geol. Collab. Japan*, (32):95-106, pls. 7.1-7.2, fig. 7.1, tabs. 7.1-7.2. (野尻湖の植物遺体) (J.E.)

120 FUJI Norio (1986): Palaeovegetation change in eastern Scandinavia during the last 15,000 years. *Bull. Fac. Educ., Kanazawa Univ., Nat. Sci.*, (35):57-74, figs. 1-3, tabs. 1-2.

121 FUJI Norio (1986): The importance of stratigraphic investigations on ancient Lake Biwa. *Bull. Fac. Educ., Kanazawa Univ., Nat. Sci.*, (35):45-56, figs. 1-3.

122 FUJI Norio (1986): Palynological study of 200-meter core samples from Lake Biwa, central Japan. II: The palaeovegetational and palaeoclimatic changes during the ca. 250,000-100,000 years B.P. *Trans. Proc. Palaeont. Soc. Japan, N.S.*, (144):490-515, figs. 1-14, tab. 1.

123 FUJI Norio (1986): Global correlation on the palaeoclimatic change between Lake Biwa sedimentary evidence and other marine and terrestrial records. *Proc. Japan Acad., Ser. B*, 62:1-4, fig. 1.

124 FUJI Norio (1986): Correlation between palaeoclimatic changes from Lake Biwa, Japan and Bogota, Colombia in southern America and palaeotemperature change from Equatorial Pacific. *Proc. Japan Acad., Ser. B*, 62:381-384, fig. 1.

125 FUJI Norio (1987): Researches in the Far East on the Holocene during the Inter-Congress time, 1983-1987. *Bull. Fac. Educ., Kanazawa Univ., Nat. Sci.*, (36):7-34, figs. 1-9, tabs. 1-3.

126 FUJI Norio(1987): Analyses of palaeovegitation and palaeoclimate based on the pollen analyses. In S. Fujii and N. Nasu (eds.): Submerged forest, Univ. Tokyo Press, 83-107.

127 FUJI Norio (1987): Palaeoenvironment around the Jomonian Teraji Jade site, Ohmi, Niigata Prefecture, central Japan. *Bull. Japan Sea Res. Inst., Kanazawa Univ.*, (19):1-22, figs. 1-12, tabs. 1-2. (新潟県縄文時代寺地硬玉遺跡の古環境解析) (J.E.)

128 FUJI Norio (1988): For international correlation of Pleistocene/Holocene boundary palynological investigation of the late Pleistocene - Holocene deposits in the Mikata area, Wakasa district, central Japan. *Bull. Fac. Educ., Kanazawa Univ., Nat. Sci.*, (37):59-76, figs. 1-8, tabs. 1-4.

129 FUJI Norio (1988): For international correlation of Pleistocene/Holocene boundary palynological investigation of the late Pleistocene - Holocene deposits in the Mihama - Kaminaka areas, Fukui Prefecture, central Japan. *Bull. Fac. Educ., Kanazawa Univ., Nat. Sci.*, (37):77-96, figs. 1-8, tabs. 1-2. (J.E.)

130 FUJI Norio (1988): [Archaeological palynology], Yuuzankaku Publish. K. K., Tokyo, 1-251. (考古花粉学) (J.)

131 FUJI Norio (1988): Secondary community of palaeovegetation around the middle Neolithic Mawaki site, Noto Peninsula, Japan. *Proc. Japan Acad., Ser. B*, 64(9):265-268, fig. 1, tab. 1.

132 FUJI Norio (1988): Palaeovegetation and palaeoclimate changes around Lake Biwa, Japan during the last ca. 3 million years. *Quat. Sci. Rev.*, 7:21-28, figs. 1-2.

133 FUJI Norio (1989): Palaeovegetation during the Jomonian Period around the Mawaki archaeological site, Noto Peninsula, Japan. *Bull. Fac. Educ., Kanazawa Univ., Nat. Sci.*, (38):41-57, photos. 1-5, figs. 1-5, tabs. 1-4.

134 FUJI Norio (1989): Stratigraphical, palaeontological and chronological investigations of the Miocene Sunakosaka Member at the Nozoki area, Kanazawa, central Japan. *Bull. Japan Sea Res. Inst., Kanazawa Univ.*, (21):1-

14, figs. 1-6. (金沢市覗の中新世砂子坂層の層位学的・古生物学的・年代学的研究) (J.)

135 FUJI Norio (1990): Climatic changes based on palynological evidences from Lake Biwa, central Japan since the middle Pleistocene. *Bull. Fac. Educ., Kanazawa Univ., Nat. Sci.*, (39):17-30, figs. 1-3.

136 FUJI Norio (1990): Miocene "Uchiura-Yukunobe Fossil Flora" from Noto Peninsula, central Japan. *Bull. Japan Sea Res. Inst., Kanazawa Univ.*, (22):17-47, pls. 1-7, figs. 1-7, tabs. 1-6. (能登の中新世"内浦行延植物化石群") (J.E.)

137 FUJI Norio, FUJII Shoji, SAKAGAMI Sumio, KATO Michio, TAKAYAMA Toshiaki and NISHIZAWA Yasuo (1986): [Palaeontological investigation of the Nanao Calcareous Sandstome Member in Noto Peninsula, central Japan]. The Nanao Education Board, 1-207, pls. 1-27. (七尾石灰質砂岩層の古生物的研究) (J.)

138 FUJI Norio and HORI Miyori (1989): Palynological investigation of the Neogene System in Kanazawa area, Ishikawa Prefecture, central Japan -Palynological investigation of the Neogene System in the Hokuriku region, central Japan (5)-. *Bull. Fac. Educ., Kanazawa Univ., Nat. Sci.*, (38):59-77, figs. 1-8, tabs. 1-2. (金沢の新第三系の花粉学的研究) (J.E.)

139 FUJI Norio and HORI Miyori (1989): Palynological investigation of the upper Neogene System in Fukumitsu area, Toyama Prefecture, central Japan. -Palynological investigation of the Neogene System in the Hokuriku region, central Japan (6)-. *Bull. Fac. Educ., Kanazawa Univ., Nat. Sci.*, (38):79-91, figs. 1-6, tabs. 1-2. (富山福光地区の新第三系の花粉学的研究) (J.E.)

140 FUJI Norio and HORI Miyori (1990): Palynological investigation of the Neogene System in the Kaga City area, Ishikawa Prefecture, central Japan. -Palynological investigation of the Neogene System in the Hokuriku region, central Japan (7)-. *Bull. Fac. Educ., Kanazawa Univ., Nat. Sci.*, (39):31-44, figs. 1-5, tabs. 1-2. (加賀市の新第三系の花粉学的研究) (J.)

141 FUJI Norio and HORI Miyori (1990): Palynological investigation of the Neogene System in the northern area of Noto Peninsula, central Japan. -Palynological investigation of the Neogene System in the Hokuriku region, central Japan (8)-. *Bull. Fac. Educ., Kanazawa Univ., Nat. Sci.*, (39):45-60, figs. 1-5, tabs. 1-2. (能登北部地域の新第三系の花粉学的研究) (J.E.)

142 FUJI Norio and Horowitz A. (1989): Brunhes epoch palaeoclimates of Japan and Israel. *Palaeogeogr. Palaeoclimat. Palaeoecol.*, 72(1-2):79-88, figs. 1-2.

143 FUJI Norio and KITANAKA Takuo (1988): Discovery of fossil plants from the Miocene Series in the Nomi hill, Ishikawa Prefecture. *Jour. Geol. Soc. Japan*, 94(2):137-140, figs. 1-3. (石川県能美丘陵の中新統からの植物化石の発見) (J.)

144 FUJI Norio and SUZUKI Mitsuo (1989): Palaeobotanical investigation of the Miocene Sunakosaka Member at the Nozoki area, Kanazawa, central Japan. *Bull. Japan Sea Res. Inst., Kanazawa Univ.*, (21):15-45, pls. 1-5. (金沢市覗の中新世砂子坂層からの植物化石) (J.E.)

145 FUJI Norio and SUZUKI Mitsuo (1990): [Silicified woods from the Uchiura-Yukunobe area, Noto Peninsula, central Japan]. *Ishikawa Prefectural Education Board*, 1-99. (能登内浦行延の珪化木) (J.)

146 FUJI Norio, SUZUKI Mitsuo, TAKABORI Katsuki, YAMADA Yoshikazu, KATO Michio, YUZIRI Shuhei and HIRAGUCHI Tetsuo (1986): [Mawaki site]. *The Noto-machi Education Board*, 1-482, pls. 116. (真脇遺跡) (J.)

147 FUJI Norio and TAGA Miyori (1986): Palynological investigation of the Nyuzen submerged forest on continental shelf of Toyama Bay, central Japan. *Bull. Fac. Educ., Kanazawa Univ., Nat. Sci.*, (35):75-94, figs. 1-13. (富山湾大陸棚の入善海底林の花粉学的研究) (J.E.)

148 FUJI Norio and TAGA Miyori (1987): Palynological investigation of the upper Neogene System in Nanao and Notojima areas, Noto Peninsula, central Japan. -Palynological investigation of the Neogene System in the Hokuriku region, central Japan (4)-. *Bull. Fac. Educ., Kanazawa Univ., Nat. Sci.*, (36):35-56. (能登七尾・能登島地区の新第三系の花粉学的研究) (J.E.)

149 FUJI Norio, TAKAYAMA Toshiaki, KATO Michio, SUZUKI Mitsuo and NODA Hiroshi (1989): [Topographical, geological and palaeontological investigations in the Higashi-iwa Tunnel of the Tatsumi flume, Kanazawa, central Japan]. *Ishikawa Prefecture*, 1-216, pls. 1-25. (加賀辰巳用水, 東岩隧道の地形学的・地質学的・古生物学的研究) (J.)

150 **FUJII Shoji** (1987): The molluscan fauna from Toyama Bay in the Japan Sea. *Jour. Coll. Lib. and Arts, Toyama Univ., Nat. Sci.*, 20(1):17-31, figs. 1-3, tabs. 1-6. (E.J.)

151 FUJII Shoji, NASU Noriyuki, SMITH Alec J., FUJI Norio, MIZUTANI Yoshihiko, SHIMAKURA Misaburo, KONISHI Kenji, IGARASHI Chiaki, MURAMOTO Junryo, TAKEMURA Toshio, SHIMODA Takashi, BOGGS Sam Jr., FUJIOKA Kantaro, MAPPA Haruna, KAWAHATA Hotaka, KONG Yong-sae and TANAKA Takeo (1986): Submerged forest off Nyuzen, Kurobegawa Alluvial Fan, Toyama Bay, central Japan. *Boreas*, 15(4):265-277, figs. 1-10, tabs. 1-3.

152 FUJII Shoji and SHIMIZU Masayuki (1988): On the molluscan fossils occurred from Rengeji, Fuchu-machi, Nei-gun, Toyama Prefecture, central part of Japan. *Jour. Coll. Lib. and Arts, Toyama Univ., Nat. Sci.*, 21(2):75-89, pl. 7, figs. 1-2, tabs. 1-3. (富山県婦負郡婦中町蓮花寺産の軟体動物化石) (J.E.)

153 FUJII Shoji and SHIMIZU Masayuki (1989): On the molluscan fossils occurred from Takakuma, Yatsuo-machi, Nei-gun, Toyama Prefecture, central part of Japan. *Jour. Coll. Lib. & Arts, Toyama Univ., Nat. Sci.*, 22(2):1-13, pls. 1-7, figs. 1-2, tab 1. (富山県婦負郡八尾町高熊産の軟体動物化石) (J.E.)

154 **FUJIMOTO Kiyoshi** and MIYAGI Toyohiko (1990): Late Holocene sea-level fluctuation and mangrove forest formation on Ponape Island, Micronesia. *Jour. Geogr.*, 99(5):507-514, figs. 1-5, tab. 1. (ミクロネシア, ポナペ島における後期完新世海水準微変動とマングローブ林の成立) (J.E.)

155 **FUJINO Kazuo** and SATO Seiji (1986): Stratigraphic analysis of the massive ground ice body in Tuktoyaktuk, Mackenzie Delta, N. W. T., Canada. In K. Fujino (ed.): Characteristics of the massive ground ice body in the western Arctic related to paleoclimatology, 1984-1985, 3-36, figs 1-12, tab. 1

156 FUJINO Kazuo and SATO Seiji (1988): Characteristics of the massive ground ice body in the western Canadian Artic 2. Prc. 5th Int. Conf. Permafrost, Trondheim, Norway, 1:143-147, figs. 1-7.

157 **FUJIOKA Kantaro**, TAYLOR Brain, NISHIMURA Akira, KOYAMA Masato, KAIHO Kunio, TAZAKI Kazue, JANECEK Thomas and Scientific Party of Leg 126 (1989):

Drilling across the Izu Bonin Arc -Results of ODP Leg 126 Cruise-. *Jour. Geogr.*, 98(7):886-910, figs. 1-9, tabs. 1-8. (伊豆・小笠原弧の横断掘削 −ODP126節成果報告−) (J.E.)

158 **FUJITA Hiroshi** (1989): Stratigraphy and geologic structure of the Pre-Neogene strata in the central Ryukyu Islands. *Jour. Sci., Hiroshima Univ., Ser. C*, 9(1):237-284, pls. 1-5, figs. 1-25, tabs. 1-11.

159 **FUJITA Toshihiko**, OHTA Suguru and OJI Tatsuo (1987): Photographic observations of the stalked crinoid *Metacrinus rotundus* Carpenter in Suruga Bay, central Japan. *Jour. Oceanogr. Soc. Japan*, 43:333-343.

160 **FUJIYAMA Ienori** (1987): Middle Miocene insect fauna of Abura, Hokkaido, Japan, with notes on the occurrence of Cenozoic fossil insects in the Oshima Peninsula, Hokkaido. *Mem. Natn. Sci. Mus., Tokyo*, (20):37-46, pls. 1-2, fig. 1. (北海道虻羅の中期中新世化石昆虫相 付, 北海道渡島半島の昆虫化石の産出状況) (J.)

161 FUJIYAMA Ienori and NOMURA Takamitsu (1986): Early Miocene insect fauna of the Hachiya Formation, Gifu Prefecture, Japan. *Bull. Mizunami Fossil Mus.*, (13):1-14, pls. 1-2, figs. 1-14. (岐阜県蜂屋累層の前期中新世化石昆虫相) (J.E.)

162 **FUKUDA Yoshio** (1986): SEM observation on wall of crypt of fossil Bivalvia, *Rocellaria* (*Cucurbitula*) *cymbium* (Spengler) from the Semata Formation (late Pleistocene). *Jour. Foss. Res.*, 19(1):1-5, figs. 1-14. (瀬又層産チビツクエガイの住房壁の構造) (J.)

163 FUKUDA Yoshio (1986): [Bone cells observed in dinosaurs tendon]. *Earth Month.*, 8(3):163-169, figs. 1-5. (恐竜の腱に認められた骨細胞) (J.)

164 **FUKUDOME Taka'aki** (1986): Growth strategy of Foraminifera. In Y. Matoba and M. Kato (eds.): Studies on Cenozoic Benthic Foraminifera in Japan, Akita Univ., Akita, 151-156. (有孔虫の成長戦略) (J.)

165 FUKUDOME Taka'aki (1986): [Growth strategy of Foraminifera]. *Mar. Sci. Month.*, 18(9):558-563. (有孔虫の成長戦略) (J.)

166 FUKUDOME Taka'aki and AITA Yoshiaki (1986): Basic program for harmonic analysis of fossil shape. In Y. Matoba and M. Kato (eds.): Studies on Cenozoic Benthic Foraminifera in Japan, Akita Univ., Akita, 169-174. (化石形態の２次元調和解析のためのパソコン用プログラム) (J.)

167 FUKUDOME Taka'aki, AOZAKI Gen, MATOBA Yasumochi and TAKEUTI Sadako (1988): Stratigraphic sequence and geothermal reservoir inferred from the drilling results in Aira Town, western margin of Kagoshima Graben. *Rep. Res. Inst., Nat. Resour., Min. Coll., Akita Univ.*, (53):41-56, pls. 1-2, figs. 1-8, tabs. 1-6. (試錐結果からみた鹿児島地溝西縁部姶良町の地下地質と温泉貯留層) (J.E.)

168 **FUKUDOMI Takayoshi** (1990): Jurassic melange, Kanoashi Complex, in western Shimane Prefecture, southwest Japan. *Jour. Geol. Soc. Japan*, 96(8):653-667, figs. 1-8, tabs. 1-5. (島根県西部のジュラ紀メランジ, 鹿足コンプレックス) (J.E.)

169 **FUKUZAWA Kazue** and MATOBA Yasumochi (1988): [Distribution of Recent Foraminifera on the continental shelf and the uppermost continental slope area off Akita and Honjo]. *Jour. Japan. Assoc. Petrol. Tech.*, 53(4):301. (秋田−本荘沖大陸棚および大陸斜面最上部の現生底生有孔虫の分布) (J.)

170 **FUNAYAMA Masaaki** (1988): Miocene radiolarian stratigraphy of the Suzu area, northeastern part of the Noto Peninsula, Japan. *Contr. Inst. Geol. Paleont., Tohoku Univ.*, (91):15-40, pls. 1-5. (能登半島珠洲地域の新第三系の岩相および放散虫化石層序) (J.E.)

171 **FURUSAWA Hitoshi** (1988): A new species of *Hydrodamaline sirenia* from Hokkaido, Japan. Takikawa Museum of Art and Natural History, Takikawa, 1-73, pls. 1-6, figs. 1-31, tabs. 1-4.

172 FURUSAWA Hitoshi (1990): Scenario of the sinerian evolution in the North Pacific Ocean. Prof. A. Kasugai Mem. Vol., Sapporo, 97-104, figs. 1-4. (北太平洋における海牛進化のシナリオ) (J.)

173 FURUSAWA Hitoshi and Numata Fossil Research Group (1990): Discovery and significance of the Takikawa sea cow (*Hydrodamalis spissa*) from Numatacho, Uryu-gun, Hokkaido, Japan. *Earth Sci.*, 44(4):224-228, figs. 1-4. (雨竜郡沼田町におけるタキカワカイギュウの発見とその意義) (J.)

174 **FURUSAWA Naoko**, MATSUI Seiichiro and SAKAI Toyosaburo (1987): Molluscan faunas of the Upper Miocene Tanokura and Irieno Formations in Tochigi Prefecture. *Mem. Tochigi Pref. Mus.*, (5):57-79, pls. 1-3. (上部中新統田野倉層上部及び入江野層の貝化石群) (J.E.)

175 **FURUTANI Hiroshi** (1986): The structure of the spicules and the systematics of the Superfamilies Entactinioidea and Plaeoscenidioidea. *NOM, Spec. Vol.*, (7):109-115, figs. 1-3, tab. 1. (Entactinioidea上科とPalaeo-scenidioidea上科の骨針の構造と分類) (J.E.)

176 FURUTANI Hiroshi (1990): Middle Paleozoic radiolarians from Fukuji area, Gifu Prefecture, central Japan. *Jour. Earth Sci., Nagoya Univ.*, 37:1-56, pls. 1-14, figs. 1-11, tabs. 1-7.

177 **FURUTANI Masakazu** (1989): Stratigraphical subdivision and pollen zonation of the middle and upper Pleistocene in the coastal area of Osaka Bay, Japan. *Jour. Geosci., Osaka City Univ.*, 32:91-121, figs. 1-16, tabs. 1-2.

178 **FUSE Keisuke** and KOTAKA Tamio (1986): The molluscan assemblages from the Hioki Group, Yamaguchi Prefecture, southwest Japan. *Monogr. Mizunami Fossil Mus.*, (6):119-141, pl. 17. (山口県日置層群産貝化石群集) (J.E.)

179 **FUTAKAMI Masao** (1986): Stratigraphy and paleontology of the Cretaceous in the Ishikari Province, central Hokkaido, Part 1. Stratigraphy of the Cretaceous in the southern areas. *Bull. Nat. Sci. Mus., Ser. C*, 12(1):7-34, pls. 1-2, figs. 1-8, tabs. 1-3.

180 FUTAKAMI Masao (1986): Stratigraphy and paleontology of the Cretaceous in the Ishikari Province, central Hokkaido, Part 2. Stratigraphy of the Cretaceous in the northern areas. *Bull. Natn. Sci. Mus., Ser. C*, 12(3): 91-120, figs. 1-16, tabs. 1-4.

181 FUTAKAMI Masao, KAWAKAMI Takeshi and OBATA Ikuwo (1987): Santonian texanitine ammonites from the Kuji Group, northeast Japan. *Bull. Iwate Pref. Mus.*, (5):103-112, pl. 3, figs. 1-5, tab. 1.

182 FUTAKAMI Masao and OBATA Ikuwo (1988): Distribution of some Turonian and Coniacian collignoniceratid ammonites. In J. Wiedmann and J. Kullmann (eds.): Cephalopods-Present and past. Schweizerbart'sche Verlagsbuch-handlung, Stuttgart, Germany, 505-512.

G

183 **GEOL Rajenda K.**, KATO Makoto, JAIN Arvind K. and SRIVASTAVA Shambhu S. (1987): Fauna from the "Muth Quartzite", Garhwall Himalaya, India. *Jour. Fac. Sci., Hokkaido Univ., Ser. 4*, 22(2):247-257, pls. 1-2, figs. 1-2.

184 **Geological Research Group of Akita University on the Nihonkai Chubu Earthquake, 1983** (1986): Ground failure caused by the Nihonkai Chubu Earthquake, 1983, in relation to subsurface geology. *Mem. Geol. Soc. Japan*, (27):237-256, pls. 1-2, figs. 1-11, tabs. 1-2. (1983年日本海中部地震による地盤災害と表層地質) (J.E.)

185 Geological Research Group of Akita University on the Nihonkai Chubu Earthquake, 1983 (1986): Late Quaternary geology and development of the coastal alluvial plain of Akita Prefecture, northeast Japan. *Mem. Geol. Soc. Japan*, (27):213-235, figs. 1-14. (秋田臨海平野の形成史) (J.E.)

186 **GLADENKOV Yuri, B.** (1988): The North Pacific holartic Neogene from an ecostratigraphic point of view. *Saito Ho-on Kai, Spec. Pub.* (*Prof. T. Kotaka Commem. Vol.*), 33-45, figs. 1-2.

187 **GOTO Hiroya** (1986): Reconsideration of the Permian Tatsuno Group in the southern part of the Kozuki-Tatsuno Belt, Hyogo Prefecture, southwest Japan. *Jour. Geol. Soc. Japan*, 92(9):663-674, figs. 1-10, tab. 1. (兵庫県上月－龍野帯南部のペルム系龍野層群の再検討) (J.E.)

188 GOTO Hiroya, MARUOKA Kunitake and ISHI Ken-ichi (1986): *Lepidolina columbiana* (Permian fusulinid) from British Columbia, Canada. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (143):422-434, pl. 86, figs. 1-8, tabs. 1-2.

189 **GOTO Masatoshi** (1986): Origin and evolution of hard tissues - A comment on Halstead (1974). *Jour. Foss. Res.*, 19(1):6-10, figs. 1-4. (硬組織の起源と進化－Halstead (1974)の紹介と批判－) (J.)

190 GOTO Masatoshi (1987): *Chlamydoselachus anguineus* -A living cladodont shark. *Rep. Japan Group Elasmobranen Stud.* (23):11-13, figs. 1-9. (ラブカ－生きているクラドダス類) (J.)

191 GOTO Masatoshi (1987): Origin and evolution of tooth enamel. In S. Suga (ed.): Tooth enamel, its formation, structure, composition and evolution. Quintessence Publishing Co., Inc., Tokyo, 222-233, figs. 3.1-3.14. (エナメル質の起源と進化) (J.)

192 GOTO Masatoshi (1987): [Tooth evolution in vertebrates -An introduction to human body geology]. *Educ. Earth Sci. & Sci. Mov.*, (16):87-94, figs. 1-14. (歯からみた脊椎動物の進化－人体地質学入門－) (J.)

193 GOTO Masatoshi (1987): Fossilization in shark teeth. In M. Akiyama (ed.): An approach to mechanisms of fossilization and phylogeny. Hokkaido University, Sapporo, 29-36, figs. 1-13. (サメ歯化石にみる化石化過程) (J.)

194 GOTO Masatoshi (1989): [On the morphology and sturucture of dermal armour, dermal tooth and tooth of Paleozoic fishes -An approrch to the origin of tooth enamel]. *Arch. Conf. Comp. Bio. Tooth Enamel, Japan*, (1):25-28, figs. 1-3. (古生代魚類の皮甲・皮歯・歯の形態と構造 －エナメル質の起源を求めて－) (J.)

195 GOTO Masatoshi (1989): Extant bullhead sharks. *Collect. & Breed.*, 51(2):64-67, figs. 1-9. (ネコザメ) (J.)

196 GOTO Masatoshi (1989): Development of dermal tooth and jaw tooth in sharks and phylogeny of hard tissues in vertebrates. In M. Omori, S. Suga and M. Goto (eds.): Biomineralization and phylogeny of marine organisms. Tokai Univ. Press, Tokyo, 219-246, figs. 1-28, tab. 1. (サメ類の皮歯および歯の発生と脊椎動物における硬組織の系統発生) (J.)

197 GOTO Masatoshi (1989): A restoration of the jaws of the giant extinct shark, *Carcharocles* (*Carcharodon*) *megalodon*. *Jour. Foss. Res.*, 22(1):7-13, figs. 1-13. (化石巨大鮫 *Carcharocles megalodon*の顎の復元) (J.)

198 GOTO Masatoshi (1990): The shape of bone 1. Is the bone "positive structure" or "negative structure"? *Bone*, 4(1):97-104, figs. 1-9. (ホネのかたち1．骨は"正の現象"か, "負の現象"か?) (J.)

199 GOTO Masatoshi (1990): The shape of bone 2. Bone of skin: dermal armour, dermal bone, dermal tooth and tooth. *Bone*, 4(2):107-118, figs. 1-16. (ホネのかたち2．皮膚の骨＝皮甲・皮骨・皮歯・歯) (J.)

200 GOTO Masatoshi (1990): The shape of bone 3. Back bone: notochord, centrum, vertebra and vertebral column. *Bone*, 4(3):115-127, figs. 1-13. (ホネのかたち3．セボネ＝背索・椎体・椎骨・背柱) (J.)

201 GOTO Masatoshi (1990): The shape of bone 4. Skull = dermal bone + vertebra + branchial arch. *Bone*, 4(4):131-142, figs. 1-11. (ホネのかたち4．頭骨＝皮骨＋脊椎骨＋鰓弓骨) (J.)

202 GOTO Masatoshi (1990): Symphysial teeth of an edestid shark, *Edestus heinrichi* Newbery et Worthen, from the Upper Carboniferous of USA. *Earth Sci.*, 44(4):1-2, pl. 1. (古生代エデツスツの正中歯列) (J.)

203 GOTO Masatoshi and GOTO Michiharu (1987): Three fossil teeth of the lamnoid sharks, *Carcharocles* and *Carcharodon* from the Hokuriku Group (late Miocene-early Pleistocene) of Takaoka City, Toyama Prefecture, central Japan. *Bull. Toyama Sci. Mus.*, (11):123-132, pl. 1, figs. 1-3. (富山県高岡市の北陸層群（中新世後期～更新世前期）より産出した化石巨大鮫およびホホジロザメの歯化石3 標本について) (J.E.)

204 GOTO Masatoshi and OHTAISHI Noriyuki (1986): Comparative odontology -Morphology, function and evolution of tooth in vertebrates. Ishiyaku Publisheds, INC., Tokyo, 1-268. (歯の比較解剖学) (J.)

205 GOTO Masatoshi, OKURA Masatoshi and OGAWA Hiroshi (1988): On teeth and dermal teeth of Chondrichthyes from the Akasaka Limestone (Middle Permian), central Japan. *Earth Sci.*, 42(5):290-297, pls. 1-2, figs. 1-6, tab. 1. (赤坂石灰岩(中部ペルム系)から発見された軟骨魚類の歯および皮歯の化石) (J.E.)

206 GOTO Michiharu (1986): Discovery of *Onychiopsis elongata* (Geyler) Yokoyama (A fern with uncertain affinity) from the Lower Jurassic Kuruma Group in Toyama and Niigata Prefecture. *Bull. Toyama Sci. Mus.*, (9):87-88, pl. 1, fig. 1. (富山県新潟県に分布する下部ジュラ系来馬層群最上部層より植物化石 *Onychiopsis elongata* (Geyler) Yokoyama の発見) (J.)

207 GOTO Michiharu and KAWAGUCHI Michiyo (1988): Discovery of Cretaceous inoceramids from the Utanobori Group in the Esashi mountains, northern Hokkaido. *Fossils, Palaeont. Soc. Japan*, (45):23-26, figs. 1-3. (北海道北部, 枝幸山地の歌登層群より白亜紀イノセラムス化石の発見) (J.E.)

208 GOTO Noboru (1988): Stratigraphy of Permian siliceous-argillaceous rocks and their tectonic relation with coarse-grained clastics in the Taishaku

area, southwest Japan. *Jour. Geol. Soc. Japan*, 94(7):501-514, figs. 1-7, tab. 1. (帝釈地域のペルム紀珪質－泥質岩類の層序と粗粒砕屑岩類との構造的関係) (J.E.)

209 **GUNJI Yukio** (1986): Structure of Recent brachiopod assemblages from the waters off Tane-ga-shima Island: Competition model in heterogeneous environments and its analysis. *Fossils, Palaeont. Soc. Japan*, (40):17-34, figs. 1-20, tabs. 1-2. (種子島沖における現生腕足動物の群集構造：不均質環境の競争モデルとその解析)

210 GUNJI Yukio (1987): Metamorphosis of the loop in Cenozoic dallinacean brachiopods and its developmental constraint. *Lethaia*, 20(3):239-255, figs. 1-9.

211 **GUPTA, V. J.** and OZAWA Tomowo (1986): Middle Permian fusulinaceans from Karakoram Himalayas. In V. J. GUPTA et al (eds.): Geology of western Himalayas (Contr. Himalayan Geology, v. 3). Hindustan Pub. Co., India, 1-11, pls. 1-3.

H

212 **HACHIYA Kiichiro**, YAMAOKA Masatoshi and MIZUNO Yoshiaki (1988): Deep sea fauna from the Middle Miocene Morozaki Group in the Chita Peninsula, Aichi Prefecture, central Japan. *Jour. Growth*, 27(4):119-139, figs. 1-8, tabs. 1-2. (師崎層群の深海化石動物群集) (J.E.)

213 **HAGA Masakazu** and YAMAGUCHI Toshiyuki (1990): Stratigraphy and fossil diatoms of the Neogene to Quaternary formations in the eastern Shimokita Peninsula, Aomori Prefecture. *Bull. Natn. Sci. Mus., Tokyo, Ser. C.*, 16 (2):55-78, figs. 1-10, tab. 1. (下北半島東部の新第三系－第四系の層序と珪藻化石) (J.E.)

214 **HAIKAWA Takehiko** (1988): The basement complex and conodonts biostratigraphy of the lowest part in the Akiyoshi Limestone Group, southwest Japan. *Bull. Akiyoshi-dai Mus., Nat. Hist.*, (23):13-37, pls. 1-4. (秋吉石灰岩層群の基盤と最下部層のコノドント化石層序) (J.E.)

215 **HAMADA Takashi** (1986): On the species of fossils. *Collect. & Breed.*, 48(1): 30-31. (化石の“種”) (J.)

216 HAMADA Takashi (1986): On the coelacanthiform fossils. *Collect. & Breed.*, 48(2):66-70, figs. 1-4. (シーラカンス類の化石) (J.)

217 HAMADA Takashi (1986): Plant fossils of the Paleo-Shiobara Lake, Tochigi Prefecture, central Japan. *Collect. & Breed.*, 48(10):440-442, figs. 1-6. (古塩原湖の化石植物) (J.)

218 HAMADA Takashi (1989): Recent trends in dinosaur studies. *Collect. & Breed.*, 51(12):526-527. (最近の恐竜研究事情) (J.)

219 **HAMANO Tatsuo**, KOYA Takashi, SHIMOYAMA Shoichi and MATSUURA Shuhei (1986): The dynamics of the molluscan community in the soft bottom of Hakata Bay, Japan, with special reference to the summer stratification period. *Benthos Res.*, (29):1-8, figs. 1-3. (博多湾における底生貝類群集の動態) (J.E.)

220 **HANAI Tetsuro** and YAMAGUCHI Toshiyuki (1987): Plio-Pleistocene ostracod fauna of Shimokita, Aomori Prefecture (Preliminary report). *Mem. Natn.*

Sci. Mus., Tokyo, (20):45-51, fig. 1. (青森県下北半島の鮮新－更新世貝形虫群集, 予報) (J.E.)

221 **HANAMURA Hajime**, UEMATSU Yasushi and SETOGUCHI Takeshi (1988): Replacement of the first premolars in Japanese shrew-moles (Talpidae: Insectivora). *Jour. Mammal.*, 69:135-138.

222 **HASE Yoshitaka** (1986): Descriptive note on the fossil leaves of the Theaceae from the late Cenozoic sediments in southern Kyusyu, Japan. *Mem. Fac. Gen. Educ., Kumamoto Univ.*, (22):17-26, pl. 1, figs. 1-3.

223 HASE Yoshitaka (1988): Late Cenozoic history and paleoenvironment of southern Kyushu, Japan. *Mem. Fac. Gen. Educ., Kumamoto Univ.*, (23):37-82, figs. 1-9, tabs. 1-15. (南部九州後期新生代の地史と古環境) (J.)

224 **HASEGAWA Shiro** (1986): [Faunal analysis of Recent foraminiferal thanatocoenosis in Toyama Bay]. *Mar. Sci. Month.*, 18(9):569-576, figs. 1-6, tabs. 1-3. (富山湾の現生有孔虫遺骸の群集解析) (J.)

225 HASEGAWA Shiro (1986): List of the foraminiferal species described by Prof. Kiyoshi Asano of Tohoku University. In Y. Matoba and M. Kato (eds.): Studies on Cenozoic Benthic Foraminifera in Japan. Akita Univ., Akita, 157-168. (東北大学浅野清先生記載の新種一覧表) (J.)

226 HASEGAWA Shiro (1987): [Fossil Foraminifera (Tatsunokuchi Formation)]. In Report on geography and geology in the Hirose valley. Assoc. Geol. Coll. Japan, Sendai Branch and Sendai City Sci. Mus., 86-90, pls. 1-5. (有孔虫化石(竜の口層)) (J.)

227 HASEGAWA Shiro (1989): [Foraminiferal assemblage in the seas around the Noto Peninsula. (Preliminary report)]. Studies on marine geology of the shelf areas around the southwest Japan: Off Noto Peninsula area, Invest. Rep. for the year 1988, Geol. Surv. Japan, 125-136. (能登半島周辺海域の有孔虫群集 (予報)) (J.)

228 HASEGAWA Shiro (1989): [Considerations on d'Orbigny's type specimens and the rule of nomenclature]. *Yukochu Kenkyu* (=*Stud. Foraminifera*), (2):33-40. (d'Orbigny (1826) の模式標本と命名法についての考察) (J.)

229 HASEGAWA Shiro (1989): Coastal benthic foraminiferal fauna in the Japan Sea. In Y. Takayanagi and K. Ishizaki (eds.): Collected papers on Foraminifera from the Japanese Islands. Toko Print., Pub. Dept., Sendai, 131-142, figs. 1-9, tab. 1. (日本海の沿岸性底生有孔虫群集) (J.E.)

230 HASEGAWA Shiro, AKIMOTO Kazumi, KITAZATO Hiroshi and MATOBA Yasumochi (1989): Late Cenozoic paleobathymetric indices based on benthic foraminifers in Japan. *Mem. Geol. Soc. Japan*, (32):241-253, fig. 1, tabs. 1-3. (底生有孔虫にもとづく日本の後期新生代古水深指標) (J.E.)

231 HASEGAWA Shiro and TAKAYANAGI Yokichi (1989): [Benthic Foraminifera from Alluvial deposits in the Onahama area, Iwaki City]. *Bull. Geol. Soc. Japan, Tohoku Branch*, (19):30. (いわき市小名浜地区の沖積層の底生有孔虫群) (J.)

232 **HASEGAWA Yoshikazu** (1986): Japanese cave and fissure deposits and paleontology. *Jour. Speleol. Soc. Japan, 10th Anniv. Spec. Vol., Speleol. Soc. Japan, Akiyoshi-dai*, 12-16, figs. 1-2. (洞窟と古生物) (J.)

233 HASEGAWA Yoshikazu (1986): [Significance of occurrence and morphological feature of *Paleoparadoxia* from the Yanagawa Formation]. Res. Rep. *Paleoparadoxia* from the Yanagawa Formation. Educat. Comm. Yanagawa Town, Fuku-

shima, 17-22, pls. 5-7, fig. 8. (梁川層産*Paleoparadoxia*の形態的特長と産出意義について) (J.)

234 HASEGAWA Yoshikazu (1990):[Taxonomy and evolution of Cetacea]. In N. Miyazaki and T. Kasuya (eds.): Biology of marine mammals. Scientist Inc., Tokyo, 3-13. (鯨類の分類と進化) (J.)

235 HASEGAWA Yoshikazu and AOSHIMA Mutsuharu (1988): Two fossil mice from Pleistocene lake deposits of Shiobara, Tochigi Prefecture. *Bull. Tochigi Pref. Mus.*, (5):1-5, pl. 1, figs. 1-2, tab. 1. (塩原湖成層産のネズミ類化石2種) (J.)

236 HASEGAWA Yoshikazu, MATSUSHIMA Yoshiaki and MIKAMI Keizo (1986): *Parastegodon* tooth from the Ashigara Group. *Mem. Inst., Field Educ., Yokohama Natn. Univ.*, (4):51-55, pls. 1-2, figs. 1-3, tab. 1. (足柄層群産パラステゴドン象) (J.)

237 HASEGAWA Yoshikazu and OKAZAKI Yoshihiko (1987): Bibliography of Japanese speleology 1981-1985, III, Paleontology. *Jour. Speleol. Soc. Japan*, 12:52-57.

238 HASEGAWA Yoshikazu, TOMIDA Yukimitsu, KOHNO Naoki, ONO Keiichi, NOKARIYA Hiroshi and UYENO Teruya (1988): Quaternary vertebrates from the Shiriya area, Shimokita Peninsula, northeastern Japan. *Mem. Natn. Sci. Mus., Tokyo*, (21):17-36, pls. 1-8, figs. 1-3, tab. 1. (下北半島尻屋地域の更新世脊椎動物群集) (J.E.)

239 HASEGAWA Yoshiyuki (1988): *Lepidolina hayasakai* (Ozawa), a species of advanced Fusulinacea. *Earth Sci.*, 42(3):3-5. (*Lepidolina hayasakai* (Ozawa)－進化した紡錘虫の一種－) (J.)

240 HATA Mitsuo and MATSUMARU Kuniteru (1988): On some *Lepidocyclina*-bearing limestone gravels from the Monju Formation, Shizuoka Group, central Japan. *Jour. Geol. Soc. Japan*, 94(9):715-717, pl. 1. (静岡層群文珠層から産出する含 *Lepidocyclina* 石灰岩礫について) (J.)

241 HATA Mitsuo and SATO Seiji (1989): Climatic change during early and middle Miocene in the southern part of the Matsumae Peninsula, Hokkaido. *Mem. Geol. Soc. Japan*, (32):207-216, figs. 1-3, tab. 1. (松前半島南部の中新世前－中期における気温変化) (J.E.)

242 HATTA Akio (1988): Fossil foraminifers and their morphology -Morphology of fossil foraminifers for laymen-. Prof. S. Kondo Mem. Vol., Chiba, 99-108. (有孔虫化石の形態－初めて有孔虫化石を学ぶ人のための形態学－) (J.)

243 HATTA Akio (1988): The foraminiferal assemblage from Kukinaga Group and Masuda Formation in Tanegashima, Nansei Islands, south Kyusyu, Japan. *Bull. Fac. Educ., Kagoshima Univ., Nat. Sci.*, 40:25-44, pls. 1-4. (南西諸島，種子島の茎永層群及び増田層産の有孔虫群集) (J.E.)

244 HATTA Akio and HAYASAKA Shozo (1987): Planktonic Foraminifera in the West Pacific Ocean (Preliminary report). *Prompt Rep. 5th Sci. Surv. South Pac.*, 6(2):47-52, pls. 1-2.

245 HATTA Akio, JAMES S. and BOWDEN A. (1986): Recent Foraminifera from Ponape Islands and the Truk Islands (Preliminary report). *Prompt Rep. 4th Sci. Surv. South Pac.*, 5(1):26-32.

246 HATTA Akio and UJIIE Hiroshi (1987): [Benthic foraminiferal assemblages of the "Sekisei-sho" region, Yaeyama-gunto, Okinawa. (Preliminary report)].

Earth Month., 9(3):159-162. (八重山群島・石西礁湖の底生有孔虫群集（予報）) (J.)

247 HATTA Akio and WATANABE A. (1988): [A basic study on preparing living Benthic Foraminifera as educational material -Annual change of foraminiferal assemblage at the Kushikino beach, Kagoshima Prefecture-]. *Kagoshima-ken Chigaku-kaishi*, (61):22-32, pls. 1-3. (現生底棲有孔虫の教材化に関する基礎的研究－鹿児島県串木野海岸の有孔虫群集の年間変化－) (J.)

248 **HATTORI Isamu** (1988): Surface texture of radiolarians and extraction method of radiolarians. *Mem. Fac. Educ., Fukui Univ., Ser. 2*, (38) pt. 2:71-85, pls. 1-4. (放散虫の表面組織と放散虫の抽出方法) (J.E.)

249 HATTORI Isamu (1989): Jurassic radiolarians from manganese nodules at three sites in the western Nanjo massif, Fukui Prefecture, central Japan (DATA). *Mem. Fac. Educ., Fukui Univ., Ser. 2*, (39) pt. 3:47-134, pls. 1-44, figs. 1-5, tabs. 1-3. (福井県南条山地西部の３地点におけるマンガンノジュールからのジュラ紀放散虫について(資料)) (J.E.)

250 **HAYAKAWA Hiroshi** (1990): Sedimentologic control and paleoenvironmental implications on shell concentrations: An example of *Inoceramus uwajimensis* Yehara from the Upper Cretaceous of Hokkaido, Japan. *Fossils, Palaeont. Soc. Japan*, (48):1-16, figs. 1-13. (化石密集層形成における堆積学的制約と古環境について－北海道上部蝦夷層群（上部白亜系）から産出する *Inoceramus uwajimensis* を例に－) (J.E.)

251 **HAYAMI Itaru** (1987): Geohistorical background of Wallace's Line and Jurassic marine biogeography. In A. Taira and M. Tashiro (eds.): Historical biogeography and plate tectonic evolution of Japan and eastern Asia. Terra Pub., Tokyo, 111-133, figs. 1-3.

252 HAYAMI Itaru (1987): [Wallace's Lane -its geohistorical background]. *Heredity*, 41(12):23-29, figs. 1-2, tab. 1. (ワラス線－その地史的背景) (J.)

253 HAYAMI Itaru (1988): Functional and taxonomic implications of internal ribs of *Propeamussium*. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (150):476-490, figs. 1-7.

254 HAYAMI Itaru (1988): A Tethyan bivalve, *Posidonotis dainellii*, from the Lower Jurassic of west Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (151):564-569, fig. 1.

255 HAYAMI Itaru (1988): [On special education of paleontology]. *Fossils, Palaeont. Soc. Japan*, (45):45-48. (古生物学の専門教育について) (J.)

256 HAYAMI Itaru (1988): Taxonomic characters of propeamussiids from Japan. *Venus, Japan. Jour. Malacol.*, 47(2):71-82, figs. 1-2. (日本産ワタゾコツキヒガイ類の分類形質) (J.E.)

257 HAYAMI Itaru (1989): Outlook on the post-Paleozoic historical biogeography of pectinids in the western Pacific region. *Nat. & Cult., Univ. Mus., Univ. Tokyo*, (1):3-25, figs. 1-4, tabs. 1-2.

258 HAYAMI Itaru (1990): Geographic distribution of Jurassic bivalve faunas in eastern Asia. In K. Ichikawa, S. Mizutani, I. Hara and A. Yao (eds.): Pre-Cretaceous terranes of Japan. Publication of IGCP Project 224, Osaka, 361-369, fig. 1.

259 HAYAMI Itaru (1990): "Mesozoic marine revolution" and evolution of bivalves. *Fossils, Palaeont. Soc. Japan*, (49):23-31. ("中生代の海洋変革"と二枚貝類の進化) (J.)

260 HAYAMI Itaru and HOSODA Ichiro (1988): *Fortipecten takahashii*, a reclining pectinid from the Pliocene of north Japan. *Palaeontology*, 31(2):419-444, pls. 39-40, figs. 1-10, tabs. 1-2.

261 HAYAMI Itaru and OKAMOTO Takashi (1986): Geometric regularity of some oblique sculptures in pectinid and other bivalves: Recognition by computer simulations. *Paleobiology*, 12(4):433-449, figs. 1-12.

262 **HAYAMI Tomoko** (1987): Bryozoa from the Danzyo Islands, Nagasaki Prefecture, Kyusyu Japan. Pt. 1. On the *Cellaria* (Arasca). *Mem. Fac. Educ., Ehime Univ., Ser. 3*, 7:121-126, figs. 1-2.

263 HAYAMI Tomoko (1988): Bryozoa from the Danzyo Islands, Nagasaki Prefecture, Kyushu, Japan. Pt. 2. On the Scrupocellariidae Levinsen (Arasca). *Mem. Fac. Educ., Ehime Univ., Ser. 3*, 8:127-133, pl. 1.

264 **HAYASAKA Shozo** (1988): Marine ecological study on the habitat of *Nautilus pompilius* in Fiji (the second operation). *Occas. Pap., Kagoshima Univ. Res. Cent., South Pac.*, (15):1-84.

265 HAYASAKA Shozo, OKI Kimihiko and SAISHO Toshio (1986): [Environmental background of *Nautilus*]. *Mar. Sci. Month.*, 18(10):623-631, figs. 1-11. (オウムガイの生息環境) (J.)

266 HAYASAKA Shozo, OKI Kimihiko and SHINOMIYA Akihiko (1988): Environmental background of the habitat of *Nautilus* off the east coast of Viti Levu, Fiji. *Occas. Pap., Kagoshima Univ. Res. Cent., South Pac.*, (15):16-23, figs. 1-9, tabs. 1-2.

267 HAYASAKA Shozo, OKI Kimihiko, TANABE Kazushige, SAISHO Toshio and SHINOMIYA Akihiko (1987): On the habitat of *Nautilus pompilius* in Tanon Strait (Philippines) and the Fiji Islands. In N. Landman and W. B. Saunders (eds.): Biology and paleobiology of the living *Nautilus*. Plenum Publishing Co., New York, 179-200, figs. 1-12.

268 HAYASAKA Shozo and SUZUKI Hiroshi (1988): Notes on drifted *Nautilus* shells at Yap, the Caroline Islands. *Saito Ho-on Kai, Spec. Pub. (Prof. T. Kotaka Commem. Vol.)*, (3):207-212, pls. 1-3, tabs. 1-2.

269 **HAYASHI Kei-ichi** (1988): Pliocene-Pleistocene palaeoenvironment and fossil ostracod fauna from southwestern Hokkaido, Japan. In T. Hanai, N. Ikeya and K. Ishizaki (eds.): Evolutionary biology of Ostracoda, its fundamentals and applications. Kodansha/Elsevier, Tokyo/Amsterdam, 557-568, figs. 1-3.

270 **HAYASHI Shingo**, IIJIMA Shizuo, ISHII Itsuo, NAKAJIMA Teruo, SAWAGUCHI Hiroshi, TANAKA Hiroyuki and YOSHIDA Takashi (1990): Late Paleozoic to Mesozoic formations in the southwestern Ashio Mountains. *Bull. Gunma Pref. Mus. Hist.*, 1-34, pl. 1, figs. 1-9, tabs. 1-3. (足尾山地南西部の中・古生界) (J.E.)

271 **HEUSSER L. E.** (1990): Northeast Asian pollen records from the last 150,000 years from deep-sea cores V28-304 and RC14-99 taken off the Pacific coast of Japan. *Rev. Palaeobot. & Palynol.*, 65(1-4):1-8, figs. 1-3, tab. 1.

272 **HIJIKATA Junko** (1986): Pollen analysis of the Quaternary sediments in Nose, in the nothern part of Osaka. *Bull. Osaka Mus., Nat. Hist.*, (40):15-20,

figs. 1-5, tab. 1. (大阪府北部，能勢地域における第四紀堆積物の花粉分析) (J.E.)

273 **Hiki Research Group** (1989): The Shiobara-type molluscan fauna from the Tsuchishio Formation (Miocene), northeastern margin of the Kanto Mountains, central Japan. *Earth Sci.*, 43(1):58-61, figs. 1-3, tab. 1. (関東山地北東縁部の土塩層（中新統）の塩原型動物群) (J.)

274 **HINO N.** and IKEYA Noriyuki (1990): On *Robustaurila kianohybria* (Hu). *Stereo-Atlas, Ostracod Shells*, 17(26):129-136.

275 **HIRANO Hiromichi** (1986): Cenomanian and Turonian biostratigraphy of the off-shore facies of the northern Pacific -An example of the Oyubari area, central Hokkaido, Japan-. *Bull. Sci. & Eng. Res. Lab., Waseda Univ.*, (113):6-20, figs. 1-10.

276 HIRANO Hiromichi (1988): Evolutionary mode of some late Cretaceous ammonites in offshore waters. In J. Wiedmann and J. Kullmann (eds.): Cephalopods-present and past. E. Schweizer' bartsche Verlangsbuchhandlung, Stuttgart, 513-523, figs. 1-9.

277 HIRANO Hiromichi (1989): Extinction theories after the death of Alvarez, L. W. *Collect. & Breed.*, 51(12):535-535, figs. 1-3. (恐竜絶滅説の行方－隕石衝突説の是非) (J.)

278 HIRANO Hiromichi and ASAI Akito (1978): Biostratigraphy and correlation of the Cenomanian and Turonian of Japan. *Jour. Geogr.*, 96(5):319-322, figs. 1-2. (本邦上部白亜系セノマニアン階・チューロニアン階の化石層序と国際対比) (J.)

279 HIRANO Hiromichi, FUKUDA Yoshio and SEKIYA Ryuzo (1990): Microstructure of some Jurassic ammonoid (hildoceratid) jaw plates. *Bull. Sci. & Eng. Res. Lab., Waseda Univ.*, (128):28-42, figs. 1-8.

280 HIRANO Hiromichi, OKAMOTO Takashi and HATTORI Koji (1990): Evolution of late Cretaceous desmoceratin ammonoids. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (157):382-411, figs. 1-17, tabs. 1-7.

281 HIRANO Hiromichi, TAKIZAWA Kanemitsu and TSUCHIDA Satoshi (1989): Biostratigraphy of the Upper Cretaceous in the Oyubari area, central Hokkaido, Japan (1). *Bull. Sci. & Eng. Res. Lab., Waseda Univ.*, (123):13-34, figs. 1-20.

282 HIRANO Hiromichi, TAKIZAWA Kanemitsu and TSUCHIDA Satoshi (1989): Biostratigraphy of the Upper Cretaceous in the Oyubari area, central Hokkaido, Japan (2). *Bull. Sci. & Eng. Res. Lab., Waseda Univ.*, (125):14-36, figs. 21-40.

283 HIRANO Hiromichi, TAKIZAWA Kanemitsu and TSUCHIDA Satoshi (1989): Biostratigraphy of the Upper Cretaceous in the Oyubari area, central Hokkaido, Japan (3). *Bull. Sci. & Eng. Res. Lab., Waseda Univ.*, (126):1-21, figs. 41-49, tabs. 1-9.

284 HIRANO Hiromichi, TAKIZAWA Kanemitsu and TSUCHIDA Satoshi (1990): Biostratigraphy of the Upper Cretaceous in the Oyubari area, central Hokkaido, Japan (4). *Bull. Sci. & Eng. Res. Lab., Waseda Univ.*, (127):8-26, fig. 50, tabs. 10-24.

285 **HIROI Yoshikuni**, YOKOSE Masashi, OBA Tomoru, KISHI Satoru, NOHARA Tsuyoshi and YAO Akira (1987): Discovery of Jurassic Radiolaria from acmite-rhodonite-bearing metachert of the Gosaisho metamorphic rocks in the Abukuma

terrane, northeastern Japan. *Jour. Geol. Soc. Japan*, 93(6):445-448, figs. 1-3, tab. 1.

286 **HIROTA Kiyoharu**, KOBAYASHI Iwao, SASAGAWA Ichiro, HORIKAWA Hideo and KAMEI Tadao (1987): On a skull bone of *Allodesmus* (Mammalia:Carnivora) found on Sado Islands, central Japan. *Pub. Sado Mus.*, (9):197-209, pls. 1-2, figs. 1-7. (佐渡島で発見されたアロデスムス*Allodesmus* (哺乳綱食肉目)の頭骨化石について) (J.E.)

287 **HISADA Ken-ichiro**, KAMIKAWA Yoichi, KISHIDA Yojiro and YAMAGIWA Nobuo (1988): Geological ages of limestone, chert and shale of the northern belt of the Chichibu terrain in the western Kanto Mountains, central Japan. *Mem. Osaka Kyoiku Univ., Ser. 3*, 37(2):183-193, pl. 1, figs. 1-3, tabs. 1-3. (関東山地西部の秩父帯北帯の石灰岩・チャート・頁岩の堆積年代) (J.E.)

288 HISADA Ken-ichiro and KISHIDA Yojiro (1986): The Hamadaira Group in the western Kanto Mountains, central Japan -The developmental processes of the Jurassic-Lower Cretaceous accretionary prism-. *Jour. Geol. Soc. Japan*, 92(8):569-590, figs. 1-9, tab. 1, Appends. 1-7. (関東山地西部の浜平層群－ジュラ系－下部白亜系付加体の発達過程) (J.E.)

289 HISADA Ken-ichiro and KISHIDA Yojiro (1987): Earliest Jurassic radiolarian assemblage obtained from the Hebiki Formation of the northern Chichibu Belt in the Kanto Mountains, central Japan. *Jour. Geol. Soc. Japan*, 93 (7):521-523, pl. 1, figs. 1-2, tab. 1. (関東山地秩父帯北帯の蛇木層からジュラ紀最前期の放散虫化石群集の産出) (J.E.)

290 HISADA Ken-ichiro, KISHIDA Yojiro and SASHIDA Katsuo (1986): Upper Jurassic chert of the Hashidate Group in the Kanto Mountains, central Japan. *Mem. Osaka Kyoiku Univ., Ser. 3*, 35(1):89-94, figs. 1-4. tab. 1.

291 HISADA Ken-ichiro, UENO Hikaru and KISHIDA Yojiro (1986): Occurrence of Cretaceous radiolarians from the Kobotoke Group, Kanto Mountains, central Japan. *NOM, Spec. Vol.*, (7):255-258, figs. 1-3. (関東山地小仏層群より白亜紀放散虫化石の産出) (J.E.)

292 **HOMMA Takeshi** (1986): Miocene Series along the middle part of the River Ara -kawa, in the northeastern marginal area of the Kanto Mountains, central Japan (Part 2)-Sedimentary facies and stratigraphy of the Tsuchishio Formation-. *Bull. Saitama Mus., Nat. Hist.*, (4):49-72, pls. 1-3, figs. 1-6, tabs. 1-3. (関東山地北東縁部荒川中流の中新統(その２)－土塩層の層相と層序－) (J.E.)

293 HOMMA Takeshi (1987): Miocene Series along the middle part of the River Ara -kawa in the northeastern marginal area of the Kanto Mountains, central Japan (Part 3)-Sedimentary facies and stratigraphy of the Yagii Formation -. *Bull. Saitama Mus., Nat. Hist.*, (5):23-48, pls. 1-3, figs. 1-8, tabs. 1-3. (関東山地北東縁部荒川中流の中新統(その３)－楊井層の層相と層序－) (J.E.)

294 **HONDA Yutaka** (1986): Paleogene molluscan assemblages of the Urahoro and Ombetsu Groups in the Kushiro Coal-field, eastern Hokkaido, Japan. *Monogr. Mizunami Fossil Mus.*, (6):199-206, figs. 1-2, tabs. 1-2. (釧路炭田古第三系貝類化石群集特性) (J.)

295 HONDA Yutaka (1986): A Paleogene molluscan fauna from Hokkaido, northern Japan. *Trans. Proc. Palaeont. Soc. Japan, Spec. Pap.*, (29):1-16, pls. 1-2, fig. 1, tabs. 1-4.

296 HONDA Yutaka (1988): Molluscan fossils from the Atsunai Group, Kushiro coal field, eastern Hokkaido, northern Japan. *Saito Ho-on Kai, Spec. Pub. (Prof. T. Kotaka Commem. Vol.)*, (2):351-363, pls. 1-4, figs. 1-5, tabs. 1-2.

297 HONDA Yutaka (1989): Paleogene molluscan faunas from the Kushiro coal field, eastern Hokkaido. *Sci. Rep., Tohoku Univ., 2nd Ser.* 60(1):1-137, pls. 1-10, figs. 1-14, tabs. 1-21.

298 **HORI Rie** (1986): *Parahsuum simplum* Assemblage (early Jurassic radiolarian assemblage) in the Inuyama area, central Japan. *NOM, Spec. Vol.*, (7):45-52, figs. 1-6. (美濃帯犬山地域の*Parahsuum simplum* 群集について) (J.E.)

299 HORI Rie (1988): Some characteristic radiolarians from Lower Jurassic bedded cherts of the Inuyama area, southwest Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (151):543-563, figs. 1-9, tabs. 1-3.

300 HORI Rie (1990): Lower Jurassic radiolarian zones of southwest Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (159):562-586, figs. 1-9, tab. 1.

301 HORI Rie and OTSUKA Tsutomu (1989): Early Jurassic radiolarians from the Mt. Norikuradake area, Mino terrane, central Japan. *Jour. Geosci., Osaka City Univ.*, 32:175-199, pls. 1-4, figs. 1-4, tabs. 1-4.

302 HORI Rie and YAO Akira (1988): *Parahsuum* (Radiolaria) from the Lower Jurassic of the Inuyama area, central Japan. *Jour. Geosci., Osaka City Univ.*, 31:47-61, pls. 1-2, figs. 1-2, tabs. 1-3.

303 **HORIBO Kenji** (1990): Petrography and depositional environment of Permian limestone of Mino terrane, Gujo-Hachiman, Gifu Prefecture, central Japan. *Jour. Geol. Soc. Japan*, 96(6):437-451, pls. 1-4, figs. 1-8, tab. 1. (岐阜県郡上八幡の美濃帯ペルム系石灰岩の岩相・生相と堆積環境) (J.E.)

304 **HORIKAWA Hideo**, CHUMAN Norichika, KOBAYASHI Shoji and KANNO Takami (1987): Pliocene cetacean fossil from the Pacific coast of Fukushima Prefecture, northeast Japan. *Sci. Rep., Fac. Educ., Fukushima Univ.*, (39):31-36, figs. 1-4, tab. 1. (福島県相馬郡小高町鮮新統産ヒゲ鯨化石について) (J.E.)

305 **HORIKOSHI Ei**, TAZAWA Jun-ichi, NAITO Naoji and KANEDA Junko (1987): Permian brachiopods from Moribu, north of Takayama City, Hida. *Jour. Geol. Soc. Japan*, 93(2):141-143, figs. 1-3. (飛騨山地高山市北方森部のペルム紀腕足類化石) (J.)

306 **HORIKOSHI Masuoki**, OHTA Suguru, TSUCHIDA Eiji, MINEGISHI Mineo, NAKAMURA Koichiro, MIURA Tomoyuki, YAMAMOTO Ryuta, FUJITA Toshihiko, TAKEDA Masatsune, KUBODERA Tsunemi, GAMO Sigeo, NODA Hiroshi, MACHIDA Yoshihiko, HAYASHI Isao, KASTORO Widiarsih and ORDONEZ, Jose A. (1986): Collection of macrobenthos and megabenthos by beam trawls and tentative lists of the trawl catch. *Preliminary Rep. Hakuho Maru Cruise KH-85-1, Flores Sea. Ocean Res. Inst., Univ. Tokyo,* 17-42, tabs. 10-15.

307 **HORIUCHI Junji** and KIMURA Tatsuaki (1986): *Ginkgo tzagajanica* Samylina from the Palaeogene Noda Group, northeast Japan, with special reference to its external morphology and cuticular features. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (142):341-353, pls. 65-68, figs. 1-8.

308 HORIUCHI Junji and KIMURA Tatsuaki (1987): *Dioonopsis nipponica* gen. et sp. nov., a new cycad from the Palaeogene of Japan. *Rev. Palaeobot. & Palynol.*, 51:213-225, pls. 1-4, figs. 1-4.

309 **HOSHINO Fusa** and MATSUZAWA Itsumi (1987): Paleoenvironment when *Mammuthus primigenius* lived in Hokkaido, Japan -The coldest stage during Wurum-. Prof. M. Matsui Mem. Vol., Sapporo, 79-89, figs. 1-6. (マンモスゾウ生息時の古環境－特に最終氷期最寒冷期について－) (J.)

310 **HOYANAGI Koichi**, ISHII Jiro, MAEDA Toshitsuge, NEMOTO Naoki and SAGAYAMA Tsumoru (1989): Sedimentary rate and paleoenvironment of the central part of the Ishikari basin -Estimation based on preliminary analyses of a piston core, obtained through the R/V "Bosei Maru II" cruise-. *Bull. Hokkaido Tokai Univ.*, (2):1-9, figs. 1-3, tabs. 1-2, photos. 1-4. (石狩海盆中央部における堆積速度と堆積環境(予報)－1988年望世丸II世のピストンコアによる推定－) (J.)

311 **HUANG Chi-yue**, MASUDA Koichiro and WU Len-chyun (1990): Miocene pelecypods in the western foothills of northern Taiwan. Part 1: Stratigraphy, faunal occurrences and paleocenographic significances. *Bull. Natn. Mus. Nat. Sci.*, (2):119-139, figs. 1-14, tabs. 1-7.

I

312 **IBARAKI Masako** (1986): Neogene planktonic foraminiferal biostratigraphy of the Kakegawa area on the Pacific coast of central Japan. *Rep. Fac. Sci., Shizuoka Univ.*, 20:39-173, pls. 1-13.

313 IBARAKI Masako (1986): [Neogene events from the viewpoint of planktonic Foraminifera]. *Mar. Sci. Month.*, 18(3):154-161, figs. 1-4. (浮遊性有孔虫からみた新第三紀のイベント) (J.)

314 IBARAKI Masako (1986): Planktonic foraminiferal datum levels recognized in the Neogene sequence of the Kakegawa area, and their relationship with the lithostratigraphy. *Jour. Geol. Soc. Japan*, 92(2):119-134, figs. 1-9. (掛川地域新第三系の浮遊性有孔虫生層序基準面とその岩相層序との関係) (J. E.)

315 IBARAKI Masako (1987): Planktonic foraminiferal event stratigraphy of the Neogene Kakegawa basin on the Pacific coast of central Japan. 4th RCPNS Congress, Barkely, 1987, Abst., 48-49.

316 IBARAKI Masako (1987): Neogene events in Japan viewed from planktonic Foraminifera. In R. Tsuchi (ed.): Pacific Neogene event studies, IGCP-246. Shizuoka, 36-38.

317 IBARAKI Masako (1988): *Lepidocyclina* from the Izu Peninsula and its implications in the northward drift of the area. In M. Ibaraki (ed.): Guidebook for excursion, Izu Peninsula and its collision with the mainland of Japan. Shizuoka, 7-17, pls. 1-2.

318 IBARAKI Masako (1989): Geologic age of Neogene biosiliceous sediments on the Pacific coast of Peru and Chile based upon planktonic Foraminifera. Pacific Science Association 6 Inter Congress, Abst., 207.

319 IBARAKI Masako (1989): Early Pleistocene marine climatic events in Japan based upon planktonic Foraminifera. Proceeding of International Symposium on Pacific Neogene continental and marine events. Nanjing Univ., Press, Nanjing, 27-31.

320 IBARAKI Masako (1989): Geologic ages of the Neogene sequences of the south Fossa Magna based on planktonic Foraminifera. *Rep. Fac. Sci., Shizuoka Univ.*, 23:85-99, pls. 1-2.

321 IBARAKI Masako (1990): Neogene planktonic Foraminifera and events in Japan. *Palaeogeogr. Palaeoclimat. Palaeoecol.*, 77:335-343, figs. 1-3.

322 Iburi Collaborative Research Group (1987): ^{14}C ages of pyroclastic deposits from Kuttara Volcano and two petrified forest buried in two stratigraphic horizons, southwestern Hokkaido. *Earth Sci.*, 41(3):188-193, figs. 1-2. (クッタラ火山の火砕堆積物の ^{14}C年代と２つの層準の化石林) (J.)

323 ICHIKAWA Koichiro (1986): Mesozoic radiolarian terranes (MRT) of southwest Japan. *NOM. Spec. Vol.*, (7):315-325. (西南日本の中生代放散虫地帯) (J. E.)

324 ICHINOSEKI Tetsuro and SAWARA Norihiko (1986): [Foraminifera from turbidites -A case of the Teradomari Formation at its type locality]. *Jour. Japan. Assoc. Petrol. Tech.*, 51(4):339-340. (タービダイト堆積物の有孔虫化石群集－模式地寺泊層の例－) (J.)

325 IGARASHI Yaeko (1990): Fossils from the Ishikari lowland (Pollen and spore 1-2). *Atlas Japan. Foss.*, (62):367-368. (石狩低地帯の化石 (花粉・胞子 1-2)) (J.)

326 IGARASHI Yaeko, MIYATA Yuichiro, NOI Hideaki and YAMADA Osamu (1990): Fossil pollen and spore assemblages of the last glacial age from the eastern part of the Konsen plateau, eastern Hokkaido. *Quat. Res., Japan.*, 29(2): 131-138, figs. 1-6. (北海道根釧台地東縁部から得られた最終氷期の花粉化石群) (J.E.)

327 IGARASHI Yaeko, TONOSAKI Tokuji and YOSHIDA Mitsuo (1988): Pollen stratigraphy of the Honbetsu and Ashoro Formations, Tokachi Group. *Earth Sci.*, 42(5):277-289, figs. 1-10, tabs. 1-3. (十勝層群本別・足寄層の花粉化石層序) (J.E.)

328 IGO Hisaharu (1988): Mixed conodont elements from Hachiman Town, Mino terrane, central Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (156): 270-285, figs. 1-7.

329 IGO Hisaharu and HISADA Ken-ichiro (1986): Lower Permian conodonts from the Kawanori Formation of the southwestern Kanto Mountains, Tokyo. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (144):516-527, pls. 96-98, fig. 1.

330 IGO Hisayoshi (1988): Permian rugose coral from Kamikagemori, Chichibu City, Saitama Prefecture, central Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (152):656-658, figs. 1-2.

331 IGO Hisayoshi (1989): Fusulinaceans as an indicator of paleobiogeography. In Y. Takayanagi (ed.): Foraminifers for the Japanese Islands, 1-9. (古生物地理区の指標としての紡錘虫) (J.)

332 IGO Hisayoshi, IGO Hisaharu and ADACHI Shuko (1988): Permian Sphinctozoan sponges from the Ichinotani Formation, Hida massif, central Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (150):453-464, figs. 1-7.

333 IGO Hisayoshi, NAGANO Norihiro and NAKINBODEE Veerasak (1988): Middle Triassic conodonts from southern Thailand (Preliminary report). *Ann. Rep., Inst. Geosci., Univ. Tsukuba*, (14):46-50, figs. 1-3.

334 IGO Hisayoshi, SASHIDA Katsuo and ADACHI Shuko (1989): Permian foraminifers from Menashidomari, Esashi Mountains, northern Hokkaido. *Ann. Rep., Inst. Geosci., Univ. Tsukuba*, (15):43-48, figs. 1-3.

335 IGO Hisayoshi, SASHIDA Katsuo, HISADA Ken-ichiro and IGO Hisaharu (1989): Carboniferous and Permian Chichibu System, reconsidered. 11e Congres International de Stratigraphie et de Geologie du Carbonifere, Beijing 1987, Compte Rendu, Beijing, 2:58-63, fig. 1.

336 IGO Hisayoshi, SASHIDA Katsuo and UENO Hikaru (1987): Early Cretaceous radiolarians from the Esashi Mountains, northern Hokkaido. *Ann. Rep., Inst. Geosci., Univ. Tsukuba*, (13):105-109, figs. 1-2.

337 **IIJIMA Azuma**, TADA Ryuji and WATANABE Yoshio (1988): Developments of Neogene sedimentary basins in the northeastern Honshu arc with emphasis on Miocene siliceous deposits. *Jour. Fac. Sci., Univ. Tokyo, Sec. 2*, 21(5): 417-446. figs. 1-6, tabs. 1-2.

338 **IIJIMA Haruo**, SEKINE Kazuaki and HASEGAWA Hatsuo (1990): Geology of the north subbelt of the Chichibu Belt in the Hinozawa area, northeast Kanto Mountains. *Bull. Natn. Sci. Mus., Ser. C*, 16(1):1-14, figs. 1-10. tab. 1. (関東山地北東部日野沢地域の秩父帯北帯の地質) (J.E.)

339 **IKEYA Noriyuki** (1989): [Ostracodes -Fruit-flies in submarine environments-]. Kagaku, 59(11):728-736, figs 1-7. (オストラコーダ-水域のショウジョウバエ-) (J.)

340 IKEYA Noriyuki and COMPTON-GOODING E. E. (1987): On *Howeina camptocyrtheroidea* Hanai. *Stereo-Atlas Ostracod Shells*, 14(1):33-36.

341 IKEYA Noriyuki and HAMADA Takashi (1990): On *Robstaurila ishizakii* (Okubo). *Stereo-Atlas Ostracod Shells*, 17(27):137-144.

342 IKEYA Noriyuki and HINO N. (1990): On *Robustaurila salebrosa* (Brady). *Stereo-Atlas , Ostracod Shells*, 17(25):121-128.

343 IKEYA Noriyuki, OHISHI Masao and UEDA Hitoshi (1986): Seasonal distribution pattern of benthonic ostracod faunas of a station in Hamana-ko Bay, Pacific coast of central Japan. *Rep. Fac. Sci., Shizuoka Univ.*, 20:189-204.

344 IKEYA Noriyuki and TSUKAGOSHI Akira (1988): The interspecific relations between three close species of the Genus *Cythere* O. F. Muller, 1785. In T. Hanai et al. (eds.): Evolutionary biology of Ostracoda, its fundamentals and applications. Kodansha/Elsevier, Tokyo/Amsterdam, 891-917, pls. 1-3, figs. 1-11.

345 IKEYA Noriyuki and UEDA Hitoshi (1988): Morphological variation of *Cytheromorpha acupunctata* (Brady) in continuous population at Hamana-ko Bay, Japan. In T. Hanai et al. (eds.): Evolutionary biology of Ostracoda, its fundamentals and applications. Kodansha/Elsevier, Tokyo/Amsterdam, 319-340, pls. 1-3, figs. 1-9, tabs. 1-3.

346 IKEYA Noriyuki, WADA Hideki, AKUTSU Hiroshi and TAKAHASHI Minoru (1990): Origin and sedimentary history of Hamana-ko Bay, Pacific Coast of central Japan. *Mem. Geol. Soc. Japan*, (36):129-150, figs. 1-13. (浜名湖の起源と地史的変遷) (J.E.)

347 **IKUJI Yukio** (1986): Benthic foraminiferal assemblage in turbidite deposits of the Shiiya and Nishiyama stages in the Niigata oil-field. In Y. Matoba and M. Kato (eds.): Studies on Cenozoic Benthic Foraminifera in Japan, Akita Univ., Akita, 119-134, pls. 1-2, figs. 1-4, tabs. 1-3. (新潟油田椎

谷・西山期の乱泥流相に含まれる底生有孔虫化石群集) (J.E.)

348 IKUJI Yukio (1986): Paleoenvironmental analysis by means of benthic foraminiferal data from the Kitakanbara area, Niigata Prefecture. *Mar. Sci. Month.*, 18(9):599-605, figs. 1-6, tabs. 1-2. (新潟油田北蒲原地域の底生有孔虫化石データによる古環境解析) (J.E.)

349 INA Haruyuki (1988): Plants from the Miocene Tomikusa Group in the southern part of Nagano Prefecture, Japan. *Bull. Mizunami Fossil Mus.*, (14):31-72, pls. 3-13, fig. 1, tabs. 1-9.

350 INA Haruyuki (1990): Miocene floras in eastern part of the Setouchi district and climatic conditions indicated by the flora. *Monogr. Mizunami Fossil Mus.*, (7):1-11, figs. 1-6. (瀬戸内区東部の中新世植物群と気候) (J.)

351 INAWASHIRO Osamu (1987): Fossil of Otarioidea from the Tatsunokuchi Formation (Lower Pliocene) of Sendai City, Miyagi Prefecture. *Earth Sci.*, 41 (4):242-243, pl. 1, fig. 1. (宮城県仙台市の竜の口層(下部鮮新統)より産出したアシカ上科動物化石について) (J.)

352 INOUE Yoko (1986): Foraminiferal assemblages from the surface deposits of Suruga Bay. *Mar. Sci. Month.*, 18(9):564-569, figs. 1-2, tab. 1. (駿河湾堆積物中の有孔虫群集) (J.E.)

353 INOUE Yoko (1989): Foraminiferal fauna in cores from the Sado basin. In Y. Takayanagi and K. Ishizaki (eds.): Collected papers on Foraminifera from the Japanese Islands. Toko Print., Pub. Dept., Sendai, 117-129, pls. 1-2, figs. 1-2, tabs. 1-5. (佐渡海盆のコア中の有孔虫群集) (J.E.)

354 INOUE Yoko (1989): Northwest Pacific Foraminifera as paleoenvironmental indicators. *Sci. Rep., Inst. Geosci., Univ. Tsukuba, Sec. B*, 10:57-162, pls. 18-33, figs. 1-24, tabs. 1-20.

355 INUZUKA Norihisa (1987): Primitive desmostylians, *Behemotops* and the evolutionary pattern of the Order Desmostylia. Prof. M. Matsui Mem. Vol., Sapporo, 13-25, pls. 1-2, figs. 1-9, tabs. 1-4. (原始的束柱目ベヘモトプスと束柱目の進化パターン) (J.)

356 INUZUKA Norihisa (1987): Some controversial points of cladistics. *Jour. Foss. Res.*, 19:45-47. (分岐分類学とその問題点) (J.)

357 INUZUKA Norihisa (1988): [Restoration of the extinct mammal, *Desmostylus*]. *Biomechanism*, (9):7-19, figs. 1-19, tabs. 1-2. (絶滅哺乳類デスモスチルスの復元) (J.)

358 INUZUKA Norihisa (1988): The skeleton of *Desmostylus* from Utanobori, Hokkaido, 1. Cranium. *Bull. Geol. Surv. Japan*, 39(3):139-190, pls. 1-8, figs. 1-17, tabs. 1-6. (北海道歌登町産*Desmostylus*の骨格 1 頭蓋) (J.)

359 INUZUKA Norihisa (1989): [Restoration of *Paleoparadoxia* from Tsuyama]. *Bull. Tsuyama Local Mus.*, (1):24-25, fig. 16. (津山産パレオパラドキシアの復元) (J.)

360 INUZUKA Norihisa (1989): Reconsideration of tooth class identification in *Desmostylus*, with special reference to the holotype of *D. japonicus* (Togari specimen). *Jour. Geol. Soc. Japan*, 95(1):17-31, figs. 1-14, tab. 1. (*Desmostylus* 臼歯の歯種固定の再検討－*D. japonicus* の模式標本 (戸狩標本) を中心として－) (J.)

361 INUZUKA Norihisa (1989): [*Desmostylus* and *Behemotops*]. In Ashoro-town Board of Education (ed.): Reports of research on Ashoro mammalian fauna, 40-76, figs. 1-52, tabs. 1-2. (デスモスチルスとベヘモトプス) (J.)

362 INUZUKA Norihisa (1989): A construction of recapitulation theory in the proboscidean skull. *Jour. Foss. Res.*, 21:40-45, figs. 1-3. (反復説の一理解－長鼻類の頭蓋を例として－) (J.)

363 INUZUKA Norihisa (1990): Drawing fossils with parallel line method. *Jour. Foss. Res.*, 23:24-25, figs. 1-4. (Parallel line methodによる化石の描法) (J.)

364 INUZUKA Norihisa and KARASAWA Hiroaki (1986): Some fossils of *Paleoparadoxia* from Miocene calcareous sandstones on the Noto Peninsula, central Japan. *Earth Sci.*, 40(4):294-300, figs. 1-7. (能登半島の中新統石灰質砂岩層産のパレオパラドキシア) (J.)

365 **IRIZUKI Toshiaki** (1989): Fossil ostracode assemblages from the Pliocene Sasaoka Formation, Akita City, Japan -With reference to sedimentological aspects-. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (156):296-318, figs. 1-15, tab. 1.

366 IRIZUKI Toshiaki, TAKAHASHI Masaki, TANAKA Yuichiro and ODA Motoyoshi (1990): Geology and age of the Neogene sedimentary rocks in the Itsukaichi basin, central Japan. *Jour. Geol. Soc. Japan.*, 96(9):759-770, pl. 1, figs. 1-6, tabs. 1-3. (五日市盆地新第三系の地質と年代) (J.E.)

367 **IRYU Yasufumi** and MATSUDA Shinya (1987): [Distribution of nonarticulated coralline algae in the reef environment of the Ryukyu Islands]. *Mar. Sci. Month.*, 19:524-529, figs. 1-7. (琉球列島のサンゴ礁における無節サンゴモの分布) (J.)

368 IRYU Yasufumi and MATSUDA Shinya (1988): Depth distribution, abundance and species assemblages of nonarticulated coralline algae in the Ryukyu Islands, southwestern Japan. Proc. 6th Int. Coral Reef Symp., Townsville, 3:101-106, figs. 1-7, append. 1.

369 IRYU Yasufumi and SUZUKI Atsushi (1990): Depositional environment of *Halimeda* Limestone of the Ryukyu Group on Yonaguni-jima. *Fossils, Palaeont. Soc. Japan*, 49:13-22, figs. 1-6, tab. 1. (与那国島の琉球層群にみられる *Halimeda* 石灰岩の堆積環境) (J.E.)

370 **ISHIBASHI Takeshi** (1986): Fusulines from the Ryukyu Islands-Part 3, Iheya-jima 2, Tonaki-jima and Okinawa-jima (Paleontological study of the Ryukyu Islands-10). *Mem. Fac. Sci., Kyushu Univ., Ser. D*, 26(1):95-123, pls. 13-22, fig. 1.

371 ISHIBASHI Takeshi and CHONGLAKMANI Chongpan (1990): Uppermost Permian ammonoids from northern Thailand. *Jour. Southeast Asian Earth Sci.*, 4(3):163-170, figs. 1-5.

372 ISHIBASHI Takeshi, HASHIMOTO Kyoichi, NOHARA Masanori and YOSHIDA Koichi (1990): [Triassic ammonites newly discovered in the western district of Yamaguchi Prefecture, Japan]. *Jour. Geol. Soc. Japan*, 96(9):771-774, figs. 1-3. (山口県西部地域の三畳系より初めて発見されたアンモナイト化石) (J.)

373 ISHIBASHI Takeshi and NAKAZAWA Keiji (1989): Triassic ammonites from West Spitsbergen. *Mem. Fac. Sci., Kyushu Uiv., Ser. D*, 26(3):215-241, pls. 35-40, figs. 1-6, tabs. 1-3.

374 **ISHIDA Hidemi** (1986): [Geological survey in the northern part of Kenya and new hominoid fossil]. *Kagaku*, 56(4):220-226, figs. 1-5, tabs. 1-2. (北ケニアの調査と新しいホミノイド化石) (J.)

375 **ISHIDA Keisuke** (1986): Discovery of Jurassic radiolarians from the "Sambo-san Group" at Hitsuzan, Kochi City, Shikoku and its significance. *Jour. Geol. Soc. Japan*, 92(2):159-161, pl. 1, figs. 1-2, tab. 1. (高知県筆山のいわゆる三宝山層群よりジュラ紀放散虫の発見とその意義) (J.)

376 ISHIDA Keisuke (1986): Geology and radiolarian ages of the Mesozoic formations in the South Zone of the Chichibu Belt in eastern Shikoku. *NOM, Spec. Vol.*, (7):235-243, figs. 1-3, tabs. 1-6. (四国東部秩父累帯南帯中生界の地質と放散虫年代) (J.E.)

377 ISHIDA Keisuke (1987): Geology and microbiostratigraphy of the southern Chichibu terrane in eastern Shikoku, southwest Japan. *Jour. Sci., Univ. Tokushima*, 20:47-121, pl. 1, figs. 1-29, tabs. 1-11. (四国東部秩父累帯南帯の地質学的・微化石年代学的研究) (J.E.)

378 ISHIDA Keisuke (1989): Analysis of mesoscopic deformation structures in melange with special respect to the stages of syn- and post-sedimentation -A case study in the southern Chichibu terrane in eastern Shikoku, southwest Japan-. *Struct. Geol.*, (34):95-109, figs. 1-5, tabs. 1-2. (メランジュの堆積時および後堆積時の中視的変形構造に関する一解析－四国東部秩父累帯南帯の例－) (J.E.)

379 **ISHIDA Yoshiaki** (1988): On the fossil ophiuroids from the Miocene in the environs of Chita Peninsula, Aichi Prefecture, Japan (No. 1). *Kaseki no Tomo*, (33):4-27. (知多半島の中新統より産出したクモヒトデ化石(その１)) (J.)

380 **ISHIGA Hiroaki** (1986): Ultra-Tamba Zone of southwest Japan. *Jour. Geosci., Osaka City Univ.*, 29:45-88, figs. 1-16, tab. 1.

381 ISHIGA Hiroaki (1986): Late Carboniferous and Permian radiolarian biostratigraphy of southwest Japan. *Jour. Geosci., Osaka City Univ.*, 29:89-100, fig. 1.

382 ISHIGA Hiroaki (1986): Late Carboniferous-Permian radiolarian biostratigraphy in Japan with special reference to distribution and phyletic lineage of *Follicucullus* in late Permian time. *NOM, Spec. Vol.*, (7):1-8, figs. 1-6. (日本の石炭紀新世－ペルム紀放散虫化石層序，とくにペルム紀新世の *Follicucullus* 属放散虫の分布と系統について) (J.E.)

383 ISHIGA Hiroaki (1989): Paleozoic and Mesozoic radiolarian fossils from Japan 1 (Paleozoic 1-3). *Atlas, Japan. Foss.*, (66):391-393. (日本の古生代・中生代放散虫化石１ (古生代 1-3)) (J.)

384 ISHIGA Hiroaki, LEITCH Evan C., NAKA Takahito, WATANABE Teruo and IWASAKI Masao (1987): Late Devonian Palaeoscenidiidae from the Hasting Block, New England fold belt, N. S. W., Australia. *Earth Sci.*, 41(6):297-302, pls. 1-2, figs. 1-3.

385 ISHIGA Hiroaki, MIYAMOTO Takami (1986): *Follicucullus* (Radiolaria) from Upper Permian Kuma Formation, Kyushu, southwest Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (141):322-335, pls. 63-64, figs. 1-4, tab. 1.

386 ISHIGA Hiroaki and SUZUKI Shigeyuki (1988): Late Paleozoic radiolarian assemblages from the Shimomidani Formation in Akiyoshi terrane, southwest Japan. *Jour. Geol. Soc. Japan*, 94(7):493-499, pl. 1, figs. 1-4.

387 ISHIGA Hiroaki, WATASE Hiromichi and NAKA Takahito (1986): Permian radiolarians from Nishiki Group in Sangun-Chugoku Belt, southwest Japan. *Earth Sci.*, 40(2):124-136, pls. 1-3, figs. 1-4. tab. 1.

388 ISHIGAKI Shinobu (1986): [Research on dinosaur foot prints -In case of Sauropoda foot prints in Morocco-]. *Earth Mon.*, 8(3):143-148, figs. 1-6. (恐竜足痕の研究－モロッコの竜脚類足痕の例－) (J.)

389 ISHIGAKI Takehisa (1988): [Fossil Foraminifera from the Kawaino Conglomerate of the Fujikawa Group, central Japan]. *Jour. Geol. Soc. Japan*, 94(3): 225-227, pl. 1. (富士川層群川合野礫岩からの有孔虫化石) (J.)

390 ISHII Atsushi and TAGUCHI Satoshi (1986): On the Lower Cretaceous Takaoka Formation in the eastern margin of Kanto Mountains. *Bull. Tokyo Gakugei Univ., Sec. 4*, 38:97-115. (関東山地東縁部, 下部白亜系高岡層) (J.E.)

391 ISHII Atsushi, TAKAHASHI Osamu and TAKAHASHI Naoko (1990): Geology of the Kawakami-Sudama area, western part of the Kanto Mountains, central Japan. *Bull. Tokyo Gakugei Univ., Sec. 4*, 42:171-181, pl. 1, figs. 1-4, tab. 1. (関東山地西部川上－須玉地域の地質) (J.E.)

392 ISHII Ken-ichi (1989): [Regional characters of the fusulinacean faunas in Japan]. *Yukochu Kenkyu* (=*Stud. Foraminifera*), (2):3-8, figs. 1-4. (日本のフズリナ群集の地域的特性について) (J.)

393 ISHIZAKI Kunihiro (1987): The crocodile *Tomistoma machikanense* and ostracodes from southwest Japan in the Middle Pleistocene. *Fossils, Palaeont. Soc. Japan*, (43):35-38, figs. 1-4. (中期更新世のマチカネワニと貝形虫) (J.)

394 ISHIZAKI Kunihiro (1990): Sea level change in mid-Pleistocene time and effects on Japanese ostracode faunas. *Bull. Mar. Sci.*, 47(1):213-220, figs. 1-2, tab. 1.

395 ISHIZAKI Kunihiro (1990): A setback for the genus *Sinocytheridea* in the Japanese mid-Pleistocene and its implications for a vicariance events. In R. Whatley and C. Maybury (eds.): Ostracoda and global events. Chapman and Hall, London, 139-152, pl. 1, figs. 1-5, tab. 1.

396 ISHIZAKI Kunihiro and IRIZUKI Toshiaki (1990): Distribution of bathyal ostracodes in sediments of Tayama Bay, central Japan. *Cour. Forschungsinst. Senckenb.*, 123:53-67, pl. 1, figs. 1-10, tab. 1.

397 ISHIZAKI Kunihiro and MORI Kei (1990): Bibliography of paleontology in Japan, 1981-1985. *Spec. Pap., Palaeont. Soc. Japan*, (31):1-143.

398 ISOZAKI Yukio (1986): The Shingai Formation in the northern Chichibu Belt, southwest Japan, and end-Permian convergent zone along the northern margin of the Kurosegawa landmass. *Jour. Geol. Soc. Japan*, 92(7):497-516, figs. 1-8, tab. 1. (秩父累帯北帯新改層とペルム紀末の黒瀬川地塊北縁収束域) (J.E.)

399 ISOZAKI Yukio (1987): End-Permian convergent zone along the northern margin of Kurosegawa landmass and its pruducts in central Shikoku, southwest Japan. *Jour. Geosci., Osaka City Univ.*, 30:51-131, figs. 1-32.

400 ISOZAKI Yukio, AMISCARAY Editha A. and RILLON Aristotle (1987): Permian, Triassic and Jurassic bedded radiolarian cherts in north Palawan Block, Philippines: Evidence of late Mesozoic subduction-accretion. *Jour. Geol. Soc. Philippines*, 31(1/4):79-93, pl. 1.

401 ISOZAKI Yukio and NISHIMURA Yujiro (1989): Fusaki Formation, Jurassic subduction-accretion complex on Ishigaki Island, southern Ryukyus and its geologic implication to late Mesozoic convergent margin of Asia. *Mem. Geol. Soc. Japan*, (33):259-275, pl. 1. (南琉球石垣島のジュラ紀付加コンプレックス富崎層と後期中生代のアジア東縁収束域) (J.E.)

402 ISOZAKI Yukio and TAMURA Hiroyuki (1989): Late Carboniferous and early Permian radiolarians from the Nagato Tectonic Zone and their implication to geologic structure of the Inner Zone, southwest Japan. *Mem. Geol. Soc. Japan*, (33):167-176, fig. 1. (長門構造帯産石炭紀新世・ペルム紀古世放散虫とその地質学的意義) (J.E.)

403 **ITIHARA Minoru**, YOSHIKAWA Shusaku, KAMEI Tadao and NASU Takayoshi (1988): Stratigraphic subdivision of Quaternary deposits in Kinki district, Japan. *Mem. Geol. Soc. Japan*, (30):111-125, figs. 1-4, tab. 1. (近畿地方の第四紀層の層序区分) (J.E.)

404 **ITOH Yasuto** and ITO Yoshihiko (1989): Confined ductile deformation in the Japan Arc inferred from paleomagnetic studies. *Tectonophysics*, 167(1):57-73, figs. 1-8, tabs. 1-4.

405 ITOH Yasuto and WATANABE Mahito (1988): Tectonic rotation of the Tomari area, easternmost part of Toyama Prefecture, inferred from paleomagnetic study. *Jour. Geol. Soc. Japan*, 94(6):457-460, figs. 1-5, tabs. 1-2. (古地磁気から推定した富山県東端部泊地域の回転運動) (J.)

406 **ITOIGAWA Junji** (1986): Temporal and spatial distributions of molluscan fauna in late Cenozoic of Japan. *Spec. Pap., Palaeont. Soc. Japan*, (29):48-54, figs. 1-3, tabs. 1-3.

407 ITOIGAWA Junji (1988): Quaternary System of the Kakegawa area, central Japan. *Mem. Geol. Soc. Japan*, (30):103-110, figs. 1-6, tab. 1. (掛川地域の第四紀層) (J.E.)

408 ITOIGAWA Junji (1988): The Miocene Kadonosawa Fauna of Japan. *Saito Ho-on Kai, Spec. Pub. (Prof. T. Kotaka Commem. Vol.)*, (3):397-403, figs. 1-2, tabs. 1-2.

409 ITOIGAWA Junji (1989): Paleoecological significance of the Miocene Mizunami Group, central Japan. *Benthos Res.*, (37):91-95, fig. 1, tab. 1. (瑞浪層群の古生態学的意義) (J.E.)

410 ITOIGAWA Junji (1990): Tempo-spatial distribution of marine molluscan fossil and their bioserial changes in Cenozoic Japan. *Monogr. Mizunami Fossil Mus.*, (7):83-99, figs. 1-6, tabs. 1-4. (海生軟体動物化石の時空分布と系統－日本の中新世を中心に－) (J.E.)

411 ITOIGAWA Junji, NISHIMOTO Hiroyuki and NOBUHARA Takami (1988): New localities of molluscan fossils of the Miocene Mizunami Group, central Japan. *Bull. Mizunami Fossil Mus.*, (15):57-64, pls. 7-8, tabs. 1-3. (瑞浪層群の貝化石の新産地) (J.)

412 ITOIGAWA Junji and SHIBATA Hiroshi (1986): Molluscan fauna of the Setouchi Miocene Series, southwest Japan. *Spec. Pap., Palaeont. Soc. Japan*, (29):149-160, pls. 16-17, fig. 1, tabs. 1-2.

413 ITOIGAWA Junji and TSUDA Karyu (1986): Paleoecological significance of tropical molluscan assemblages in Japanese Miocene, with special reference to mangrove swamp assemblages. *Monogr. Mizunami Fossil Mus.*, (6):171-182, figs. 1-4, tabs. 1-2. (中新世熱帯系貝類群集の古生態特性－特にマングロー

ブ沼群集について) (J.E.)

414 ITOIGAWA Junji and TSUDA Karyu (1986): [Paleoenvironment of Middle Miocene in Japan]. *Mar. Sci., Month.*, 18(3):136-139, figs. 1-4. (中新世中期の日本の古環境) (J.)

415 ITOIGAWA Junji and YAMANOI Tohru (1990): Climatic optimum in the mid-Neogene of the Japanese Island. Pacific Neogene Events. Univ. Tokyo Press, Tokyo, 3-14, figs. 1-8.

416 **IWAKI Takako** and MAEDA Haruyoshi (1989): Mudstone facies and the fossil molluscan assemblages of the Upper Cretaceous Izumi Group in the southeastern Awaji Island, southwest Japan. *Res. Rep., Kochi Univ., Nat. Sci.*, 38:187-201, pls. 1-6. (淡路島南東部和泉層群の泥岩相と化石動物群) (J.E.)

417 **Iwamura Research Group** (1989): New localities of *Vicarya* in the Iwamura basin, Gifu Prefecture, Japan. *Bull. Mizunami Fossil Mus*, (16):117-120, pl. 1, figs. 1-2, tab. 1. (岐阜県岩村盆地の*Vicarya* 新産地) (J.)

418 **IWASAKI Toshinori**, SASHIDA Katsuo and IGO Hisayoshi (1989): Mesozoic strata of the Kitaaiki-Kawakami area in Minamisaku County, Nagano Prefecture, northwest Kanto Mountains, central Japan. *Jour. Geol. Soc. Japan*, 95(10): 733-753, pl. 1, figs. 1-8, tabs. 1-3. (関東山地北西部, 長野県南佐久郡北相木－川上村の中生界) (J.E.)

419 **IWATA Keiji**, HARIYA Yu, CHOI Jai-ho, YAGI Eri and MIURA Takeshi (1990): Radiolarian age of the manganese deposits of the Tokoro Belt, northeast Hokkaido. *Jour. Fac. Sci., Hokkaido Univ., Ser. 4*, 22(4):565-576, pls. 1-2, figs. 1-9, tab. 1.

420 IWATA Keiji and KATO Yukihiro (1986): Upper Cretaceous radiolarians of the Yubetsu Group and Hidaka Supergroup in the northern Hidaka Belt. *NOM, Spec. Vol.*, (7):75-85, pls. 1-2. (湧別層群および日高帯北部の日高累層群の白亜紀後期放散虫化石群集) (J.E.)

421 IWATA Keiji and TAJIKA Jun (1986): Late Cretaceous radiolarians of the Yubetsu Group, Tokoro Belt, Northeast Hokkaido. *Jour. Fac. Sci., Hokkaido Univ., Ser. 4*, 21(4):619-644, pls. 1-9, figs. 1-3.

422 IWATA Keiji and TAJIKA Jun (1989): Jurassic and Cretaceous radiolarians from the pre-Tertiary System in the Hidaka Belt, Marusappu region, northeast Hokkaido. *Jour. Fac. Sci., Hokkaido Univ., Ser. 4*, 22(3):453-466, pls. 1-5, figs. 1-3.

423 **IWAUCHI Akiko** and HASE Yoshitaka (1986): Fossil diatom assemblages of the Asono Formation (Middle Pleistocene), Oita Prefecture. *Quat. Res., Japan*, 24:283-293, pl. 1, figs. 1-7, tab. 1. (大分県阿蘇野層 (中期更新世) の珪藻化石群集) (J.)

424 IWAUCHI Akiko and HASE Yoshitaka (1986): Late Cenozoic vegetation and paleoenvironment of northern and central Kyushu, Japan -Part 2, Ajimu-Innai area (Upper Pilocene)-. *Jour. Geol. Soc. Japan*, 92(8):591-598, pl. 1, figs. 1-4, tabs. 1-2. (中・北部九州後期新生代の植生と古環境－その２, 安心院－院内地域 (上部鮮新統)－) (J.)

425 IWAUCHI Akiko and HASE Yoshitaka (1987): Late Cenozoic vegetation and paleoenvironment of northern and central Kyushu, Japan -Part 3, Southern part of Kusu basin (Lower and Middle Pleistocene)-. *Jour. Geol. Soc. Japan.*, 93(7):469-489, figs. 1-14, tabs. 1-2. (中・北部九州後期新生代の

植生と古環境－その３，玖珠盆地南部(下部・中部更新統)－) (J.)

426 IWAUCHI Akiko and HASE Yoshitaka (1989): Late Cenozoic vegetation and paleoenvironment of northern and central Kyushu, Japan -Part 4, Oyama-Tsuetate area (Lower Pleistocene)-. *Jour. Geol. Soc. Japan*, 95(1):63-75, figs. 1-7, tabs. 1-3. (中・北部九州後期新生代の植生と古環境－その４，大山・杖立地域(下部更新統)－) (J.)

427 IWAUCHI Akiko and HASE Yoshitaka (1989): Pollen analysis of Tsumori Formation (Pleistocene) in Mashiki-machi, Kumamoto Prefecture. *Mem. Fac. Educ., Kumamoto Univ., Nat. Sci.*, (24):103-110, pl. 1, figs. 1-4, tab. 1. (熊本県上益城郡益城町津森層の花粉分析) (J.)

J

428 **JIMBO Yukinori** (1988): Molluscan fossils of the Naganuma Formation, Yokohama City. *Nat. Hist. Rep., Kanagawa Pref. Mus.*, (9):83-94, pls. 1-5, figs. 1-2, tab. 1. (長沼層の貝化石について) (J.)

429 **JUNG Kyu-kui** (1988): Morphology and taxonomy of late Cenozoic uvigerine Foraminifera from Japan. *Sci. Rep., Tohoku Univ., 2nd Ser.*, 59(2):99-175, pls. 25-49, figs. 1-45.

430 JUNG Kyu-kui (1989): A brief note on morphology and taxonomy of late Cenozoic uvigerine Foraminifera from Japan. In Y. Takayanagi and K. Ishizaki (eds.): Collected papers on Foraminifera from the Japanese Islands. Toko Print., Publ. Dept., Sendai, 151-154. (日本産後期新生代uvigerine有孔虫の形態と分類概要) (J.)

K

431 **KADOTA Masato**, SUEKANE Tetsuo and KANIE Yasumitsu (1988): Miocene reef corals from the Miura Peninsula, south-central Japan. *Sci. Rep., Yokosuka City Mus.*, (36):11-18, pls. 1-2, figs. 1-2, tab. 1. (三浦半島中新世礁性サンゴ化石) (J.E.)

432 **KADOTA Osao** and TOKUNAGA Shigemoto (1987): On the pollen fossils from the Cretaceous System in the Sanchu Graben and from the related areas. *Jour. Coll. Arts & Sci., Chiba Univ., B*, 20:37-43, pl. 1, figs. 1-3, tabs. 1-3. (山中地溝帯白亜系と関連地域産の花粉化石について) (J.E.)

433 **KAFANOV Alexander I.** (1986): Comparison of the geographical and stratigraphical ranges of Fortipectininae and Patinopectininae (Bivalvia: Pectinidae). *Monogr. Mizunami Fossil Mus.*, (6):23-40, figs. 1-8.

434 **KAIHO Kunio** (1986): [Faunal changes of the latest Cretaceous -Paleogene Benthic Foraminifera: Middle Eocene event]. *Mar. Sci., Month.*, 18(9):607-611, figs. 1-5. (白亜紀末紀－古第三紀の底生有孔虫群の変遷－中期始新世のイベント－) (J.)

435 KAIHO Kunio (1986): *Haplophragmoides apertiumbilicatus*, new name for *Haplophragmoides umbilicatus* Kaiho, 1984 (preoccupied). *Sci. Rep., Tohoku Univ., 2nd Ser.*, 56(1):41.

436 KAIHO Kunio (1988): Uppermost Cretaceous to Paleogene bathyal benthic foraminiferal biostratigraphy of Japan and New Zealand: Latest Paleocene-Mid-

dle Eocene benthic foraminiferal species turnover. *Rev. Paleobiol., Spec. Vol.*, (2):553-559, figs. 1-4.

437 KAIHO Kunio (1988): [Evolution of Cenozoic bathyal and abyssal benthic foraminiferal faunas and paleoceanographic causes]. *Yukochu Kenkyu* (=*Stud. Foraminifera*), (1):16-18, figs. 1-2. (新生代半深海－深海底生有孔虫フォーナの進化とその海洋的要因) (J.)

438 KAIHO Kunio (1989): Eocene benthic foraminiferal paleobiogeography and paleoceanographic circulation in intermediate waters. In Y. Takayanagi and K. Ishizaki (eds.): Collected papers on Foraminifera from the Japanese Islands. Toko Print., Pub. Dept., Sendai, 41-48, figs. 1-6, tabs. 1-4. (中層水域における始新世底生有孔虫フォーナの古生物地理と古海洋循環) (J. E.)

439 KAIHO Kunio (1989): [New discoveries of the Cretaceous/Tertiary boundary in Hokkaido]. *Yukochu Kenkyu* (=*Stud. Foraminifera*), (2):41-42, fig. 1. (白亜紀／第三紀境界に関する２つの発見) (J.)

440 KAIHO Kunio (1989): Morphotype changes of deep-sea Foraminifera during the Cenozoic Era and their paleoenvironmental implications. *Fossils, Palaeont. Soc. Japan*, (47):1-23, figs. 1-13, tabs. 1-4. (新生代における深海底生有孔虫の殻形態の変遷と古環境的意義) (J. E.)

441 KAIHO Kunio and HASEGAWA Shiro (1986): Bathymetric distribution of Benthic Foraminifera in the bottom sediments off Onahama, Fukushima Prefecture, northeast Japan. In Y. Matoba and M. Kato (eds.): Studies on Cenozoic Benthic Foraminifera in Japan, Akita Univ., Akita, 43-52, figs. 1-10. (福島県小名浜沖底質堆積物中の底生有孔虫の深度分布) (J.)

442 KAIHO Kunio and NISHI Hirotsugu (1989): Eocene and Oligocene Benthic Foraminifera of the Hyuga Group, Kyushu, Japan. In Y. Takayanagi and K. Ishizaki (eds.): Collected papers on Foraminifera from the Japanese Islands. Toko Print., Publ. Dept., Sendai, 49-60, figs. 1-5, tab. 1. (九州の日向層群の始新世・漸新世底生有孔虫) (J. E.)

443 KAIHO Kunio, OKADA Hisatake and TAKAYANAGI Yokichi (1986): The best section representing the Eocene/Oligocene boundary in Japan. In C. Pomerol and I. Premori-Silva (eds.): Terminal Eocene events. Elsevier Scientific Publishers, Amsterdam, 159-160, figs. 1-2.

444 KAIHO Kunio and SAITO Tsunemasa (1986): Terminal Cretaceous sedimentary sequence recognized in the northernmost Japan based on planktonic foraminiferal evidence. *Proc. Japan Acad., Ser. B*, 62(5):145-148, figs. 1-4.

445 **KAMADA Yasuhiko** (1986): Nanatsugama stalactite caves in the Nishisonogi Peninsula, Nagasaki Prefecture, Japan. In H. Nakagawa, T. Kotaka and Y. Takayanagi (eds.): Essays in geology, Prof. N. Kitamura Commem. Vol., Toko Print., Pub. Dept., Sendai, 157-165, figs. 1-5, tabs. 1-2. (長崎県西彼杵半島の七釜鍾乳洞) (J. E.)

446 **KAMEI Tadao** (1987): New finds of the wooly mammoths teeth from the sea bed of the Nemuro Strait, Hokkaido, Japan. Prof. M. Matsui Mem. Vol., Sapporo, 1-12, pl. 1, fig. 1, tabs. 1-2. (北海道根室海峡で新たに発見されたマンモスゾウ臼歯化石) (J.)

447 KAMEI Tadao (1990): Faunal change of Miocene mammals in east Asia. *Monogr. Mizunami Fossil Mus.*, (7):129-135, figs. 1-2, tabs. 1-2. (東アジアの中新世哺乳動物の変遷) (J.)

448 KAMEI Tadao (1990): Fossil elephants in the Japanese Islands. *Collect. & Breed.*, 52(1):6-13, figs. 1-6. (日本にいたゾウの系統と進化) (J.)

449 KAMEI Tadao (1990): The Japan Sea and elephants. *Quat. Res., Japan*, 29(3): 163-172, figs. 1-2, tab. 1. (日本海と象) (J.E.)

450 KAMEI Tadao, ISHIGAKI Shinobu and TAMURA Mikio (1989): [Footprint fossils in the Kobiwako Group]. *Kagaku*, 59(5):320-323, figs. 1-4. (古琵琶湖層群の足跡化石) (J.)

451 KAMEI Tadao, KAWAMURA Yoshinari and TARUNO Hiroyuki (1988): Mammalian stratigraphy of the late Neogene and Quaternary in the Japanese Islands. *Mem. Geol. Soc. Japan*, (30):181-204, figs. 1-4. (日本の第四系の哺乳動物による分帯) (J.E.)

452 KAMEI Tadao, KUGA Naoyuki, INUZUKA Norihisa, KAMIYA Hidetoshi and MIEDA Haruo (1989): [Research report of *Paleoparadoxia* from Tsuyama]. *Bull. Tsuyama Local Mus.*, (1):1-48, pls. 1-7, figs. 1-25, tabs. 1-3. (津山産パレオパラドキシア化石産出調査報告) (J.)

453 KAMEI Tadao, TARUNO Hiroyuki and KAWAMURA Yoshinari (1988): Implication of mammal fauna for the Quaternary geohistory of the Japanese Islands. *Quat. Res., Japan*, 26(3):293-303. (日本列島の第四紀地史への哺乳動物相のもつ意義) (J.E.)

454 **KAMEYAMA Tokuhiko** (1989): Discovery of late Pleistocene fossil beds in the new hills, east of Oita City, Kyushu. *Earth Sci.*, 43(2):112-115, fig. 1, tabs. 1-2. (大分市東部丹生台地の上部更新統からの新しい化石産出層の発見) (J.)

455 **KAMIKAWA Yoichi**, KISHIDA Yojiro, KAIHO Kunio and HISADA Ken-ichiro (1988): Radiolarians obtained from the Cretaceous formations of the Sanchu Graben in the Kanto Mountains, central Japan. *Jour. Geol. Soc. Japan*, 94(11):903-905, pl. 1, figs. 1-3. (関東山地の山中地溝帯白亜系から放散虫化石の産出) (J.)

456 **KAMIYA Hidetoshi** (1988): Some observations on the cementum of *Paleoparadoxia* from Tsuyama City, Okayama Prefecture, western Japan. *Jour. Foss. Res.*, 21(1):5-8, figs. 1-13. (岡山県津山市より産出した*Paleoparadoxia* の歯のセメント質の観察) (J.)

457 **KAMIYA Takahiro** (1988): Contrasting population ecology of two species of *Loxoconcha* (Ostracoda, Crustacea) in Recent *Zostera* (eelgrass) beds: adaptive differences between phytal and bottom-dwelling species. *Micropaleontology*, 34(4):316-331, pl. 1, figs. 1-15, tabs. 1-2.

458 KAMIYA Takahiro (1988): Different sex-ratios in two Recent species of *Loxoconcha* (Ostracoda). *Lethaea*, 68(5/6):337-345, pl. 1, figs. 1-4, tab. 1.

459 KAMIYA Takahiro (1988): Morphological and ethological adaptations of Ostracoda to microhabitats in *Zostera* beds. In T. Hanai, N. Ikeya and K. Ishizaki (eds.): Evolutionary biology of Ostracoda. Kodansha/Elsevier, Tokyo/Amsterdam, 303-318, pl. 1, figs. 1-13.

460 KAMIYA Takahiro (1989): Differences between the sensory organs of phytal and bottom-dwelling *Loxoconcha* (Ostracoda, Crustacea). *Jour. Micropalaeont.*, 8(1):37-47, pls. 1-2, figs. 1-8.

461 KAMIYA Takahiro (1989): Functional morphology of Ostracoda in seagrass beds

-With special references to the copulatory behavior. *Benthos Res.*, (35/36):75-88, figs. 1-16. (藻場の介形虫類の機能形態－特に生殖行動との関連について) (J.)

462 **KAMOI Yukihiko**, SAITO Michiharu, FUJITA Hidetada and KOBAYASHI Iwao (1988): Plant fossil assemblage of the last glacial age in the northern part of Niigata Prefecture, central Japan. *Quat. Res., Japan*, 27(1):21-29, pl. 1, figs. 1-6, tabs. 1-2. (新潟県北部に産する最終氷期の植物遺体群集) (J. E.)

463 **KAMON Mitsuru** and NAKAZAWA Keiji (1989): Geology of the southern Chichibu Belt in the eastern part of Shimizu-cho, Wakayama Prefecture, southwest Japan. *Jour. Geol. Soc. Japan*, 95(1):45-61, pls. 1-2, figs. 1-8, tabs. 1-6. (和歌山県清水町東部の秩父累帯南帯の地質) (J. E.)

464 **KANAUCHI Atsuko** (1988): The vegetational history during the last glacial period from Yanohara bog, Fukushima Prefecture, northeastern part of Japan. *Quat. Res., Japan*, 27(3):177-186, figs. 1-7, tab. 1. (福島県南部・矢の原湿原堆積物の花粉分析による最終氷期の植生変遷) (J. E.)

465 KANAUCHI Atsuko, TAHARA Yutaka, NAKAMURA Jun and SUGIHARA Shigeo (1989): Stratigraphy and pollen analysis of the boring core at Lake Ippekiko (Numa-Ike), Ito City, Shizuoka Prefecture, Japan. *Quat. Res., Japan*, 28(1):27-34, figs. 1-5. (静岡県伊東市一碧湖(沼池)におけるボーリング・コアの層序と花粉分析) (J.)

466 **KANAZAWA Ken'ichi** (1990): Early Pleistocene glacio-eustatic sea-level fluctuations as deduced from periodic changes in cold and warm-water molluscan associations in the Shimokita Peninsula, northeast Japan. *Palaeogeogr. Palaeoclimat. Palaeoecol.*, 79(3/4):263-273, figs. 1-6, tab. 1.

467 KANAZAWA Ken'ichi and YAMAGUCHI Toshiyuki (1988): Geology of the Plio-Pleistocene Hamada Formation in the Shimokita Peninsula, Aomori Prefecture. *Bull. Natn. Sci. Mus., Tokyo, Ser. C*, 14(2):45-57, figs. 1-8, tab. 1. (下北半島中部の鮮新－更新統浜田層の地質) (J. E.)

468 **KANEKO Atsushi** (1986): Trilobites from the upper part (H4 Member) of the Lower Carboniferous Hikoroichi Formation, Kitakami Mountains, northeast Japan. *Jour. Geol. Soc. Japan*, 92(1):69-71, pl. 1, fig. 1. (北上山地下部石炭系日頃市層上部層(H4部層)産三葉虫化石群) (J.)

469 KANEKO Atsushi (1990): A new trilobite genus *Rhinophacops*. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (157):360-365, figs. 1-2, tab. 1.

470 **KANEKO M.**, ISHIKAWA H. and YAMAGISHI Y. (1987): Foraminifera from the Nakazato site. Nakazato site 1 -Remains and paleoenvironment 1. Research commission on the Nakazato site along the Tohoku Shinkansen, 309-325. (中里遺跡の有孔虫化石) (J.)

471 KANEKO M., ISHIKAWA H. and YAMAGISHI Y. (1987): [On the fossil Foraminifera]. Rep. investigation on history of Kuki City, 9. Change in natural environment. Rep. Geol. Survey, 50-68, pls. 1-5. (有孔虫化石について) (J.)

472 KANEKO M., ISHIKAWA H. and YAMAGISHI Y. (1988): Foraminifera at the Fukuro-Teichi site, Kita-ku, Tokyo. Report of the excavation for constructing the Tohoku Shinkansen, 265-280, pls. 1-4. (袋低地遺跡の有孔虫化石) (J.)

473 **KANIE Yasumitsu** (1990): Shell morphology of living *Calyptogena soyoae* and *Akebichoncha kawamurai* and Neogene *C. nipponica* from south-central Japan. *Sci. Rep., Yokosuka City Mus.*, (38):19-23, figs. 1-3. (南関東の現生シロ

ウリガイ・アケビガイと新第三紀シロウリガイ類の殻形態) (J.E.)

474 KANIE Yasumitsu, MATSUDA Tokihiko, MATSUSHIMA Yoshiaki, HIRATA Daiji, KASHIMA Kaoru and MATSUBARA Akiko (1989): Morphology of the natural monument, "Moroiso Uplifted Beach Line" and the adjacent Holocene deposits in the southwestern part of the Miura Peninsula, south-central Japan. *Sci. Rep., Yokosuka City Mus.*, (37):45-53, figs. 1-8, tabs. 1-2. (三浦市天然記念物「諸磯の隆起海岸」および周辺の完新統) (J.E.)

475 **KANMERA Kametoshi** and SANO Hiroyoshi (1986): Stratigraphic and structural relationships among pre-Jurassic accretionary and collisional systems in Akiyoshi terrane. Guidebook for field excursion of 1st International Symposium on pre-Jurassic geologic evolution of eastern continental margin of Asia (IGCP224), Osaka, 51-68.

476 KANMERA Kametoshi, SANO Hiroyoshi and ISOZAKI Yukio (1990): Akiyoshi terrane. In K. Ichikawa et al. (eds.): Pre-Cretaceous terranes of Japan. Publication of IGCP Project 224, Osaka, 49-62.

477 **KANNO Saburo** (1986): Revision of genus *Vicarya* (Gastropoda) from the Indo Pacific region. *Bull. Joetsu Univ. Educ.*, 5(3):31-57, pls. 1-7, figs. 1-5.

478 KANNO Saburo, AMANO Kazutaka and BAN Hiromitsu (1989): *Calyptogena* (*Calyptogena*) *pacifica* Dall (Bivalvia) from the Neogene System in the Joetsu district, Niigata Prefecture. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (153):25-35, figs. 1-7, tab. 1.

479 KANNO Saburo, AMANO Kazutaka and NODA Hiroshi (1988): *Vicarya* and its associated molluscan fauna from the Kunnui Formation in Oshamanbe, southwest Hokkaido. *Saito Ho-on Kai, Spec. Pub.*, (*Prof. T. Kotaka Commem. Vol.*), (2):373-389, pls. 1-3, figs. 1-2, tab. 1.

480 **KANO Akihiro** (1988): Facies and depositional conditions of a carbonate mound (Tithonian-Berriasian, SW-Japan). *Facies*, 18:27-48, pls. 4-5, figs. 1-12.

481 KANO Akihiro (1989): Deposition and palaeoecology of an Upper Silurian stromatoporoid reef on southernmost Gotland, Sweden. *Geol. Jour.*, 24:295-315, figs. 1-19, tabs. 1-2.

482 KANO Akihiro (1990): Species, morphologies and environmental relationships of the Ludlovian (upper Silurian) stromatoporoids on Gotland, Sweden. *Stockholm Contrib. Geol.*, 42(2):85-121, figs. 1-20, tabs. 1-3.

483 **KANO Kazuhiko** and YANAGISAWA Yukio (1989): Ages of the Aniai-type and Daijima-type Floras in Japan. *Bull. Geol. Surv. Japan*, 40:647-653, figs. 1-2, tabs. 1-2. (阿仁合型植物群及び台島型植物群の年代) (J.E.)

484 **KANOH Manabu**, TOSHIMITSU Seiichi and TASHIRO Masayuki (1989): Stratigraphy and depositional facies of the Himenoura Group in the Koshikijima Islands, Kagoshima Prefecture. *Res. Rep., Kochi Univ., Nat. Sci.*, 38:157-172, pls. 1-6. (鹿児島県甑島地域の姫浦層群の層序と堆積相) (J.E.)

485 **KARASAWA Hiroaki** (1989): Decapod crustaceans from the Miocene Mizunami Group, central Japan. Part 1. Superfamily Thalassinoidea, Leucosioidea and Grapsidoidea. *Bull. Mizunami Fossil Mus.*, (16):1-28, pls. 1-3, tab. 1.

486 KARASAWA Hiroaki (1989): Late Cenozoic elasmobranchs from the Hokuriku district, central Japan. *Sci. Rep., Kanazawa Univ.*, 34(1):1-57, pls. 1-8, fig. 1, tabs. 1-6.

487 KARASAWA Hiroaki (1990): Decapod crustaceans from the Miocene Mizunami Group, central Japan. Part 2. Section Oxyrhyncha, Cancridea and Brachyrhyncha. *Bull. Mizunami Fossil Mus.*, (17):1-33, pls. 1-8, figs. 1-2, tab. 1.

488 KARASAWA Hiroaki (1990): Fossil crab, *Carcinoplax longimana* (De Haan), from off shore of Okinoshima, Kochi, Shikoku, Japan. *Jour. Foss. Res.*, 22(2): 58-60, fig. 1. (高知県沖ノ島沖より得られた十脚甲殻類*Carcinoplax longimana* (De Haan)の化石) (J.)

489 KARASAWA Hiroaki (1990): Miocene decapod crustacean assemblages from southwest Japan, with special reference to the intertidal assemblages of muddy bottom. *Monogr. Mizunami Fossil Mus.*, (7):101-116, figs. 1-4, tabs. 1-4. (西南日本の中新世十脚甲殻類群集－特に潮間帯泥底群集について－) (J.)

490 KARASAWA Hiroaki, OKUMURA Yoshitsugu and NARUSE Atsushi (1990): Discovery of crab footprints from the Miocene Mizunami Group, central Japan. *Bull. Mizunami Fossil Mus.*, (17):93-96, pls. 15-18, fig. 1. (瑞浪層群から産したカニの足跡化石) (J.)

491 **KASE Tomoki** (1986): Mode of life of the Silurian uncoiled gastropod *Semitubina sakoi* n. sp. from Japan. *Lethaia*, 19:(4):327-337, figs. 1-7.

492 KASE Tomoki (1988): Early Carboniferous (Visean) gastropods from the Hikoroichi Formation of the Kitakami Mountains, northeast Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (149): 361-370, figs. 1-5.

493 KASE Tomoki (1988): Reinterpretation of *Brunonia annulata* (Yokoyama) as an early Cretaceous carinariid mesogastropod (Mollusca). *Jour. Paleont.*, 62 (5):766-771, figs. 1-5.

494 KASE Tomoki (1988): Research report on ecology of a living fossil of extinct naticids, *Globularia fluctuata* (Sowerby) (Gastropoda, Mollusca) in Palawan, the Philippines. *Jour. Geogr.*, 97(6):623-625. (生きている化石モクレンタマガイ*Globularia fluctuata* (Sowerby)の生態学的調査（フィリピン・パラワン島)) (J.)

495 KASE Tomoki (1989): Autecology of *Labrocuspis*, a Middle Devonian omphalotrochid gastropod. *Lethaia*, 22:149-157, figs. 1-6.

496 KASE Tomoki (1990): Late Cretaceous gastropods from the Izumi Group of southwest Japan. *Jour. Paleont.*, 64(4):563-578, figs. 1-5.

497 KASE Tomoki (1990): Research report on ecology of a living fossil of extinct naticids, *Globularia fluctuata* (Sowerby) (Gastropoda, Mollusca) in Palawan, the Philippines -II. *Jour. Geogr.*, 99(4):368-401, fig. 1, photo. 1. (生きている化石モクレンタマガイ*Globularia fluctuata* (Sowerby)の生態学的調査(フィリピン・パラワン島)・第２次) (J.)

498 KASE Tomoki, HAMADA Takashi and NIKO Shuji (1987): First record of a hyolith (Paleozoic Mollusca) from Japan. *Bull. Natn. Sci. Mus., Tokyo, Ser. C.*, 13(1):29-34, figs. 1-2.

499 KASE Tomoki and NISHIDA Tamio (1986): A Middle Devonian gastropod faunule from the Nakazata Formation of Kitakami, northeast Japan. *Bull. Natn. Sci. Mus.*, Tokyo, *Ser. C.*, 12(3):73-89, figs. 1-6.

500 KASE Tomoki and NISHIDA Tamio (1988): Two new Middle Devonian gastropods from the Nakazato Formation of Kitakami, northeast Japan. *Saito Ho-on Kai, Spec. Pub. (Prof. T. Kotaka Commem. Vol.)*, (3):257-261, pl. 1, fig. 1.

501 **KASENO Yoshio** (1986): Late Pleistocene paleogeography and paleoenvironment of Japan Sea as revealed by the piston-core analysis. *Quat. Res., Japan*, 25(4):305-371, figs. 1-6, tab. 1. (後期更新世の日本海の古地理と古環境－ピストン・コアによる解析を中心に－) (J.E.)

502 **KASHIMA Kaoru**, OTA Yoko, MATSUSHIMA Yoshiaki, LIEW Ping-mei and SAWA Masumi (1990): Holocene sea-level change in Takagami lowland, the Choshi Peninsula, Japan. *Quat. Res., Japan*, 29(2):139-149, figs. 1-10, tab. 1. (銚子半島高神低地における完新世海水準変化) (J.E.)

503 **KASHIMA Naruhiko** (1986): Jurassic olistostrome Futaiwa Formation of northwestern edge of the Chichibu Belt in western Shikoku. *NOM, Spec. Vol.*, (7):225-233, figs. 1-4, tab. 1. (四国西端部, ジュラ紀オリストストローム双岩層) (J.E.)

504 KASHIMA Naruhiko, IRIE Teruo and KINOSHITA Nobuhiro (1987): Diatom, contributors of coralloid speleotheme, from Togawa-Sakai-dani-do Cave in Miyazaki Prefecture, central Kyushu, Japan. *Int. Jour. Speleol.*, (16):95-100, figs. 1-3.

505 KASHIMA Naruhiko, SHINOHARA Toshinori, TAKAHASHI Jiro and MATSUURA Hirofumi (1988): Rhyolites in the Upper Cretaceous Izumi Group at the Ominegadai hill area, northwestern Shikoku, Japan. Prof. S. Sato Mem. Vol., Matsuyama, 17-25, figs. 1-6, tab. 1.

506 KASHIMA Naruhiko and TAKAHASHI Jiro (1988): Geology and radiolarian age of the three aqueduct tunnels (Takagushi, Tokunomori and Kanayama) at the Shimanto Belt, western Shikoku, Japan. (Geological studies of the construction of the aqueduct tunnels for government operated Nanto Irrigation Project -Part 5). *Mem. Fac. Educ., Ehime Univ., Ser. 3*, 11(1):15-29, figs. 1-10. (四国西部四万十帯, 高串・徳の森・金山三隧道の地質と放散虫化石年代(南予用水農業水利事業隧道の地質学的研究－その５)) (J.E.)

507 **KASHIWAGI Hideharu** (1990): Behavior of geologic bodies under paleostress field and groundwater environment at the foundation of the Nakakita Dam, northeast Japan. *Jour. Sci., Hiroshima Univ., Ser. C*, 9(2):335-346, pl. 1, figs. 1-9, tabs. 1-5.

508 **Kashiwazaki Naumann's Elephant Research Group** (1989): *Palaeoloxodon naumanni* (Makiyama) from the Upper Pleistocene in Kujiranami, Kashiwazaki City, Niigata Prefecture, central Japan. *Earth Sci.*, 43(1):49-53, figs. 1-6, tab. 1. (新潟県柏崎市鯨波の上部更新統から発掘されたナウマンゾウ化石) (J.)

509 Kashiwazaki Naumann's Elephant Research Group (1989): The ^{14}C age of fossil woods from the locality of *Palaeoloxodon naumanni* (Makiyama) in Kashiwazaki, Niigata Prefecture, central Japan -^{14}C age of the Quaternary deposits in Japan (170)-. *Earth Sci.*, 43(1):62-64, figs. 1-2. (新潟県柏崎市鯨波におけるナウマンゾウ化石産出層の^{14}C年代－日本の第四紀層の^{14}C年代(170)－) (J.)

510 **KATO Makoto** (1990): Pre-Cretaceous rocks in Hokkaido. In K. Ichikawa, S. Mizutani, I. Hara, S. Hada and A. Yao (eds.): Pre-Cretaceous terranes of Japan. Publication of IGCP Project 224, Osaka, 281-283, fig. 1.

511 KATO Makoto (1990): Palaeozoic corals. In K. Ichikawa, S. Mizutani, I. Hara, S. Hada and A. Yao (eds.): Pre-Cretaceous terranes of Japan. Publication of IGCP Project 224, Osaka, 307-311, fig. 1.

512 KATO Makoto and EZAKI Yoichi (1986): Permian corals of Salt Range, (A preliminary report). *Proc. Japan Acad., Ser. B*, 62(7):231-234, figs. 1-2

513 KATO Makoto and EZAKI Yoichi (1986): Rugose corals from the Upper Silurian of Scania, Sweden. *Jour. Fac. Sci., Hokkaido Univ., Ser. 4*, 21(4):483-504, pls. 1-3, figs. 1-5.

514 KATO Makoto and EZAKI Yoichi (1986): Permian corals from Pahang and Trengganu, Malaysia. *Jour. Fac. Sci., Hokkaido Univ., Ser. 4*, 21(4):645-668, pls. 1-7, figs. 1-2.

515 KATO Makoto, GEOL Rajendra K. and SRIVASTAVA Shambhu S. (1987): Ordovician algae from Spiti, India. *Jour. Fac. Sci., Hokkaido Univ., Ser. 4*, 22(2): 313-323, pls. 1-2, figs. 1-3.

516 KATO Makoto and GUPTA Vishwa J. (1989): Late Palaeozoic corals from the Himalayas. *Jour. Fac. Sci., Hokkaido Univ., Ser. 4*, 22(3):399-424, pls. 1-5, figs. 1-6.

517 KATO Makoto, HASHIMOTO Kazuo and EZAKI Yoichi (1987): [Carboniferous corals of Tateishi, Fukushima Prefecture, Japan]. Kashima-cho Bunkazaishiryou, Fukushima, 1-10, pls. 1-7, figs. 1-4. (立石のサンゴ化石) (J.)

518 KATO Makoto, KATSUI Yoshi, KITAGAWA Yoji and MATSUI Makoto (1990): [Regional geology of Japan, Part 1, Hokkaido]. Kyoritsu Shuppan Co. Ltd., Tokyo, 1-337. (地方地質誌, 北海道 1)

519 KATO Makoto, KAWAMURA Makoto, KAWAMURA Toshio, TAZAWA Jun-ichi, NIIKAWA Isao and NAKAMURA Koji (1989): Present knowledge on the Carboniferous of the Kitakami Mountains. 11^{e} Congres International de Stratigraphie et de Geologie du Carbonifere, Beijing 1987, Compte Rendu, Beijing, 2:64-73, figs. 1-3.

520 KATO Makoto, NIIKAWA Isao, KAWAMURA Toshio, EZAKI Yoichi and SATO Etsuro (1989): [Corals, Fossils from Onimaru]. *Ofunato City Mus.*, 13-14. (サンゴ類, おにまるの化石) (J.)

521 **KATO Michio** (1986): [Foraminiferal fossils]. In N. Fuji (ed.): Paleontological studies of the Nanao Calcareous Sandstone, Noto Peninsula. *Nanao Board of Educ., Ishikawa Pref.*, 36-104, pls. 12-17. (有孔虫類化石) (J.)

522 KATO Michio (1986): Recent shallow water Foraminifera in Hiroshima Bay, Seto Inland Sea, Japan. In Y. Matoba and M. Kato (eds.): Studies on Cenozoic Benthic Foraminifera in Japan. Akita Univ., Akita, 27-42, figs. 1-36, tabs. 1a-1b. (広島湾の現生底生有孔虫群集) (J.)

523 KATO Michio (1989): Benthic foraminifers from the Japan Sea piston cores. In Y. Takayanagi and K. Ishizaki (eds.): Collected papers on Foraminifera from the Japanese Islands. Toko Print., Pub. Dept., Sendai, 111-116. (日本海ピストン・コアの底生有孔虫) (J.E.)

524 **KATO Susumu** and ICHINOSEKI Tetsuro (1990): Echinoids from the Tanosawa Formation in the Ajigasawa district, Aomori Prefecture, Japan. *Bull. Mizunami Fossil Mus.*, (17):61-69, figs. 1-3, tab. 1. (青森県鯵ヶ沢地域田野沢層産のウニ化石) (J.E.)

525 KATO Susumu, INOUE Yoko and YAGUCHI Rhyoichi (1989): Stratigraphy of the MITI Omaezaki-oki well. *Jour. Geol. Soc. Japan*, 96(11):851-864, figs. 1-8,

tab. 1. (基礎試錐「御前崎沖」の層序) (J.E.)

526 **KATO Yukihiro** and IWATA Keiji (1989): Radiolarian biostratigraphic study of the pre-Tertiary Systems around Kamikawa basin, central Hokkaido, Japan. *Jour. Fac. Sci., Hokkaido Univ., Ser. 4*, 22(3):425-452. pls. 1-8.

527 KATO Yukihiro, IWATA Keiji, UOZUMI Satoru and NAKAMURA Koji (1986): Re-examination on the Pre-Tertiary System distributed in the Toma-Kaimei district of central Hokkaido. *Jour. Geol. Soc. Japan*, 92(3):239-242, figs. 1-3, tabs. 1-3. (北海道中央部, 当麻－開明地域に分布する先第三系の再検討) (J.)

528 **KAWABATA Kiyoshi** (1988): New species of latest Jurassic and earliest Cretaceous radiolarians from the Sorachi Group in Hokkaido, Japan. *Bull. Osaka Mus., Nat. Hist.*, (43):1-13, pls. 1-3, figs. 1-4.

529 **KAWAHARA Fumio**, IKUTA Yasuaki and MAESUE Nobuyuki (1989): On a late Triassic-early Jurassic bivalve *Cardinia* sp. from Kake-cho, Hiroshima Prefecture. *Jour. Geol. Soc. Japan*, 95(9):715-717, pl. 1, figs. 1-2. (広島県加計町から産出した三畳紀後期～ジュラ紀前期の二枚貝化石) (J.)

530 **KAWAKAMI Takeshi**, FUTAKAMI Masao and OBATA Ikuwo (1986): Ammonite specimens preserved in the Iwate Prefectural Museum, Part 3. *Bull. Iwate Pref. Mus.*, (4):9-14, pl. 2, figs. 1-2, tabs. 1-2. (岩手県立博物館所蔵のアンモナイト標本 その3) (J.E.)

531 KAWAKAMI Takeshi and YANAGISAWA Tadaaki (1986): On the occurrence of an echinoid from the Upper Cretaceous Sawamawari Formation, Iwaizumi Graben, Iwate Prefecture. *Bull. Iwate Pref. Mus.*, (4):1-7, pl. 1, figs. 1-3, tab. 1. (岩泉地溝帯, 上部白亜系沢廻層初産出のウニ化石) (J.E.)

532 **KAWAMURA Makoto**, KATO Makoto and Kitakami Paleozoic Research Group (1990): Southern Kitakami terrane. In K. Ichikawa, S. Mizutani, I. Hara, S. Hada and A. Yao (eds.): Pre-Cretaceous terranes of Japan. Publication of IGCP Project 224, Osaka, 249-266, figs. 1-3, tabs. 1-2.

533 **KAWAMURA Yoshinari** (1988): Quaternary rodent faunas in the Japanese Islands (Part 1). *Mem. Fac. Sci., Kyoto Univ., Ser. Geol. & Mineral.*, 53(1/2):31-348, figs. 1-159, tabs. 1-78.

534 KAWAMURA Yoshinari (1989): Quaternary rodent faunas in the Japanese Islands (Part 2). *Mem. Fac. Sci., Kyoto Univ., Ser. Geol. & Mineral.*, 54(1/2):1-235, pls. 1-26, figs. 160-212, tabs. 79-124.

535 KAWAMURA Yoshinari (1990): Molars of arvicolid rodents and their evolution. *Mammal. Sci.*, 30(1):59-74, figs. 1-14. (ハタネズミ類の臼歯とその進化) (J.E.)

536 KAWAMURA Yoshinari and IIDA Kazuaki (1989): An early Middle Pleistocene murid rodent molar from the Kobiwako Group, Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (155):159-168, figs. 1-6.

537 KAWAMURA Yoshinari, KAMEI Tadao and TARUNO Hiroyuki (1989): Middle and late Pleistocene mammalian faunas in Japan. *Quat. Res., Japan*, 28(4):317-326, tab. 1. (日本の中・後期更新世の哺乳動物相) (J.E.)

538 KAWAMURA Yoshinari and MATSUHASHI Yoshitaka (1989): Late Pleistocene fissure sediments and their mammalian fauna at site 5 of Yage Quarry, Inasa, Shizuoka Prefecture, central Japan. *Quat. Res., Japan*, 28(2):95-102, figs. 1-6, tab. 1. (静岡県引佐町谷下採石場第5地点の後期更新世裂罅堆積物とその哺乳動物相) (J.E.)

539 KAWAMURA Yoshinari, MATSUHASHI Yoshitaka and MATSU'URA Shuji (1990): Late Quaternary mammalian faunas at Suse Quarry, Toyohashi, central Japan, and their implications for the reconstruction of the faunal succession. *Quat. Res., Japan*, 29(4):307-317, figs. 1-4, tabs. 1-3. (豊橋市嵩山採石場産の第四紀後期哺乳動物群とその意義) (J.E.)

540 KAWAMURA Yoshinari and NAKAYA Hideo (1987): Additional materials of the late Miocene rodents from the Namurungule Formation of Samburu hills, northern Kenya. *Monogr. African Stud., Suppl. Issue,* (5):99-106, pl. 1.

541 KAWAMURA Yoshinari, YAMADA Yoko and ANDO Yoko (1986): Late Pleistocene micromammals from Taishaku-Kannondo Cave site (First preliminary report). *Ann. Bull., Hiroshima Univ., Taishaku-kyo Site Res. Cent.*, 9:67-85, figs. 32-34, tabs. 5-6. (帝釈観音堂洞窟遺跡産の後期更新世小型哺乳動物化石(第1報)) (J.)

542 KAWANA Toshio, NAKATA Takashi and OMURA Akio (1987): Age of the fossil coral from the "Tsunami-ufuishi" on Ohama of Ishigaki Island, the south Ryukyus, Japan. *Quat. Res., Japan*, 26(2):155-158, figs. 1-2, phots. 1-2. (石垣島大浜の"津波大石"のサンゴ化石年代) (J.)

543 KAWANA Toshio, NODA Hiroshi, MATSUDA Shinya and ONO Tomonori (1989): [Shimajiri Group and Ryukyu Limestone in the southern part of Okinawa-jima]. Guidebook at the 95th annual meeting of the Geological Society of Japan, Naha, 1-27, pls. 1-2, figs. 1-13, tabs. 1-5. (沖縄本島南部の島尻層群と琉球石灰岩) (J.)

544 KAYANE Hajime, YAMAMURO Masumi and MATSUMOTO Eiji (1987): *Pomatoleios kraussii* (BAIRD) as a paleo sea level indicator on the southeast coast of Boso Peninsula, central Japan. *Quat. Res., Japan*, 26(1):47-57, pl. 1, figs. 1-5, tab. 1. (房総半島南東岸における旧汀線の指標としてのヤッコカンザシ) (J.E.)

545 KHOO Teng-tiong, YAW B. S., KIMURA Tatsuaki and KIM Jong-heon (1988): Geology and palaeontology of the Redang Islands, Trengganu, Peninsular Malaysia. *Jour. Southeast Asian Earth Sci.*, 2(3/4):123-130, figs. 1-9.

546 KIKUCHI Yoshibumi and NIKAIDO Akinobu (1987): Gregareous occurrence of echinoid *Linthia tokunagai* from the Pliocene Kume Formation in Ibaraki Prefecture, northeastern Honshu, Japan. *Ann. Rep., Inst. Geosci., Univ.* Tsukuba, (13):87-91, figs. 1-5, tab. 1.

547 KILMER Frank (1988): A paleoenvironmental sketch of Taiwan for the Miocene-early Pliocene interval. *Saito Ho-on Kai, Spec. Pub.* (*Prof. T. Kotaka Commem. Vol.*), (3):47-67, figs. 1-10.

548 KIM Bong-kyun and KIMURA Tatsuaki (1986): Study on the Daedong Flora, Korea. *Proc. Korean Acad., Nat. Sci.*, (25):145-195.

549 KIM Jong-heon (1989): *Sphenophyllum* sp. (Sphenophyllales) newly found from Upper Triassic Baegunsa Formation, Nampo Group, Korea. *Bull. Natn. Sci. Mus., Tokyo, Ser. C*, 15(3):93-96, figs. 1-3.

550 KIM Jong-heon and KIMURA Tatsuaki (1987): Cuticle of *Sagenopteris* (Caytoniales), an extinct gymnospermous plant, first observed in Japan. *Proc. Japan Acad., Ser. B*, 63(6):179-182.

551 KIM Jong-heon and KIMURA Tatsuaki (1987): *Sphenobaiera coreanica* Kim et Kimura sp. nov., from the Bansong Group in the Danyang Coal-Field, Korea. *Proc. Japan Acad., Ser. B*, 63(6):183-185.

552 KIM Jong-heon and KIMURA Tatsuaki (1988): *Lobatannularia nampoensis* (Kawasaki) Kawasaki from the Upper Triassic Baegunsa Formation, Nampo Group, Korea. *Proc. Japan Acad., Ser. B*, 64(8):221-224, figs. 1-5.

553 **KIMINAMI Kazuo**, KAWABATA Kiyoshi and MIYASHITA Sumio (1990): Discovery of Paleogene radiolarians from the Hidaka Supergroup and its significance with special reference to ridge subduction. *Jour. Geol. Soc. Japan*, 96 (4):323-326, figs. 1-2. (日高累層群中からの古第三紀放散虫化石の発見とその意義，特に海嶺の沈みこみについて) (J.)

554 **KIMURA Ichiro** and HARA Manabu (1988): Marine diatoms from the Tokai Group. *Bull. Aichi Univ. Educ., Nat. Sci.*, 37:77-88, pl. 1, figs. 1-4, tab. 1. (東海層群の海生珪藻) (J.)

555 **KIMURA Katsumi** (1986): Stratigraphy and paleogeography of the Hidakagawa Group of the northern Shimanto Belt in the southern part of Totsugawa Village, Nara Prefecture, southwest Japan. *Jour. Geol. Soc. Japan*, 92(3): 185-203, pl. 1, figs. 1-11, tabs. 1-4. (奈良県十津川村南部四万十累帯北帯の日高川層群－層序と古地理－) (J.E.)

556 KIMURA Katsumi (1988): Geology and tectonic setting of the Ultra-Tamba Belt in the western part of Ayabe City, Kyoto Prefecture, southwest Japan. *Jour. Geol. Soc. Japan*, 94(5):361-379, pls. 1-2, figs. 1-11, tab. 1. (京都府綾部市西部の超丹波帯の地質と造構環境) (J.E.)

557 **KIMURA Koshi** (1989): Stratigraphical and sedimentological studies of the Paleogene to Miocene strata in southwestern Shikoku, Japan. *Jour. Sci., Hiroshima Univ., Ser. C*, 9(1):133-197, pls. 1-2, figs. 1-45, tabs. 1-4.

558 **KIMURA Masaichi** (1988): Discovery of *Balaenoptera* cf. *borealis* from the Middle Miocene in the Fukushima Prefecture. *Jour. Geol. Soc. Japan*, 94 (10):783-784, pl. 1, figs. 1-2, tab. 1. (福島県中部中新統からのイワシクジラの発見) (J.)

559 KIMURA Masaichi and FURUSAWA Hitoshi (1990): Fossils from the Ishikari lowland (Mammals 1, -Proboscidea, Artiodaclyla). *Atlas, Japan. Foss.*, (62): 369. (石狩低地帯の化石(哺乳類１－長鼻類・偶蹄類)) (J.)

560 KIMURA Masaichi and FURUSAWA Hitoshi (1990): Fossils from the Ishikari lowland (Mammals 2, -Proboscidea). *Atlas, Japan. Foss.*, (62):370. (石狩低地帯の化石(哺乳類２－長鼻類)) (J.)

561 KIMURA Masaichi and FURUSAWA Hitoshi (1990): Fossils from the Ishikari lowland (Mammals 3, -Sirenia). *Atlas, Japan. Foss.*, (62):371. (石狩低地帯の化石(哺乳類３－海牛類)) (J.)

562 KIMURA Masaichi and FURUSAWA Hitoshi (1990): Fossils from the Ishikari lowland (Mammals 4, -Pinnipedia). *Atlas, Japan. Foss.*, (62):372. (石狩低地帯の化石(哺乳類４－鰭脚類)) (J.)

563 KIMURA Masaichi, ISHIDA Minoru and AMAOKA Kunio (1989): On the scorpaenid fossil, *Sebastes owstoni* from the Pliocene Enbetsu Formation in Haboro-cho, Hokkaido. *Earth Sci.*, 43(1):54-57. (北海道羽幌町の鮮新統遠別層産魚類化石ハツメについて) (J.)

564 KIMURA Masaichi, KOKUBU Hidehiko, KUMANO Sumio and MATSUI Masaru (1987): Desmostylian molar found from Shimukappu-mura, Yufutsu-gun, Hokkaido. *Earth Sci.*, 41(1):61-64, pl. 1, figs. 1-3, tab. 1. (北海道勇払郡占冠村から発見されたデスモスチルス臼歯について) (J.)

565 KIMURA Masaichi and MATSUBARA Chie (1990): Whale fossils from Rumoi, Hokkaido. Prof. A. Kasugai Mem. Vol., Sapporo, 105-114, pls. 1-3. (留萌市産クジラ化石について) (J.)

566 KIMURA Masaichi, YAMASHITA Shigeru, UEDA Jukichi, GANZAWA Yoshihiro and TAKAKU Koichi (1987): Whales from the Lower Pliocene of Numata-cho, Uryu-gun, Hokkaido. Prof. M. Matsui Mem. Vol., Sapporo, 27-57, pls. 1-7, figs. 1-23, tabs. 1-5. (北海道雨竜郡沼田町の下部鮮新統産クジラ化石) (J.)

567 KIMURA Tatsuaki (1986): [Plants surrounding dinosaurs]. *Earth Month.* 8(3): 181-186, fig. 1. (恐竜をとりまく植物) (J.)

568 KIMURA Tatsuaki (1987): Geographical distribution of Palaeozoic and Mesozoic plants in east and southeast Asia. In A. Taira and M. Tashiro (eds.): Historical biogeography and plate tectonic evolution of Japan and eastern Asia. Terra Pub, Tokyo, 135-200.

569 KIMURA Tatsuaki (1987): Recent knowledge of Jurassic and early Cretaceous floras in Japan and phytogeography of this time in east Asia. *Bull. Tokyo Gakugei Univ., Sec. 4*, 39:87-115, figs. 1-2, tab. 1.

570 KIMURA Tatsuaki (1988): Jurassic macrofloras in Japan and palaeophytogeography in east Asia. *Bull. Tokyo Gakugei Univ., Sec. 4*, 40:147-164, figs. 1-6.

571 KIMURA Tatsuaki and AIBA Hiroaki (1986): *Onychiopsis yokoyamai* (Yabe) comb. nov. from the Lower Cretaceous plant-beds in the outer zone of Japan. *Bull. Natn. Sci. Mus., Tokyo, Ser. C*, 12(2):41-52, pls. 1-2, figs. 1-16.

572 KIMURA Tatsuaki and KIM Bong-kyun (1988): New taxa in the late Triassic Daedong Flora, south Korea. Part 1. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (152):603-624, figs. 1-9.

573 KIMURA Tatsuaki and KIM Bong-kyun (1989): New taxa in the late Triassic Daedong Flora, south Korea. Part 2. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (155):141-158, figs. 10-19.

574 KIMURA Tatsuaki, NAITO Gentaro and OHANA Tamiko (1986): Early Jurassic plants in Japan. Part 7. Fossil plants from the Nishinakayama Formation, Toyora Group, Yamaguchi Prefecture, southwest Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (144):528-540, pls. 99-100, figs. 1-11.

575 KIMURA Tatsuaki and OHANA Tamiko (1986): Epidermal structure of fossil leaves. *Fossils, Palaeont. Soc. Japan*, (41):29-35, figs. 1-6. (化石葉の組織 (表皮構造)) (J.)

576 KIMURA Tatsuaki and OHANA Tamiko (1987): Some early Cretaceous plants from the outer zone of Japan. *Bull. Natn. Sci. Mus., Tokyo, Ser. C*, 13(1):13-27, pls. 1-2, figs. 1-8.

577 KIMURA Tatsuaki and OHANA Tamiko (1987): Middle Jurassic and some late Liassic plants from the Toyora Group, southwest Japan (1). *Bull. Natn. Sci. Mus., Tokyo, Ser. C*, 13(2):41-76, pls. 1-4, figs. 1-23.

578 KIMURA Tatsuaki and OHANA Tamiko (1987): Middle Jurassic and some late Liassic plants from the Toyora Group, southwest Japan (2). *Bull. Natn. Sci. Mus., Tokyo, Ser. C*, 13(3):115-148, pls. 5-10, figs. 24-42.

579 KIMURA Tatsuaki and OHANA Tamiko (1988): Late Jurassic plants from the Tochikubo Formation (Oxfordian), Somanakamura Group, in the outer zone of

northeast Japan. 1. *Bull. Natn. Sci. Mus., Tokyo, Ser. C*, 14(3):103-133, pls. 1-7, figs. 1-14.

580 KIMURA Tatsuaki and OHANA Tamiko (1988): Late Jurassic plants from the Tochikubo Formation (Oxfordian), Somanakamura Group, in the outer zone of northeast Japan. 2. *Bull. Natn. Sci. Mus., Tokyo, Ser. C*, 14(4):151-185, pls. 8-16, figs. 15-30.

581 KIMURA Tatsuaki and OHANA Tamiko (1989): Late Jurassic plants from the Oginohama Formation, Oshika Group in the outer zone of northeast Japan (1). *Bull. Natn. Sci. Mus., Tokyo, Ser. C*, 15(1):1-24, pls. 1-8, figs. 1-15.

582 KIMURA Tatsuaki and OHANA Tamiko (1989): Late Jurassic plants from the Oginohama Formation, Oshika Group in the outer zone of northeast Japan (2). *Bull. Natn. Sci. Mus., Tokyo, Ser. C*, 15(2):53-70, pls. 9-13, figs. 16-21.

583 KIMURA Tatsuaki and OHANA Tamiko (1990): Triassic-Jurassic plants in Japan. In K. Ichikawa, S. Mizutani, I. Hara, S. Hada and A. Yao (eds.): Pre-Cretaceous terranes of Japan. Publication of IGCP Project 224, Osaka, 371-379, fig. 1.

584 KIMURA Tatsuaki, OHANA Tamiko and AIBA Hiroaki (1990): Late Jurassic plants from the Shishiori Group in the outer zone of northeast Japan (1). *Bull. Natn. Sci. Mus., Tokyo, Ser. C*, 16(4):127-153, figs. 1-23.

585 KIMURA Tatsuaki, OHANA Tamiko, KURIHARA Yutaka and KOMORI Kazuo (1986): Middle Jurassic Utano Flora and its significance for biostratigraphy and palaeophytogeography in east Asia (abstract). *Proc. Japan Acad., Ser. B*, 62(9):341-344, fig. 1.

586 KIMURA Tatsuaki, OHANA Tamiko and MIMOTO Kenji (1988): Discovery of a podocarpaceous plant from the Lower Cretaceous of Kochi Prefecture, in the outer zone of southwest Japan. *Proc. Japan Acad., Ser. B*, 64(8):213-216, figs. 1-4.

587 KIMURA Tatsuaki, OHANA Tamiko, TAKIMOTO Hideo, IKEHARA Ken, AIBA Hiroaki and FURUOYA Hiroyuki (1988): Late Jurassic plants in the outer zone of northeast Japan. *Proc. Japan Acad., Ser. B*, 64(8):217-220, fig. 1.

588 KIMURA Tatsuaki, OHANA Tamiko and TSUJII Masanori (1988): Early Jurassic plants in Japan. Part 8. Supplementary description and concluding remarks. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (151):501-522, figs. 1-21, tabs. 1-2.

589 KIMURA Tatsuaki and OKAWARA Hitomi (1986): Discovery of fossil plants from the "Okunikko Ryolites" at the Kaorizawa Valley, Katashina-mura, Tone-gun, Gumma Prefecture. *Jour. Geol. Soc. Japan*, 92(7):525-526, figs. 1-2. (群馬県利根郡片品村香沢に分布する奥日光流紋岩類より植物化石の発見) (J.)

590 KIMURA Tatsuaki, TANIMOTO Yasunori and MIYAMOTO Takami (1986): Discovery of late Devonian plants from the "Yuzuruha" Formation, Kyushu, southwest Japan. *Jour. Geol. Soc. Japan*, 92(11):813-816, figs. 1-2.

591 **KISHIDA Yojiro** and HISADA Ken-ichiro (1986): Radiolarian assemblages of the Sambosan Belt in the western part of the Kanto Mountains, central Japan. *NOM, Spec. Vol.*, (7):25-34, figs. 1-8, tabs. 1-3. (関東山地西部三宝山帯の放散虫群集) (J.E.)

592 **KITAGAWA Yoshio**, IGARASHI Yaeko, YOSHIDA Mitsuo and KOSHIMIZU Satoshi (1988): Pleistocene stratigraphy in the Ishikari lowland, Hokkaido Japan.

Mem. Geol. Soc. Japan, (30):13-23, figs. 1-2, tabs. 1-2. (北海道石狩低地帯周辺の更新統) (J.E.)

593 **KITAMURA Akihisa** (1990): An attempt to infer paleocurrent from orientation of open, yet articulated bivalves shells -A case study of *Clinocardium fastosum* from the Omma Formation (early Pleistocene)-. *Jour. Geol. Soc. Japan*, 96(8):613-621, pl. 1, figs. 1-5. (殻が開いた状態のニ枚貝化石による古流向の推定－大桑層産*Clinocardium fastosum* の場合－) (J.E.)

594 KITAMURA Akihisa and KONDO Yasuo (1990): Cyclic changes of sediments and molluscan fossil associations caused by glacio-eustatic sea-level changes during the early Pleistocene -A case study of the middle part of the Omma Formation at the type locality-. *Jour. Geol. Soc. Japan*, 96(1):19-36, pl. 1, figs. 1-15. (前期更新世の氷河性海水準変動による堆積サイクルと貝化石群集の周期的変化－模式地の大桑層中部の例－) (J.E.)

595 **KITANAKA Takuo** and FUJI Norio (1988): Neogene Daijima-type "Tatsunokuchi Fossil Flora" in Kaga, Ishikawa Prefecture, central Japan. *Bull. Fac. Educ., Kanazawa Univ., Nat. Sci.*, (37):97-117, pls. 1-4, figs. 1-4, tabs. 1-5. (J.E.)

596 **KITAZATO Hiroshi** (1986): [Paleogeographic development of the southern Fossa Magna district]. *Earth Month.*, 8(10):605-611, figs. 1-5. (南部フォッサマグナ地域における古地理の変遷) (J.)

597 KITAZATO Hiroshi (1986): Ecological observations of Benthic Foraminfera living in the rocky shore. In Y. Matoba and M. Kato (eds.): Studies on Cenozoic Benthic Foraminifera in Japan. Akita Univ., Akita, 1-12, pls. 1-2, figs. 1-3, tabs. 1-2. (岩礁地生底生有孔虫類の生態) (J.)

598 KITAZATO Hiroshi (1986): [What animal is Foraminifera: Considerations for the movement and functional morphology of test in Benthic Foraminifera]. *Mar. Sci. Month.*, 18(9):552-557, figs. 1-9. (有孔虫とはどういう生物か？－底生有孔虫の運動と殻の機能形態についての考察－) (J.)

599 KITAZATO Hiroshi (1987): [Fossil Foraminifera -Fossil Foraminifera occurred from the Holocene deposits of Kawasaki City-]. In Y. Matsushima (ed.): The geological studies on the Alluvial deposits in the Tama and Tsurumi Rivers lowland, Kawasaki. Data Collecting Committee of Kawasaki City Museum, Kawasaki. 39-49, pls. 1-2, figs. 23-26. (有孔虫化石の調査－川崎の沖積層から産出する有孔虫化石－) (J.)

600 KITAZATO Hiroshi (1987): [Geographic distributions of Benthic Foraminifera in the south Fossa-Magna region, central Japan]. *Fossils, Palaeont. Soc. Japan*, (43):18-23. (南部フォッサマグナにおける底生有孔虫の古生物地理) (J.E.)

601 KITAZATO Hiroshi (1988): [Biology of Benthic Foraminifera]. *Yukochu Kenkyu (=Stud. Foraminifera)*, (1):28-32. (底生有孔虫の生物学) (J.)

602 KITAZATO Hiroshi (1988): Ecology of Benthic Foraminifera in the tidal zone of a rocky shore. *Rev. Paleobiol., Spec. Vol.*, 815-825, pls. 1-2, figs. 1-5.

603 KITAZATO Hiroshi (1988): Geology of the axial part of the Suruga Trough -Diving survey reports of the submersible "Shinkai 2000", Dive No. 309-. *JAMSTECTR Deepsea Res.*, 89-100, photos. 1-2, figs. 1-5, tabs. 1-2. (駿河トラフ中軸部の地質－「しんかい2000」による潜航調査報告－) (J.E.)

604 KITAZATO Hiroshi (1988): Locomotion of some Benthic Foraminifera in and on sediments. *Jour. Foram. Res.*, 18(4):344-349, pl. 1, figs. 1-4.

605 KITAZATO Hiroshi (1989): [Study on functional morphology of Benthic Foraminifera]. Report of research project, grant-in-aid for scientific research, (B) 1988, Shizuoka, 1-13. (底生有孔虫類の機能形態学的研究) (J.)

606 KITAZATO Hiroshi (1989): Vertical distribution of Benthic Foraminifera within sediments (Preliminary report). *Benthos Res.*, (35/36):41-51, pls. 1-2. (底生有孔虫類の堆積物中での垂直分布(予報)) (J.E.)

607 KITAZATO Hiroshi and ARAI Fusao (1986): On-Pm 1 tephra in the Oshika Formation, Udo hill. *Geosci. Rep., Shizuoka Univ.*, (12):245-249, pl. 1, figs. 1-3. (有度丘陵, 小鹿層に挟在するOn-Pm 1テフラ) (J.E.)

608 KITAZATO Hiroshi and MATSUMARU Kuniteru (1990): Neogene sequences of Izu-Kakegawa region. Guidebook for the field trip no. 3, 4th International Symposium on Benthic Foraminifera, Sendai, 1-30, pls. 1-7, figs. 1-17.

609 **KITO Norio** (1987): Stratigraphic relation between greenstones and clastic sedimentary rocks in the Kamuikotan Belt, Hokkaido, Japan. *Jour. Geol. Soc. Japan*, 93(1):21-35, pls. 1-3, figs. 1-9, tabs. 1-3. (北海道神居古潭帯における緑色岩と砕屑性堆積岩の関係) (J.E.)

610 KITO Norio, KAIHO Kunio, TAKAHASHI Koji and WADA Nobuhiko (1986): Geologic age of the pleisiosaurian fossil from Hobetsu-cho, Hokkaido, Japan. *Bull. Hobetsu Mus.*, (3):1-6, pls. 1-3. (北海道穂別町産長頸竜化石の地質年代) (J.)

611 **KIYOHARA Hosimi** and MORIOKA Hiroshi (1987): ^{14}C age of *Palaeoloxodon naumanni* (Makiyama) from the sea bottom off the coast of San'in -^{14}C age of the Quaternary deposits in Japan (165)-. *Earth Sci.*, 41(4):248-250, figs. 1-3. (山陰沖海底産ナウマンゾウ化石の^{14}C年代－日本の第四紀層の^{14}C年代(165)－) (J.)

612 **KIYONAGA Jota** (1990): Pollen analysis of Holocene sediments from lowland along the Kashio River, southwestern part of Yokohama, Japan. *Quat. Res., Japan*, 29(4):351-360, figs. 1-4. (横浜市南西部, 柏尾川低地で得られた完新世堆積物の花粉分析) (J.E.)

613 **KOBAYASHI Fumio** (1986): Middle Permian foraminifers of the Gozenyama Formation, southern Kwanto Mountains, Japan. *Bull. Natn. Sci. Mus., Tokyo, Ser. C*, 12(4):131-163, pls. 1-10.

614 KOBAYASHI Fumio (1988): Middle Permian foraminifers of the Omi Limestone, central Japan. *Bull. Natn. Sci. Mus., Tokyo, Ser. C*, 14(1):1-35, pls. 1-13.

615 KOBAYASHI Fumio (1988): Late Paleozoic foraminifers of the Ogawadani Formation, southern Kwanto Mauntains, Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (150):435-452, figs. 1-7, tab. 1.

616 **KOBAYASHI Hiroaki** (1988): Neogene silicoflagellate biostratigraphy of the Japan Sea coastal region, with reference to DSDP Hole 438A. *Sci. Rep., Tohoku Univ., 2nd Ser.*, 59(1):1-98, pls. 1-24, figs. 1-28, append. 1.

617 **KOBAYASHI Iwao** (1986): Character and development of the Omma-Manganji fauna in the Niigata oil-field, central Japan. *Spec. Pap., Palaeont. Soc. Japan*, (29):245-255, pl. 21, figs. 1-3, tabs. 1-2.

618 KOBAYASHI Iwao (1988): Growth pattern on the inner shell surface and the internal shell structure of some gastropods. *Saito Ho-on Kai, Spec. Pub. (Prof. T. Kotaka Commem. Vol.)*, (3):221-228, pls. 1-4, fig. 1, tabs. 1-3.

619 KOBAYASHI Iwao (1988): Shell structure of bivalvian molluscs and its phylogenetical evolution. In M. Omori, S. Suga and M. Goto (eds.): Biomineralization and phylogeny of marine organisms. Tokai Univ. Press, Shimizu, 97-112, figs. 1-5, tab. 1. (二枚貝の貝殻構造とその系統進化) (J.)

620 KOBAYASHI Iwao (1990): Plio-early Pleistocene faunal change in the paleo-Japan Sea, especially in the Niigata oil-field area, central Honshu, Japan. In R. Tsuchi (ed.): Pacific Neogene events. Univ. Tokyo Press, Tokyo, 77-83, figs. 1-4.

621 KOBAYASHI Iwao and SASAGAWA Ichiro (1987): Tertiary elasmobranchs fossil from Hiranezaki, Sado Island -The paleontological study of the Orito Formation (Part 2)-. *Pub. Sado Mus.*, (9):231-237, pl. 1, figs. 1-2. (佐渡, 平根崎における新第三系産の板鰓類化石－下戸層の古生物学的研究(その２)－) (J.E.)

622 KOBAYASHI Iwao, TAKAYASU Katsumi and TATEISHI Masaaki (1989): Outline of Neogene events of marine environment in the Niigata and San-in sedimentary basins, central and southwest Japan. Proceeding International Symposium on Pacific Neogene continental and marine events, Matsue, 7-17, figs. 1-5, tabs. 1-2.

623 KOBAYASHI Iwao and TATEISHI Masaaki (1987): Quaternary stratigraphy of Niigata district, central Japan. Proceedings of the First International Colloquium on Quaternary stratigraphy of Asia and Pacific area, Osaka. 43-54, figs 1-3, tab. 1.

624 KOBAYASHI Iwao, TATEISHI Masaaki, YASUI Satoshi, KAZAOKA Osamu, KUROKAWA Katsuki, ABURAI Hiroshi and WATANABE Kikuo (1986): Stratigraphy and paleoenvironment of Nishiyama and Haizume Formations and Uonuma Group in Niigata sedimentary basin. *Jour. Geol. Soc. Japan*, 92(5):375-390, figs. 1-8. (新潟積成盆地における西山・灰爪累層, 魚沼層群の層序と古環境) (J.E.)

625 KOBAYASHI Iwao, YAHATA Tomoko, SUGIMOTO Shizuko and IYODA Shigeko (1986): Molluscan fauna of the Haizume Formation in the Nishiyama oil-field, Niigata Prefecture. *Monogr. Mizunami Fossil Mus.*, (6):105-118, pls. 15-16, figs. 1-3, tabs. 1-4. (新潟県西山油帯における灰爪累層の軟体動物化石群) (J.E.)

626 KOBAYASHI Iwao and YOSHIWARA Kazuyoshi (1990): Cephalopodian fossil from the Middle Miocene Teradomari Formation in the Niigata district, central Japan. *Earth Sci.*, 44(5):283-286, figs. 1-3. (中部中新統の寺泊層から産出した頭足類化石) (J.)

627 **KOBAYASHI Teiichi** (1986): A comparison of the Cambrian trilobites between the north and south side of the western Pacific basin. *Proc. Japan Acad., Ser. B*, 62(8):295-298.

628 KOBAYASHI Teiichi (1986): Relation between the Ordovician faunas of Asia and Australia. *Proc. Japan Acad., Ser. B*, 62(8):299-302.

629 KOBAYASHI Teiichi (1986): On the Pacific biogeography of the Cambro-Ordovician age. *Proc. Japan Acad., Ser. B*, 62(10):373-376.

630 KOBAYASHI Teiichi (1986): A contribution to the history of geological researches in eastern Asia: 1. *Jour. Geogr.*, 95(3):186-198, figs. 1-2, tabs. 1-2. (東亜地質研究史考－前篇) (J.E.)

631 KOBAYASHI Teiichi (1986): A contribution to the history of geological researches in eastern Asia: (2). *Jour. Geogr.*, 95(4):225-240, figs. 3-5, tab. 3. (東亜地質研究史考－中篇) (J.E.)

632 KOBAYASHI Teiichi (1986): A contribution to the history of geological researches in eastern Asia: (3). *Jour. Geogr.*, 95(5):367-382, fig. 6. (東亜地質研究史考－後篇) (J.E.)

633 KOBAYASHI Teiichi (1986): A contribution to the history of geological researches in eastern Asia: Supplement. *Jour. Geogr.*, 95(6):424-435. (東亜地質研究史考－続篇) (J.)

634 KOBAYASHI Teiichi (1986): "Principles of palaeontology" and textbook of palaeontology. *Jour. Geogr.*, 95(2):143-144. (「古生物学の基礎」と古生物学教科書) (J.)

635 KOBAYASHI Teiichi (1987): The Cambro-Ordovician in eastern Asia, its history of research and the present status. *Jour. Geogr.*, 96(1):46-63, figs. 1-9, tab. 1. (東亜細亜の寒武奥陶両系－其の探求史と現在の知識) (J.E.)

636 KOBAYASHI Teiichi (1987): The Cambrian and Ordovician Systems in the Asian-Pacific area: (1). *Jour. Geog.*, 96(2):98-111, figs. 1-5, tabs. 1-3. (太平洋地域の寒武奥陶両系層序論－前篇) (J.E.)

637 KOBAYASHI Teiichi (1987): The Cambrian and Ordovician Systems in the Pacific area: (2). *Jour. Geogr.*, 96(3):131-143, figs. 6-9, tabs. 4-5. (太平洋地域の寒武奥陶両系層序論－中篇) (J.E.)

638 KOBAYASHI Teiichi (1987): The Cambrian and Ordovician Systems around the Pacific basin, Part 3. *Jour. Geogr.*, 96(5):259-277, figs. 10-11, tabs. 6-10. (太平洋地域の寒武奥陶両系層序論－後篇) (J.E.)

639 KOBAYASHI Teiichi (1987): The Cambrian and Ordovician Systems in the south side of Eurasia and the origin of the Tethys Sea. *Jour. Geogr.*, 96(6):339-368, figs. 1-3, tabs. 1-11. (欧亜大陸南側の寒武奥陶両系とテチス海の起源) (J.E.)

640 KOBAYASHI Teiichi (1987): On the Redlichiacea (Trilobita) and the Redlichian province. *Proc. Japan Acad.*, *Ser. B*, 63(2):43-46.

641 KOBAYASHI Teiichi (1987): On the Damesellidae (Trilobita) in eastern Asia. *Proc. Japan Acad.*, *Ser. B*, 63(3):59-62, fig. 1, tab. 1.

642 KOBAYASHI Teiichi (1987): On the Damesellian province of the early Upper Cambrian age on the west Pacific side. *Proc. Japan Acad.*, *Ser. B*, 63(3):63-66.

643 KOBAYASHI Teiichi (1987): The trilobite provinciality of the Tethys Sea in Cambrian Period. *Proc. Japan Acad.*, *Ser. B*, 63(4):119-122, figs. 1-6.

644 KOBAYASHI Teiichi (1987): The ancestory of the Cephalopoda. From *Helcionella* to *Plectronoceras*. *Proc. Japan Acad.*, *Ser. B*, 63(5):135-138, figs. 1-3.

645 KOBAYASHI Teiichi (1987): A Permian trilobite from Spitsbergen, Norway with a note on the biogeographic bearing of genus *Neoproetus*. *Proc. Japan Acad.*, *Ser. B*, 63(5):139-142, fig. 1.

646 KOBAYASHI Teiichi (1987): Ordovician cephalopods in Hwangho basin, eastern Asia. *Proc. Japan Acad., Ser. B*, 63(7):235-238.

647 KOBAYASHI Teiichi (1987): Ordovician cephalopods in Yangtze and neighbouring areas. *Proc. Japan Acad., Ser. B*, 63(7):239-241.

648 KOBAYASHI Teiichi (1987): On the *Manchuroceras* and *Piloceras* provinces in the Ordovician Period. *Proc. Japan Acad., Ser. B*, 63(9):310-312.

649 KOBAYASHI Teiichi (1987): Comparison of Ordovician cephalopods between Australia and eastern Asia. *Proc. Japan Acad., Ser. B*, 63(9):313-315.

650 KOBAYASHI Teiichi (1987): Ordovician cephalopods in the Andes, south America. *Proc. Japan Acad., Ser. B*, 63(9):316-318.

651 KOBAYASHI Teiichi (1987): Ordovician cephalopods in the boreal areas. *Proc. Japan Acad., Ser. B*, 63(9):319-322.

652 KOBAYASHI Teiichi (1988): On the Cambro-Ordovician Formations in the northern areas. *Jour. Geogr.*, 97(1):1-9, fig. 1, tabs. 1-3. (北方の寒武・奥陶両系所見) (J.E.)

653 KOBAYASHI Teiichi (1988): The Silurian biostratigraphy of the Asian-Pacific area discussed from the view-point of Trilobita. *Jour. Geogr.*, 97(3):125-143, tabs. 1-8. (三葉虫群に基づくアジア・太平洋地域の志留紀古地理論) (J.E.)

654 KOBAYASHI Teiichi (1988): The Devonian trilobites in Japan and their comparison with the neighbouring faunas. *Jour. Geogr.*, 97(7):663-671, fig. 1, tabs. 1-4. (泥盆紀の日本三葉虫群とその古地理論上の意義) (J.E.)

655 KOBAYASHI Teiichi (1988): The Silurian cephalopods and trilobites from the Yokokurayama Formation, Shikoku, Japan. *Proc. Japan Acad., Ser. B*, 64(1):1-4.

656 KOBAYASHI Teiichi (1988): The Silurian trilobites in Japan. *Proc. Japan Acad., Ser. B*, 64(1):5-8, tabs. 1-2.

657 KOBAYASHI Teiichi (1988): Relation between the Silurian trilobites of Japan and Mongolian geosyncline. *Proc. Japan Acad., Ser. B*, 64(4):81-84, tab. 1.

658 KOBAYASHI Teiichi (1988): Comparison of the Silurian trilobites in Japan, South China, Thailand and Malaysia. *Proc. Japan Acad., Ser. B*, 64(4):85-87, tab. 1.

659 KOBAYASHI Teiichi (1988): The Silurian trilobites of the Asian Pacific areas. *Proc. Japan Acad., Ser. B*, 64(4):88-91, tab. 1.

660 KOBAYASHI Teiichi (1988): The Devonian trilobites from the Fukuji and other Formations in Japan. *Proc. Japan Acad., Ser. B*, 64(5):103-105, tab. 1.

661 KOBAYASHI Teiichi (1988): New trirobites of the Devonian Fukuji Fauna. *Proc. Japan Acad., Ser. B*, 64(5):106-107, figs. 1-10.

662 KOBAYASHI Teiichi (1988): The Japanese Islands in the Palaeozoic age. *Proc. Japan Acad., Ser. B*, 64(6):143-146.

663 KOBAYASHI Teiichi (1988): The Japanese Islands of the Mesozoic age. *Proc. Japan Acad., Ser. B*, 64(7):190-192, fig. 1.

664 KOBAYASHI Teiichi (1989): The Permo-Carboniferous palaeogeography of eastern Asia discussed with reference to trilobite faunas. *Jour. Geogr.*, 98 (1):34-48, figs. 1-5, tabs. 1-5. (二畳・石炭紀の日本産三葉虫群に基づく古生代後期の東亜細亜古地理論) (J. E.)

665 KOBAYASHI Teiichi (1989): A general view on the growth of the Japanese Island. *Jour. Geogr.*, 98(2):164-173, figs. 1-3. (日本列島形成史の達観) (J. E.)

666 KOBAYASHI Teiichi (1989): The early Palaeozoic cephalopods of eastern Asia. *Lethaea*, 69(5/6):369-379, figs. 1-7.

667 KOBAYASHI Teiichi (1990): Bibliography of geology and palaeontology of Japan in the Meiji-Taisho age, 1 (Foreign authors). *Jour. Geogr.*, 99(2): 198-201. (明治大正時代の日本地質古生物学の文献目録1(外国人)) (J.)

668 KOBAYASHI Teiichi and HAMADA Takashi (1986): A new Permian genus of Trilobita from Bolivia. *Proc. Japan Acad.*, *Ser. B*, 62(6):181-183, figs. 1-4.

669 KOBAYASHI Teiichi and HAMADA Takashi (1986): On the change of provinciality of late Palaeozoic trilobites in South America. *Proc. Japan Acad.*, *Ser. B*, 62(7):224-226.

670 KOBAYASHI Teiichi and HAMADA Takashi (1986): The second addition to the Silurian trilobite fauna of Yokokura-yama, Shikoku, Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (143):447-462, pls. 90-92, figs. A-C.

671 KOBAYASHI Teiichi and HAMADA Takashi (1987): A new Carboniferous trilobite from the Hida plateau, west Japan. *Proc. Japan Acad.*, *Ser. B*, 63(4):115-118, figs. 1-5

672 KOBAYASHI Teiichi and HAMADA Takashi (1987): The third addition to the Silurian trilobite fauna of Yokokurayama, Shikoku, Japan. *Trans. Proc. Palaeont. Soc. Japan. N. S.*, (147):109-116, figs. 1-3.

673 KOBAYASHI Teiichi and HAMADA Takashi (1987): On the Silurian trilobite faunule of Hitoegane near Fukuji in the Hida plateau, Japan. *Trans. Proc. Palaeont. Soc. Japan. N. S.*, (147):131-145, figs. 1-5.

674 KOBAYASHI Teiichi and HAMADA Takashi (1988): Present status of studies on Silurian trilobites and cephalopods in Japan. *Jour. Geogr.*, 97(6):543-554, fig. 1, tabs. 1-4. (日本の志留紀三葉虫と頭足類とその古地理的意義) (J. E.)

675 KOBAYASHI Teiichi and SAKAGAMI Sumio (1989): A Silurian trilobite from Thailand. *Proc. Japan Acad.*, *Ser. B*, 65(3):31-33, fig. 1.

676 KOBAYASHI Teiichi and SAKAGAMI Sumio (1989): A new Carboniferous trilobite from north Thailand. *Proc. Japan Acad.*, *Ser. B*, 65(4):64-66, fig. 1.

677 KOBAYASHI Teiichi and SAKAGAMI Sumio (1989): A Permian trilobite from north Thailand. *Proc. Japan Acad.*, *Ser. B*, 65(4):67-69, fig. 1.

678 KOBAYASHI Teiichi and SAKAGAMI Sumio (1989): On the trilobites in Thailand and Malaysia. *Proc. Japan Acad.*, *Ser. B*, 65(5):70-72, fig. 1, tab. 1.

679 **KOBAYASHI Yasuhiko** (1987): Molluscan assemblage from the Otanoshike Formation, Kushiro area. Prof. M. Matsui Mem. Vol., Sapporo, 113-129, pls. 1-3, figs. 1-3, tabs. 1-3. (大楽毛層の軟体動物化石) (J.)

680 **KODATO Toshio** (1988): [Foraminiferal assemblages in carbonate sediments in the sea around Miyako-jima]. *Jour. Japan. Assoc. Petrol. Tech.*, 53(4):302. (宮古島周辺海域における炭酸塩堆積物中の有孔虫群集) (J.)

681 KODATO Toshio and NAKAGAWA Hiroshi (1989): [Foraminifera in carbonate sediments in the sea surrounding the Miyakojima]. *Jour. Japan. Assoc. Petrol. Tech.*, 54(4):61. (宮古島周辺海域における炭酸塩堆積物中の有孔虫群集(その2)) (J.)

682 **KODERA Haruto** and NOMURA Takamitsu (1988): Early Miocene cyprinid fishes collected from the Hachiya Formation, Gifu Prefecture, Japan. *Bull. Mizunami Fossil Mus.*, (14):1-12, pls. 1-2, figs. 1-7, tabs. 1-2. (岐阜県蜂屋累層の前期中新世コイ科魚類化石) (J.E.)

683 **KOIKE Hiroko** (1986): Microstructure of growth increments in the shell of *Mercenaria mercenaria* (Linne). *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (141):289-295, pls. 51-52.

684 KOIKE Hiroko, NAKAJIMA Tohru and NAKAI Nobuyuki (1989): Stable carbon isotopic and gut content analysis of a tidal flat food web. *Benthos Res.*, (37):1-10, figs. 1-5. (安定同位体と消化管珪藻分析による干潟植物網の解析について－現生生態学と古生態学の接点－) (J.E.)

685 **KOIKE Toshio** (1988): Lower Triassic conodonts *Platyvillosus* from the Taho Limestone in Japan. *Sci. Rep., Yokohama Natn. Univ., Sec. 2*, (35):61-79, pls. 1-2, figs. 1-6, tab. 1.

686 KOIKE Toshio (1990): The conodont apparatus of *Ellisonia triassica* Muller. *Sci. Rep., Yokohama Natn. Univ., Sec. 2*, (37):35-46, pls. 1-2, figs. 1-6, tab. 1.

687 **KOIZUMI Akihiro** (1990): The Naumann's elephant found from the latest Pleistocene deposits in Yokohama. *Nat. Hist. Rep., Kanagawa Pref. Mus.*, (11): 49-52, figs. 1-5. (横浜市港北区東山田から産出した新期ローム層堆積期のナウマンゾウ化石) (J.)

688 KOIZUMI Akihiro (1990): Early Pleistocene Otariidae from Iimuro Formation, Kawasaki, Kanagawa Prefecture, Japan. *Bull. Kanagawa Pref. Mus., Nat. Sci.*, (19):45-66, figs. 1-14, tabs. 1-5. (川崎市の上総層群飯室層(下部更新統)産アシカ科動物化石について) (J.E.)

689 KOIZUMI Akihiro and MATSUSHIMA Yoshiaki (1990): Molluscan fossils of the genus *Panomya* from the Lower Pleistocene Koshiba Formation in the southern area of Yokohama. *Nat. Hist. Rep., Kanagawa Pref. Mus.*, (11):13-22, figs. 1-6, tab. 1. (横浜南部の上総層群小柴層(前期更新世)から産出したチシマガイ類二枚貝化石について) (J.)

690 KOIZUMI Akihiro, MATSUSHIMA Yoshiaki and ARAI Fusao (1990): Elephant fossil from the lower part of Oshinuma Formation and paleoenvironment, Kawawa, Yokohama, Japan. *Bull. Kanagawa Pref. Mus., Nat. Sci.*, (19):1-17, figs. 1-10, tabs. 1-2. (横浜北部オシ沼層下部層の長鼻類化石と古環境について) (J.E.)

691 **KOIZUMI Itaru** (1986): Diatom biochronostratigraphy of the Neogene in the Joban coal-field, northeast Japan -Yunagaya, Shirado and Takaku Groups-. In H. Nakagawa, T. Kotaka and Y. Takayanagi (eds.): Essays in geology, Prof. N. Kitamura Commem. Vol. Toko Print., Pub. Dept., Sendai, 175-191, pls. 1-2, figs. 1-4, tabs. 1-4. (常磐炭田新第三系の珪藻年代層序－湯長谷・白土・高久層群－) (J.E.)

692 KOIZUMI Itaru (1986): Late Neogene diatom temperature record in the northwest Pacific Ocean. *Sci. Rep., Coll. Gen. Educ., Osaka Univ.*, 34(2):145-153, figs. 1-3.

693 KOIZUMI Itaru (1986): Pliocene and Pleistocene diatom datum levels related with paleoceanography in the northwest Pacific. *Mar. Micropaleont.*, 10 (4):309-325, pls. 1-4, figs. 1-8, tabs. 1-2.

694 KOIZUMI Itaru (1986): [Siliceous sediments and marine events in the Miocene]. *Mar. Sci., Month.*, 18(3):146-153, figs. 1-4. (中新世の珪質堆積物と海洋事件) (J.)

695 KOIZUMI Itaru (1987): [Planktic microfossils as recorders of paleoclimatic and oceanic changes]. *Earth Month.*, 9(12):712-719, figs. 1-11, tab. 1. (古気候変動と海流系変動の記録者としての浮遊性微化石) (J.)

696 KOIZUMI Itaru (1987): Pulses of Tsushima current during the Holocene. *Quat. Res., Japan*, 26(1):13-25, pls. 1-3, figs. 1-7. (完新世における対馬暖流の脈動) (J.)

697 KOIZUMI Itaru (1988): Early Miocene proto-Japan Sea. *Jour. Paleont. Soc. Korea*, 4(1):6-20, pls. 1-2, figs. 1-4, tabs. 1-3.

698 KOIZUMI Itaru (1989): Holocene pilsea of daiatom growths in the warm Tsushima current in the Japan Sea. *Daiatom Res.*, 4(1):55-68, figs. 1-38.

699 KOIZUMI Itaru (1990): Miocene to Pliocene marine diatoms from Caleta Herradura de Mejillones section, Chile. *Rep. Andean Stud., Shizuoka Univ., Spec. Vol.*, 3:17-22, figs. 1-2, tab. 1.

700 KOIZUMI Itaru (1990): Successional changes of middle Miocene diatom assemblages in the northwestern Pacific. *Palaeogeogr. Palaeoclimat. Palaeoecol.*, 77(2/3):181-193, figs. 1-9.

701 KOIZUMI Itaru (1990): The disappearance of the *Coscinodiscus yabei* Zone in the subarctic Hokkaido region. *Jour. Fac. Sci., Hokkaido Univ., Ser. 4*, 22(4):577-589, pl. 1, figs. 1-4, tab. 1.

702 KOIZUMI Itaru and MATOBA Yasumochi (1989): On the top of the Nishikurosawa Stage. *Mem. Geol. Soc. Japan*, (32):187-195, pl. 1, figs. 1-4. (西黒沢階の上限について) (J.E.)

703 KOIZUMI Itaru and YANAGISAWA Yukio (1990): Evolutionary change in diatom morphology -An example from *Nitzschia fossilis* to *Pseudoeunotia doliolus*-. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (157):347-359, figs. 1-9.

704 **KOJIMA Fumitoshi**, HAYANO Noriko, HAYANO Hisamitu, HIRANO Takumi, YANO Sinji, YAMADA Kazumi and IZAWA Kenji (1989): Notes on Permian trilobites from Akuda, Gujouhatiman, Gifu Prefecture, central Japan. *Chigaku Kenkyu*, 38(7/9):167-174, pls. 1-2, figs. 1-2, tab. 1. (郡上八幡産ペルム紀三葉虫について) (J.)

705 **KOJIMA Natsuhiko** (1989): Dinoflagellate cyst analysis of Holocene sediments from Lake Hamana in central Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (155):197-211, figs. 1-7, tabs. 1-3.

706 **KOJIMA Satoru** (1986): Occurrence of Permian radiolarians from chert pebbles in conglomerate at Yokoo, Nyukawa Village, Gifu Prefecture, central Japan. *NOM, Spec. Vol.*, (7):175-179, figs. 1-3. (岐阜県大野郡丹生川村横尾付近に

分布する礫岩より二畳紀放散虫化石の産出) (J.E.)

707 KOJIMA Satoru (1989): Mesozoic terrane accretion in northeast China, Sikhote-Alin and Japan regions. *Palaeogeogr. Palaeoclimat. Palaeoecol.*, 69(3/4):213-232, pls. 1-2, figs. 1-6, tab. 1.

708 KOJIMA Satoru and MIZUTANI Shinjiro (1987): Triassic and Jurassic Radiolaria from the Nadanhada range, northeast China. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (148):256-275, figs. 1-5, tab. 1.

709 KOJIMA Satoru, MIZUTANI Shinjiro, NAGAI Hiromi, SAITO Makoto, TSUKAMOTO Hitoshi and YOGO Michiyo (1989): Design and utilization of the data base system for radiolarian fossils in the Nagoya University Museum. *Bull. Nagoya Univ. Mus., Furukawa Mus., Spec. Rep.*, (1):1-192. (名古屋大学総合研究資料館(古川資料館)における放散虫化石データベースの構築とその利用) (J.E.)

710 **KOMA Takeshi**, ANDO Kazuo, UNOZAWA Akira and SAKAMOTO Toru (1988): Geochemical study on sedimentary environment of Quaternary mudstones of Urizura hill, Ibaraki Prefecture, Japan. *Bull. Geol. Surv. Japan*, 39(9):573-599, figs. 1-16, tabs. 1-4. (茨城県中部瓜連丘陵の第四系泥質層の化学組成・化石珪藻から見た堆積環境) (J.E.)

711 **KONDA Isao** and CHIJI Manzo (1987): Change of foraminiferal thanatocoenoses of the Osaka Bay during the late fifty years. *Bull. Kansai Nat. Reserv. Organization*, (14):11-22. pls. 1-2. (大阪湾における有孔虫群集の変化) (J.E.)

712 KONDA Isao and CHIJI Manzo (1989): Change of foraminiferal thanatocoenoses in Tanabe Bay, Kii Peninsula, during the last thirty years. In Y. Takayanagi and K. Ishizaki (eds.): Collected papers on Foraminifera from the Japanese Islands. Toko Printing, Pub. Dept., Sendai, 105-110. (紀伊半島田辺湾における最近の有孔虫群集の変化) (J.E.)

713 KONDA Isao and MIZUNO Atsuyuki (1987): Middle Holocene foraminiferal assemblages in the boring cores from the Lake Shinji and the eastern Hikawa plain. *Stud. San'in Reg., Nat. Environ., Shimane Univ.*, (3):175-185, pl. 1. (宍道湖・斐川平野東部のボーリングコア中の有孔虫群集) (J.E.)

714 **KONDO Shintaro**, SETOGUCHI Takeshi, SHIGEHARA Nobuo and NAGAI Hiroshi (1990): A morphological study of the dental arch in colobus monkeys. *Japan. Jour. Oral Biol.*, 32:337-350. (コロブスモンキーにおける歯列弓の形態学的研究) (J.E.)

715 **KONDO Tsutomu**, IGARASHI Yaeko and SAGAYAMA Tsumoru (1988): Middle to Upper Pleistocene deposits of Shizukawa hills in Hokkaido -Discussion on the cold stage and the relative sea-level change during the last interglacial age-. *Jour. Geol. Soc. Japan*, 94(5):343-359, figs. 1-8, tabs. 1-5. (北海道静川台地の中～上部更新統－特に最終間氷期中の寒冷期および相対的海水準変化) (J.E.)

716 **KONDO Yasuo** (1986): Shallow marine gravelly deltas and associated faunas from the Upper Pleistocene Negoya Formation, Shizuoka, Japan. *Jour. Fac. Sci., Univ. Tokyo, Sec. 2*, 21:169-190, pl. 3, fig. 11.

717 KONDO Yasuo (1986): Spatial distribution of Benthic Foraminifera from the transgressive deposits in the late Pleistocene Negoya Formation, Shizuoka Prefecture, Japan. *Geosci. Rep., Shizuoka Univ.*, (12):239-243, fig. 1, tab. 1. (静岡県後期更新世根古屋層の海進期堆積物に含まれる底生有孔虫化石の空間分布) (J.E.)

718 KONDO Yasuo (1987): Burrowing depth of infaunal bivalves-Observation of living species and its relation to shell morphology. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (148):306-323, figs. 1-6, tab. 1, append. figs. 1-9.

719 KONDO Yasuo (1989): A method of analyzing mode of occurrence of bivalve fossils -Comparison of position and orientation of living and fossil bivalves-. *Benthos Res.*, (37):73-82. figs. 1-5. (二枚貝化石の産状観察法－現生二枚貝の堆積物内における生息位置と化石二枚貝の地層中における方向性との比較観察法－) (J.E.)

720 KONDO Yasuo (1989): Faunal condensation in early phases of glacio-eustatic sea-level rise, found in the middle to late Pleistocene Shimosa Group, Boso Peninsula, central Japan. In A. Taira and F. Masuda (eds.): Sedimentary facies in the active plate margin. Terra Pub, Tokyo, 197-212, figs. 1-6.

721 KONDO Yasuo (1989): 'In situ' observation of a bathyal bivalve *Limopsis tajimae* by mean of box core sampling, with comparative description of the fossil counterparts. *Venus, Japan. Jour. Malacol.*, 48(1):27-39, figs. 1-8, tab. 1.

722 KONDO Yasuo(1990): Preserved life orientations of soft-bottom infaunal bivalves: Documentation of some Quaternary forms from Chiba, Japan. *Nat. Hist. Res., Nat. Hist. Mus. & Inst, Chiba*, (1):31-42, figs. 1-16, tabs. 1-2.

723 **KONISHI Kenji** (1989): Limestone of the Daiichi Kashima seamount and the fate of a subducting guyot: Fact and speculation from the Kaiko "Nautile" dives. *Tectonophysics*, 160:249-265, figs. 1-14, tabs. 1-3.

724 **KONTA Tadashi**, SAITO Kazuo, WATANABE Yuji and OKADA Hisatake (1986): K-Ar study on volcanic rocks in the Yoshino Formation in Yamagata. *Jour. Geol. Soc. Japan*, 92(5):371-374, figs. 1-2, tabs. 1-2. (山形県吉野層火山岩のK-Ar年代) (J.)

725 **KOSAKA Tomoyoshi**, KUBOTA Masafumi, SHIBA Masahiro, KITAZUME Osamu and TOKUDA Taisuke (1990): Discovery of early Miocene planktonic foraminifers from the Uchiyama Formation in the northwestern part of the Kanto Mountainland, central Japan. *Earth Sci.*, 44(3):154-158, figs. 1-4. (関東山地北西部の内山層から発見された前期中新世の浮遊性有孔虫化石) (J.)

726 **KOSUGI Masato** (1988): Formation of shell mounds and its paleoenvironments around the Paleo-Okutokyo Bay at the early Jomon Stage. *Jour. Geogr.*, 97(6):641-644, figs. 1-3. (古奥東京湾奥部における縄文時代黒浜期の貝塚形成と古環境) (J.)

727 KOSUGI Masato (1989): Processes of formation on fossil diatom assemblages and the paleoecological analysis. *Benthos Res.*, (35/36):17-28, figs. 1-7, tabs. 1-3. (珪藻化石群集の形成過程と古生態解析) (J.E.)

728 KOSUGI Masato (1989): Salinty from the fomer Tokyo Bay in Holocene based on diatom assemblages. *Quat. Res., Japan*, 28(1):19-26, figs. 1-6. (珪藻化石群集による古奥東京湾の塩分濃度の推定) (J.E.)

729 **KOTAKA Tamio** (1986): [Effect of fossil -An instance of the fossils from Aizu basin, Fukushima Prefecture-]. Gakuho, H. Noguchi Mem. Hall, Fukushima, 8(1):1-2. (化石の効用(会津盆地の化石を例に)) (J.)

730 KOTAKA Tamio (1986): Origin and migration route of Japanese Cenozoic turritellid gastropods. *Spec. Pap., Palaeont. Soc. Japan*, (29):111-117, pl. 11, figs. 1-4.

731 KOTAKA Tamio (1986): Recent development in the problems of the origin and migration of Japanese Cenozoic molluscs. Proceeding of the International Symposium on Shallow Tethys 2, Wagga Wagga, Australia, 391-397, figs. 1-10.

732 KOTAKA Tamio and MARINCOVICH Louie Jr. (eds.) (1986): Japanese Cenozoic Mollusca, -Their origin and migration-. *Spec. Pap., Palaeont. Soc. Japan*, (29):1-255, pls. 1-21.

733 **KOTAKE Nobuhiro** (1988): Upper Cenozoic marine sediments in southern part of the Boso Peninsula, central Japan. *Jour. Geol. Soc. Japan*, 94(3):187-206, figs. 1-11, tab. 1. (房総半島南東端地域の海成上部新生界) (J.E.)

734 KOTAKE Nobuhiro (1988): Fossilization process of trace fossils -An example of *Spirophyton-Zoophycos* burrow system. *Fossils, Palaeont. Soc. Japan*, (45):36-37. (生痕化石の化石化過程－特に*Spirophyton-Zoophycos*システムに注目して) (J.)

735 KOTAKE Nobuhiro (1989): Paleoecology of the *Zoophycos* producers. *Lethaia*, 22(3):327-341, figs. 1-13.

736 KOTAKE Nobuhiro (1989): Taphonomy of the trace fossils in bathyal deposits distributing Boso Peninsula, central Japan. *Benthos Res.*, (35/36):53-60, figs. 1-6. (房総半島に分布する漸深海帯堆積物に見られる生痕化石のタフォノミー) (J.E.)

737 KOTAKE Nobuhiro (1990): Mode of ingestion and egestion of the *Chondrites* and *Zoophycos* producers. *Jour. Geol. Soc. Japan*, 96(10):859-868, pl. 1, figs. 1-4. (生痕化石*Chondrites* および*Zoophycos* をつくる生物群の摂食・排せつ様式) (J.E.)

738 **KOYAMA Masato** and KITAZATO Hiroshi (1989): Paleomagnetic evidence for Pleistocene clockwise rotation in the Oiso hills: A possible record of interaction between the Philippine Sea plate and northeast Japan. *Geophys. Monogr.*, 50:249-265.

739 KOYAMA Masato, KITAZATO Hiroshi and YANO Toru (1986): [Tectonic movements of the Oiso hills by paleomagnetic evidences]. *Earth Month.*, 8(10):620-625. (古磁気からみた大磯丘陵の構造運動) (J.)

740 **KOZAI Takeshi** (1986): Early Cretaceous pulsidis (Bivalvia) from Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (144):479-489, pl. 95, fig. 1.

741 KOZAI Takeshi (1987): Cretaceous *Caestocorbula* (Bivalvia) from Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (148):324-334, figs. 1-4.

742 KOZAI Takeshi (1989): A study of *Corbula* and *Nipponicorbula* (Bivalvia) from the Cretaceous of Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (153): 36-47, figs. 1-4.

743 **KUDO Tetsuro**, SATO Tokiyuki and SASAKI Kazuhiko (1988): [Latest knowledge of microbiostratigraphy of the Yabase oil field]. *Jour. Japan. Assoc. Petrol. Tech.*, 53(4):301. (八橋油田の微化石層序に関する最近の知見) (J.)

744 **KUMON Fujio**, MATSUYAMA Hisanori and NAKAJO Kenji (1986): Revised latest Jurassic to Cretaceous radiolarians assemblages from the Hidakagawa Group

in the Shimanto Belt, Kii Peninsula. *Fossils, Palaeont. Soc. Japan*, (41): 17-27, pls. 1-2, figs. 1-4, tab. 1. (紀伊半島四万十累帯日高川層群の改訂ジュラ紀最後期－白亜紀放散虫化石群集) (J.E.)

745 **KURIHARA Kenji** and KENNETT James P. (1986): Neogene benthic foraminifers: Distribution in depth traverse, southwest Pacific. *Initial Rep., DSDP*, 90:1037-1077, pls. 1-9, figs. 1-10, tabs. 1-3.

746 KURIHARA Kenji and KENNETT James P. (1988): Bathymetric migration of deep-sea Benthic Foraminifera in the southwest Pacific during the Neogene. *Jour. Foram. Res.*, 18(1):75-83, pl. 1, figs. 1-2.

747 KURIHARA Kenji, MATSUKAWA Masaki and OBATA Ikuwo (1989): Foraminifera from the Lower Cretaceous of the Sanchu tarrane, Kanto region, central Japan. *St. Paul's Rev. Sci.*, (30):9-17, pl. 1, fig. 1, tab. 1.

748 **KURIMOTO Chikao** (1986): Northern subbelt of the Chichibu Belt in the Shimizu-Misato area, Wakayama Prefecture, southwest Japan. *Jour. Geol. Soc. Japan*, 92(10):737-748, figs. 1-5, tabs. 1-2. (和歌山県清水－美里地域の秩父累帯北帯) (J.E.)

749 KURIMOTO Chikao (1986): Ultra-Tamba Zone in the Fukuchiyama area, Kyoto Prefecture -Its constituent rocks and distribution-. *Earth Sci.*, 40(1): 64-67, figs. 1-4. (京都府福知山地域の超丹波帯－構成岩類と分布について－) (J.)

750 KURIMOTO Chikao (1987): Triassic and Jurassic radiolarians from the southwestern part of the Mino terrane, central Japan. *Bull. Geol. Surv. Japan*, (38):69-80, pls. 1-2, figs. 1-2, tabs. 1-2. (美濃帯南西部からの三畳紀及びジュラ紀放散虫化石) (J.E.)

751 KURIMOTO Chikao (1989): Microfossils from the Gozaishoyama district in the southwestern part of the Mino terrane, central Japan. *Bull. Geol. Surv. Japan*, (40):55-63, pls. 1-2, figs. 1-2, tab. 1. (美濃帯南西部，御在所山地域から産出した微化石) (J.E.)

752 **KURITA Yoshitaka** (1986): Two species of fossil crabs found from the Uonuma Group, Niigata Prefecture, central Japan. *Earth Sci.*, 40(4):264-273, pl. 1, figs. 1-8, tabs. 1-2. (魚沼層群より産出した２種のカニ化石) (J.E.)

753 **KURITA Yuji**, MIWA Michiko and HIRAMATSU Chikara (1987): [Pliocene-Pleistocene boundary in the Hakkoku Anticline, Niigata Prefecture]. *Jour. Japan. Assoc. Petrol. Tech.*, 52(4):350-351. (新潟県八石背斜地域の鮮新統－更新統境界) (J.)

754 **KUROKAWA Katsuki**, YAJIMA Yusuke, KABA Makoto, MAKINO Hideru, TAKAHASHI Katsuya, YAMADA Hiroyuki and SAKUMA Kunihiko (1987): Geology of the Ashio Belt in the Oshirakawa area, Irihirose, Niigata Prefecture, central Japan. *Earth Sci.*, 41(4):221-230, pl. 1, figs. 1-6. (新潟県入広瀬村大白川地域の足尾帯の地質) (J.E.)

755 **KUROKO Hiroshi** (1987): A fossil leaf mine of Nepticulidae (Lepidoptera) from Japan. *Bull. Sugadaira Montane Res. Cent., Univ. Tsukuba*, (8):119-121.

756 **KUWANO Yukio** (1986): Geological age of the Fukuji Formation, central Japan. *Mem. Natn. Sci. Mus., Tokyo*, (19):67-70. (福地層の地質年代) (J.)

757 KUWANO Yukio (1987): Early Devonian conodonts and ostracodes from central Japan. *Bull. Natn. Sci. Mus., Tokyo, Ser. C*, 13(2):77-105, pls. 1-9, figs. 1-5, tabs. 1-2.

758 **KYUMA Yoko** and NISHIDA Tamio (1987): *Akiyoshiceras*, a new neoicoceratid ammonoid genus from the Upper Carboniferous of Akiyoshi, (Molluscan paleontology of the Akiyoshi Limestone Group -7). *Bull. Akiyoshi-dai Mus., Nat. Hist.*, (22):23-41, pls. 1-5, figs. 1-8, tabs. 1-3.

L

759 **LOCKLEY Martin G.**, MATSUKAWA Masaki and OBATA Ikuwo (1989): Dinosaur tracks and radial cracks: Unusual footprint features. *Bull. Natn. Sci. Mus., Tokyo, Ser. C*, 15(4):151-160.

M

760 **MAEDA Haruyoshi** (1986): Stratigraphy and fossil molluscan fauna of the Upper Cretaceous System in the Bibai area, Hokkaido, north Japan. *Jour. Geol. Soc. Japan*, 92(2):135-153, pl. 1, figs. 1-5, tabs. 1-3. (北海道美唄地域の上部白亜系層序と化石動物群) (J.E.)

761 MAEDA Haruyoshi (1986): [Some late Jurassic ammonites from central Nepal]. *Seibutsuchiri Kenkyukai News, Newsl. Biogeogr. Stud., Univ. Mus., Univ. Tokyo*, (5):29-33. (第7次東大ヒマラヤ植物調査隊が採集した中部ネパールのジュラ紀後期アンモナイト) (J.)

762 MAEDA Haruyoshi (1987): A new late Albian ammonite assemblage from the Hibihara Formation, Monobe area, Kochi, southwest Japan. *Mem. Fac. Sci., Kochi Univ., Ser. E*, 8:71-81, pl. 1.

763 MAEDA Haruyoshi (1987): Taphonomy of ammonites from the Cretaceous Yezo Group in the Tappu area, northwestern Hokkaido, Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (148):285-305, figs. 1-16.

764 MAEDA Haruyoshi (1990): Mechanism of fossilization: The introduction of taphonomy. *Kagaku*, 60(3):159-163, figs. 1-5. (化石化のメカニズムを探る:ータフォノミーへの招待ー) (J.)

765 MAEDA Haruyoshi, MIYATA Ken'ichi and KAWAJI Yoshihiro (1987): Sedimentary environments of the Lower Cretaceous Fujikawa Formation, Katsuura area, Tokushima, southwest Japan. *Res. Rep., Kochi Univ., Nat. Sci.*, 36:93-107, pls. 1-4. (徳島県勝浦地域に分布する下部白亜系藤川層の堆積環境について) (J.E.)

766 **MAEDA Shiro** (1990): Palaeontological study on the Cretaceous non-marine molluscs from the Hekou (Huokou) basin, Fujian Province, China. *Jour. Geogr.*, 99(4):396-398. (中国, 福建省寧化県禾口盆地の白亜紀非海棲軟体動物) (J.)

767 **MAEDA Yasuo** (1989): Vegetation history of the last glacial age in the Tanba district of Hyogo Prefecture, Japan. *Quat. Res., Japan*, 27(4):229-232, figs. 1-2. (最終氷期における兵庫県丹波地方の植生史) (J.E.)

768 MAEDA Yasuo, MATSUSHIMA Yoshiaki, MATSUMOTO Eiji, MATSUDA Isao and IHIRA Masashi (1986): Holocene environmental changes in the Nemuro Peninsula, eastern Hokkaido. *Mem. Pref. Office, Nemuro Munic. Mus.*, (1):3-22, pls. 1-5, figs. 1-4, tabs. 1-2, phot. 1. (約5千年前以降における根室半島ノッカ

マップ付近の自然環境の変遷) (J.)

769 MAEDA Yasuo, NAKAI Nobuyuki, MATSUMOTO Eiji, NAKAMURA Tosio, KUSUNOKI Satosi, MATSUSHIMA Yoshiaki, SATO Hiroshi, MATSUBARA Akiko, KUMANO Shigeru, KUROMI Masahiro, NUKADA Masahiro, AOKI Tetsuya, FURUTA Noboru, KOBASHI Takuji, MATSUI Jyuntaro, KAWAHARA Norifumi and YAMASHITA Hiroki (1989): Holocene paleoenvironmental changes in the Kei lowland, eastern part of the San-in coast. *Ritsumeikan Chirigaku*, (1):1-19, figs. 1-11, tabs. 1-2. (完新世における山陰海岸東部気比低地(兵庫県豊岡市)の古環境) (J.)

770 **MAEMOKU Hideaki** and TSUBONO Kenichiro (1990): Holocene crustal movement in the southern part of Kii Peninsula, outer zone of southwest Japan. *Jour. Geogr.*, 99(4):349-369, figs. 1-8, tabs. 1-3. (紀伊半島南部の完新世地殻変動) (J.E.)

771 **MAIYA Seijuro** (1987): [Benthic foraminiferal zonation in the oil fields of Japan: Present status and problems]. *Jour. Japan. Assoc. Petrol. Tech.*, 52(4):351. (裏日本油田地域における底生有孔虫化石区分の現状と問題) (J.)

772 MAIYA Seijuro (1988): Neogene events as revealed by changes of foraminiferal assemblages from central and northern Japan. *Spec. Pub., Osaka Mus. Nat. Hist.*, 31-48, figs. 1-9. (有孔虫化石群の変遷に見られる新第三紀イベント) (J.E.)

773 MAIYA Seijuro, AKIBA Fumio and INOUE Yoko (1986): Hiatuses in the Neogene sequence on land and seas of Honshu based on microbiostratigraphy and paleoenvironmental change. *Mar. Sci. Month.*, 18(3):162-168, fig. 1. (微化石層序と古環境変化にもとづく本邦陸域および周辺海域における新第三系のHiatusについて) (J.)

774 MAIYA Seijuro, ICHINOSEKI Tetsuro, KURITA Hiroshi, KATO Kunihiro, TAKETOMI Hiroshi and KOHATA Nobuhiro (1986): [Foraminiferal biostratigraphy of the Neogene distributed in the Nishikubiki-Kotani-Himekawa areas in the north Fossa Magna, and correlation with the standard succession in the Niigata area]. *Jour. Japan. Assoc. Petrol. Tech.*, 51(4):346. (北部フォッサマグナ西頚城－小谷・姫川地域に分布する新第三系の有孔虫化石層序と新潟標準層序との対比について) (J.)

775 MAIYA Seijiro and INOUE Yoko (1986): A remarkable calcareous foraminiferal assemblage associated with Antarctic bottom water and CCD on the Southern Ocean floor. In Y. Matoba and M. Kato (eds.): Studies on Cenozoic Benthic Foraminifera in Japan. Akita Univ., Akita, 79-94, pls. 1-4, figs. 1-3, (南極底層水に付随する石灰質有孔虫群集と南極海のＣＣＤ) (J.E.)

776 MAIYA Seijuro, WATANABE Kikuo, YAMADA Masamichi and OKADA Hisatake (1989): [Microbiostratigraphy of the Nanatani Formation in the well Nikoro SK-1, Tochio, Niigata Prefecture]. *Jour. Japan. Assoc. Petrol. Tech.*, 54(4):312-313. (新潟県栃尾市荷頃SK-1における七谷層の微化石層序) (J.)

777 **MAJIMA Ryuichi** (1987): Life positions of fossil naticid opercula (Mollusca: Gastropoda). *Jour. Paleont.*, 61(1):62-65, figs. 1-4.

778 MAJIMA Ryuichi (1987): Taxonomic study of Japanese species of *Glossaulax* (Gastropoda: Naticidae). *Venus, Japan. Jour. Malacol.*, 46(2):57-74, figs. 1-10. (日本産ツメタガイ類(腹足綱：タマガイ科)の分類) (J.E.)

779 MAJIMA Ryuichi (1988): Evolution of Japanese *Glossaulax* species (Gastropoda: Naticidae). 1: *G. didyma*, *G. vesicalis*, *G. bicolor* and *G. reiniana*. *Fossils, Palaeont. Soc. Japan*, (44):13-23, figs. 1-8. (日本産*Glossaulax* (Gastropoda: Naticidae)の進化. －第一部：*G. didyma*, *G. vesicalis*, *G. bi-*

color および*G. reiniana* の進化－) (J.E.)

780 MAJIMA Ryuichi (1988): Evolution of Japanese *Glossaulax* species (Gastropoda: Naticidae). 2: *G. hyugensis*, *G. hagenoshitensis* and *G. nodai*. *Fossils, Palaeont. Soc. Japan*, (45):1-7, figs. 1-6. (日本産*Glossaulax* (Gastropoda: Naticidae)の進化. －第二部：*G. hyugensis*, *G. hagenoshitensis* および *G. nodai* の進化－) (J.E.)

781 MAJIMA Ryuichi (1989): Cenozoic fossil Naticidae (Mollusca: Gastropoda) in Japan. *Bull. Amer. Paleont.*, 96(331):1-159, pls. 1-14, figs. 1-25, tabs. 1-43.

782 MAJIMA Ryuichi (1989): Neogene stratigraphy along the Arakawa River near Yorii, and of the Ogawa basin, Hiki hills, and Iwadono hills, central Saitama Prefecture, central Japan. *Geosci. Rep., Shizuoka Univ.*, (15):1-24, figs. 1-13, tabs. 1-5. (埼玉県中央部，荒川から岩殿丘陵にかけて分布する新第三系の層序) (J.E.)

783 MAJIMA Ryuichi (1989): [On Naticids (Gastropods) of Hokkaido. (1) Holocene]. *Ezohelix*, (1):3-10, fig. 1. (北海道産タマガイ類(巻貝)について (1) -現生－) (J.)

784 MAJIMA Ryuichi and FUKUDA Osamu (1986): [Consideration on occurrences of fossil naticid opercula (Gastropoda)]. *Chishitsu News*, (378):14-20, figs. 1-6. (タマガイ類(巻貝)の蓋化石の産状について考える) (J.)

785 MAJIMA Ryuichi, IMAI Shizuka, UCHIMURA Ryuichi, KIDA Shougo and HAYAKAWA Masao (1990): Finding of *Calyptogena* sp. (Bivalvia) from the late Pliocene Hijikata Formation, Kakegawa City, Shizuoka Prefecture, central Japan. *Jour. Geol. Soc. Japan*, 96(7):553-556, figs. 1-3. (掛川層群土方層からシロウリガイの発見) (J.)

786 MAJIMA Ryuichi and TAKAHASHI Hirokazu (1987): Miocene molluscs from the Kozono Formation, Saitama Prefecture, central Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (148):246-25, figs. 1-4, tab. 1.

787 **MALZ Heinz** and IKEYA Noriyuki (1986): *Miocyprideis* and *Bishopina*, related but different cyprideidine Ostracoda. *Rep. Fac. Sci., Shizuoka Univ.*, 20: 175-187, pls. 1-3, tab. 1.

788 MALZ Heinz and TABUKI Ryoichi (1988): The ostracod genus *Abrocythereis* (Miocene to Recent) from the Indopacific. *Geol. et Palaeont.*, (22):157-173, pls. 1-4, figs. 1-5, tab. 1.

789 **MANABE Ken-ichi** and SUZUKI Kenji (1988): Stratigraphy and correlation of the non-marine Pliocene-Pleistocene in northeast Honshu, Japan. *Mem. Geol. Soc. Japan*, (30):39-50, figs. 1-6. (東北地方の非海成鮮新－更新統の層序と対比) (J.E.)

790 **MANABE Makoto**, HASEGAWA Yoshikazu and AZUMA Youichi (1989): Two new dinosaur footprints from the early Cretaceous Tetori Group. In D. D. Gillette and M. G. Lockley (eds.): Dinosaur tracks and traces. Cambridge Univ. Press, New York, 309-312.

791 **Mandano Fossil Research Group** (1987): On a fossil Otariidae (Mammalia) from the Middle Pleistocene Mandano Formation of Ichihara City, Chiba Prefecture, Japan. *Erath Sci*, 41(6):327-330, figs. 1-4, tab. 1. (千葉県市原市の中部更新統万田野層から発見されたアシカ科化石について) (J.)

792 **MANO Katsutomo** (1989): On the fossilzation of molluscs from the Kioroshi and Narita Formations, Chiba Prefecture, central Japan. *Jour. Foss. Res.*,

22(1):1-5, figs. 1-8. (木下層および成田層に見られる貝類の化石化の例について) (J.)

793 **MARINCOVICH Louie Jr.** (1988): Recognition of an earliest Middle Miocene warm-water event in a southwestern Alaskan molluscan fauna. *Saito Ho-on Kai, Spec. Pub.* (*Prof. T. Kotaka Commem. Vol.*), (3):1-24, pls. 1-3, figs. 1-2, tab. 1.

794 MARINCOVICH Louie Jr. and KASE Tomoki (1986): An occurrence of *Turritella* (*Hataiella*) *sagai* in Alaska: Implications for the age of the Bear Lake Formation. *Bull. Natn. Sci. Mus., Tokyo, Ser. C*, 12(2):61-66.

795 **MARUO Hiromi**, TERAKADO Hiroyuki, TERAKADO Tsukumo and TANAKA Toshinori (1986): [Dismemberment and assembly of *Brachiosaurus*]. *Earth Month.*, 8(3):170-175, figs. 1-6. (ブラキオサウルスの解体と組立) (J.)

796 MARUO Hiromi, TERAKADO Hiroyuki, TERAKADO Tsukumo and TANAKA Toshinori (1986): [Modeling dinosaur foot prints -In the case of Sebayashi, Gunma Prefecture-]. *Earth Month.* 8(3):176-180, fig. 1, tabs. 1-6. (恐竜足跡の型作製－群馬県瀬林の例－) (J.)

797 **MARUYAMA Toshiaki** (1988): Morphological analysis of the fossil diatom *Denticulopsis lauta* on the basis of biometry -Recognition of species by size and shape-. *Fossils, Palaeont. Soc. Japan*, (44):33-43, figs. 1-15. (生物測定にもとづく珪藻化石*Denticulopsis lauta* の形態解析－大きさと形による種の認識－) (J.)

798 MARUYAMA Toshiaki and IWAI Masao (1990): [Size variations of fossil diatoms from the Kerguelen Plateau in comparison to that from the offing of San-riku-oki, Japan]. *Kaiyo Month.*, 22(5):277-282, figs. 1-6. (ケルゲレン海台と三陸沖の珪藻化石の大きさくらべ) (J.)

799 MARUYAMA Toshiaki and MATSUYAMA Chikara (1989): [Sannohe-Hachinohe district]. In Editorial Committee of Tohoku, Part 2 of Regional Geology of Japan (ed.): Regional Geology of Japan, Part 2. Tohoku, Kyoritsu Shuppan, Tokyo, 140-148, figs. 5.14, tab. 5.8-5.10. (三戸－八戸地域) (J.)

800 **MASUDA Koichiro** (1986): Historical change of the Neogene molluscan fauna of Japan with special reference to pectinids. *Monogr. Mizunami Fossil Mus.*, (6):1-21, pls. 1-3, figs. 1-3, tabs. 1-8. (本邦新第三紀貝類群集の変遷－pectinidsを中心にして－) (J.E.)

801 MASUDA Koichiro (1986): Notes on origin and migration of the Cenozoic pectinids in the northern Pacific. *Spec. Pap., Palaeont. Soc. Japan*, (29):95-110, pls. 7-10, figs. 1-7.

802 MASUDA Koichiro (1987): On origin and migration of Cenozoic pectinids in the northern Pacific. Proceedings of the International Symposium on Shallow Tethys 2, Wagga Wagga, Australia, 399-403, figs. 1-3.

803 MASUDA Koichiro, HANDA Masakazu, KANNO Masaki, MIYASAKA Yoshihiko, NEMOTO Jun, SASAKI Takashi, TAKAIZUMI Yukihiro and WAKO Katsuo (1990): Remarks on molluscan fauna from the Dainenji Formation, Sendai, Miyagi Prefecture, Japan. *Saito Ho-on Kai Mus., Nat. Hist., Res. Bull.*, (58):1-17, pls. 1-4, figs. 1-2.

804 MASUDA Koichiro and HUANG Chi-yue (1990): Miocene Pelecypoda in the western foothills of northern Taiwan. Part 2: Systematic description. *Bull. Natn. Mus., Nat. Sci.*, (2):141-189, pls. 1-11.

805 MASUDA Koichiro and HUANG Chi-yue (1990): Check list of Tertiary and Quaternary Mollusca in Taiwan. *Acta Geol. Taiwanica*, (28):31-76.

806 MASUDA Koichiro, OGASAWARA Kenshiro and FUSE Keisuke (1989): *Chlamys nisataiensis* Otuka and its related species. *Saito Ho-on Kai Mus., Nat. Hist., Res. Bull.*, (57):11-21, pls. 1-2, figs. 1-2, tabs. 1-3.

807 MASUDA Koichiro and OISHI Masayuki (1990): Molluscan fauna in association with *Desmostylus* from Kintaichi, Ninohe City, Iwate Prefecture, northeast Japan. *Bull. Iwate Pref. Mus.*, (8):17-26, pls. 1-3, fig. 1. (岩手県二戸市金田一よりデスモスチルスに伴って産出した貝類化石) (J.E.)

808 MASUDA Koichiro and SASAKI Takashi (1987): On some gastropods from the Miocene Moniwa Formation in Sendai City, Miyagi Prefecture, northeast Honshu, Japan. *Saito Ho-on Kai Mus., Nat. Hist., Res. Bull.*, (55):1-11, pl. 1, tab. 1

809 MASUDA Koichiro and SATO Yoshio (1988): Molluscan fauna of the Yaeyama Group in Iriomote-jima, Okinawa Prefecture, Japan. *Saito Ho-on Kai, Spec. Pub. (Prof. T. Kotaka Commem. Vol.)*, (3):439-449, pls. 1-4, fig. 1.

810 MASUDA Koichiro and YOSHIDA Syoitsu (1990): A new Miocene *Neptunea* from Akita Prefecture, northeast Honshu, Japan. *Saito Ho-on Kai Mus., Nat. Hist., Res. Bull.*, (58):19-22, pl. 1, fig. 1.

811 **MATOBA Yasumochi** (1989): [Problems concerning paleogeography of the late Cenozoic Benthic Foraminifera]. *Yukochu Kenkyu* (=*Stud. Foraminifera*), (2):20-32, figs. 1-14. (後期新生代底生有孔虫の古生物地理に関する諸問題) (J.)

812 MATOBA Yasumochi and HONMA Noboru (1986): [Bathymetric distribution of Recent Foraminifera off Nishitsugaru, Sea of Japan]. *Jour. Japan. Assoc. Petrol. Tech.*, 51(4):353. (西津軽沖日本海の現世底生有孔虫の深度分布) (J.)

813 MATOBA Yasumochi and HONMA Noboru (1986): Depth distribution of Recent Benthic Foraminifera off Nishitsugaru, eastern Sea of Japan. In Y. Matoba and M. Kato (eds.): Studies on Cenozoic Benthic Foraminifera in Japan. Akita Univ., Akita, 53-78, pls. 1-4, figs. 1-6, tabs. 1-2. (西津軽沖日本海の現世底生有孔虫の深度分布) (J.E.)

814 MATOBA Yasumochi and KATO Michio, eds. (1986): Studies on Cenozoic Benthic Foraminifera in Japan. Akita Univ., Akita, 1-174. (新生代底生有孔虫の研究) (J.)

815 MATOBA Yasumochi, SHIRAISHI Tateo, USUDA Masaro and OKAMOTO Kin'ichi (1989): [Oga area]. In Editorial Committee of Tohoku, Part 2 of Regional Geology of Japan (ed.): Regional Geology of Japan, Part 2, Tohoku, Kyoritsu Shuppan, Tokyo, 158-163, fig. 1, tabs. 1-2. (男鹿地域) (J.)

816 MATOBA Yasumochi, TOMIZAWA Akifumi and FUKASAWA Kazue (1990): Neogene and Quaternary sedimentary sequences in the Oga Peninsula. Guidebook for the field trip no. 2, 4th International Symposium on Benthic Foraminifera, Sendai, 1-62, pls. 1-12, figs. 1-33.

817 **MATSUBARA Akiko** (1988): Geomorphic development of barriers in the coastal lowlands during the Holocene -A case study of the coastal lowlands along the Suruga Bay, central Japan-. *Bull. Geogr. Dept., Univ. Tokyo*, (20):57-77.

818 MATSUBARA Akiko (1989): Geomorphic development of barriers in the coastal lowlands during the Holocene -A case study of the lowlands along the Suruga Bay, central Japan-. *Geogr. Rev., Japan,* 62(2):160-183. (完新世における砂州地形の発達過程－駿河湾沿岸低地を例として－) (J.E.)

819 MATSUBARA Akiko, MATSUSHIMA Yoshiaki, ISHIBASHI Katsuhiko, MORIWAKI Hiroshi and KASHIMA Kaoru (1986): Environmental changes during the Holocene in the Matsuzaki lowland, western part of the Izu Peninsula, central Japan. *Jour. Geogr.*, 95(5):23-40, figs. 1-7, tab. 1. (伊豆半島西岸松崎低地の完新世における環境変遷) (J.E.)

820 **MATSUDA Tokihiko**, YUI Masao, MATSUSHIMA Yoshiaki, IMANAGA Isamu, HIRATA Daiji, TOGO Masao, KASHIMA Kaoru, MATSUBARA Akiko, NAKAI Nobuyuki, NAKAMURA Tosio and MATSUOKA Kazumi (1988): Subsurface study of Isehara Fault, Kanagawa Prefecture, detected by drilling -Depositional environments during the last 7000 years and fault displacement associated with the Gangyou Earthquake in A. D. 878-. *Bull. Earthq. Res. Inst., Univ. Tokyo,* 63:145-182, figs. 1-9, tabs. 1-4. (伊勢原断層(神奈川県)の試錐による地下調査－過去約7000年間の堆積環境と元慶２年地震の変位－) (J.E.)

821 **MATSUDA Tomoko** (1987): Occurrence of *Apiotrigonia* (*Apiotorigonia*) *hetonaina* Tashiro from the Upper Cretaceous Osoushinai Formation of north Hokkaido. *Fossils, Palaeont. Soc., Japan,* (42):1-5, pl. 1, figs. 1-2, tab. 1. (北海道北部上部白亜系オソウシナイ層産*Apiotorigonia* (*Apiotorigonia*) *hetonaiana* Tashiroについて) (J.E.)

822 **MATSUI Seiichiro** (1988): The Pliocene Takikawa-Honbetsu Fauna: An ecological and biogeographic comparison with the Tatsunokuchi and Omma-Manganji Faunas. *Saito Ho-on Kai, Spec. Pub.* (*Prof. T. Kotaka Commem. Vol.*), (3): 459-468, fig. 1, tab. 1.

823 MATSUI Seiichiro (1990): Pliocene-Pleistocene molluscan association in north-central Japan and their relationship to environments. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (160):641-662, figs. 1-6, tab. 1.

824 **MATSUKAWA Masaki** (1987): Early shell morphology of *Karsteniceras* (Ancyloceratid) from the Lower Cretaceous Choshi Group, Japan and its significance to the phylogeny of Cretaceous heteromorph ammonites. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (148):346-359, figs. 1-4, tabs. 1-2.

825 MATSUKAWA Masaki (1988): Barremian ammonites from the Ishido Formation, Japan -Supplements and faunal analysis-. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (149):396-416, figs. 1-11, tabs. 1-2.

826 MATSUKAWA Masaki and ETO Fumiya (1987): Stratigraphy and sedimentary environment of the Lower Cretaceous System in the Katsuragawa basin, southwest Japan -Comparison of the two Cretaceous subbelts in the Chichibu Belt-. *Jour. Geol. Soc. Japan,* 93(7):491-511, pls. 1-2, figs. 1-10, tabs. 1-4. (徳島県勝浦川盆地の下部白亜系の層序と堆積環境－特に秩父帯の南北２帯の白亜系を比較して－) (J.E.)

827 MATSUKAWA Masaki and OBATA Ikuwo (1986): [Dinosaur foot prints in the Lower Cretaceous Sebayashi Formation]. *Earth Month.*, 8(3):149-157, figs. 1-10, tabs. 1-3. (下部白亜系瀬林層の恐竜足跡) (J.)

828 MATSUKAWA Masaki and OBATA Ikuwo (1986): [Thinking process on the discovery and the proofs of dinosaur footprints -An example of Sanchu Cretaceous-]. *Educ. Earth Sci.*, 39(3):81-90. (恐竜の足跡の発見・証明にいたる思考過程－山中白亜系の例－) (J.)

829 MATSUKAWA Masaki and OBATA Ikuwo (1988): *Acanthohoplites reesidei* (Anderson) from the Lower Cretaceous Sebayashi Formation, Japan. *Bull. Natn. Sci. Mus., Tokyo, Ser. C*, 14(2):79-86, figs. 1-3.

830 MATSUKAWA Masaki and OBATA Ikuwo (1989): Interpretation of dinosaur footprints from the Lower Cretaceous Sebayashi Formation, Japan. In D. D. Gillette and M. G. Lockley (eds.): Dinosaur tracks and traces. Cambridge Univ. Press, New York, 409-412.

831 MATSUKAWA Masaki, OBATA Ikuwo and HARADA Yutaka (1989): Dinosaur Center of Nakazato Village, Gunma, Japan and its significance -Social reduction from geological study and some environmental problems in the village-. *Educ. Earth Sci.*, 42(2):61-71. (群馬県中里村恐竜センターの意義－研究の社会的還元と環境整備の問題点－) (J.)

832 MATSUKAWA Masaki, OBATA Ikuwo and LOCKLEY Martin G. (1989): Taxonomical reexamination of dinosaur footprints from the Cretaceous Sebayashi Formation, Japan. *Jour. Geogr.*, 98(4):486-489. (群馬県中里村恐竜足跡の分類学的な再検討) (J.)

833 MATSUKAWA Masaki, YANG Seong-young and OBATA Ikuwo (1987): A comparative study on Cretaceous dinosaur footprints from Japan and Korea. *Jour. Geogr.*, 96(5):312-314. (日本産と韓国産の恐竜足跡の比較研究) (J.)

834 **MATSUKUMA Akihiko** (1986): Cenozoic glycymeridid bivalves of Japan. *Spec. Pap., Palaeont. Soc. Japan*, (29):77-94, pls. 5-6, figs. 1-7, tabs. 1-3.

835 MATSUKUMA Akihiko (1986): *Glycymeris cisshuensis* (Mollusca: Bivalvia), an ancestral species of temperate glycymeridids from Japan and Korea. *Monogr. Mizunami Fossil Mus.*, (6):59-74, pls. 6-7, figs. 1-4.

836 MATSUKUMA Akihiko (1986): Studies on the Kawamura Collecion (Mollusca) stored in the National Science Museum, Tokyo -3. Genus *Tapes* Megerle, 1811 (Bivalvia), with description of a new species. *Venus, Japan. Jour. Malacol.*, 45(1):11-30, pls. 1-2, fig. 1.

837 MATSUKUMA Akihiko (1987): Studies on the Kawamura Collection (Mollusca) stored in the National Science Museum, Tokyo -4. The family Placunidae (Bivalvia) with special reference to their ligament. *Venus, Japan. Jour. Malacol.*, 45(4):231-244, pl. 1.

838 MATSUKUMA Akihiko (1989): Taxonomy and geographical distribution of southwestern Japanese species of *Grammatomya*, *Dysmea* and *Kermadysmea* (Bivalvia: Psammobiidae). *Mem. Natn. Sci. Mus., Tokyo*, (22):97-118, pls. 1-3, figs. 1-13, tabs. 1-4.

839 MATSUKUMA Akihiko (1990): Studies on the Kawamura Collection (Mollusca) stored in the National Science Museum, Tokyo -5. The family Pholadomyidae with description of a new species. *Venus, Japan. Jour. Malacol.*, 48(4): 207-221, pls. 1-2.

840 MATSUKUMA Akihiko, GOSHIMA Seiji and KUWAHARA Yasuhiro (1988): Taxonomy and geographical distribution of *Megangulus* (Mollusca: Bivalvia) from the northern Pacific. *Mem. Natn. Sci. Mus., Tokyo*, (21):113-122, figs. 1-4.

841 MATSUKUMA Akihiko and OKAMOTO Kazuo (1986): New Cenozoic glycymeridid bivalves (Mollusca) from Japan. *Mem. Natn. Sci. Mus., Tokyo*, (19):91-100, figs. 1-3.

842 MATSUKUMA Akihiko and OKUTANI Takashi (1986): Studies on the Kawamura Collection (Mollusca) in the National Science Museum, Tokyo -2. Catalogue

of type specimens, with description of *Pinna cellophana* n. sp. (Bivalvia). *Venus, Japan. Jour. Malacol.*, 45(1):1-10, pl. 1, figs. 1-4.

843 MATSUKUMA Akihiko, OZAWA Tomowo and YOOSUKH Wantana (1988): *Paphia (Protapes) irrediviva* Makiyama, an extinct tropical embayment element of Japanese Cenozoic mollusks, and allied species from the Indo-West Pacific. *Saito Ho-on Kai, Spec. Pub. (Prof. T. Kotaka Commem. Vol.)*, (3):405-415, pls. 1-4, figs. 1-12.

844 MATSUKUMA Akihiko and YOOSUKH Wantana (1988): Living *Bassina* and *Placamen* (Bivalvia: Veneridae) from the Australasia and the Indo-West Pacific. *Saito Ho-on Kai, Spec. Pub. (Prof. T. Kotaka Commem. Vol.)*, (3):567-582, pls. 1-2, figs. 1-20.

845 **MATSUMARU Kuniteru** (1986): Biostratigraphy based on the larger Foraminifera from the Ryukyu Limestone of Hateruma Jima. In H. Nakagawa, T. Kotaka and Y. Takayanagi (eds.): Essays in Geology, Prof. N. Kitamura Commem. Vol., Sendai, 205-217, figs. 1-4, tabs. 1-2. (波照間島の琉球石灰岩の大型有孔虫生物層位学的研究) (J.E.)

846 MATSUMARU Kuniteru (1988): [Problems on Mesozoic-Cenozoic larger Foraminifera]. *Yukochu Kenkyu (=Stud. Foraminifera)*, (1):7-9. (中生代・新生代の大型有孔虫に関する諸問題) (J.)

847 MATSUMARU Kuniteru (1989): A view of essential species of the *Lepidocyclina-Miogypsina* fauna. In Y. Takayanagi and K. Ishizaki (eds.): Collected papers on Foraminifera from the Japanese Islands. Toko Print. Pub. Dept., Sendai, 61-67. (*Lepidocyclina-Miogypsina* フォーナの主要な種に関する所見) (J.)

848 MATSUMARU Kuniteru (1990): A new genus of the miogypsinid Foraminifera from southwest Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (158):535-539, fig. 1.

849 MATSUMARU Kuniteru (1990): A new genus of the trematophorate miliolids (Fabulariidae) from the Eocene Setogawa Group, southwest Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (160):663-673, figs. 1-7.

850 MATSUMARU Kuniteru and KIMURA Koshi (1989): Larger Foraminifera from the Eocene Shimizu and Miocene Misaki Formations in Tosa Shimizu City, Kochi Prefecture, Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (156):255-269, figs. 1-6.

851 MATSUMARU Kuniteru and SAKAI Harutaka (1989): *Nummulites* and *Assilina* from Tansen area, Palpa district, the Nepal Lesser Himalayas. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (154):68-76, figs. 1-4.

852 **MATSUMOTO Tatsuro** (1987): Notes on *Forbesiceras* (Ammonoidea) from Hokkaido (Studies of Cretaceous ammonites from Hokkaido -60). *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (145):16-31, figs. 1-7.

853 MATSUMOTO Tatsuro (1987): Note on *Pachydesmoceras*, a Cretaceous ammonite genus. *Proc. Japan Acad., Ser. B*, 63(1):5-8, fig. 1.

854 MATSUMOTO Tatsuro (1988): Notes on some Cretaceous ammonites from south Sakhalin held at Tohoku University, Sendai. *Sci. Rep., Tohoku Univ., 2nd Ser.*, 59(2):177-190, pls. 50-53, tabs. 1-11.

855 MATSUMOTO Tatsuro (1989): A gigantic ammonite from Hobetsu, Hokkaido (Studies of Cretaceous ammonites from Hokkaido -64). *Bull. Hobetsu Mus.*, (5):1-11, pls. 1-2, figs. 1-3, tab. 1.

856 MATSUMOTO Tatsuro (1989): Some inoceramids (Bivalvia) from the Cenomanian (Cretaceous) of Japan -5. A world-wide species *Inoceramus pictus* Sowerby from Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (153):12-24, figs. 1-10, tab. 1.

857 MATSUMOTO Tatsuro (1990): A kossmaticeratid ammonite from Noborikawa, Hokkaido, with remarks on relevant taxa (Studies of Cretaceous ammonites from Hokkaido -66). *Bull. Hobetsu Mus.*, (6):1-14, pl. 1, figs. 1-2, tabs. 1-2.

858 MATSUMOTO Tatsuro (1990): An interesting pachydiscid ammonite from Hokkaido, with remarks on relevant taxa (Studies of Cretaceous ammonites from Hokkaido -67). *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (160):618-630, figs. 1-5, tabs. 1-3.

859 MATSUMOTO Tatsuro and ASAI Akito (1989): Cenomanian (Cretaceous) inoceramids (Bivalvia) from Hokkaido and Sakhalin -1. *Birostrina nipponica* (Nagao et Matsumoto). *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (155):178-196, figs. 1-32, tabs. 1-2.

860 MATSUMOTO Tatsuro, ASAI Akito and HIRANO Hiromichi (1987): Some inoceramids (Bivalvia) from the Cenomanian (Cretaceous) of Japan -2. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (147):146-164, figs. 1-8, tabs. 1-3.

861 MATSUMOTO Tatsuro, ASAI Akito, HIRANO Hiromichi and NODA Masayuki (1988): Some inoceramids (Bivalvia) from the Cenomanian (Cretaceous) of Japan -3. Three species occurring commonly in the north-west Pacific region. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (149):378-395, figs. 1-9, tabs. 1-3.

862 MATSUMOTO Tatsuro, MAIYA Seijuro and NODA Masayuki (1988): Inoceramids and Foraminifera correlation in the Upper Cretaceous of Kikume-zawa, Hokkaido. *Fossils, Palaeont. Soc. Japan*, (44):25-32, figs. 1-2, tabs. 1-2. (北海道菊面沢の上部白亜系におけるイノセラムス・有孔虫化石の対応) (J. E.)

863 MATSUMOTO Tatsuro and MIYAUCHI Toshiya (1986): Further notes on *Parasolenoceras* (heteromorph ammonoid) from Hokkaido (Studies of Cretaceous ammonites from Hokkaido -59). *Sci. Rep., Yokosuka City Mus.*, (34):7-16, pl. 1, figs. 1-4.

864 MATSUMOTO Tatsuro and MOROZUMI Yoshiro (1988): A sphenodiscid ammonite acquired rarely from the Cretaceous of Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (150):465-475, figs. 1-4.

865 MATSUMOTO Tatsuro, MOROZUMI Yoshiro and OZAWA Tomowo (1986): Note on an ammonite species of *Pachydiscus* from Awaji Island, southwest Japan. With Appendix by T. Matsumoto: Remarks on the so-called *Pachydiscus egertoni* (Forbes). *Bull. Osaka Mus., Nat. Hist.*, (40):1-13, pl. 1, figs. 1-5.

866 MATSUMOTO Tatsuro, MURAMOTO Kikuwo, TAKAHASHI Takemi, YAMASHITA Minoru and KAWASHITA Yoshitaro (1986): On *Neocrioceras spinigerum* (Jimbo), a species of Cretaceous heteromorph ammonoids (Studies of Cretaceous ammonites from Hokkaido -55). With Appendix by T. Matsumoto: Remarks on the genus *Neocrioceras*. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (143):463-474, pls. 93-94, fig. 1.

867 MATSUMOTO Tatsuro, NEMOTO Mamoru and SUZUKI Chisato (1990): Gigantic ammohites from the Cretaceous Futaba Group of Fukushima Prefecture. With Appendix by T. Matsumoto and M. Nemoto: An ammonite referable to *Forresteria* from the Futaba Group. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (157):366-381, figs. 1-10. tabs. 1-2, tab. 1.

868 MATSUMOTO Tatsuro, NEMOTO Mamoru and WATANABE Toshimitsu (1989): On *Puzosia kuratai* Tokunaga and Shimizu, 1926, a Cretaceous ammonite species. *Fossils, Palaeont. Soc. Japan*, (47):25-38, figs. 1-10, tab. 1. (白亜紀アンモナイト*Puzosia kuratai* Tokunaga and Shimizu, 1926について) (J.E.)

869 MATSUMOTO Tatsuro and NODA Masayuki (1986): A note on an inoceramid species (Bivalvia) from the Lower Coniacian (Cretaceous) of Hokkaido. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (140):263-273, pls. 41-44, figs. 1-3, tabs. 1-4.

870 MATSUMOTO Tatsuro and NODA Masayuki (1986): Some inoceramids (Bivalvia) from the Cenomanian (Cretaceous) of Japan -1. New or little known four species from Hokkaido and Kyushu. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (143):409-421, pls. 81-85, tabs. 1-4.

871 MATSUMOTO Tatsuro and NODA Masayuki (1986): Middle Cretaceous inoceramid stratigraphy. Appendix 2. In R. A. Reyment and P. Bengtson (compilers): Events of the Mid-Cretaceous -Final report of results obtained by IGCP Project no. 58, 1974-1985. Pergamon Press, Oxford, 145-153, fig. 54, tabs. 24-25.

872 MATSUMOTO Tatsuro, NODA Masayuki and TOSHIMITSU Seiichi (1989): Gigantic ammonite held in the Hobetsu Museum -Its record of occurrence and its stratigraphic position. *Bull. Hobetsu Mus.*, (5):13-25, pls. 1-2, figs. 1-6. (穂別町立博物館の巨大アンモナイトーその産出記録と層位) (J.E.)

873 MATSUMOTO Tatsuro and SAITO Rinji (1987): Little known ammonite *Grandidiericeras* from Hokkaido (Studies of Cretaceous ammonites from Hokkaido -58). *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (145):1-9, figs. 1-5, tab. 1.

874 MATSUMOTO Tatsuro and SUEKANE Tetsuro (1987): Some acanthoceratid ammonites from the Yubari Mountains, Hokkaido -Part 1 (Studies of Cretaceous ammonites from Hokkaido -62). *Sci. Rep., Yokosuka City Mus.*, (35):1-14, pls. 1-4, figs. 1-3, tabs. 1-2.

875 MATSUMOTO Tatsuro, SUEKANE Tetsuro and KAWASHITA Yoshitaro (1989): Some acanthoceratid ammonites from the Yubari Mountains, Hokkaido -Part 2 (Studies of Cretaceous ammonites from Hokkaido -65). *Sci. Rep., Yokosuka City Mus.*, (37):29-44, figs. 1-9, tabs. 1-4.

876 MATSUMOTO Tatsuro and SUGIYAMA Ryozo (1986): Note on an inoceramid species from the Upper Cretaceous Taneichi Formation of Iwate Prefecture. *Bull. Iwate Pref. Mus.*, (4):17-26, pl. 3, figs. 1-3, tabs. 1-3. (岩手県の上部白亜系種市層から産したイノセラムス類の1種について) (J.E.)

877 MATSUMOTO Tatsuro and TAKAHASHI Takemi (1986): A record of *Menabites* (Ammonoidea) from Hokkaido (Studies of Cretaceous ammonites from Hokkaido -57). *Proc. Japan Acad., Ser. B*, 62(3):79-82, figs. 1-2.

878 MATSUMOTO Tatsuro with collaboration of T. Takahashi, Y. Kawashita, K. Muramoto, M. Kera, Y. Kera, T. Shimanuki, M. Yamashita and H. Kokubun (1988): A monograph of the Puzosiidae (Ammonoidea) from the Cretaceous of Hokkaido (Studies of Cretaceous ammonites from Hokkaido -63). in Part 2 (Descriptions of species). *Spec. Pap., Palaeont. Soc. Japan*, (30):1-179, figs. 1-88.

879 MATSUMOTO Tatsuro and TANAKA Keisaku (1988): Some inoceramids (Bivalvia) from the Cenomanian (Cretaceous) of Japan -4. An interesting new species from Hokkaido. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (151):570-581, figs. 1-15, tabs. 1-2.

880 MATSUMOTO Tatsuro, TOSHIMITSU Seiichi and KAWASHITA Yoshitaro (1990): On *Hauericeras* de Grossouvre, 1894, a Cretaceous ammonite genus. *Trans. Proc. Palaeont. Soc., Japan, N. S.*, (158):439-458, figs. 1-8, tabs. 1-2.

881 MATSUMOTO Tatsuro and YOKOI Katsujoh (1987): Tiny ammonite *Worthoceras* from Hokkaido (Studies of Cretaceous ammonites from Hokkaido, -61). With appendix by T. Matsumoto: Further remarks on *Worthoceras*. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (146):42-48, figs. 1-4, tab. 1.

882 **MATSUMOTO Toshio** (1986): Stratigraphy of the Miocene Series in the area southeast of Tottori City, Tottori Prefecture, southwest Japan. *Jour. Geol. Soc. Japan*, 92(4):269-287, figs. 1-6, tabs. 1-2. (鳥取市南東方地域の中新統の層序) (J.E.)

883 **MATSUOKA Atsushi** (1986): *Tricolocapsa yaoi* Assemblage (late Jurassic radiolarians) from the Togano Group in Shikoku, southwest Japan. *Jour. Geosci., Osaka City Univ.*, 29:101-115, pls. 1-2, figs. 1-2, tab. 1.

884 MATSUOKA Atsushi (1986): Faunal change of radiolarians around the Jurassic -Cretaceous boundary -With special reference to some multi-segmented nassellarians. *Fossils, Palaeont. Soc. Japan*, (40):1-15, pls. 1-4, figs. 1-2. (ジュラ紀・白亜紀境界付近における放散虫化石群の変化(予察)－とくに多節Nassellariaについて－) (J.E.)

885 MATSUOKA Atsushi (1986): Stratigraphic distribution of two species of *Tricolocapsa* in the Hisuikyo section of the Kamiaso area, Mino terrane. *NOM, Spec. Vol.*, (7):59-62, figs. 1-3. (美濃帯上麻生地域の飛水峡セクションにおける*Tricolocapsa* 属２種の層位分布) (J.E.)

886 MATSUOKA Atsushi (1987): Radiolarian age of the Shiriya Group in Aomori Prefecture, northeast Japan. *Fossils, Palaeont. Soc. Japan,* (42):7-13, pl. 1, figs. 1-3. (青森県尻屋層群の放散虫年代) (J.E.)

887 MATSUOKA Atsushi (1988): Discovery of early Jurassic radiolarians from the north Kitakami Belt (s.s.), northeast Japan. *Earth Sci.*, 42:104-106, pl. 1, fig. 1. (北部北上帯(狭義)よりジュラ紀古世放散虫化石の発見) (J.)

888 MATSUOKA Atsushi (1988): First appearance biohorizon of *Tricolocapsa conexa* within Jurassic siliceous mudstone sequences of the Kamiaso area in the M ino terrane, central Japan -A correlation of radiolarian zones of the Middle Jurassic. *Jour. Geol. Soc. Japan*, 94(8):583-590, pl. 1, figs. 1-6, tabs. 1-2.

889 MATSUOKA Atsushi (1989): Radiolarian fossils from the Koyamada Formation (lowest Cretaceous) of the Somanakamura Group, northeast Japan. *Fossils, Palaeont. Soc. Japan*, (46):11-16, pl. 1, fig. 1. (相馬中村層群小山田層(最下部白亜系)からの放散虫化石) (J.E.)

890 MATSUOKA Atsushi and OJI Tatsuo (1990): Middle Jurassic radiolarian fossils from the Magisawa Formation in the Taro Belt, north Kitakami Mountains. *Jour. Geol. Soc. Japan*, 96(3):239-241, pl. 1, fig. 1, tab. 1. (北部北上山地田老帯槙木沢層からのジュラ紀中世放散虫化石の産出) (J.)

891 MATSUOKA Atsushi and YAO Akira (1986): A newly proposed radiolarian zonation for the Jurassic of Japan. *Mar. Micropaleont.*, 11:91-106, pls. 1-3, figs. 1-4.

892 **MATSUOKA Hiromi** (1990): New method to evaluate dissolution of $CaCO_3$ in the

deep-sea sediments. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (157):430-434, figs. 1-3.

893 MATSUOKA Hiromi and OKADA Hisatake (1989): Quantitative analysis of Quaternary nannoplankton in the subtropical northwestern Pacific Ocean. *Mar. Micropaleont.*, 14:97-118, pl. 1, figs. 1-8, tabs. 1-2.

894 MATSUOKA Hiromi and OKADA Hisatake (1990): Time-progressive morphometrical changes of genus *Gephyrocpasa* (calcareous nannoplankton) in Quaternary Sequence of the tropical Indian Ocean, Site 709. *Proc. ODP, Sci. Results*, 115:255-270, pls. 1-4, figs. 1-10, tabs. 1-2.

895 **MATSUOKA Kazumi** (1988): Cyst-theca relationships in diplosalid group (Peridiniales, Dinophyceae). *Rev. Palaeobot. & Palynol.*, 56(1/2):95-122, pls. 1-7, figs. 1-8, tab. 1.

896 MATSUOKA Kazumi and BUJAK Jonathan P. (1988): Cenozoic dinoflagellate cysts from the Navarin basin, Norton Sound and ST. George basin, Bering Sea. *Bull. Fac. Liberal Arts, Nagasaki Univ., Nat. Sci.*, 29(1):1-147, pls. 1-19, figs. 1-24.

897 MATSUOKA Kazumi, BUJAK Jonathan P. and SHIMAZAKI Togo (1987): Late Cenozoic dinoflagellate cyst biostratigraphy from the west coast of northern Japan. *Micropaleont.*, 33(3):214-229, pls. 1-2, figs. 1-9.

898 **MATSUOKA Keiji** (1987): Evolutionary events for the Kobiwako Group from a view point of molluscan fauna. In R. Tsuchi (ed.): Pacific Neogene event studies. Shizuoka, 65-67.

899 MATSUOKA Keiji (1987): Malacofaunal succession in Pliocene to Pleistocene non-marine sediments in the Omi and Ueno basins, central Japan. *Jour. Earth Sci., Nagoya Univ.*, 35(1):23-115, figs. 1-27, tabs. 1-15.

900 MATSUOKA Keiji (1988): Pliocene freshwater bivalves (*Lamprotula* and *Cuneopsis*: Unionidae) from the Iga Formation, Mie Prefecture, central Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (149):417-429, figs. 1-5.

901 MATSUOKA Keiji (1990): Faunal change of non-marine molluscs in Cenozoic. *Monogr. Mizunami Fossil Mus.*, (7):123-128. (新生代の淡水生軟体動物の変遷) (J.)

902 MATSUOKA Keiji and SHIMIZU Iwao (1988): Freshwater molluscs from the Middle Pleistocene Toyono Formation in Nagano prefecture, central Japan. *Bull. Mizunami Fossil Mus.*, (14):89-102, pls. 19-20, figs. 1-4, tab. 1. (長野県豊野層の淡水生貝類化石) (J.E.)

903 **MATSUSHIMA Yoshiaki** (1986): A new locality of fossil *Protapes irrediviva* in Totsuka, southwest part of Yokohama. *Nat. Hist. Rep. Kanagawa, Kanagawa Pref. Mus.*, (7):105-110, photos. 1-3, figs. 1-3, tab. 1. (化石ヨシズガイの新産地) (J.)

904 MATSUSHIMA Yoshiaki (1986): Molluscan fossils from the Nakazato Formation (Middle Pleistocene) in the south part of Yokohama. *Nat. Hist. Rep. Kanagawa., Kanagawa Pref. Mus.*, (7):111-115, photos. 1-3, fig. 1. (横浜南部, 杉田町から産出した中里層(中部更新統)の化石) (J.)

905 MATSUSHIMA Yoshiaki (1987): A shark tooth remain of *Carcharodon* from Nakatsu Group, Kanagawa Prefecture. *Nat. Hist. Rep. Kanagawa, Kanagawa Pref.*

Mus., (8):33-36, figs. 1-2. (中津層群から産出したホホジロザメの歯化石について) (J.)

906 MATSUSHIMA Yoshiaki (1987): Holocene marine environmental change in the inner part of Mikawa Bay, central Japan. *Bull. Kanagawa Pref. Mus., Nat. Sci.*, (18):23-34, figs. 1-6, tabs. 1-2. (貝類群集からみた三河湾湾奥に於ける約6500年前以降の自然環境の変遷) (J.E.)

907 MATSUSHIMA Yoshiaki (1988): The environmental changes deduced from the warm-adapted molluscan fauna in the coast of Japan Sea, with special reference of Hokkaido coast. *Coll. & Breed.*, 50(2):67-71, figs. 1-8, tab. 1. (貝類からみた日本海沿岸の変遷 ―特に北海道沿岸を例として) (J.)

908 MATSUSHIMA Yoshiaki (1990):Late Pleistocene molluscan fossils from the Hekikai Formation. *Bull. Kanagawa Pref. Mus., Nat. Sci.*, (19):19-32, figs. 1-5, tabs. 1-2. (愛知県刈谷付近の碧海層の貝化石) (J.E.)

909 MATSUSHIMA Yoshiaki (1990): *Nautilus pompilius* drifts on the northeast coast of Sumba Island, Indonesia. *Bull. Kanagawa Pref. Mus., Nat. Sci.*, (19):33-43, figs. 1-9. (インドネシア、スンバ島における*Nautilus*の漂着) (J.E.)

910 MATSUSHIMA Yoshiaki and NARA Masayoshi (1987): Radiocarbon ages of the molluscan shells from the Holocene marine deposits in the Tanabu Plain, Shimokita Peninsula, northeast Japan, with consideration on their related problems. *Bull. Kanagawa Pref. Mus., Nat. Sci.*, (17):57-72, pls. 1-5, figs. 1-4, tab. 1. (下北半島田名部平野の海成沖積層から産出した貝殻の^{14}C年代とそれに関する問題) (J.E.)

911 MATSUSHIMA Yoshiaki and YAMAGUCHI Yoshihide (1987): Radiocarbon ages of the molluscan fossils and peat from the Alluvial deposits in Yokohama City. *Nat. Hist. Rep. Kanagawa, Kanagawa Pref. Mus.*, (8):37-40, figs. 1-3. (横浜市内沖積層産の貝化石と泥炭の^{14}C年代) (J.)

912 MATSUSHITA Mariko (1989): Holocene vegetation history in Haibara on Omaezaki point, central Japan. *Japan. Jour. Ecol.*, 39(3):183-188, figs. 1-3. (御前崎榛原町周辺の後氷期における植生変遷史) (J.E.)

913 MATSUSHITA Mariko, MAEDA Yasuo, MATSUMOTO Eiji and MATSUSHIMA Yoshiaki (1988): Vegetation history during Holocene at Shingu on Kii Peninsula and Muroto point, south-western Japan, with special reference to development of *Castanopsis* forest. *Japan. Jour. Ecol.*, 38:1-8, figs. 1-4, tab. 1. (新宮(紀伊半島)および室戸岬の完新世植生史－とくにシイ林の成立について) (J.E.)

914 MATSUSHITA Mariko and SANUKIDA Satoshi (1988): Holocene vegetation history around Lake Hamana on the Pacific coast of central Japan. *Quat. Res., Japan*, 26(4):393-399, figs. 1-5.

915 MATSUSHITA Satoshi and KITAZATO Hiroshi (1990): Seasonality in the benthic foraminiferal community and the life history of *Trochammina hadai* Uchio in Hamana Lake, Japan. In Ch. Hemleben et al. (eds.): Paleoecology, biostratigraphy, paleoceanography and taxonomy of agglutinated Foraminifera. Kluwer Academic Publishers, Netherlands, 695-715.

916 MATSUSUE Kazuyuki (1986): Foraminiferal biostratigraphy of the lower part of the Akiyoshi Limestone Group. *Sci. Rep., Dept. Geol., Kyushu Univ.*, 14(4):163-185, pls. 2-7. (秋吉石灰岩層群下部層の有孔虫化石層序) (J.E.)

917 MATSUSUE Kazuyuki (1988): Some aberrant fusulinaceans from the Upper Carboniferous sequence of the Akiyoshi Limestone Group, southwest Japan. *Trans. Proc. Palaeont. Soc. Japan. N. S.*, (152):644-653, figs. 1-4.

918 **MATSUURA Shuji** (1986): [Fossils concerned the origin of hominoid and its chronological discussion]. *Kagaku*, 56(4):210-219, fig. 1. (人類の起源にかかわる化石、その年代論) (J.)

919 **MATSUZAWA Itsumi** and KOSAKA Toshiyuki (1987): On the Quaternary System in the Cape district -With special reference to the horizon of *Mammonteus primigenius* (M^2)-. Prof. M. Matsui Mem. Vol., Sapporo, 71-78, figs. 1-3, tabs. 1-2. (襟裳岬付近の第四系－とくにマンモスゾウ産出層準について－) (J.)

920 **MATSUURA Nobuomi** and SHIMOYAMA Shoichi (1986): Molluscan shell remains from Kahoku-lowland, Ishikawa Prefecture, central Japan. *Bull. Japan Sea Res. Inst., Knazawa Univ.*, (18):69-78. (石川県河北低地の自然貝層) (J.E.)

921 **MAZIMA Nobuo**, MISHIMA Hiroyuki and NONAKA Yoshihiko (1990): A fossil tusk of *Palaeoloxodon naumanni* (Makiyama) from the Upper Pleistocene Anesaki Formation in Ichihara, Chiba Prefecture, central Japan. *Earth Sci.*, 44 (1):31-35, figs. 1-4, tab. 1. (千葉県市原市の上部更新統姉崎層より産出したナウマンゾウ切歯化石) (J.)

922 **MIDORIKAWA Yoshiyuki** and UJIIE Hiroshi (1987): On the sediments of the "Sekisei-sho" region, Yaeyama-gunto, Okinawa. *Earth Month.*, 9(3):152-158, figs. 1-12. (八重山群島・石西礁の底質) (J.)

923 **MIMOTO Kenji** (1986): Fossils in Kochi Prefecture. Illustrations of the specimens kept by the members of the Kochi Fossil Society. Kochi Fossil Society, Kochi, 1-54, pls. 1-20. (高知の化石－高知化石研究会会員所蔵標本図集－) (J.)

924 MIMOTO Kenji (1988): Data on the bathymetrical distribution of Japanese bivalves. *Chiribotan*, 19(1):1-4, figs. 1-5, tabs. 1-2. (日本産二枚貝の深度分布についての一資料) (J.)

925 MIMOTO Kenji (1988): Occurrence of Cretaceous plants from Ryoseki, Kochi Prefecture in 1987. *Chigaku Kenkyu*, 37(7/9):183-190. (高知県領石で植物化石多産(1987年)) (J.)

926 MIMOTO Kenji, MORINO Yoshihiro and NOSE Kazuo (1990): Discovery of the diceratid rudist (Bivalvia) from the Torinosu Limestone in Kochi Prefecture. *Chigaku Kenkyu*, 39(2):107-110, figs. 1-3. (鳥ノ巣石灰岩からの厚歯二枚貝diceratidの発見) (J.E.)

927 MIMOTO Kenji and NOSE Kazuo (1990): Occurrence of a Silurian bivalve from Yokokurayama in Shikoku. *Chigaku Kenkyu*, 39(2):111-113, figs. 1-2. (四国横倉山からのシルル紀二枚貝の産出) (J.E.)

928 MIMOTO Kenji and OKAMURA Katsunori (1989): *Zamites* leaf from the Torinosu Limestone in Kochi Prefecture. *Chigaku Kenkyu*, 38(7/9):175-179. (高知県の鳥ノ巣石灰岩産*Zamites* 葉) (J.E.)

929 **MINAKI Mutsuhiko**, NOSHIRO Shuichi and SUZUKI Mitsuo (1988): *Hemiptela mikii* sp. nov. (Ulmaceae), fossil fruits and woods from Pleistocene of central Japan. *Bot. Mag., Tokyo*, 101(1063):337-351, figs. 1-7, tabs. 1-3.

930 **MINOURA Nachio** (1987): Lower Devonian crinoid *Pernerocrinus* from the southern Kitakami Mountains, N. E. Japan. *Jour. Fac. Sci., Hokkaido Univ.*,

Ser. 4, 22(2):337-355, pls. 1-3, figs. 1-4, tabs. 1-2.

931 **MISHIMA Hiroyuki** and Fossil Mammal Research Group for Nojiri-ko Excavation (1990): A fossil female tusk of *Palaeoloxodon naumanni* (Makiyama) from the Nojiri-ko Formation found at the 9th Nojiri-ko Excavation. *Jour. Foss. Res.*, 23(1):19-23, figs. 1-2, tab. 1. (第９次野尻湖発掘で得られたナウマンゾウの雌の切歯化石) (J.)

932 **MITOMO Kiyobumi**, MACHIDA Mizuo and TOZUKA Atsuko (1986): On the latest information from the Yaoroshi Tuff and the Hanno Gravel. *Bull. Saitama Mus., Nat. Hist.*, (4):73-86, pls. 1-4, figs. 1-5, tab. 1. (矢颪凝灰岩層および飯能礫層における新知見について) (J.E.)

933 MITOMO Kiyobumi, MACHIDA Mizuo and TOZUKA Atsuko (1987): Fossil diatoms in the river bottom of Oppegawa, Akao, Sakado City, Saitama. *Bull. Saitama Mus., Nat. Hist.*, (5):59-62, pls. 1-5, fig. 1. (埼玉県坂戸市赤尾，越辺川河床の珪藻化石) (J.E.)

934 **MITUSIO Taikou** and FURUKAWA Hiroyasu (1988): Quaternary strata in Shikoku district Japan. *Mem. Geol. Soc. Japan*, (30):145-154, figs. 1-3, tabs. 1-3. (四国地方の第四紀層) (J.)

935 MITUSIO Taikou, OKAMURA Makoto, YASUDA Hisato, KAGAMI Hideo, SOH Wonn and MURAYAMA M. (1989): Preliminary report on the slope of Nankai Trough, Tosa basin, and Muroto basin -Results of the Tansei-Maru cruise, KT88-16. *Mem. Fac. Sci., Kochi Univ., Ser. E*, 10:13-28, pls. 1-5, figs. 1-15, tabs. 1-2.

936 **MIYAMOTO Takami** and TANIMOTO Yasunori (1986): Discovery of late Permian radiolarians from the so-called Yuzuruha Formation, Kumamoto Prefecture, southwest Japan. *NOM, Spec. Vol.*, (7):211-217, pls. 1-2, figs. 1-3, tab. 1. ("湯鶴葉層"より後期ペルム紀型放散虫化石の発見) (J.E.)

937 **MIYASHITA Osamu** (1986): Pollen assemblage of the Kazusa Group in the northern part of the Tama hills, southwestern Kanto, Japan. *Jour. Geol. Soc. Japan*, 92(7):517-524, figs. 1-4, tabs. 1-2. (多摩丘陵北域における上総層群の花粉群集) (J.E.)

938 **MIYATA Yuichiro**, YAMAMURA Tsuneo, NABETANI Atsushi, IWATA Takao, OBATA Masayuki, YUUKI Tomoya and TOKUHASHI Shuichi (1990): Formation process of lacustrine deltas -An example from the Echi River Delta, Lake Biwa- 2. Geological setting and sedimentary facies. *Jour. Geol. Soc. Japan*, 96 (10):839-858, pls. 1-2, figs. 1-10, tabs. 1-2. (淡水成デルタの形成過程－琵琶湖愛知川河口部を例として－２．地質構成と堆積相) (J.E.)

939 **MIYOSHI Norio** (1989): Preliminary pollen analytical study of a late-Pleisto-cene deposit from the Tokusa basin, Yamaguchi Prefecture. *Quat. Res., Japan*, 28(1):41-48, figs. 1-3, tab. 1. (徳佐盆地(山口県)における後期更新世の花粉分析(予報)) (J.E.)

940 **MIZUNO Toshiaki** and AMANO Kazutaka (1988): Molluscan fauna from the Kota Formation in Joetsu City -Studies on the molluscan fossils from the western part of Joetsu district, Niigata Prefecture (Part 4)-. *Bull. Mizunami Fossil Mus.*, (14):73-88, pls. 14-18. (上越市の居多層産軟体動物群－新潟県上越地域西部の軟体動物化石の研究(その４)－) (J.E.)

941 **MIZUNO Yoshiaki** (1989): [Consideration on *Linthia* from the Morozaki Group]. *Kaseki no Tomo*, (34):3-10, pls. 1-2, figs. 1-2, tabs. 1-3. (師崎層群の *"Linthia"* 考) (J.)

942 MIZUNO Yoshiaki, HACHIYA Kiichiro and YAMAOKA Masatoshi (1989): Some fossil echinoids from the Miocene Morozaki Group in the Chita Peninsula, central Japan. *Kaseki no Tomo*, (35):2-19, pls. 1-4, figs. 1-6, tabs. 1-6. (中新統師崎層群産のウニ類化石) (J.)

943 **MIZUTANI Shinjiro**, KOJIMA Satoru, SHAO Ji'an and ZHANG Qinglong (1986): Mesozoic radiolarians from the Nadanhada area, northeast China. *Proc. Japan Acad., Ser. B*, 62(9):337-340, figs. 1-2.

944 MIZUTANI Shinjiro, SHAO Ji'an and ZHANG Qinglong (1990): The Nadanhada terrane in relation to Mesozoic tectonics on continental margins of East Asia. *Acta Geol. Sinica*, 3(1):15-29, figs. 1-4.

945 **MOMOHARA Arata**, MIZUNO Kiyohide, TSUJI Sei-ichiro and KOKAWA Shohei (1990): Early Pleistocene plant biostratigraphy of the Shobudani Formation, southwest Japan, with reference to extinction of plants. *Quat. Res., Japan*, 29(1):1-15, pl. 1, figs. 1-4, tab. 1.

946 **MOORE Ellen J.** (1988): Diagenetic history of sequential calcited, barite, and quartz within the chamber of the Tertiary nautiloid *Aturia*, southwestern Washington. *Saito Ho-on Kai, Spec. Pub. (Prof. T. Kotaka Commem. Vol.)*, 193-201, pls. 1-2, figs. 1-2, tab. 1.

947 **MORI Kei** (1986): Intraspecific variations of Recent and Tertiary solitary corals from New Zealand. *Jour. Geogr.*, 95(4):291-293. (ニュージーランドにおける現生および第三系産単体サンゴの種内変異に関する基礎的研究) (J.)

948 MORI Kei (1987): Historical review of the Paleozoic stromatoporoid studies and problems in classification. *Jour. Geogr.*, 96(6):392-402, figs. 1-8. (古生代層孔虫研究史と分類上の問題点) (J.E.)

949 MORI Kei (1987): Intraspecific morphological variations in a Pleistocene solitary coral, *Caryophyllia (Premocyathus) compressa* Yabe and Eguchi. *Jour. Paleont.*, 61(1):21-31, figs. 1-9, tabs. 1-2.

950 **MORI Shinobu** (1986): Diatom assemblages and late Quaternary environmental changes in the Nobi plain, central Japan. *Jour. Earth Sci., Nagoya Univ.*, 34:109-138, pls. 1-10, figs. 1-12, tabs. 1-2.

951 **MORINAGA Hiroshi** and OKUMURA Kiyoshi (1988): Upper Cretaceous Izumi Group in the eastern part of the Asan Mountains, Shikoku, Japan. *Jour. Geol. Soc. Japan*, 97(7):672-683, figs. 1-10. (阿讃山脈東部板野－引田地域の和泉層群) (J.E.)

952 **MORINO Yoshiro** (1989): Mode of occurrence of nerineid (Jurassic Gastropoda) from the Koike Limestone in the Soma area, Fukushima Prefecture. *Benthos Res.*, (37):83-90, figs. 1-4, tab. 1. (福島県相馬地域の小池石灰岩におけるネリネア類の産状) (J.E.)

953 **MORINO Yoshihiro**, KOZAI Takeshi, WADA Takashi and TASHIRO Masayuki (1989): On the Lower Cretaceous Birafu Formation including the Torinosu type limestone in the Monobe area, Kochi Prefecture. *Res. Rep., Kochi Univ., Nat. Sci.*, 38:73-83, pls.1-2, figs. 1-5, tabs. 1-2. (高知県物部地域の鳥巣式石灰岩を含む下部白亜系美良布層について) (J.E.)

954 **MORIWAKI Hiroshi**, MACHIDA Hiroshi, HATSUMI Yuichi and MATSUSHIMA Yoshiaki (1986): Phreatomagnetic eruptions affected by post-glacial transgression in the northern coastal area of Kagoshima Bay, southern Kyusyu, Japan. *Jour. Geogr.*, 95(2):24-43, phots. 1-8, figs. 1-12, tab. 1. (鹿児島湾北岸におけるマグマ水蒸気噴火とこれに影響を与えた縄文海進) (J.E.)

955 **MORIYA Naruhiro**, MURATA Yujiro, TAKAHASHI Kiyoshi, KODATO Toshio and ICHINOSEKI Tetsuro (1986): [Stratigraphic consideration and paleo-environment of the Lower Neogene distributed in the eastern Dewa hill based on Foraminifera]. *Jour. Japan. Assoc. Petrol. Tech.*, 51(4):338-339. (出羽丘陵東部に分布する新第三系下部の有孔虫化石に基づく層序学的考察と古環境) (J.)

956 **MUKAI Hiroshi** and TAKEDA Masatsune (1987): A giant amphipod Crustacea from the Miocene Morozaki Group in the Chita Peninsula, central Japan. *Bull. Natn. Sci. Mus., Tokyo, Ser. C*, 13(1):35-39, figs. 1-4.

957 **MURAKAMI Shiori** and YAMAGUCHI Toshiyuki (1988): Chitons found in the vicinity of the Kominato Marine Laboratory, Amatsu-Kominato Machi, Chiba Prefecture, and its adjacent regions. *Ann. Rep., Mar. Ecosyst. Res. Cent., Chiba Univ.*, (8):39-41. (千葉県天津小湊町千葉大学理学部小湊実験所地先及び房総周辺海域のヒザラガイ類) (J.)

958 **MURAMATSU Takeshi** (1986): Late Cretaceous-earliest Paleogene? radiolarians from the Shimanto Belt (Northern Belt) in the southern part of the Akaishi Mountains, central Japan. *Jour. Geol. Soc. Japan*, 92(4):311-313, pl. 1, fig. 1, tab. 1. (赤石山地南部の四万十帯(北帯)から発見された白亜紀～古第三紀最初期？放散虫化石) (J.)

959 **MUSASHINO Makoto**, KIRIMURA Shigemi and ISHIGA Hiroaki (1987): Discovery of *Neoalbaillella* (late Permian Radiolaria) from Oi Formation of Ultra-Tamba Zone, southwest Japan. *Earth Sci.*, 41(3):194-197, pl. 1, figs. 1-4. (超丹波帯大飯層からのペルム紀新世*Neoalbaillella* 属放散虫の発見) (J.)

960 **MUTOU Asako**, YAMAGUCHI Toshiyuki and KITAZATO Hiroshi (1990): Molluscan and foraminiferal assemblages of the Pleistocene Ninomiya Formation, distributed in the Oiso hills. *Nat. Hist. Rep. Kanagawa, Kanagawa Pref. Mus.*, (11):23-36, phots. 1-3, figs. 1-3, tab. 1. (大磯丘陵に分布する二宮層の貝，有孔虫化石群集) (J.)

N

961 **NAGAI Hiromi** (1986): Jurassic *Eucyrtidiellum* (Radiolaria) from central Japan. *Bull. Nagoya Univ. Mus., Furukawa Mus.*, (2):1-21, pls. 1-2, figs. 1-3, tab. 1.

962 NAGAI Hiromi (1987): Middle Jurassic *Eucyrtidiellum* (Radiolaria) from Kutsuwano, Gifu Prefecture, central Japan. *Bull. Nagoya Univ. Mus., Furukawa Mus.*, (3):1-11, pls. 1-3, figs. 1-3, tab. 1. (岐阜県櫛野のジュラ紀中期の放散虫*Eucyrtidiellum*) (J.E.)

963 NAGAI Hiromi (1988): Early Jurassic *Eucyrtidiellum* (Radiolaria) from Kami-aso, Gifu Prefecture, central Japan. *Bull. Nagoya Univ. Mus., Furukawa Mus.*, (4):1-9, pls. 1-2, figs. 1-3.

964 NAGAI Hiromi (1990): Jurassic (Lower Toarcian) radiolarians from the Hyde Formation, central Oregon, North America. *Bull. Nagoya Univ. Mus., Furukawa Mus.*, (6):1-7, pls. 1-6, tab. 1. (Hyde Formationのジュラ紀(Lower Toarcian)放散虫) (J.E.)

965 NAGAI Hiromi and MIZUTANI Shinjiro (1990): Jurassic *Eucyrtidiellum* (Radiolaria) in the Mino terrane. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (159):587-602, figs. 1-4, tab. 1

966 NAGASAWA Kazuo (1988): A fossil molar of *Palaeoloxodon naumanni* (Makiyama) from Goten, Murayama City, Yamagata Prefecture, northeast Japan. *Bull. Yamagata Pref. Mus.*, (9):41-49, pl. 1. figs. 1-7, tab. 1. (村山市碁点から産出したナウマンゾウ臼歯化石) (J.)

967 NAGASAWA Kazuo (1990): A fossil femur of Proboscidea from Goten, Murayama City, Yamagata Prefecture, northeast Japan. *Bull. Yamagata Pref. Mus.*, (11):1-8, pl. 1, figs. 1-4, tabs. 1-3. (山形県村山市碁点から産出した長鼻類の大腿骨化石) (J.)

968 NAGASAWA Kazuo and TAKAHASHI Keiichi (1989): Proboscidean fossil molars from Yamagata Prefecture, northeast Japan. *Bull. Yamagata Pref. Mus.*, (10):51-67, pls. 1-6, figs. 1-4, tab. 1. (山形県産の長鼻類臼歯化石) (J.)

969 NAGASAWA Kazuo and YAMANOI Tohru (1990): Fossil insects from the Upper Miocene Yamaguchi Formation in Barazaki, Tendo City, Yamagata Prefecture, northeast Japan. *Bull. Yamagata Pref. Mus.*, (11):11-18, pl. 1, figs. 1-7, tab. 1. (山形県天童市原崎の上部中新統山口層から産出した昆虫化石) (J.)

970 NAGATA Hidehisa, KITO Norio and NAKAGAWA Mitsuru (1987): Serpentinite gravels found in the Yezo Supergroup, Hokkaido, Japan -New evidence for the age of serpentinite intrusion of the Kamuikotan Tectonic Belt-. *Earth Sci.*, 41(1):57-60, figs. 1-5, tab. 1. (蝦夷累層群中に見出された蛇紋岩礫－神居古潭構造帯の蛇紋岩の迸入時期についての新資料－) (J.)

971 NAGATA Kyoichi (1986): On the radiolarian biostratigraphy and the preservation related to silica diagenesis, Atsunai-Toyokoro area, eastern part of Hokkaido. *NOM, Spec. Vol.*, (7):95-108, pl. 1, figs. 1-11. (北海道東部厚内－豊頃地区における放散虫化石層序と放散虫化石の保存度について) (J. E.)

972 NAGATA Masaru, KITO Norio and NIIDA Kiyoshi (1986): The Kumaneshiri Group in the Kabato Mountains: The age and nature as an early Cretaceous volcanic arc. *Monogr. Assoc. Geol. Collab. Japan*, (31):63-79, pl. 1, figs. 1-11, tabs. 1-2. (樺戸山地の中生界－隈根尻層群の年代と白亜紀火山弧としての性格) (J.E.)

973 NAKA Takahiro and ISHIGA Hiroaki (1987): Carboniferous to Jurassic (especially Permian) radiolarians recovered from the Chugoku region (a review). *Mem. Fac. Sci., Shimane Univ.*, 21:153-167, figs. 1-13.

974 NAKAGAWA Hisao (1988): Marine Quaternary System in Tohoku and Kanto regions, Japan. *Mem. Geol. Soc. Japan.*, (30):25-38, figs. 1-7. (東北, 関東地方の海成第四系) (J.E.)

975 NAKAGAWA Tomio (1987): Fossil *Bathynomus* (Isopoda, Crustacea) from the Miocene Uchiura Group, Fukui Prefecture, central Japan. *Earth Sci.*, 41 (5):290-292, figs. 1-2. (福井県内浦層群から産出したオオグソクムシ(甲殻綱, 等脚目)化石) (J.)

976 NAKAGAWA Tomio (1989): Intertidal molluscan assemblages in the Miocene Kunimi Formtion, Fukui Prefecture, central Japan. *Bull. Fukui Pref. Mus.*, (3):23-45, pls. 1-3, figs. 1-6, tabs. 1-2. (福井県丹生山地北部の中新統, 国見累層産潮間帯性貝類化石群集) (J.E.)

977 NAKAGAWA Tomio and CHIJI Manzo (1988): Planktonic foraminifers from the Miocene sequence in the Kaetsu area, Ishikawa Prefecture, central Japan. *Bull. Japan Sea Res. Inst., Kanazawa Univ.*, (20):93-110, pls. 1-2. (石川県加越地域の中新統から産出した浮遊性有孔虫化石) (J.E.)

978 NAKAGAWA Tomio and GOTO Masatoshi (1990): On the teeth of the genus *Isurus* from the Miocene in the northern part of Fukui Prefecture, central Japan. *Bull. Fukui Munic. Mus., Nat. Hist.*, (37):1-6, pl. 1, figs. 1-3. (福井県北部の中新統から産出したアオザメ属の歯化石について) (J.)

979 NAKAHARA Koushi, TANAKA Tsutomu, ENDO Mitsuhisa and KOBAYASHI Iwao (1987): Neogene and lower Quaternary stratigraphy in the southwestern area of the Kuninaka plain, Sado Island, central Japan. *Pub. Sado Mus.*, (9):103-115. figs. 1-5, tab. 1. (佐渡国中平野南西部の新第三系・下部更新統) (J.E.)

980 NAKAJIMA Tsuneo (1986): Fossil pharyngeal teeth of cyprinids from the Kusuhara Formation of the Age Group -A comparison to the cyprinid fauna of the Kobiwako Group-. *Bull. Mizunami Fossil Mus.*, (13):105-114, pl. 21, figs. 1-2, tab. 1. (奄芸層群楠原累層産コイ科魚類咽頭歯化石－古琵琶湖層群コイ科魚類相との比較－) (J.E.)

981 NAKAJIMA Tsuneo (1988): First discovery of a fossil cyprinid pharyngeal tooth from the Himetani Formation of the Miocene Suzuka Group, Mie, central Japan. *Bull. Mizunami Fossil Mus.*, (15):65-68, pl. 9, fig. 1. (鈴鹿層群姫谷層よりコイ科魚類咽頭歯化石の発見) (J.)

982 NAKAJIMA Tsuneo, MATSUOKA Keiji and KITABAYASHI Eiichi (1988): Cyprinid fossils from the Pleistocene Kusu Group, Oita Prefecture, Kyushu, Japan. *Bull. Mizunami Fossil Mus.*, (14):103-112, pl. 21, figs. 1-2, tab. 1. (大分県玖珠層群産コイ科魚類化石) (J.)

983 NAKAMORI Toru (1986): Community structures of Recent and Pleistocene hermatypic corals in the Ryukyu Islands, Japan. *Sci. Rep., Tohoku Univ., 2nd Ser.*, 56(2):71-133, pls. 1-26, figs. 1-57, tabs. 1-14.

984 NAKAMORI Toru (1987): [Ecological distributions of the hermatypic corals]. *Mar. Sci. Month.*, 19:491-497, figs. 1-7, tab. 1. (造礁サンゴ群集の生態分布) (J.)

985 NAKAMORI Toru (1989): Skeletal growth model of the dendritic hermatypic corals limited by light shelter effect. Proc. 6th International Coral Reef Symposium, Townsville, 3:113-118, figs. 1-6, tab. 1.

986 NAKAMORI Toru and IRYU Yasufumi (1989): [Topography of the coral reef and distribution of the reef building organisms]. In N. Hori et al. (eds.): Tropics in Japan: Natural history of coral islands (Series of coral islands in Japan) Vol.1. Kokon-shoin, Tokyo, 396-412, figs. 3.1-3.9, tab. 3.1. (サンゴ礁の地形区分と造礁生物の礁内分布) (J.)

987 NAKAMORI Toru and SHIGESADA Nanako (1989): Community structures of hermatypic corals. *Benthos Res.*, (37):57-64, figs. 1-4. (造礁サンゴの群集構造) (J.E.)

988 NAKAMURA Koji, KIMURA Gaku and WINSNES Thore S. (1987): Branchiopod zonation and age of the Permian Kapp Starostin Formation (Central Spitsbergen). *Polar Res.*, 5(2):207-219, figs. 1-5, tab. 1.

989 NAKAMURA Koji, KIMURA Gaku, WINSNES Thore S. and LAURITZEN Ornulf (1990): Permian and Permian-Triassic boundary in central Spitsbergen. In T. Tatsumi (ed.): The Japanese scientific expeditions to Svalbard, 1983-1988. Kyoikusha, Tokyo, 137-153, pls. 1-3, figs. 1-5, tab. 1.

990 NAKAMURA Koji and TAZAWA Jun-ichi (1990): Faunal provinciality of the Permian brachiopods in Japan, In K. Ichikawa, S. Mizutani, I. Hara, S. Hada and A. Yao (eds.): Pre-Cretaceous terranes of Japan. Publication of

IGCP Project 224, Osaka, 313-320, figs. 1-3.

991 **NAKAMURA Manjiro** (1988): On some algal remains from the Akiyoshi Limestone Group. *Bull. Akiyoshi-dai Mus., Nat. Hist.*, (23):1-11, pls. 1-3. (秋吉石灰岩層群産藻類化石のあるものについて) (J.)

992 NAKAMURA Manjiro (1990): On some interesting algal remains from the Akiyoshi Limestone Group. *Bull. Akiyoshi-dai Mus., Nat. Hist.*, (25):1-5, pls. 1-2. (秋吉石灰岩層群産新化石藻について) (J.)

993 NAKAMURA Manjiro and NAGASHIMA Hideyuki (1987): On some interesting Permian Dasycladacan fossils in Japan. *Stud. Lib. Arts & Sci., Sci. Univ. Tokyo*, (19):237-250, pls. 1-3. (日本二畳系産カサノリ科化石藻の珍種について) (J.)

994 NAKAMURA Manjiro and NAGASHIMA Hideyuki (1990): Review on the Solenoracean fossils from the Upper Paleozoic in Japan. *Stud. Lib. Arts & Sci., Sci. Univ. Tokyo*, (22):149-163, pls. 1-4. (日本の上部古生界産ソレノポーラ科化石藻について) (J.)

995 **Nakano-umi and Shinji-ko Research Group**, MATSUMOTO Eiji, INOUCHI Yoshiro and KASHIMA Kaoru (1987): Natural history of the Nakano-umi and Shinji lakes -6: Core sampling in 1986 and preliminary report on foraminiferal and diatom assemblages in the bottom sediments of the Lake Nakano-umi. *Geol. Rep., Shimane Univ.*, (6):61-84. (中海・宍道湖の自然史研究－その６, 中海における1986年度柱状採泥と湖底表層堆積物中の有孔虫・珪藻群集（予報)) (J.)

996 **NAKAO Seiji**, KOTAKE Nobuhiro and NIITSUMA Nobuaki (1986): Geology of the Ishido area in the southern part of the Boso Peninsula, central Japan. *Geosci. Rep., Shizuoka Univ.*, (12):209-238, figs. 1-17, tabs. 1-4. (房総半島南部石堂地域の地質) (J.E.)

997 **NAKASEKO Kojiro**, NISHIMURA Akiko and YAMAUCHI Moriyoshi (1989): Paleozoic and Mesozoic radiolarian fossils from Japan 3 (Cretaceous 1-4). *Atlas, Japan. Foss.*, (68):403-408. (日本の古生代・中生代放散虫化石 3 (白亜紀１－４)) (J.)

998 NAKASEKO Kojiro, YAMAUCHI Moriaki and OHNO Terufumi (1986): Eching method for the observation of clay sediments. *Jour. Geol. Soc. Japan*, 92(2):163-165, pl. 1, figs. 1-2. (エッチング法による泥質堆積物の観察) (J.)

999 **NAKASHIMA Kouichi** and NISHI Takuro (1987): Sandstone sills and dikes emplaced in Triassic and Jurassic siliceous rocks of the southern Chichibu terrane in Kyushu. *Sci. Rep., Dept. Geol., Kyushu Univ.*, 15(1): 153-166, pls. 3-6, figs. 1-15, tabs. 1-2. (九州秩父累帯南帯トリアス紀・ジュラ紀珪質岩類中の砂岩シルおよび岩脈) (J.E.)

1000 **NAKAYA Hideo** (1986): [Paleoenvironment of Pre-hominoid and phylogenetic research of east African Miocene mammals]. *Proc. Japan Assoc. Afr. Stud.*, (17):10-11. (人類誕生時の古環境解析と東アフリカ中新世哺乳類の系統研究) (J.)

1001 NAKAYA Hideo (1987): [Fossil Pleistocene *Palaeoloxodon* (Proboscidea, Mammalia) from offshore sea bottom of Kan'onzi, Kagawa, southwestern Japan]. In M. Kimura (ed.): Prof. M. Matsui Mem. Vol., Sapporo, 59-62, pl. 1, figs. 1-3. (香川県観音寺市沖から発見されたゾウ化石) (J.)

1002 NAKAYA Hideo (1987): [Mammal remains from Daimon Site]. *Excavat. Rep., Archeol. Sites, Route Shikoku Transverse High Way*, 2:394-396, pl. 1. (大門遺跡産出の哺乳類遺体) (J.)

1003 NAKAYA Hideo (1987): [Mammal remains from Higashinomaru Site of the Takamatsu Castle]. In Educational Board of Kagawa Prefecture (ed.): Excavation Report of Higashinomaru Site in the Takamatsu Castle, Takamatsu, 250-255, pl. 1. (高松城東ノ丸跡出土の獣骨について) (J.)

1004 NAKAYA Hideo (1987): The Neogene mammalian fauna of the Sub-Saharan Africa. *Jour. Afr. Stud.*, (30):107-115, figs. 1-4. (アフリカ(サハラ以南)の新第三紀哺乳動物群) (J.E.)

1005 NAKAYA Hideo (1987): Pleistocene fossil bovids from Japan. *Jour. Foss. Res.*, 19(2):48-52, figs. 1-2. (日本産の更新世ウシ科化石) (J.E.)

1006 NAKAYA Hideo (1987): [Usefulness of Cladistics -Contradiction to Inuzuka's comments to Cladistics in Journal of Fossil Research Vol. 19, no. 2, March, 1987]. *Jour. Foss. Res.*, 20(1):21-23. (分岐分類学はいかに有効か—化石研究会会誌第19巻第2号(1987年3月)特集-系統復元の方法-に於ける「犬塚」論文に対する批判—) (J.)

1007 NAKAYA Hideo (1989): [Japanese name of the Plesiosaurian fossil (HMG 1) (Class Reptilia, Subclass Euryapsida, Order Sauropterygia, Suborder Plesiosauria, Superfamily Plesiosauroidea, Family Elasmosauridae) from Hobetsu, Hokkaido, northern Japan]. *Bull. Hobetsu Mus.*, (6):43-49. (穂別町より産出した長頸竜化石(HMG1)(爬虫綱, 広弓亜綱, 鰭竜目, 長頸竜亜目, プレシオサウルス上科, エラスモサウルス科)の和名について) (J.)

1008 NAKAYA Hideo (1989): Late Miocene mammaliam interchange of Sub-Saharan Africa -Paleoenvironments of large hominoids evolution-. In G. Giacobini (ed.): Hominidae, Jaca Book, Milano, Italy, 67-70, figs. 1-2.

1009 NAKAYA Hideo (1989): Upper Cretaceous Elasmosaurid (Reptilia, Plesiosauria) from Hobetsu, Hokkaido, northern Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (154):94-117, figs. 1-14, tabs. 1-7.

1010 NAKAYA Hideo (1990): [Animal remains from Nagai Site, Zentsu'uji City (1)]. *Excavat. Rep., Archeol. Sites, Route Shikoku Transverse High Way*, 9:865-868, pl. 1. (善通寺市永井遺跡産出の動物遺体(1)) (J.)

1011 NAKAYA Hideo and FUJIMOTO Mitsushi (1990): Theoretical morphology of horn of Bovidae (Mammalia, Artiodactyla). *Earth Sci*, 44(4):196-204, figs. 1-12, tab. 1. (ウシ科(哺乳類, 偶蹄目)の角の形態解析) (J.E.)

1012 NAKAYA Hideo, PICKFORD Martin, YASUI Kinya and NAKANO Yoshihiko (1987): Additional large mammalian fauna from the Namurungule Formation, Samburu hills, northern Kenya. *Monogr. African Stud., Supplement. Issue*, (5):47-98, pls. 1-10, figs. 1-6.

1013 NAKAYA Hideo and WATABE Mahito (1990): *Hipparion* from the Upper Miocene Namurungule Formation, Samburu hills, Kenya: Phylogenetic significance of newly discovered skull. *Geobios*, 23(2):195-219, pls. 1-2, figs. 1-18, tabs. 1-3.

1014 NAKAZATO Hiroomi, SHIMOKAWA Koichi and IWAI Noboru (1990): [ESR age measurement of molluscan fossils from the Middle and Upper Pleistocene Kazusa and Shimosa Groups]. *Earth Month.*, 12(1):37-42, figs. 1-8, tab. 1. (中・上部更新統, 上総・下総層群産貝化石のESR年代測定) (J.)

1015 NAKAZAWA Keiji, NAKAMURA Koji and KIMURA Gaku (1987): Discovery of *Otoceras boreale* Spath from west Spitsbergen. *Proc. Japan Acad., Ser. B*, 63(6):171-174, figs. 1-2.

1016 **NEMOTO** Naoki (1990): Foraminifera of the Maido Formation in Ajigasawa district, Aomori Prefecture, northeast Japan. *Fossils, Palaeont. Soc. Japan*, (48):17-33, figs. 1-14, tabs. 1-2. (青森県鰺ヶ沢地域の舞戸層の有孔虫群) (J.)

1017 **NIIKAWA** Isao (1986): On large rugose corals from the Lower Carboniferous of Fukuji, Gifu Prefecture. *Mem. Natn. Sci. Mus., Tokyo*, (19):71-77, figs. 1-2. (岐阜県福地地域の下部石炭系から 産出した大型四射サンゴ化石について) (J.)

1018 **NIITSUMA** Nobuaki, MATSUSHIMA Yoshiaki and HIRATA Daiji (1989): Abyssal molluscan colony of *Calyptogena* in the Pliocene strata of the Miura Peninsula, central Japan. *Palaeogeogr. Palaeoclimat. Palaeoecol.*, 71 (1/2):193-203, figs. 1-8, tab. 1.

1019 **NIKO** Shuji (1986): *Mediocris* (Primitive Fusulinacea) from the Ichinotani Formation, Fukuji district, central Japan. *Sci. Pap., Coll. Arts & Sci., Univ. Tokyo*, 35(2):165-174, pls. 1-3, figs. 1-2, tabs. 1-2.

1020 NIKO Shuji (1987): Early Carboniferous *Eostaffella* (Primitive Fusulinacea) from the Ichinotani Formation, Fukuji district, central Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (147):117-130, figs. 1-5.

1021 NIKO Shuji (1989): A new Devonian cephalopod from the Nakazato Formation of the southern Kitakami Mountains. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (156):291-295, fig. 1.

1022 NIKO Shuji (1989): Loeblichiidae (Primitine Fusulinacea) from the Ichinotani Formation, Gifu Prefecture. *Sci. Pap., Coll. Arts & Sci., Univ. Tokyo*, 39(2):125-133, figs. 1-2.

1023 NIKO Shuji (1990): Early Carboniferous (Visean) cephalopods from the Hikoroichi Formation, southern Kitakami Mountains. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (159): 554-561, figs. 1-3.

1024 NIKO Shuji (1990): Early Devonian (Gedinnian) actinocerid cephalopods from the Fukuji Formation, central Japan. *Jour. Palaeont.* 64(4):595-600, figs. 1-3.

1025 NIKO Shuji and HAMADA Takashi (1986): The Middle Silurian Foraminifera (*Saccamminopsis*) from the Gion-yama Formation, central Kyushu. *Sci. Pap., Coll. Arts & Sci., Univ. Tokyo*, 36(2):173-178, figs. 1-3.

1026 NIKO Shuji and HAMADA Takashi (1987): *Adnatoceras* from Middle Carboniferous of the Ichinotani Formation, Fukuji district, central Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (148):223-227, figs. 1-3.

1027 NIKO Shuji and HAMADA Takashi (1988): Early Devonian receptaculitid (*Ischadites*) from the Fukuji Formation, central Japan. *Jour. Geol. Soc. Japan*, 94(5):337-342, pl. 1, figs. 1-2.

1028 NIKO Shuji, HAMADA Takashi and YASUI Toshio (1989): Silurian Orthoceratoceae (Mollusca: Cephalopoda) from the Yokokurayama Formation, Kurosegawa terrane. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (154):59-67, figs. 1-3.

1029 NIKO Shuji and IKEBE Nobuo (1988): *Fisherites*, a receptaculitid from the Middle Ordovician of Pyongyang Coal-field. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (149):371-377, figs. 1-3.

1030 NIKO Shuji and NISHIDA Tamio (1987): Early Permian cephalopods from the Mizuyagadani Formation, Fukuji district, central Japan. *Trans. Proc.*

Palaeont. Soc. Japan, N. S., (146):35-41, figs. 1-3.

1031 NIKO Shuji, NISHIDA Tamio and KYUMA Yuko (1987): Middle Carboniferous Orthocerataceae and Psedorthocerataceae (Mollusca: Cephalopoda) from the Akiyoshi Limestone, Yamaguchi Prefecture (Molluscan paleontology of the Akiyoshi Limestone Group -8). *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (148):335-345, figs. 1-4.

1032 NIKO Shuji and WATANABE Akiyasu (1987): Late Carboniferous and early Permian fusulinids from Kuzuryu Lake district, Fukui Prefecture (Part 1, Ozawainellidae; Schubertellidae; Fusulinidae). *Sci. Pap., Coll. Arts & Sci., Univ. Tokyo*, 37(1):37-58, figs. 1-10.

1033 NIKO Shuji, YAMAKITA Satoshi, OTOH Shigeru, YANAI Shuichi and HAMADA Takashi (1987): Permian radiolarians from the Mizuyagadani Formation in Fukuji area, Hida Marginal Belt and their significance. *Jour. Geol. Soc. Japan*, 93(6):431-433, pl. 1, figs. 1-2. (飛騨外縁帯福地地域の水屋ケ谷層より産出したペルム紀放散虫化石とその意義) (J.)

1034 **NISHI Hiroshi**, YOKOTA Satoshi and SAITO Tsunemasa (1989): An early Cretaceous (Early Middle Albian) planktonic foraminiferal fauna from the Hinagu Formation of northern Kyushu, Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (153):1-11, figs. 1-4.

1035 **NISHI Hirotsugu** (1987): Structural analysis of Tashiro Formation of Hyuga Group based on planktonic foraminiferal zonation -An example of structural analysis of accretionary prism-. *Sci. Rep., Dept. Geol., Kyushu Univ.*, 15(1):59-81, figs. 1-16. (浮遊性有孔虫化石帯区分による日向層群田代層の構造解析－付加体の構造解析の一例－) (J.E.)

1036 NISHI Hirotsugu (1988): Structural analysis of part of the Shimanto accretionary complex, Kyushu, Japan, based on planktonic foraminiferal zonation. *Modern Geology*, 12(1/4):47-69, figs. 1-17.

1037 NISHI Hirotsugu (1988): Structural analysis of the Shimanto accretionary complex, Kyushu, Japan, based on foraminiferal biostratigraphy. *Tectonics*, 7(3):641-652, figs. 1-10.

1038 NISHI Hirotsugu (1989): [Planktonic Foraminifera from the Paleogene-Lower Miocene Shimanto Supergroup]. *Yukochu Kenkyu* (=*Stud. Foraminifera*), (2):9-14, figs. 1-4. (古第三系－下部中新統四万十累層群より産する浮遊性有孔虫化石群集について) (J.)

1039 **NISHIDA Harufumi** (1986): On a new *Tempskya* stem from Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (143):435-446, pls. 87-89, figs. 1-3, tab. 1.

1040 NISHIDA Harufumi (1989): Structure and affinities of the petrified plants from the Cretaceous of northern Japan and Saghalien 5. Tree fern stems from Hokkaido, *Paracyathocaulis ogurae* gen. et comb. nov., and *Cyathocaulis yezopteroides* sp. nov. *Botan. Mag., Tokyo*, 102(1066):255-282, figs. 1-9, figs. 1-9, tabs. 1-3.

1041 NISHIDA Harufumi and NISHIDA Makoto (1986): Structure and affinities of the petrified plants from the Cretaceous of northern Japan and Saghalien 4. Petrified plants from the Upper Cretaceous of Saghalien (2). *Botan. Mag., Tokyo*, 99(1054):205-212, figs. 1-5.

1042 NISHIDA Harufumi and NISHIDA Makoto (1988): *Protomonimia kasainakajhongii* gen. et sp. nov.: A permineralized magnolialean fructifications from the mid-Cretaceous of Japan. *Botan. Mag., Tokyo*, 101:397-426, figs. 1-16, tab. 1.

1043 **NISHIDA Makoto**, NASA Toshitaka and NISHIDA Harufumi (1987): A synopsis of *Nothofagoxylon* from South America with special reference to the species from Ultima Esperanza and Tierra del Fuego, Chile. *Sci. Rep., Res. Inst., Evol. Biol.*, (3):22-32.

1044 NISHIDA Makoto and NISHIDA Harufumi (1986): *Rikuzenoxylon callixyloides* gen. et sp. nov., a silicified wood from the Lower Carboniferous of Iwate Prefecture. *Jour. Japan. Bot.*, 61:1-6, pls. 1-2.

1045 NISHIDA Makoto and NISHIDA Harufumi (1986): Structure and affinities of the petrified plants from the Cretaceous of northern Japan and Saghalien 3. Petrified plants from the Upper Cretaceous of Saghalien (1). *Botan. Mag., Tokyo*, 99(1054):191-204, figs. 1-9, tab. 1.

1046 NISHIDA Makoto and NISHIDA Harufumi (1987): Petrified woods from the Upper Cretaceous of Quiriquina Island near Concepcion, Chile. In M. Nishida (ed.): Contributions to the Botany in the Andes 2. Academia Scientific Book, Tokyo, 5-11, pls. 1-3, figs. 1-4.

1047 NISHIDA Makoto and NISHIDA Harufumi (1990): A silicified fern rhizome from the Jurassic of Japan. In K. HG. Sing and K. U. Kramer (eds.): Proceedings of the International Symposium in Systematic Pteridology (1988). China Science and Technology Press, Beijing, 327-330.

1048 NISHIDA Makoto, NISHIDA Harufumi and NASA Toshitaka (1988): Anatomy and affinities of the petrified plants from the Tertiary of Chile 5. *Botan. Mag., Tokyo,* 101(1063):293-309, figs. 1-9, tab. 1.

1049 NISHIDA Makoto, NISHIDA Harufumi and OHSAWA Takeshi (1989): Comparison of petrified woods from the Cretaceous and Tertiary of Antarctica and Patagonia. *Proc. Natn. Inst., Polar Res. Symp., Polar Biol.*, (2):198-212.

1050 NISHIDA Makoto, NISHIDA Harufumi and RANCUSI Miguel H. (1988): Notes on the petrified plants from Chile (1). *Jour. Japan. Bot.*, 63:39-48.

1051 NISHIDA Makoto, OHSAWA Takeshi and NISHIDA Harufumi (1990): Anatomy and affinities of the petrified plants from the Tertiary of Chile (6). *Botan. Mag., Tokyo*, 103:255-268.

1052 **NISHIDA Shiro** (1987): Calcareous nannoplankton biostratigraphy in the Sunda Sea. *CCOP Tech. Bull.*, 19:69-72.

1053 NISHIDA Shiro (1990): Nannoplankton assemblages in the Equatorial Pacific. Prelim. Rep. Hakuho-maru Cruise KH88-1, Tokyo, 83-87.

1054 NISHIDA Shiro, HATADA Naoki (1990): Cretaceous radiolarian assemblages from Ohmine Mountains, Kii Peninsula. *Bull. Nara Univ. Educ.*, 39(2):11-27, pls. 1-3, figs. 1-2, tabs. 1-2. (紀伊半島中央部大峯山地の放散虫化石群集) (J.)

1055 NISHIDA Shiro and YAHAGI Hiroyuki (1986): [Nannoplanktons and manganese nodules]. *Earth Month.*, 8(5):288-291, figs. 1-3, tabs. 1-2. (ナンノプランクトンとマンガン団塊) (J.)

1056 **NISHIMURA Akiko** (1986): Paleocene radiolarians at Site 384, DSDP. *NOM, Spec. Vol.*, (7):87-93, pls. 1-2, fig. 1, tab. 1. (北西大西洋の暁新世の放散虫) (J.E.)

1057 NISHIMURA Akiko (1987): Cenozoic Radiolaria in the western North Atlantic, Site 603, Leg 93 of the Deep Sea Drilling Project. *Init. Rep., DSDP*, 93 (2):713-737, pls. 1-6, fig. 1, tabs. 1-4.

1058 NISHIMURA Akira (1986): Deep-sea sediments in the central Equatorial Pacific basin (GH81-4 area). *Cruise Rep., Geol. Surv. Japan*, (21):56-83.

1059 NISHIMURA Harumi (1986): A preliminary report on growth of radiolarian shells. *NOM, Spec. Vol.*, (7):157-166, figs. 1-7. (放散虫の殻の成長について(予察)) (J.E.)

1060 NISHIMURA Harumi (1987): Microstructures of cephalis of *Cyrtocapsella tetrapera* Haeckel (Radiolaria). *Fossils, Palaeont. Soc. Japan*, (43):25-33, pls. 1-2, figs. 1-6. (*Cyrtocapsella tetrapera* Haeckel(Radiolaria)の頭部殻室の微細構造) (J.E.)

1061 NISHIMURA Harumi (1987): Taxonomic study on Cenozoic Nassellaria (Radiolaria). *Sci. Rep., Inst. Geosci., Univ. Tsukuba, Sec. B*, 11:69-172, figs. 1-43.

1062 NISHIMURA Kouichi and ISHIGA Hiroaki (1987): Radiolarian biostratigraphy of the Maizuru Group in Yanahara area, southwest Japan. *Mem. Fac. Sci., Shimane Univ.*, 21:169-188, pls. 1-4, figs. 1-4.

1063 NISHIMURA Yujiro, ITAYA Tetsumaru, ISOZAKI Yukio and KAMEYA Atsushi (1989): Depositional age and metamorphic history of 220 Ma high P/T type metamorphic rocks: An example of the Nishiki-cho area, Yamaguchi Prefecture, southwest Japan. *Mem. Geol. Soc. Japan*, (33):143-166, pl. 1. (西南日本内帯220Ma高圧変成岩の原岩年代と変成履歴－山口県錦町地域の例－) (J.E.)

1064 NISHIWAKI Chikao, NOZAWA Tamotsu, SATO Tadashi, TERAOKA Youji and YOSHIDA Takashi (1988): Geological map of the Circum-Pacific region (northwest Quadrant), 1:10,000,000. (With explanatory text). Circum-Pacific Council for Energy and Mineral Resources, U.S.A.

1065 NISHIZAWA Yasuo and SAKAGAMI Sumio (1986): [Paleontological study of the Nanao Sandstone Member in Noto Peninsula. Part 3. Bryozoans]. Educational Committee of Nanao City, Ishikawa Pref., Nanao, 78-95. (能登七尾石灰質砂岩層の古生物学的研究, 第3節こけ虫類化石) (J.)

1066 NISIBATA Masahumi, YAMAMURO Masami and KAYANE Hajime (1988): *Pomatoleios kraussii* (Baird) and bench as paleo sea-level indicators on the west and south coast of Miura Peninsula, central Japan. *Quat. Res., Japan*, 27(2): 31-38, figs. 1-7, tabs. 1-2. (三浦半島西岸および南岸における旧汀線の指標としてのヤッコカンザシとベンチ) (J.E.)

1067 NOBUHARA Takami (1990): Horizontal distribution of molluscan assemblages along the Soga Tuff horizon in the Soga Formation of the Kakegawa Group, Shizuoka Prefecture, Japan. *Bull. Mizunami Fossil Mus.*, (17):70-91, figs. 1-5, tabs. 1. (掛川層群曽我累層の軟体動物化石群集の水平分布－曽我凝灰岩層を鍵層として－) (J.E.)

1068 NOBUTA Keizo and IWAMATSU Akira (1986): Submarine sliding deposits of the Cretaceous Shimanto Group in the Saiki district, Oita Prefecture, eastern Kyushu, Japan. *Rep. Fac. Sci., Kagoshima Univ., Earth Sci. & Biol.*, (19):107-131, pls. 1-2, figs. 1-13, tabs. 1-4. (大分県佐伯地域に分布する四万十層群の海底地すべり堆積物) (J.E.)

1069 NODA Hiroshi (1986): Notes on a trace fossils *Haentzschelinia* from the early middle Miocene Moniwa Formation in Sendai, Miyagi Prefecture, northeast Honshu, Japan. *Ann. Rep., Inst. Geosic., Univ, Tsukuba*, (12):68

-71, figs. 1-3.

1070 NODA Hiroshi (1986): Origin and migration of *Anadara* -Especially the genus *Hawaiarca* (Bivalvia)-. *Spec. Pap., Palaeont. Soc. Japan*, (29):57-76, pls. 3-4, figs. 1-4, tabs. 1-2.

1071 NODA Hiroshi (1987): First discovery of trace fossil *Tisoa* from the Pliocene Shinzato Formation in Okinawa-jima, Okinawa Prefecture, southwest Japan. *Ann. Rep., Inst. Geosci., Univ. Tsukuba*, (13):100-104, figs. 1-8.

1072 NODA Hiroshi (1987): Preliminary report on the geology and paleontology of the environs of Teshio, Hokkaido. Part 8-1. New *Tosalorbis* (Annelida) from the late Miocene Wakkanai Formation in Teshio, northern Hokkaido, Japan. *Hum. Cult. Environ. Stud., N. Hokkaido, Univ. Tsukuba*, (8):1-11, pl. 1, figs. 1-5, tab. 1.

1073 NODA Hiroshi (1988): Molluscan fossils from the Ryukyu Islands, southwest Japan, Part 2. Gastropoda and Pelecypoda from the Shinzato Formation in the middle part of Okinawa-jima. *Sci. Rep., Inst. Geosic., Univ. Tsukuba, Sec. B*, 9:29-85, pls. 5-19, fig. 1.

1074 NODA Hiroshi (1988): Neogene arcoids (Mollusca; Bivalvia) from the Ryukyu Islands, southwest Japan. *Saito Ho-on Kai, Spec. Pub. (Prof. T. Kotaka Commem. Vol.)*, (2):107-127, pls. 1-4, fig. 1, tabs. 1-2.

1075 NODA Hiroshi (1989): [Molluscan fossils]. In N. Fuji, M. Kato, M. Oda, K. Matsumaru, T. Takayama, H. Noda and M. Suzuki (eds.): [Geology and paleontology of the environs of Higashiiwa Tunnel in Kanazawa], Ishikawa Prefecture, 149-153, pls. 1-5, tab. 4. (貝類化石) (J.)

1076 NODA Hiroshi (1990): Crustacean sand-ball from the Middle Miocene Iriomote Formation in Iriomote-jima, Okinawa Prefecture, southwest Japan. *Ann. Rep., Inst. Geosic., Univ. Tsukuba*, (16):50-54, figs. 1-9.

1077 NODA Hiroshi and AMANO Kazutaka (1986): Preliminary report on the geology and paleontology of the environs of Teshio, Hokkaido. Part 7. *Anadara (Anadara) uozumii* and some associated molluscan fossils from the Pliocene "Yuchi" Formation. *Hum. Cult. Environ. Stud., N. Hokkaido, Univ. Tsukuba*, (7):1-12, pls. 1-5, figs. 1-3. (北海道天塩町周辺の地質及び古生物概報, その７. 鮮新統“勇知”層産*Anadara* (*Anadara*) *uozumii* と若干の共産貝化石) (J. E.)

1078 NODA Hiroshi and AMANO Kazutaka (1987): Preliminary report on the geology and paleontology of the environs of Teshio, Hokkaido. Part 8-2. First occurrence of *Neptunea soluta* (Gastropoda) from the Pliocene "Yuchi" Formation. *Hum. Cult. Environ. Stud., N. Hokkaido, Univ. Tsukuba*, (8):15-19, pl. 2, fig. 1.

1079 NODA Hiroshi, KIKUCHI Yoshibumi and NIKAIDO Akinobu (1989): Paleobiogeographical significance of the first occurrence of the extinct Miocene genus *Acilana* (Mollusca; Bivalvia) from the Pliocene Kume Formation in Ibaraki Prefecture, northern Kanto, Japan. *Prof. H. Matsuo Mem. Vol.*, Matsuyama, 53-64, pl. 1, figs. 1-2. (茨城県鮮新統久米層から中新世絶滅属*Acilana*(軟体動物；二枚貝類)の 初産出と古生物学地理学的意義について) (J. E.)

1080 NODA Hiroshi, KOUDA Yoshiki and SUZUKI Nao (1989): [Molluscan fossils from the Taki Formation in Fukushima]. *Iwaki-shi Maibotsubunkazai Chousa Houkokusho*, (22):211-212, pls. 25-26, fig. 27, tab. 5. (滝層産貝類化石) (J.)

1081 NODA Hiroshi and LEE Yeon-gyu (1989): Wood-boring bivalve *Martesia striata* from the Middle Miocene Sinhyeon Formation in the Ulsan basin, Korea. *Ann. Rep., Inst. Geosci., Univ. Tsukuba*, (15):61-67, figs. 1-5.

1082 NODA Hiroshi, OGASAWARA Kenshiro and NOMURA Ritsuo (1986): Systematic and paleobiogeographic studies on the Japanese Miocene argonautid *"Nautilus" izumoensis*. *Sci. Rep., Inst. Geosci., Univ. Tsukuba, Sec. B*, 7:15-42, pls. 5-12, figs. 1-11, tabs. 1-3.

1083 NODA Hiroshi and OKAMOTO Kazuo (1988): Crustacean raking imprints from the Oligocene Taoyama Formation in Yamaguchi Prefecture, southwest Japan. *Ann. Rep., Inst. Geosci., Univ. Tsukuba*, (14):51-55, figs. 1-5.

1084 NODA Hiroshi and SATO Yoshio (1990): Marine sequences and fossils in the Tsukuba, Joban and Daigo districts. Guidebook for the field trip no. 1, International Symposium on Shallow Tethys 3, Sendai, 1-51, pls. 1-21, figs. 1-20, tabs. 1-3.

1085 NODA Hiroshi and TAKAHASHI Hirokazu (1986): Distribution of *Anadara* (*Hataiarca*) *kakehakaensis* and characteristics of the associated molluscan fauna in the early Middle Miocene of Japan. *Monogr. Mizunami Fossil Mus.*, (6):49-58, pl. 1, fig. 1, tabs. 1-2. (*Anadara* (*Hataiarca*) *kakehataensis* の分布と共産する貝化石群の特性) (J.E.)

1086 **NODA Masayuki** (1986): A new species of *Inoceramus* (*Cordiceramus*) (Bivalvia) from the Upper Coniacian (Cretaceous) of Hokkaido. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (142):354-365, pls. 69-73, figs. 1-6, tabs. 1-3.

1087 NODA Masayuki (1988): Notes on Cretaceous inoceramids from Sakhalin, held at Tohoku University, Sendai. *Saito Ho-on Kai, Spec. Pub.* (*Prof. T. Kotaka Commem. Vol.*), (3):137-175, pls. 1-8, figs. 1-35, tabs. 1-20.

1088 NODA Masayuki (1988): A note on *Inoceramus tenuistriatus* Nagao et Matsumoto (Bivalvia) from the Upper Turonian (Cretaceous) of Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (151):582-600, figs. 1-10, tabs. 1-6.

1089 NODA Masayuki and TOSHIMITSU Seiichi (1990): Notes on a Cretaceous bivalve *Inoceramus* (*Platyceramus*) *mantelli* de Mercey from Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (158):485-512, figs. 1-16, tabs. 1-6.

1090 **NOHARA Tomohide** and TABUKI Ryoichi (1990): Seasonal distribution of ostracods on two species of marine plants in Okinawa, Japan. In R. Whatley and C. Maybury (eds.): Ostracoda and Gloval events -Proc. 10th International Symposium on Ostracoda. Chapman and Hall, London, 355-363, figs. 1-5, tabs. 1-3.

1091 **NOI Hideaki** (1987): Stratigraphy and pollen analysis of the Middle Pleistocene Series in the Nojiri-Takaoka area, Miyazaki Prefecture, Japan. *Jour. Geol. Soc. Japan*, 93(12):897-907, pl. 1, figs. 1-7, tabs. 1-2. (宮崎県野尻－高岡地域に分布する中部更新統の層序と花粉分析) (J.E.)

1092 NOI Hideaki, SATO Yoshio and HATANAKA Ken-ichi (1990): Geological and palynological study of the Alluvial deposits in the Ukita area, Miyazaki Prefecture, southwest Japan. *Jour. Fac. Lit., Kitakyushu Univ., Ser. B*, 22:73-80, figs. 1-4, tab. 1. (宮崎市浮田地域における沖積層の花粉分析と古環境変遷) (J.E.)

1093 **Nojiriko Kafun Group** and SAKAMOTO Kiyoko (1990): Fossils from the Nojiriko Formation 1 (Pollen grains 1. Spermatophyta, AP). *Atlas, Japan. Foss.*, (59):351. (野尻湖層の化石 1 (花粉・木本植物)) (J.)

1094 Nojiriko Kafun Group and SAKAMOTO Kiyoko (1990): Fossils from the Nojiriko Formation 1 (Pollen grains 2. Angiospermae, NAP and Pteridophyta). *Atlas, Japan. Foss.*, (59):352. (野尻湖層の化石1(花粉2・草本植物およびシダ植物胞子) (J.)

1095 Nojiriko Keisou Group, FUJITA Tsuyoshi and MIYAGAWA Masaru (1990): Fossils from the Nojiriko Formation 1 (Diatom 1). *Atlas, Japan. Foss.*, (59):353. (野尻湖層の化石1(珪藻 1)) (J.)

1096 Nojiriko Keisou Group, FUJITA Tsuyoshi and MORI Yuuichi (1990): Fossils from the Nojiriko Formation 1 (Diatom 2). *Atlas, Japan. Foss.*, (59):354. (野尻湖層の化石1(珪藻 2)) (J.)

1097 Nojiriko Shokubutsu Group and ITOH Tokuji (1990): Fossils from the Nojiriko Formation 1 (Plant remains 1-2). *Atlas, Japan. Foss.*, (59):349-350. (野尻湖層の化石1(植物遺体 1-2)) (J.)

1098 **NOKARIYA Hiroshi** and KITABAYASHI Eiichi (1987): Pleistocene ranid frog from a lake deposit in Kyushu, Japan. *Bull. Natn. Sci. Mus., Tokyo, Ser. C*, 13 (4):171-182.

1099 **NOMURA Ritsuo** (1986): Benthic Foraminifera from the stratotype section of the Kuri Formation distributed in Oda City, Shimane Prefecture. In Y. Matoba and M. Kato (eds.): Studies on Cenozoic Benthic Foraminifera in Japan. Akita Univ., Akita, 135-150, figs. 1-5, tabs. 1-7. (島根県大田市久利層の様式地における底生有孔虫化石) (J.)

1100 NOMURA Ritsuo (1986): [Foraminiferal test structure for the indicator of environment]. *Mar. Sci. Month.*, 18(9):583-587, figs. 1-7, tabs. 1-2. (環境指示者としての有孔虫の殻壁構造) (J.)

1101 NOMURA Ritsuo (1986): Geology of the central part in the Shimane Peninsula -Part 1. Miocene stratigraphy-. *Jour. Geol. Soc. Japan*, 92(6):405-420, figs. 1-9. (島根半島中央部中新統の地質－その1層序について－) (J.E.)

1102 NOMURA Ritsuo (1986): Geology of the central part in the Shimane Peninsula -Part 2. Biostratigraphy and paleoenvironment viewed from Benthic Foraminifera-. *Jour. Geol. Soc. Japan*, 92(7):461-475, pls. 1-3, figs. 1-11. (島根半島中央部中新統の地質－その2底生有孔虫化石群集について－) (J.E.)

1103 NOMURA Ritsuo (1986): On the stratigraphy of argillaceous rocks distributed in Chikumi area of the Shimane Peninsula. *Mem. Fac. Educ., Shimane Univ.*, 20:63-69, figs. 1-3, tab. 1. (島根半島千酌地域の泥質岩の層序について) (J.E.)

1104 NOMURA Ritsuo (1987): [Climatic change of benthic foraminifers]. *Earth Month.*, 9(12):729-734, figs. 1-5, tabs. 1-2. (底生有孔虫の気候変動) (J.)

1105 NOMURA Ritsuo (1988): Ecological significance of wall micro-structure of Benthic Foraminifera in the southwestern Sea of Japan. *Rev. Paleobiol., Vol. Spec.*, (2):859-871, pls. 1-3, figs. 1-8, tab. 1.

1106 NOMURA Ritsuo (1988): Middle Miocene Benthic Foraminifera from Shobara area, Hiroshima Prefecture. *Mem. Fac. Educ., Shimane Univ.*, 22(2):21-30. (広島県庄原地域の底生有孔虫群集) (J.E.)

1107 NOMURA Ritsuo (1988): Miocene Benthic Foraminifera from Masuda area, Shimane Prefecture. *Stud. San'in Reg., Nat. Environ., Shimane Univ.*, (4):

17-34, pls. 1-3, figs. 1-7, tabs. 1-2. (島根県益田地域の中新世底生有孔虫化石) (J.E.)

1108 NOMURA Ritsuo (1989): [Age of "Foram. Sharp Line"]. *Yukochu Kenkyu* (=*Stud. Foraminifera*), (2):15-19, figs. 1-4. (Foram. Sharp Lineの地質年代(予報)) (J.)

1109 NOMURA Ritsuo (1989): An outline of Japanese Miocene cassidulinid foraminiferal zonation. Y. Takayanagi and K. Ishizaki (eds.): Collected papers on Foraminifera from the Jpanese Islands, Sendai. 69-70. (日本の中新世cassidulinid有孔虫化石帯区分の概要) (J.)

1110 NOMURA Ritsuo (1989): On the Foram. Sharp Line in the Bihoku Group. *Stud. San'in Reg., Nat. Environ., Shimane Univ.*, (5):35-44, figs. 1-8. (備北層群中のForam. Sharp Lineについて) (J.E.)

1111 NOMURA Ritsuo (1990): [Benthic Foraminifera at the K/T boundary: In the case of Site 752, Broken Ocean Ridge in the East-Indean Sea]. *Kaiyo Month.*, 22(5):282-287, figs. 1-3. (K/T境界における底生有孔虫：東インド洋ブローケン海嶺Site752の場合) (J.)

1112 NOMURA Ritsuo (1990): ["Benthic events" by salinity shock]. *Kaiyo Month.*, 22(5):288-297, figs. 1-8. (Salinity shockによる"Benthic events") (J.)

1113 NOMURA Ritsuo (1990): Foram. Sharp Line from the Middle Miocene of the Shin'ichi basin, Hiroshima Prefecture. *Mem. Fac. Educ., Shimane Univ.*, 24 (2):37-40. (広島県高野町新市盆地におけるForam. Sharp Line) (J.)

1114 NOMURA Ritsuo (1990): Miocene Benthic Foraminifera from Caleta Herradura de Mejillones, northern Chile. *Rep. Andean Stud., Shizuoka Univ.*, 3:23-32, figs. 1-4, tab. 1.

1115 NOMURA Ritsuo (1990): Late Middle Miocene Foraminifera from the Matsue Formation, Shimane Prefecture. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (158):459-484, figs. 1-11, tabs. 1-2.

1116 NOMURA Ritsuo and IKEHARA Ken (1986): [Foraminiferal assemblage off western San'in (Preliminary Report)]. Studies on the marine geology of continental shelf of western Japan: Hibikinada and Off Mishima areas. Investigation Report for the year 1985, Geological Survey of Japan, Tsukuba, 110-127. (山陰西部海域の有孔虫群集(予報)) (J.)

1117 NOMURA Ritsuo and IKEHARA Ken (1987): [Foraminiferal assemblages off San'in]. Studies on the marine geology of continental shelf of western Japan: Off Hinomisaki and Tottori. Investigation Report for the year 1986, Geological Survey of Japan, Tsukuba, 165-176. (山陰沖の底生有孔虫群集) (J.)

1118 NOMURA Ritsuo and IKEHARA Ken (1988): [Benthic foraminiferal assemblage from Wakasa Bay and off Hokuriku Province]. Studies on marine geology of the shelf areas around the southwest Japan: Off Kyogamine-misaki and Gentatsu-se areas. Investigation Report for the year 1987, Geological Survey of Japan, Tsukuba, 154-166. (若狭湾・北陸沖の底生有孔虫群集) (J.)

1119 NOMURA Ritsuo and MATSUMOTO Toshio (1990): Benthic Foraminifera from the Tottori Group. *Stud. San'in Reg., Nat Environ., Shimane Univ.*, (6):57-63, pl. 1, figs. 1-2, tab. 1. (鳥取層群の底生有孔虫化石) (J.E.)

1120 NOMURA Ritsuo and SETO Koji (1987): Miocene Foraminifera from the Tari basin of Tottori Prefecture. *Stud. San'in Reg., Nat. Environ., Shimane*

Univ., (3):95-107, pls. 1-2, figs. 1-10, tab. 1. (鳥取県多里盆地の中新世底生有孔虫化石) (J.E.)

1121 NONAKA Yoshihiko, HORIUCHI Masatsura, MISHIMA Hiroyuki, MIYAZAKI Shigeo and Fossil Deer Research Group of Ichikawa (1986): A pair of complete deer horns of *Cervus* (*Nipponicervus*) *praenipponicus* from the Upper Pleistocene in northern part of Boso Peninsula. *Jour. Geol. Soc. Japan*, 92(11):809-811, pl. 1, figs. 1-3, tab. 1. (房総半島北部の上部更新統産のニホンムカシジカ化石) (J.)

O

1122 OBA Tadamichi (1986): [Past climiatic change and ocean circulation]. *Mar. Sci. Month.*, 18(5):314-321. (過去の気候変動と海洋循環) (J.)

1123 OBA Tadamichi (1987): Upper Pleistocene of the Japan Sea floor. *Quat. Res., Japan*, 25(4):319-321. (日本海海底の上部更新統) (J.E.)

1124 OBA Tadamichi (1988): Comment for sea level change. *Quat. Res., Japan*, 26 (3):243-250. (海水準変化に関するコメント) (J.E.)

1125 OBA Tadamichi (1988): Oceanic environmental change from the last glacial topostglacial periods. *Geochemistry* (=*Chikyukagaku*), 22(1):13-19. (最終氷期から後氷期にかけての海洋環境の変化) (J.E.)

1126 OBA Tadamichi (1989): [Change of environment in the Sea of Japan -History of the Past 85,000 years-]. *Kagaku*, 59(10):672-681. (日本海の環境変化ー過去8.5万年の歴史ー) (J.)

1127 OBA Tadamichi and AKASAKA Norio (1990): Paleoenvironmental change of the Japan Sea based on organic carbon contents of two piston cores. *Quat. Res., Japan*, 29(5):417-425, figs. 1-4. (2本のピストン・コアの有機炭素量に基づく日本海の古環境変化) (J.E.)

1128 OBA Tadamichi and UOMOTO Kazunori (1989): [Oxygen- and carbon-isotopic ratios in planktonic foraminifers in sediment trap JT-01and 02]. *Kaiyo Month.*, 21(4):239-246. (セジメント・トラップJT-01, 02中の浮遊性有孔虫殻の酸素・炭素同位体比) (J.)

1129 OBATA Ikuwo (1986): [Significance of information related to dinosaur]. *Earth Month.*, 8(3):132-137. (恐竜に関する情報の意義) (J.)

1130 OBATA Ikuwo (1988): Cretaceous formations in northeast Japan. *Earth Sci.*, 42(6):385-395. (東北日本の白亜系) (J.E.)

1131 OBATA Ikuwo, KAWASHITA Yoshitaro, MAIYA Seijuro, TAKETANI Yojiro, FUTAKAMI Masao and SUZUKI Tadashi (1989): An Upper Cretaceous Plesiosaur (Family Elasmosauridae) from the Wakkanai area, Hokkaido. *Bull. Natn. Sci. Mus., Tokyo, Ser. C*, 15(1):25-31.

1132 OBATA Ikuwo, MARUO Hiromi, TERAKADO Hiroyuki, MURAKAMI Tsukumo, TANAKA Toshinori and MATSUKAWA Masaki (1989): Replicas of dinosaur tracks, using silicone rubber and fiberglass-reinforced plastics. In D. D. Gillette and M. G. Lockley (eds.): Dinosaur tracks and traces. Cambridge Univ. Press, New York, 413-415.

1133 OBATA Ikuwo and MATSUKAWA Masaki (1988): Some boreal or subboreal ammonites in the Japanese Barremian. In J. Wiedmann and J. Kullmann (eds.):

Cephalopods -Present and past. Schweizer-bart'sche Verlagsbuchhandlung, Stuttgart, Germany, 469-476, figs. 1-4.

1134 ODA Motoyoshi (1986): [Correlation and age by mean of planktonic Foraminifera]. In K. Ogasawara, K. Masuda and Y. Matoba (eds.): Neogene and Quaternary molluscs from the Akita oil-field, Japan. Commem. Assoc., Prof. T. Takayasu's Retirement, Akita, 93-96. (浮遊性微化石による対比と年代論) (J.)

1135 ODA Motoyoshi (1986): Some aspects and problems concerned with microfossil biochronology for the Neogene in central and northeast Honshu, Japan. In H Nakagawa, T. Kotaka and T. Takayanagi (eds.): Essays in geology, Prof. N. Kitamura Commem. Vol., Sendai, 297-312, figs. 1-4. (新第三紀の微化石年代尺度の現状と問題点－中部および東北日本を中心として－) (J.E.)

1136 ODA Motoyoshi (1989): [Planktonic foraminiferal assemblage in north of Noto Peninsula. (Preliminary report)]. Studies on marine geology of the shelf areas around the southwest Japan: Off Noto Peninsula area. Investigation Report for the year 1988, Geological Survey of Japan, Tsukuba, 122-124. (能登半島北方海域における浮遊性有孔虫群集(予察)) (J.)

1137 ODA Motoyoshi (1989): [Planktonic foraminiferal assemblages in sediment trap (JT-01, JT-02) in the Japan Trench]. *Kaiyo Month.*, 21(4):221-227. (日本海(溝)セジメント・トラップ(JT-01・JT-02)中の浮遊性有孔虫群集) (J.)

1138 ODA Motoyoshi, AKIMOTO Kazumi and ASAI Toshimitsu (1987): Planktonic foraminiferal biostratigraphy of the Nishiyatsushiro and Shizukawa Groups in the Iitomi area, south Fossa-Magna region, central Honshu, Japan. *Fossils, Palaeont. Soc. Japan*, (43):8-14. (南部フォッサマグナ飯富地域の西八代・静川両層群の浮遊性有孔虫化石による地質年代) (J.)

1139 ODA Motoyoshi and IKEHARA Ken (1987): [Planktonic foraminiferal assemblages off north San'in (Preliminary report)]. Studies on the marine geology of continental shelf of western Japan: Off Hinomisaki and Tottori. Investigation Report for the year 1986, Geological Survey of Japan, Tsukuba, 162-163. (山陰北部海域における浮遊性有孔虫群集(予報)) (J.)

1140 ODA Motoyoshi and IKEHARA Ken (1988): [Planktonic Foraminifera from the northeastern area off San'in region. (Preliminary report)]. Studies on marine geology of the shelf areas around the southwest Japan: Off Kyoga-mine-misaki and Gentatsu-se areas. Investigation Report for the year 1987, Geological Survey of Japan, Tsukuba, 167-169. (山陰東北部海域における浮遊性有孔虫群集(予察)) (J.)

1141 ODP Leg 112 Shipboard Scientific Party (1987): Convergent tectonic and coastal upwelling: A history of the Peru continental margin. *Jour. Geogr.*, 96(6):380-391, figs. 1-5. (沈み込みのテクトニクスと沿岸湧昇流－ペルー縁辺域の地史－) (J.E.)

1142 OGASAWARA Kenshiro (1986): Paleoenvironmental significance of the late Cenozoic "*Astarte*" (Bivalvia) in the Northern Pacific region. *Monogr. Mizunami Fossil Mus.*, (6):183-198, pls. 21-22, figs. 1-3, tab. 1. (北太平洋地域の新生代後期における"*Astarte*"属の古環境特性) (J.E.)

1143 OGASAWARA Kenshiro (1986): Note on origin and migration of the Omma-Manganzian Fauna, Japan. *Spec. Pap., Palaeont. Soc. Japan*, (29):227-244, figs. 1-4, tabs. 1-4.

1144 OGASAWARA Kenshiro (1988): Neogene bio-events in terms of warm- and cold-water molluscs in northeast Honshu, Japan. In R. Tsuchi, M. Chiji and Y.

Takayanagi (eds.): Neogene biotic evolution and related events. Osaka Mus., Nat. Hist., Spec. Pub., Osaka, 49-70, figs. 1-7, tabs. 1-6. (東北日本の暖・寒流系貝類の消長からみた新第三紀の生物事件) (J.E.)

1145 OGASAWARA Kenshiro (1988): Early Cretaceous fresh-water molluscs from the Monomiyama Formation, southern Kitakami Mountains, Japan. *Saito Ho-on Kai, Spec. Pub. (Prof. T. Kotaka Commem. Vol.)*, (2):301-315, pls. 1-4, figs. 1-7, tabs. 1-2.

1146 OGASAWARA Kenshiro, HASEGAWA Shiro and MARUYAMA Toshiaki (1990): Neogene marine sequences and benthic foraminifers. Guidebook for the field trip C, 4th International Symposium on Benthic Foraminifera, Sendai, 1-17, pls. 1-3, figs. 1-6, tab. 1.

1147 OGASAWARA Kenshiro, Ijima Shinji and KASENO Yoshio (1989): Miocene molluscs from the Tenguyama Formation, Toyama Prefecture, Hokuriku district, Japan. *Sci. Rep., Kanazawa Univ.*, 34(2):67-93, pls. 1-4, figs. 1-5, tabs. 1-2.

1148 OGASAWARA Kenshiro, KANEKO Kazuo, SHIMIZU Masayuki and HIROOKA Kimio (1990): [Neogene of the Yatsuo area]. Guidebook at the 97th annual meeting of the Geological Society of Japan, 1-23, pl. 1, figs. 1-24, tabs. 1-3. (八尾周辺の新第三系) (J.)

1149 OGASAWARA Kenshiro, MARUYAMA Takahiko, DOI Nobuo, YOSHIDA Takeyoshi and MATOBA Yasumochi (1986): [Island arc traverse route No. 16 (Ugowada-Taiheizan-Yoroibatadamu-Nyutousan)]. In N. Kitamura (ed.): Shinseidai Tohoku Honshu-ko Chisitsu Shiryo-shu. Hobundo, Sendai, 1-13, figs. 1-2. (島弧横断ルートno. 16 (羽後和田－太平山－鎧畑ダム－乳頭山)) (J.)

1150 OGASAWARA Kenshiro and MASUDA Koichiro (1989): Paleobathymetric indexes of the Neogene molluscs in Tohoku district and their implications. *Mem. Geol. Soc. Japan*, (32):217-227, figs. 1-5, tab. 1. (東北地方新第三系貝類化石の古水深指標とその適用) (J.E.)

1151 OGASAWARA Kenshiro, MASUDA Koichiro and MATOBA Yasumochi (eds.) (1986): Neogene and Quaternary molluscs from the Akita oil-field, Japan. Commemorative Association of Professor T. Takayasu's Retirement and Supporter's Foundation of Mineral Industry Museum. Mining College, Akita University, Akita, 1-310, pls. 1-85, figs. 1-45, tabs. 1-40. (秋田油田地域新第三系・第四系貝類化石図鑑) (J.)

1152 OGASAWARA Kenshiro and MORITA Rihito (1990): A new Miocene gastropod species co-occurred with *Paleoparadoxia* specimens from the Yanagawa Formation, Fukushima Prefecture, northeast Honshu, Japan. *Saito Ho-on Kai Mus., Nat. Hist., Res. Bull.*, (58):25-30, pl. 1, fig. 1, tab. 1.

1153 OGASAWARA Kenshiro, ODA Motoyoshi and HORIKOSHI Ei (1986): [Island arc traverse route No. 13 (Noshiro-Ohdate-Hanawa-Sannohe-Kaijyoudake)]. In N. Kitamura (ed.): Shinseidai Tohoku Honshu-ko Chisitsu Shiryo-shu. Hobundo, Sendai, 1-16, figs. 1-2. (島弧横断ルートno. 13 (能代－大館－花輪－三戸－陸上岳)) (J.)

1154 OGASAWARA Kenshiro, ODA Motoyoshi and HORIKOSHI Ei (1986): [Island arc traverse route No. 14 (Oga Peninsula-Gojome-Ani-Ryugamori)]. In N. Kitamura (ed.): Shinseidai Tohoku Honshu-ko Chisitsu Shiryo-shu. Hobundo, Sendai, 1-21, figs. 1-2. (島弧横断ルートno. 14 (男鹿半島－五城目－阿仁－竜ケ森)) (J.)

1155 OGASAWARA Kenshiro, SASAKI Osamu and CHIBA Noriyuki (1988): The Dainenjian molluscan association from the environs of Sendai and its zoogeographic

significance. *Saito Ho-on Kai Mus., Nat. Hist., Res. Bull.*, (56):1-15, pls. 1-3, figs. 1-6, tab. 1.

1156 OGASAWARA Kenshiro, SASAKI Osamu and NEMOTO Jun (1989): The Otokawa Fauna of the Hokuriku Neogene and its geohistorical significance. In Y. Kashima, M. Komatsu, J. Takahashi and I. Kawabe (eds.): Prof. H. Matsuo Mem. Vol., Matsuyama, 65-74, pls. 1-3, figs. 1-3, tab. 1. (北陸新第三系の音川動物群とその地史的意義) (J.E.)

1157 OGASAWARA Kenshiro and SATO Hiroshi (1986): Mioccene molluscs from the Utsuno and Ginzan Formations, Ou backbone ranges, northeast Honshu, Japan. *Saito Ho-on Kai Mus., Nat. Hist., Res. Bull.*, (54):1-19, pls. 1-3, figs. 1-5. tabs. 1-2.

1158 OGASAWARA Kenshiro, SUZUKI Keiji and KOUCHI Osamu (1989): Late Miocene brackish-water molluscs from the Fujitoge Formation, western mountainous region of the Aizu basin, northeast Honshu, Japan. *Saito Ho-on Kai Mus., Nat. Hist., Res. Bull.*, (57):27-37, pls. 1-2, figs. 1-4.

1159 OHANA Tamiko and KIMURA Tatsuaki (1986): *Ginkgo diminuta*, sp. nov., from the Upper Cretaceous Omichidani Formation in the Inner Zone of Japan. *Proc. Japan Acad., Ser. B*, 62(9):345-348, figs. 1-14.

1160 OHANA Tamiko and KIMURA Tatsuaki (1987): Preliminary notes on the *Multicapelous* female flower with conduplicate carpels from Upper Cretaceous of Hokkaido, Japan. *Proc. Japan Acad., Ser. B*, 63(6):175-178, fig. 1.

1161 O'HARA Sakae and NEMOTO Nagayuki (1988): Pectinids from the Taga Group of the Joban coalfield. *Saito Ho-on Kai, Spec. Pub.* (*Prof. T. Kotaka Commem. Vol.*), 1-24, pls. 1-3, fig. 1, tab. 1.

1162 OHE Fumio (1988): [Fossil *Chauliodus* sp. from the Miocene Sankai Formation in Chita Peninsula]. *Kaseki no Tomo*, (32):2-8. (知多半島中新統山海累層から得られたホウライエソ(*Chauliodus* sp.)の化石に就いて) (J.)

1163 OHE Fumio (1990): Faunal change of the Miocene marine fish in Japan. *Monogr. Mizunami Fossil Mus.*, (7):25-59, figs. 1-5, tab. 1. (中新世の魚類相－海水魚類の変遷－) (J.E.)

1164 OHE Fumio, TAGUCHI Eiji, OKUMURA Yoshitsugu and NISHIMOTO Hiroyuki (1986): Ascomberoid premaxillary (Pisces; *Scomberomorus* sp.) from the Middle Miocene Katsuta Group, Tsuyama City, Okayama Prefecture, southwest Japan. *Bull. Mizunami Fossil Mus.*, (13):27-38, pls. 4-6, figs. 1-4, tabs. 1-3. (勝田層群産サワラ *Scomberomorus* sp. の前上顎骨の形態とその古生態) (J.E.)

1165 OHMI Kazuyoshi (1986): Three fossil marine mammals from the Neogene of Sakiyama Peninsula, Ishikawa Prefecture, central Japan. *Earth Sci.*, 40(6): 449-452, pl. 1. fig. 1, tab. 1. (石川県七尾市崎山半島の新第三系より発見された３例の海生哺乳動物化石について) (J.)

1166 OHNO Terufumi (1986): Palaeotidal characteristics determined by microgrowth patterns in bivalves. *Palaeontology*, 32(2):237-263, pls. 31-32, figs. 1-9, tabs. 1-3.

1167 OHO Yukimasa and SADA Kimiyoshi (1986): The structural relationship between calcareous and non-calcareous rocks in the southwestern part of the Taishaku upland, Hiroshima Prefecture, western Japan. *Jour. Geol. Soc. Japan.*, 92(6):421-428, pl. 1, figs. 1-6, tab. 1. (広島県帝釈台南西部における石灰岩層群と非石灰岩層の構造関係) (J.E.)

1168 **OHTA Hidemasa**, ISHIGURO Hitoshi, IWAHASHI Satoru and NIITSUMA Nobuaki (1986): Geology of the eastern area of the Tanzawa Mountains, central Japan. *Geosci. Rep., Shizuoka Univ.*, (12):153-189, figs. 1-2, tabs. 1-4. (丹沢山地東部の地質) (J.E.)

1169 **OHTSUKA Yasuo** (1986): Early internal shell microstructure of some Mesozoic Ammonoidea: Implication for higher taxonomy. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (141):275-288, pls. 45-50, figs. 1-4, tabs. 1-3.

1170 **OHTSUKI Masahiro** and KANAZAWA Itaru (1990): A revision of a *Platycerus* fossil (Coleoptera: Lucanidae) from the late Pleistocene Nojiri-ko Formation. *Bull. Osaka Mus., Nat. Hist.*, (44):23-28, figs. 1-3. (後期更新世のルリクワガタ属の化石の再検討) (J.E.)

1171 **OISHI Masayuki** (1987): Pliocene baleen whales and large sea lion from Ichinoseki and Hiraizumi area, Iwate Prefecture, Japan. *Bull. Iwate Pref. Mus.*, (5):85-98, pls. 1-4, figs. 1-9, tabs. 1-5. (岩手県一関市および西磐井郡平泉町の鮮新統から産出した鯨類・鰭脚類化石) (J.E.)

1172 OISHI Masayuki, HASEGAWA Yoshikazu, MARUYAMA Toshiaki, NAKASHITA Shigeo and KAWAKAMI Takeshi (1990): An occurrence of postcranial skeleton of *Desmostylus* from Kintaichi, Ninohe City, Iwate Prefecture, northeast Japan. *Bull. Iwate Pref. Mus.*, (8):1-16, figs. 1-14, tab. 1. (岩手県二戸市金田一におけるデスモスチルス骨格化石の産出) (J.E.)

1173 OISHI Masayuki and TAKAHASHI Masaki (1990): Miocene formations in the Takasaki district, central Japan -With special reference to the developmental process of the Niwaya Unconformity-. *Contr. Inst. Geol. Paleont., Tohoku Univ.*, (92):1-17, figs. 1-11, tab. 1. (群馬県高崎地域に分布する中新統－とくに庭谷不整合形成過程について－) (J.E.)

1174 **OJI Tatsuo** (1986): [Crinoid fossils from the Morozaki Group]. *Kaseki no Tomo*, (29):2-5. (師崎層群のウミユリ) (J.)

1175 OJI Tatsuo (1986): Skeletal variation related to arm regeneration in *Metacrinus* and *Saracrinus*, Recent stalked crinoids. *Lethaia*, 19(4):355-360, figs. 1-4.

1176 OJI Tatsuo (1989): Distribution of the stalked crinoids from Japanese and nearby waters. *Nat. & Cult., Univ. Mus., Univ. Tokyo*, (1):27-43, figs. 1-4, tab. 1.

1177 OJI Tatsuo (1989): Growth rate of stalk of *Metacrinus rotundus* (Echinodermata: Crinoidea) and its functional significance. *Jour. Fac. Sci., Univ. Tokyo, Sec. 2*, 22(1):39-51, figs. 1-6.

1178 OJI Tatsuo (1990): Crinoidea. In "Echinoderms from continental shelf and slope around Japan" vol. 1. Japan fisheries resource conservation association, Tokyo, 25-33. (ウミユリ綱, 日本陸棚周辺の棘皮動物) (J.E.)

1179 OJI Tatsuo (1990): Miocene Isocrinidae (stalked crinoid) from Japan and their biogeographic implication. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (157):412-429, figs. 1-6.

1180 OJI Tatsuo (1990): Dimorphism and geographic distribution of two phenotypes of a west Atlantic stalked crinoid *Endoxocrinus parrae* (Gervais). *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (159):603-606, figs. 1-3, append. 1.

1181 **OKADA Atsumasa** and MORI Sinobu (1987): ^{14}C age and diatom analysis of the Holocene sediments at the southern part of Nagoya City, Japan -^{14}C age of

the Quaternary deposits in Japan (163)-. *Earth Sci.*, 41(1):71-73, figs. 1-2, tab. 1. (名古屋市堀田通の沖積層の^{14}C年代と珪藻分析－日本の第四紀層の^{14}C年代(163)－) (J.)

1182 **OKADA Hakuyu**, TARDUNO John A., NAKASEKO Kojiro, NISHIMURA Akiko, SLITER William V. and OKADA Hisatake (1989): Microfossil assemblages from the late Jurassic to early Cretaceous Nikoro pelagic sediments, Tokoro Belt, Hokkaido, Japan. *Mem. Fac. Sci., Kyushu Univ., Ser. D*, 26(3):193-214, pls. 31-34, figs. 1-11, tabs. 1-4.

1183 **OKADA Hisatake** (1987): Calcareous nannofossil biostratigraphy and paleoenvironmental analysis of marine formations exposed in the south Fossa Magna region. *Fossils, Palaeont. Soc. Japan*, (43):5-8, figs. 1-2. (南部フォッサマグナの海成層に関する石灰質ナンノ化石の生層序と古環境) (J.)

1184 OKADA Hisatake (1989): Examples of diachroneity observed in the Upper Paleogene of the tropical Indian Ocean and possible new datum events. *INA News Lett.*, 11(2):86-87.

1185 OKADA Hisatake (1989): Morphometric and floral variations of calcareous nannoplanktons in relation to their living environment. *INA News Lett.*, 11(2):87-88.

1186 OKADA Hisatake (1990): Quaternary and Paleogene calcareous nannofossils, Leg 115. *Proc. ODP., Sci. Results*, 115:129-174, pls. 1-3, figs. 1-4, tabs. 1-20.

1187 OKADA Hisatake, YAMADA Masaharu, MATSUOKA Hiromi, MUROTA Takashi and ISOBE Tatsuo (1987): Calcareous nannofossils and biostratigraphy of the Upper Cretaceous and lower Paleogene Nemuro Group, eastern Hokkaido, Japan. *Jour. Geol. Soc. Japan*, 93(5):329-348, pls. 1-2, figs. 1-8, tabs. 1-4.

1188 **OKADA Motohiko** (1990): Occurrence of Permian radiolarians from Ujitawara-cho, southern Kyoto Prefecture. *Jour. Geol. Soc. Japan*, 96(11):937-939, pl. 1, fig. 1. (京都府南部宇治田原町から産出した二畳紀放散虫化石) (J.)

1189 **OKAMI Kazuyoshi**, EHIRO Masayuki, KURIYAGAWA Hiroe and ASANUMA Akiko (1987): *Leptophloeum* bearing formation in the "Hayachine Tectonic Belt", Kitakami Massif, northeast Japan. *Jour. Geol. Soc. Japan*, 93(5):321-327, pl. 1, figs. 1-3. (北上山地, "早池峰構造帯"中の*Leptophloeum* 産出層) (J.E.)

1190 **OKAMOTO Kazuo**, HAYASHI Yaeko and KATSUHARA Masato (1989): Fossil Mollusca from the Miocene at Myoga, Shobara City, a new locality of *Geloina* in Shobara, and the relationship between *Tateiwaia* species and substrata -Study of the Bihoku Group 2-. *Bull. Mizunami Fossi Mus.*, (16):43-53, pls. 5-7, figs. 1-2, tabs. 1-2. (庄原市明賀の中新統からの貝類化石, 庄原市の *Geloina* の新産地, および*Tateiwaia* speciesと底質との関係について－備北層群の研究２－) (J.E.)

1191 OKAMOTO Kazuo and IBARAKI Masako (1987): "Plio-Pleistocene" Mollusca from the southwestern sea of Japan. 16th Pacific Science Congress Seoul 1987, Seoul, 274.

1192 OKAMOTO Kazuo and IBARAKI Masako (1988): Early Pleistocene Mollusca from the southwestern area of the Sea of Japan (or the northeastern Tsushima Strait). *Jour. Paleont. Soc. Korea*, 4(1):30-36, figs. 1-2.

1193 OKAMOTO Kazuo and IBARAKI Masako (1988): Early Pleistocene fossil Mollusca from the Sea of Japan off Yamaguchi Prefecture, southwest Japan. *Saito*

Ho-on Kai, Spec. Pub. (*Prof. T. Kotaka Commem. Vol.*), (3):523-532, pls. 1-2.

1194 OKAMOTO Kazuo, KATSUHARA Masato, UENO Yasuyo and SUMIYOSHI Osamu (1990): Molluscan assemblages from the Miocene Bihoku Group in the Kaisekidani area, Miyauchi-cho, Shobara City, southwest Japan -Study of the Bihoku Group 3-. *Bull. Mizunami Fossil Mus.*, (17):35-49, pls. 9-11, figs. 1-2, tabs. 1-4. (庄原市宮内町貝石谷の中新世備北層群の貝化石群集－備北層群の研究３－) (J.E.)

1195 OKAMOTO Kazuo, KAWATANI Takuya, NAKAGAWA Kyoko, HARA Hiroyuki and SAKANOUE Hajime (1986): Faunal characteristics of the Miocene Bihoku Group in the Takami area, Mizuho-cho, Shimane Prefecture. In H. Noda, T. Kotaka, K. Masuda, J. Itoigawa and K. Chinzei (eds.): Faunal characteristics of Japanese Cenozoic molluscs. *Monogr. Mizunami Fossil Mus.*, (6):143-154, pls. 19-20, figs. 1-3, tabs. 1-2. (島根県瑞穂町高見地域の中新世備北層群産貝化石群の特性) (J.E.)

1196 OKAMOTO Kazuo, MIYANOMAE Hiroko and NAMIKAWA Takako (1989): Vertical sequence of the molluscan assemblages from the Miocene Bihoku Group at Negita, Shobara City, Hiroshima Prefecture -Study of the Bihoku Group 1-. In Prof. H. Matsuo Mem. Vol., Matsuyama, 43-52, figs. 1-2, tabs. 1-2. (庄原市根木田の中新世備北層群の貝類化石－備北層群の研究１－) (J.E.)

1197 **OKAMOTO Takashi** (1988): Analysis of heteromorph ammonoids by differential geometry. *Palaeontology*, 31(1):35-52, pl. 7, figs. 1-12.

1198 OKAMOTO Takashi (1988): Changes in life orientation during the ontogeny of some heteromorph ammonoids. *Palaeontology*, 31(2):281-294, figs. 1-11.

1199 OKAMOTO Takashi (1988): Developmental regulation and morphological saltation in the heteromorph ammonite *Nipponites*. *Paleobiology*, 14(3):272-286. figs. 1-11, tab. 1.

1200 OKAMOTO Takashi (1989): Comparative morphology of *Nipponites* and *Eubostrychoceras* (Cretaceous nostoceratids). *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (154):117-139, figs. 1-15, tab. 1.

1201 OKAMOTO Takashi (1989): Method and perspective of theoretical morphology -Geometric description of tubular objects and their hydrostatic application. *Fossils, Palaeont. Soc. Japan*, (46):17-28, figs. 1-7. (理論形態学の方法と展望－管状体の幾何学的記述法と静水力学的応用) (J.)

1202 **OKAMURA Makoto** and MATSUGI Hiroaki (1986): Cretaceous radiolarians from the time equivalent formations of arc-trench system, Shikoku. *NOM, Spec. Vol.*, (7):117-129, pls. 1-4, figs. 1-4, tabs. 1-2. (白亜系同時異相堆積物の放散虫群) (J.E.)

1203 **OKAZAKI Yoshihiko** (1987): Additional materials of *Metasqualodon symmetricus* (Cetacea: Mammalia) from the Oligocene Ashiya Group, Japan. *Bull. Kitakyushu Mus., Nat. Hist.*, (7):133-138, pl. 3.

1204 OKAZAKI Yoshihiko (1988): Oligocene squalodont (Cetacea: Mammalia) from the Ashiya Group, Japan. *Bull. Kitakyushu Mus., Nat. Hist.*, (8):75-80, pl. 1.

1205 OKAZAKI Yoshihiko (1988): [Discovered ancestral mystacocetids]. *Anima*, (188):98-101, 6 figs. (ヒゲ鯨の祖先に出会った) (J.)

1206 OKAZAKI Yoshihiko (1989): An occurrence of fossil bony-toothed bird (Odontopterygiformes) from the Ashiya Group (Oligocene), Japan. *Bull. Kitakyushu Mus., Nat. Hist.*, (9):123-126, pl. 1.

1207 **OKI Kimihiko** (1986): Preliminary report on living population of Benthic Foraminifera in Kagoshima Bay, south Kyushu, Japan. In Y. Matoba and M. Kato (eds.): Studies on Cenozoic Benthic Foraminifera in Japan. Akita Univ., Akita, 13-26, figs. 1-8, tab. 1. (鹿児島湾の底生有孔虫生体群集の予察的研究) (J.)

1208 OKI Kimihiko (1986): [Rate of sedimentation estimated by L/Tl value of Benthic Foraminifera]. *Mar. Sci Month.*, 18(9):588-592, figs. 1-5. (底生有孔虫のL/Tl値から見た堆積速度－鹿児島湾の研究－) (J.)

1209 OKI Kimihiko (1988): [Ecological study of living benthic foraminiferal thanatocoenoses and biocoenoses in Kagoshima Bay]. *Yukochu Kenkyu* (=*Stud. Foraminifera*), (1):23-27, figs. 1-2, tab. 1. (鹿児島湾における現生底生有孔虫遺骸・生体群集の生態学的研究) (J.)

1210 OKI Kimihiko (1988): Notes on the assemblages of benthonic Foraminifera from the habitat of *Nautilus* in Fiji. *Occas. Pap., Kagoshima Univ. Res. Cent., South Pac.*, (15):74-84, figs. 1-4, tabs. 1-2.

1211 OKI Kimihiko (1989): Ecological analysis of benthonic Foraminifera in Kagoshima Bay, south Kyushu, Japan. *South Pac. Stud., Kagoshima Univ. Res Cent., South Pac.*, 10(1):1-191, pls. 1-22, figs. 1-68, tabs. 1-12, appends. 1-2.

1212 OKI Kimihiko (1989): Distribution of the genus *Buliminella* from areas around Japan. In Y. Takayanagi and K. Ishizaki (eds.): Collected papers on Foraminifera from the Japanese Islands. Toko Print., Pub. Dept., Sendai, 143-150, figs. 1-2, tab. 1. (日本周辺海域における*Buliminella* 属の生息分布) (J.)

1213 **OKIMURA Yuji** (1987): Taishaku Limestone -Its sedimentary environments and invertebrate fossils. In Nature of Taishaku-kyo, Board of Education, Tojo Town, Hiroshima Pref., Hiroshima, 59-75, pls. 5-7. (帝釈石灰岩が形成された海と古生物) (J.)

1214 OKIMURA Yuji (1987): Bibliography of the Taishaku Limestone (Carboniferous and Permian). In Nature of Taishaku-kyo, Board of Education, Tojo Town, Hiroshima Pref., Hiroshima, 539-543. (帝釈石灰岩研究に関する文献) (J.)

1215 OKIMURA Yuji (1988): [Present status in the research on the Paleozoic smaller Foraminifera in Japan]. *Yukochu Kenkyu* (=*Stud. Foraminifera*), (1): 6. (本邦の古生代小型有孔虫類研究の現状) (J.)

1216 OKIMURA Yuji (1988): Primitive colaniellid foraminiferal assemblage from the Upper Permian Wargal Formation of the Salt Range, Pakistan. *Jour. Paleont.*, 62(5):715-723.

1217 OKIMURA Yuji (1989): Faunal characteristic and bioprovince of Japanese Paleozoic smaller Foraminifera. In Y. Takayanagi and K. Ishizaki (eds.): Collected papers on Foraminifera from the Japanese Islands. Toko Print., Pub. Dept., Sendai, 11-14. (本邦古生代小型有孔虫化石群と古生物地理) (J.)

1218 OKIMURA Yuji and NAKATSUKASA Noboru (1987): [Geomorphology and geology of the Taishaku-dai area, with special reference to geology, river terrace and caves of the Taishaku valley]. In Research on Natural Environment of Taishaku-kyo (Geomorphology and Geology). Chugoku Electric Co., Hiroshima, 18-42, pls. 1-3, figs. 6-17, tabs. 1-2. (帝釈台地域の地形と地質, とくに帝釈川流域の地質, 河岸段丘および洞穴群) (J.)

1219 OKIMURA Yuji, SUZUKI Shigeyuki, FUJITA Hiroshi and YOSHIDA Yasushi (1986): A preliminary report on the Mesozoic radiolarians from the Kurakake-toge Formation and the Ikuridani Group of the Suzuka Mountains. *NOM, Spec. Vol.*, (7):181-185, pl. 1, figs. 1-3, tab. 1. (鈴鹿山脈中部, 鞍掛峠層・幾里谷層の再検討) (J.E.)

1220 OKUBO Atsushi and KIMURA Tatsuaki (1989): *Nilssonia yezoensis*, sp. nov. from the Upper Cretaceous Hakobuchi Group in Hokkaido, Japan. *Bull. Natn. Sci. Mus., Tokyo. Ser. C*, 15(3):97-107, pls. 1-2, figs. 1-4.

1221 OKUBO Ichiro (1988): On the Recent *Aurila* species from Japan. In T. Hanai, N. Ikeya and K. Ishizaki (eds.): Developments in palaeontology and stratigr a-phy, 11. Evolutionary biology of Ostracoda, its foundamentals and appl i-cations. Kodansha/Elsevier, Tokyo/Amsterdam, 135-144, figs. 1-5.

1222 OKUMURA Kiyoshi (1988): Molluscan fossils from the Pleistocene Ninomiya Group in the Oiso hills, Kanagawa Prefecture, central Japan. *Cult. Prop. Rep., Ninomiya Town Educ. Commit.*, (16):1-99. (中部更新統二宮層群産の軟体動物化石) (J.E.)

1223 OKUMURA Kiyoshi (1990): Molluscan fossils from the Naganuma Formation, at Tengakuin-shita, Fujisawa, Kanagawa Prefecture. *Nat. Hist. Rep. Kanagawa, Kanagawa Pref. Mus.*, (11):37-44, pls. 1-2, figs. 1-2. (藤沢市天岳院下, 長沼層産貝化石) (J.)

1224 OKUMURA Kiyoshi and KOYANAGI Tateoki (1989): Molluscan fossils from the Ashigara Group, southwestern part of the Kanto region, central Japan. *Bull. Mizunami Fossil Mus.*, (16):65-83, pls. 8-9, fig. 1, tabs. 1-2.

1225 OKUMURA Kiyoshi, YOKOYAMA Tatsuya, OTSUKA Keijiro and TODA Michihito (1990): Molluscan shells from the Alluvial deposits in the northern part of Tokushima plain, and their ^{14}C ages. *Chigaku Kenkyu*, 39(1):37-56, pls. 1-5, figs. 1-4, tabs. 1-2. (徳島平野北部, 大谷川および姫田より発見された貝化石群とその^{14}C年代) (J.E.)

1226 OMURA Akio (1988): Geologic history of the Kikai Island, central Ryukyus, Japan: Summary of Uranium-series dating of fossil corals from the Riukiu Limestone. *Mem. Geol. Soc. Japan*, (29):253-268, figs. 1-5, tabs. 1-5. (中部琉球喜界島の地史-琉球石灰岩産サンゴ化石のウラン系列年代測定のまとめとして-) (J.)

1227 ONISHI Ikuo (1990): Floral change in coastal areas on the western Japan Sea since the Middle Pleistocene. *Quat. Res., Japan*, 29(3):223-234, figs. 1-7, tab. 1. (日本海西部沿岸地域の更新世中期以降の植生変化) (J.E.)

1228 ONO Hiroyuki and KIMURA Masaichi (1990): An osteological study on the skull of *Masoplodon* stranded on Kitahiyama beach, Japan. Prof. A. Kasugai, Mem. Vol., Sapporo, 115-131, pls. 1-4. (北檜山町海岸産*Mesoplodon* 属の頭蓋骨の比較研究) (J.)

1229 ONO Keiichi (1986): [Reconstruction of a dinosaur *Iguanodon*]. *Earth Month.*, 8(3):158-162, figs. 1-5. (恐竜イグアノドンの復元) (J.)

1230 ONO Keiichi (1989): A bony-toothed bird from the Middle Miocene, Chichibu basin, Japan. *Bull. Natn. Sci. Mus., Tokyo, Ser. C*, 15(1):33-38, fig. 1, tab. 1.

1231 ONO Keiichi and UYENO Teruya (1989): Vertebrate remains from Yatsudai Shell Mound. Sanbu Archaeological Institute, Chiba, 3-14, pls. 1-4, figs. 1-2.

(谷津台遺跡出土の脊椎動物遺存体) (J.)

1232 ONO Tomonori, MIDORIKAWA Yoshiyuki, YAMAMOTO Satoshi and UJIIE Hiroshi (1989): Sediments taken from the sea-bottom around the southern Ryukyu Island arc during RN-84, -86, and -87 cruises. *Bull. Coll. Sci., Univ. Ryukyus*, (47):115-151. (RN 84, 86, 87 航海で採集された琉球弧周辺海域の底質試料について) (J.E.)

1233 ONO Tomonori, YAMAMOTO Satoshi and UJIIE Hiroshi (1987): Fluctuation of carbonate and interstitutional-exchangeable elements in sediments from the ocean surrounding the Ryukyu Islands. *The Compass*, 64(4):196-206.

1234 ONOE Toru (1989): Palaeoenvironmental analysis based on the Pleistocene Shiobara Flora in the Shiobara volcanic basin, central Japan. *Rep. Geol. Surv. Japan*, (269):1-207, pls. 1-31, figs. 1-15, fossil-figs. 1-10, tabs. 1-11. (栃木県塩原産更新世植物群による古環境解析) (J.E.)

1235 ONOE Toru, OZAKI Masanori and YOSHIDA Fumio (1986): Plant fossils from the Tokai Group in the Chita Peninsula, Aichi Prefecture, Japan. *Bull. Geol. Surv. Japan*, 37(4):201-206, pls. 1-2, figs. 1-3, tab. 1. (知多半島東海層群からの植物化石) (J.)

1236 OSOZAWA Soichi (1986): Origin of chert, limestone and basalt complex in Japan. *Jour. Geol. Soc. Japan*, 92(10):709-722, pls. 1-2, figs. 1-11, tab. 1. (本邦におけるチャート・石灰岩・玄武岩複合岩体の起源) (J.E.)

1237 OTA Yoko, ISHIBASHI Katsuhiko, MATSUSHIMA Yoshiaki, MATSUDA Tokihiko, MIYOSI Masumi, KASHIMA Kaoru and MATSUBARA Akiko (1986): Holocene relative sea-level change in the soutern part of Izu Peninsula, central Japan; Data from subsurface investigation. *Quat. Res., Japan*, 25(3):203-223, figs. 1-11, tab. 1. (掘削調査にもとづく伊豆半島南部における完新世相対的海水準変化) (J.E.)

1238 OTA Yoko, YONEKURA Nobuyuki and MATSUMOTO Eiji (1989): Notes on the coral reef terraces, Huon Peninsula, Papua New Guinea -International expedition in 1988-. *Jour. Geogr.*, 98(2):177-182, figs. 1-2, photos. 1-9. (パプアニューギニア, ヒュオン半島のサンゴ礁段丘の国際共同調査) (J.)

1239 OTOH Shigeru (1987): Late Paleozoic tectonic development in the northern part of the Chichibu geosyncline in the east Chugoku Mountains, southwest Japan. *Jour. Fac. Sci., Univ. Tokyo, Sec. 2*, 21(4):379-415, figs. 1-19.

1240 OTSUKA Hiroyuki (1987): Middle- and late-Pleistocene mammalian faunae in the Japanese Islands with special reference to the mammalian fauna of the Nishiyagi Formation in Akashi district. *Bull. Natn. Mus., Japan. Hist.*, 13: 275-287. (日本列島における更新世中・後期の哺乳動物化石群) (J.E.)

1241 OTSUKA Hiroyuki (1987): Growth of antler in the subgenus *Sika* (Cervid, mammal) from the Pleistocene formation in Seto Inland Sea, west Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (152):625-643, figs. 1-16.

1242 OTSUKA Hiroyuki (1988): Vertebrate fossils from the Bisan-seto, Part 2. Cervidae in vertebrate fossils from the sea bottom of Bisan-seto, west Japan. Rep. Res. Yamamoto Collect., 1(Descriptions) and 2(Plates), 1988, Kurashiki Mus. Nat. Hist., Kurashiki. (J.)

1243 OTSUKA Hiroyuki (1990): Fossil deer assemblage from sea bottom of Bisan-seto area with special reference to their stratigraphic position (Pleistocene deer fauna in Seto Inland Sea, Part 3). *Rep. Fac. Sci., Kagoshima Univ., Earth Sci. & Biol.*, (22):55-87, pls. 1-4, figs. 1-8, tabs. 1-2.

1244 OTSUKA Hiroyuki (1990): Fossil deer from the Tokuno-shima, Ryukyu Islands, southwest Japan. *Mem. Natn. Sci. Mus., Tokyo*, 23:185-196, pl. 1, figs. 1-2, tab. 1. (徳之島の更新世鹿化石) (J.)

1245 OTSUKA Hiroyuki and FURUKAWA Hiroyasu (1988): Early and Middle Pleistocene stratigraphy in Kyushu and Ryukyu, Japan. *Mem. Geol. Soc. Japan*, (30):155-168, figs. 1-2, tabs. 1-2. (九州・琉球地方の下部および中部更新統の層序) (J.E.)

1246 **OTSUKA Tsutomu** (1988): Paleozoic-Mesozoic sedimentary complex in the eastern Mino terrane, central Japan and its Jurassic tectonism. *Jour. Geosci., Osaka City Univ.*, 31:63-122, figs. 1-20, tabs. 1-10, append-figs. 1-7.

1247 OTSUKA Tsutomu, MORIKIYO Toshiro, YANO Kenji, OHTOMO Yukiko and TOGASHI Hitoshi (1986): Mesozoic strata and their soft-sediment deformation in the Ryoke Belt, northern Kiso Mountains, central Japan. *Earth Sci.*, 40(5): 307-321, pls. 1-3, figs. 1-9, tab. 1. (領家帯弱変成部の中生界とその未固結時変形－木曽山地北部の例 －) (J.E.)

1248 **OYAMA Katsura** and NISHIMOTO Hiroyuki (1988): New fossil molluscs indicating tropical sea elements from the Miocene Bihoku Group, southwest Honshu, Japan, Part 1. *Bull. Mizunami Fossil Mus.*, (15):1-6, pl. 1.

1249 **OZAKI Kimihiko** (1987): *Tetracentron* leaves from the Neogene of Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (146):77-87, figs. 1-4.

1250 **OZAWA Tomowo** (1986): [Formative process of eastern Asia viewed from paleobiogeography]. *Kagaku*, 56(5):303-311. (古生物地理からみた東アジアの形成過程) (J.)

1251 OZAWA Tomowo (1987): An outline of fossil pleurotomariaceans. *Collect. & Breed.*, 49(2):68-72, figs. 1-4, tab. 1. (オキナエビスガイ類の化石) (J.)

1252 OZAWA Tomowo (1987): Permian fusulinacean biogeographic provinces in Asia and their tectonic implications. In A. Taira and M. Tashiro (eds.): Historical biogeography and plate tectonic evolution of Japan and eastern Asia. Terra Pub., Tokyo, 47-64.

1253 OZAWA Tomowo, KOBAYASHI Fumio, WATANABE Kozo, OKIMURA Yuji, ADACHI Shuko and TAKAYANAGI Yokichi (1990): Bibliography of the literature on Foraminifera from Japan published during the years 1890 to 1989, including Japanese workers' contributions on materials collected from elsewhere in the world. Part 1. Paleozoic Foraminifera. *Sci. Rep., Tohoku Univ., 2nd Ser., Spec. Vol.*, (7):13-48.

1254 OZAWA Tomowo, NAKAGAWA Tomio and TAKEYAMA Ken-ichi (1986): Middle Miocene molluscan fauna of the Uchiura Group, Wakasa province, southwest Japan. *Spec. Pap., Palaeont. Soc. Japan*, (29):135-148, pls. 12-15, figs. 1-6, tab. 1.

P

1255 **PILLAI Deirdre D. L.** and ISHIGA Hiroaki (1987): Discovery of late Permian radiolarian from Kozuki Formation, Kozuki-Tatsuno Belt, southwest Japan. *Jour. Geol. Soc. Japan*, 93(11):847-849, pl. 1, figs, 1-2, tab. 1.

R

1256 Research Group (1988): Biostratigraphic study of Paleozoic and Mesozoic groups in central and northern Thailand -An interim report-. Mem. Dept. Geol., Fac. Sci., Kyushu Univ., 1-47, pls. 1-33.

1257 Research Group for Natural History of Lake Biwa (1986): Fresh-water fossil assemblages from the Pleistocene Kobiwako Group on the southwest side of Lake Biwa. *Bull. Mizunami Fossil Mus.*, (13):57-103, pls. 9-20, figs. 1-2, tabs. 1-8. (琵琶湖南西岸の古琵琶湖層群の淡水生化石群集) (J.)

1258 Research Group on the Paleoenvironment of the Narita Formation (1990): The horizon of the Naumann's elephants from the Narita Formation. *Jour. Foss. Res.*, 22(2):47-55, figs. 1-4. photos. 1-7. (成田層産のナウマンゾウ化石の産出層準とその古環境) (J.)

1259 ROSENBERGER Alfred L., SETOGUCHI Takeshi and SHIGEHARA Nobuo (1990): The fossil record of callitrichine Primates. *Jour. Hum. Evol.*, 19:209-236.

S

1260 SADA Kimiyoshi, TANAKA Keiko and FUJIMOTO Mutsumi (1989): A study of fusulinacean faunas of the Carboniferous Mitsudo Group in Okayama Prefecture and brief notes on the origin of the primitive fusulinaceans. In Y. Takayanagi and K. Ishizaki (eds.): Collected papers on Foraminifera from the Japanese Islands. Toko Print., Pub. Dept., Sendai, 15-20. (岡山県光遠層群の石炭紀紡錘虫群集についての研究とprimitive紡錘虫の起源についての覚え書き) (J.E.)

1261 SADO Masako (1990): Study of atmospheric pollen by volumetric methods. *Rev. Palaeobot. & Palynol.*, 64(1/4):61-69, figs. 1-4, tabs. 1-2.

1262 SAEGUSA Haruo (1990): A speculation on the migration and evolution of Japanese stegodonts. *Collect. & Breed.*, 52(1):14-18, figs. 1-5. (日本のステゴドンをめぐって) (J.)

1263 SAGAYAMA Tsumoru (1987): Diatomaceous fossils in the Neogene System of the southern part of Ishikari hill, Hokkaido. *Rep. Geol. Surv. Hokkaido*, (58):47-53, figs. 1-3, tab. 1. (北海道石狩丘陵南部新第三系の珪藻化石) (J.E.)

1264 SAGAYAMA Tsumoru (1987): Diatom biostratigraphy of the Pliocene in the Konsen plain, east Hokkaido. *Jour. Geol. Soc. Japan*, 93(9):643-652, pl. 1, figs. 1-7, tabs. 1-3. (東部北海道, 根釧原野鮮新統の珪藻生層序) (J.E.)

1265 SAGAYAMA Tsumoru (1988): Diatom assemblage from Kaiyo-kaizan (seamount), northeast margin of the Japan basin. *Jour. Geol. Soc. Japan*, 94(4):295-300, pl. 1, figs. 1-2, tab. 1. (日本海盆北東縁, 海洋海山の珪藻群集) (J.E.)

1266 SAGAYAMA Tsumoru (1989): Diatom zones of the Neogene around the Ishikari lowland, central Hokkaido. *Rep. Geol. Surv. Hokkaido*, (60):177-186, figs. 1-6. (中央北海道, 石狩低地帯周辺の新第三系珪藻帯) (J.E.)

1267 SAGAYAMA Tsumoru and KIMURA Masaichi (1989): First discovery of a Pliocene walrus skull in the northern Pacific. *Rep. Geol. Surv. Hokkaido*, (60):187-190, pl. 1, fig. 1, tab. 1.

1268 SAGAYAMA Tsumoru and YAHATA Masahiro (1987): Diatom biostratigraphy of the Neogene in southwest Hokkaido -Kogawatoge of Kitahiyama-cho-. Prof. M. Matsui Mem. Vol., Sapporo, 131-136, pl. 1, figs. 1-2, tab. 1. (西南北海道, 新第三系の珪藻生層序－北檜山町小川峠ルート－) (J.)

1269 SAHASHI N., IKUSE M., OHMOTO T., SAITO Y., TANAHASHI Y. and TAKEDA H. (1990): Relationship between seasonal and annual total pollen counts of *Cryptomerica japonica* and *Cupressaceae* and number of outpatients with *Sugi pollinosis* in central Japan. *Rev. Palaeobot. & Palynol.*, 64(1/4):79-86, figs. 1-9, tabs. 1-4.

1270 SAIDA Tsugumichi (1987): Triassic and Jurassic radiolarians in chert clasts of the Tetori Group in Tamodani area of Izumi Village, Fukui Prefecture, central Japan. *Jour. Geol. Soc. Japan*, 93(1):57-59, pl. 1, fig. 1. (福井県大野郡和泉村田茂谷地域の手取層群中のチャート礫に含まれる三畳紀およびジュラ紀放散虫化石) (J.)

1271 SAITO Makoto (1989): Jurassic melanges in the Tanigumi area, Gifu Prefecture, Mino terrane. *Jour. Geol. Soc. Japan*, 95(8):579-594, pls. 1-3, figs. 1-6, tabs. 1-4. (美濃帯西部岐阜県谷汲村地域のジュラ紀メランジェ) (J.E.)

1272 SAITO Takeshi (1988): Molluscan fossils from the Nanamagari Formation (Miocene) in Kanazawa city, Ishikawa Prefecture, Japan. *Bull. Mizunami Fossil Mus.*, (14):139-144, pl. 33, figs. 1-3, tab. 1.

1273 SAITO Tsunemasa (1987): Studies on the New Zealand Eocene-Oligocene boundary: Data. Dept., Earth Sci., Fac. Sci., Yamagata Univ., Yamagata, 1-55, pls. 1-5.

1274 SAITO Tsunemasa (1989): Origin and evolution of planktonic Foraminifera with special reference to Mesozoic and Cenozoic faunas in the northwestern Pacific region. In Y. Takayanagi and K. Ishizaki (eds.): Collected papers on Foraminifera from the Japanese Islands. Toko Print., Pub. Dept., Sendai, 21-39, figs. 1-10. (浮遊性有孔虫の起源および進化と北西太平洋地域の中・新生代フォーナ) (J.)

1275 SAITO Tsunemasa, BARRON John A. and SAKAMOTO Masamichi (1988): An early late Oligocene age indicated by diatoms for a primitive desmostylian mammal *Behemotops* from eastern Hokkaido, Japan. *Proc. Japan Acad., Ser. B*, 64(9):269-273, figs. 1-2.

1276 SAITO Tsunemasa and KAIHO Kunio (1986): [Cretaceous-Tertiary (C-T) boundary and dinosaur extinction]. *Earth Month.*, 8(3):192-202, figs. 1-7. (白亜紀－第三紀(C-T)境界と恐竜の絶滅) (J.)

1277 SAITO Tsunemasa, YAMANOI Tohru and KAIHO Kunio (1986): End-Cretaceous devastation of terrestrial flora in boreal Far East. *Nature*, 323(6085): 253-255, figs. 1-3.

1278 SAITO Yoshiki, MATSUMOTO Eiji and KASHIMA Kaoru (1989): Sea level of the last glaciation maximum based on In-Place sediments on the shelf off Sendai, northeast Japan. *Quat. Res., Japan*, 28(2):111-119, pl. 1, figs. 1-4, tabs. 1-2.

1279 SAKA Yukiyasu and TEZUKA Shigeo (1988): Southern belt of the Chichibu terrane in the Shima Peninsula, southwest Japan. *Jour. Geogr.*, 97(1):10-24, figs. 1-9, tab. 1. (志摩半島の秩父帯南帯) (J.E.)

1280 SAKAGAMI Sumio et al. (1986): Biostratigraphic study of Paleozoic and

Mesozoic Groups in central Andes -An Interim Report (2)-. Dept. Earth Sci Fac. Sci., Chiba Univ., 1-83, figs. 1-17, photos. 1-13.

1281 SAKAGAMI Sumio (1988): On the Paleozoic Bryozoa of northeast Japan. *Earth Sci.*, 42(4):237-239. (東北日本の古生代こけむし石について) (J.)

1282 SAKAGAMI Sumio (1989): Restudy on the geological history of the South Sea Islands. *Jour. Geogr.*, 98(4):103-105. (南洋群島地史変遷の再検討) (J.)

1283 SAKAGAMI Sumio (1990): Paleozoic and Triassic bryozoans. (In "Pre-Cretaceous terranes of Japan"). Publication of IGCP Project no. 224, Osaka, 321-328, figs. 1, tab. 1.

1284 SAKAGAMI Sumio and HATTA Akio (1987): Fossil assemblage in the Aimeriik volcaniclastic rocks in Babelthuap Island, Palau. *Prom. Rep., 5th Sci. Surv., South Pacific, Kagoshima Univ., Res. Cent., South Pacific, Rep. 7, Subject 2*, 53-56, pl. 1, fig. 1, tab. 1.

1285 SAKAGAMI Sumio and HATTA AKio (1990): History and geology of the Palau Islands. *Jour. Geogr.*, 99(3):230-246, figs. 1-6, tabs. 1-7. (パラオ諸島の歴史と地質) (J.E.)

1286 SAKAGAMI Sumio, HATTA Akio, MATSUMOTO Midori and MIZUNO Yoshihiro (1987): Fossil pollen and spores from the Airai lignite-bearing beds in Babelthuap Island, Palau. *Prom. Rep., 5th Sci. Surv., South Pacific, Kagoshima Univ. Res. Cent., South Pacific, Subject 2*, 57-61, figs. 1-3, tab. 1.

1287 SAKAGAMI Sumio and MIYAMA Yasuyuki (1988): On the limestone-bearing conglomerates in the Maki and Terauchi Formations in the Atetsu Limestone Plateau, southwest Japan. *Proc. Japan Acad., Ser. B*, 64(4):92-97, fig. 1.

1288 SAKAGAMI Sumio and NAKORNSRI Nikorn (1987): On some Silurian corals from northeast Thailand. *Proc. Japan Acad., Ser. B*, 63(7):242-245, figs. 1-4.

1289 SAKAGAMI Sumio and SUGIMURA Akihiro (1987): *Hinaclema*, a new Carboniferous genus from the Hina Limestone, southwest Japan. *Proc. Japan Acad., Ser. B*, 63(7):246-249, figs. 1-7.

1290 SAKAGAMI Sumio and UENO Katsumi (1987): On the tuffaceous conglomerate at northwestern part of Koike in the Sakawa basin, Shikoku, Japan. *Proc. Japan Acad., Ser. B*, 63(3):71-75, figs. 1-3.

1291 SAKAI Harutaka (1988): Toi-misaki olistostrome of the southern belt of the Shimanto terrane, south Kyushu -1. Reconstruction of depositional environments and stratigraphy before the collapse. *Jour. Geol. Soc. Japan*, 94(10):733-747, pls. 1-5, figs. 1-8, tab. 1. (南九州, 四万十帯南帯の都井岬オリストストローム1. 崩壊前の堆積環境と層序の復元) (J.E.)

1292 SAKAI Harutaka and NISHI Hiroshi (1990): Geologic age of the Taisyu Group and the Katsumoto Formation in the Tsushima and Iki Islands, off northwest Kyushu on the basis of planktonic foraminifers. *Jour. Geol. Soc. Japan*, 96(5):389-392, figs. 1-5, tab. 1.

1293 SAKAI Harutaka, NISHI Hiroshi and MIYACHI Mutsumi (1990): Geologic age of the unconformity between the Sasebo and the Nojima Groups, northwest Kyushu and its tectonic significances. *Jour. Geol. Soc. Japan*, 96(4):327-330, figs. 1-3, tab. 1.

1294 SAKAI Toyosaburo (1986): Lithostratigraphy of the Neogene Arakawa Group at the type section (Tochigi Prefecture, Japan). *Bull. Utsunomiya Univ., Fac*

Gen. Educ., Sec. 2, (19):49-70. (中新統荒川層群(栃木県)の様式地における層序) (J.E.)

1295 **SAKAKIBARA Masayuki** and TANAKA Keisaku (1986): Discovery of *Inoceramus* from the Saroma Group, the Tokoro Belt, northeastern Hokkaido. *Earth Sci.*, 40 (3):205-206, pl. 1, fig. 1. (常呂帯佐呂間層群から発見されたイノセラムス) (J.)

1296 **SAKAMOTO Kazuo** and UYENO Teruya (1988): A new righteye flounder from the late Pleistocene Togane Formation, Chiba Prefecture, Japan. *Bull. Natn. Sci. Mus., Tokyo, Ser. C*, 4(3):135-142, figs. 1-5.

1297 SAKAMOTO Kazuo and UYENO Teruya (1988): A fossil of the righteye flounder, *Clidoderma asperrimum*, from Pliocene Tatsunokuchi Formation, Soma City, Fukushima Prefecture, Japan. *Bull. Natn. Sci. Mus., Tokyo, Ser. C*, 14(1): 37-43, figs. 1-4.

1298 SAKAMOTO Kazuo and UYENO Teruya (1989): A new Middle Miocene righteye flounder *Hippoglossoides naritai* from Tokoro, Hokkaido, Japan. *Bull. Natn. Sci. Mus., Tokyo, Ser. C*, 15(2):71-79, figs. 1-4, tab. 1.

1299 SAKAMOTO Kazuo and UYENO Teruya (1989): *Platichthys miostellatus*, a new Miocene righteye flounder from Yaita City, Tochigi Prefecture, Japan. *Bull. Natn. Sci. Mus., Tokyo, Ser. C*, 15(4):161-166, figs. 1-4.

1300 **SAKAMOTO Osamu**, MACHIDA Mizuo, HONMA Takeshi, INOYAMA Takeshi, HONMA Shin'-ichi and SHIMADA Kenshu (1988): Occurrence of the skeleton of *Stegodon aurorae* Matsumoto from Sasai, Sayama City, central Japan. *Bull. Saitama Mus., Nat. Hist.*, (6):33-44, pls. 1-9, figs. 1-3, tabs. 1-4. (埼玉県狭山市笹井産アケボノゾウの骨格化石の産出について) (J.)

1301 **SAMATA Tetsuro** (1988): Organic matrix in the molar enamel of Pliocene proboscida *Gomphotherium* sp. *Jour. Geol. Soc. Japan*, 94(5):325-336, figs. 1-3, tabs. 1-3. (鮮新世の長鼻類*Gomphotherium* sp.の臼歯エナメル質に含まれる有機基質) (J.E.)

1302 **SANADA Saburo**, SUZUKI Yasuaki, KAWANA Akira, TAKAHASHI Hideki and HATAKEYAMA Masaaki (1986): Occurrence of some plant fossils from Goryo in southern part of Boso Peninsula, Japan. *Collect. & Breed.*, 48(7):313-315, figs. 1-2. (房総半島南部産の植物化石) (J.)

1303 **SANO Hiroyoshi** (1988): Permian oceanic-rocks of Mino terrane, central Japan, Part 1, Chert facies. *Jour. Geol. Soc. Japan*, 94(9):697-709, pls. 1-2, figs. 1-10, tab. 1.

1304 SANO Hiroyoshi (1988): Permian oceanic-rocks of Mino terrane, central Japan Part 2, Limestone facies. *Jour. Geol. Soc. Japan*, 94(12):963-976, pls. 1-5. figs. 1-6, tab. 1.

1305 SANO Hiroyoshi (1989): Permian oceanic-rocks of Mino terrane, central Japan Part 3, Limestone-breccia facies. *Jour, Geol. Soc. Japan*, 95(7):527-540, pls. 1-5, figs. 1-5, tab. 1.

1306 SANO Hiroyoshi (1989): Permian oceanic-rocks of Mino terrane, central Japan Part 4, Supplements and concluding remarks. *Jour. Geol. Soc. Japan*, 95(8): 595-602, pls. 1-3, figs. 1-2.

1307 SANO Hiroyoshi, IIJIMA Yasuo and HATTORI Hiromichi (1987): Stratigraphy of the Paleozoic rocks in the Akiyoshi terrane of the central Chugoku Massif. *Jour. Geol. Soc. Japan*, 93(12):865-880, figs. 1-12, tab. 1. (中国山地中央部秋吉帯古生界の層序) (J.E.)

1308 SANO Hiroyoshi and KANMERA Kametoshi (1988): Paleogeographic reconstruction of accreted oceanic rocks: Akiyoshi, southwest Japan. *Geology*, 16:600-603.

1309 SASAGAWA Ichiro, YASUI Satoshi and GOTO Masatoshi (1989): Fossil teeth of the great white shark, *Carcharodon carcharias*, found from the Uonuma Group in Takiya, Nagaoka City, central Japan. *Bull. Nagaoka Munic. Sci. Mus.*, (24):1-6. (新潟県長岡市滝谷の魚沼層群から産出したホホジロザメの歯の化石) (J.E.)

1310 SASAKI Kazuhiko and KUDO Tetsuro (1986): [Early Pleistocene paleoenvironment at the Ojiya area, Niigata Prefecture from the viewpoint of fossil Foraminifera]. *Jour. Japan. Assoc. Petrol. Tech.*, 51(4):338. (有孔虫化石群集からみた新潟県小千谷地域における更新世初頭の古環境) (J.)

1311 SASAKI Osamu (1990): Parameters for description of the shell form of the genus *Anadara* (Mollusca; Bivalvia). *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (158):513-534, figs. 1-16, tabs. 1-2.

1312 SASAKI Osamu and OGASAWARA Kenshiro (1986): Intertidal molluscan assemblage from the Miocene Sunakozaka Formation, Ishikawa -Toyama area, Hokuriku district, Japan. *Mem. Natn. Sci. Mus., Tokyo*, (19):79-89, pls. 5-6, figs. 1-8, tabs. 1-2. (北陸地方石川, 富山県境付近の中新統砂子坂層産潮間帯性貝類化石群集) (J.E.)

1313 SASHIDA Katsuo (1988): Lower Jurassic multisegmented Nassellaria from the Itsukaichi area, western part of Tokyo Prefecture, central Japan. *Sci. Rep., Inst. Geosic., Univ. Tsukuba, Sec. B*, 9:1-27, pls. 1-4, figs. 1-5, tab. 1.

1314 SASHIDA Katsuo, IGO Hisayoshi, ADACHI Shuko and ITO Sayuri (1989): Radiolarian dating of the Torinosu-type limestone in the Kanto Mountains, central Japan. *Ann. Rep., Inst. Geosci., Univ. Tsukuba*, (15):54-60, figs. 1-4, tab. 1.

1315 SASHIDA Katsuo and TONISHI Keiji (1986): Upper Permian stauraxon polycystine Radiolaria from Itsukaichi, western part of Tokyo Prefecture. *Sci. Rep., Inst. Geosci., Univ. Tsukuba, Sec. B*, 7:1-13, pls. 1-4, figs. 1-2.

1316 SASHIDA Katsuo and TONISHI Keiji (1988): Additional note on Upper Permian radiolarian fauna from Itsukaichi, western part of Tokyo Prefecture, central Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (151):523-542, figs. 1-10.

1317 SASHIDA Katsuo, TONISHI Keiji and IGO Hisayoshi (1986): Lower Jurassic radiolarians from the Takarazawa area of Itsukaichi Town, Tokyo Prefecture, central Japan. *NOM, Spec. Vol.*, (7):35-43, figs. 1-5. (東京都五日市宝沢付近より産する前期ジュラ紀放散虫) (J.E.)

1318 SATO Hiroshi (1986): Geologic development of the Cenozoic System in central northeast Honshu (Between Sakata and Furukawa). *Contr. Inst. Geol. Paleont., Tohoku Univ.*, (88):1-32, figs. 1-35, tabs. 1-4. (東北地方中部地域(酒田－古川間)の新生代地質構造発達史(第1部)) (J.E.)

1319 SATO Seiji (1987): On the sedimentary basin in the early Neogene time in the central part of Hokkaido, and the earliest Miocene sediments in the basin. *Jour. Japan. Assoc. Petrol. Tech.*, 52(2):9-19, figs. 1-8. (北海道中軸部の新第三紀初期の堆積盆および新第三紀最初期の堆積物) (J.E.)

1320 SATO Seiji (1987): On the so-called Mid-Neogene climatic optimum at 16 Ma in Hokkaido, north Japan. In R. Tsuchi (eds.): Pacific Neogene Event Study, Shizuoka, 88-93, figs. 1-3.

1321 SATO Seiji (1989): Palynological study of the Kawabata-Kotanbetsu-Masuporo Formation in central Hokkaido. *Jour. Fac. Sci., Hokkaido Univ., Ser. 4,* 22(3):387-398, figs. 1-8.

1322 SATO Seiji (1989): Palyno-stratigraphic study of the Tertiary in the Joban coal field, northeast Japan. *Jour. Geol. Soc. Japan,* 95(3):171-187, figs. 1-8, tabs. 1-2. (常磐炭田第三系の花粉層序学的研究) (J.E.)

1323 **SATO Tadashi** (1988): [Origin of Japanese Paleozoic and Mesozoic limestones]. *Limestone,* (236):7-15, figs. 1-8. (日本の中・古生界の石灰岩はどこから来たか(その1)) (J.)

1324 SATO Tadashi (1989): Radiolarian revolution in the study of Japanese Paleozoic-Mesozoic. *Jour. Japan Soc., Eng. Geol.*, 30(3):153-162, figs. 1-7. (日本中・古生界研究の放散虫革命) (J.)

1325 SATO Tadashi, HASHIMOTO Kyoichi and SUYAMA Yoshiji (1986): Discovery of a late Jurassic ammonite *Perisphinctes* from the Kuga Group in Yamaguchi Prefecture. *Bull. Yamaguchi Pref. Mus.*, (12):1-5, figs. 1-2. (山口県玖珂層群よりジュラ紀後期アンモナイトの発見) (J.E.)

1326 SATO Tadashi, SHIMONOYA Toyokazu and TAKAHASHI Yoshio (1990): [Illustrations of ammonites in Fukui Prefecture]. Fukui Municipal Museum of Natural History, Fukui, 1-74, pls. 1-31, figs. 1-2. (図録福井県産アンモナイト) (J.)

1327 **SATO Tokiyuki** and KUDO Tetsuro (1986): [Paleoenvironmental analysis by means of Foraminifera -Niigata oil field]. *Mar. Sci., Month.*, 18(9):593-598. (有孔虫化石による古環境解析－新潟油田地域を例として－) (J.)

1328 SATO Tokiyuki and KUDO Tetsuro (1986): Paleoenvironmental change of early Pleistocene in the Niigata oil-field area as indicated by the foraminiferal fauna. In Y. Matoba and M. Kato (eds.): Studies on Cenozoic Benthic Foraminifera in Japan. Akita Univ., Akita, 105-114. (有孔虫化石群集からみた新潟油田地域における更新世初頭の古環境変化) (J.)

1329 SATO Tokiyuki and TAKAYAMA Toshiaki (1988): Calcareous nannofossil Zones of the Quaternary. *Mem. Geol. Soc. Japan,* (30):205-217, pl. 1, figs. 1-8. (石灰質ナンノプランクトンによる第四系化石帯区分) (J.E.)

1330 SATO Tokiyuki, TAKAYAMA Toshiaki, KATO Michio and KUDO Tetsuro (1987): Calcareous microfossil biostratigraphy of the uppermost Cenozoic formations distributed in the coast of the Japan Sea -Pt. 1: Niigata area. *Jour. Japan. Assoc. Petrol. Tech.*, 52(3):231-241, figs. 1-11. (日本海側に発達する最上部新生界の石灰質微化石層序その1：新潟地域) (J.E.)

1331 SATO Tokiyuki, TAKAYAMA Toshiaki, KATO Michio and KUDO Tetsuro (1988): Calcareous microfossil biostratigraphy of the uppermost Cenozoic formations distributed in the coast of the Japan Sea -Pt. 3: Akita area and Oga Peninsula. *Jour. Japan. Assoc. Petrol. Tech.*, 53(3):199-212, figs. 1-17. (日本海側に発達する最上部新生界の石灰質微化石層序その3：秋田地域および男鹿半島) (J.E.)

1332 SATO Tokiyuki, TAKAYAMA Toshiaki, KATO Michio, KUDO Tetsuro and KAMEO Koji (1988): Calcareous microfossil biostratigraphy of the uppermost Cenozoic formations distributed in the coast of the Japan Sea -Part 4: Conclusion-. *Jour. Japan. Assoc. Petrol. Tech.*, 53(6):475-491, pl. 1, figs. 1-9. (日本

海側に発達する最上部新生界の石灰質微化石層序　その４：総括－太平洋側および鮮新統／更新統境界の模式地との対比）（J.E.）

1333 SATO Toru, MURATA Masafumi and YOSHIDA Hidekazu (1986): Triassic to Jurassic radiolarian biostratigraphy in the southern part of Chichibu terrane of Kyushu, Japan. *NOM, Spec. Vol.*, (7):9-23, figs. 1-17, tab. 1.（九州秩父累帯南帯における三畳紀－ジュラ紀放散虫化石帯）（J.E.）

1334 SATO Toshihiko (1989): An abnormal microstructure in the skeletons of Recent and fossil scleractinian corals, its cause and diagenesis. *Earth Sci.*, 43(4):200-210, pls. 1-4, figs. 1-2.（現生および化石イシサンゴ(Scleractinia)に見られる異常硬組織，その成因と続成変化）（J.E.）

1335 SATO Yoichi, HASEGAWA Yoshikazu and YONEZAWA Azusa (1988): The Urohyal of Japanese Miocene clupeid fish, *Eosardinella hishinariensis*. *Sci. Rep., Yokohama Natn. Univ., Sec. 2*, (35):57-59, figs. 1-3.

1336 SATO Yoshio, MASUDA Koichiro and SHUTO Tsugio (1986): Pelecypod fauna of the Shimajiri Group in Miyako-jima, Okinawa Prefecture, Japan. *Mem. Fac. Sci., Kyushu Univ., Ser. D*, 26(1):1-49, pls. 1-5, figs. 1-2, tab. 1.

1337 SATO Yoshio and TOSHIMITSU Seiichi (1990): The manner of making replica in gelogical museum. *Chishitsu News*, (431):77-80, photos. 1-8.（地質標本館のレプリカ標本の作成）（J.）

1338 SATOH Atsushi, HASHIMOTO Kazuo and HASEGAWA Yoshikazu (1989): Early Miocene desmostylid skull from the Goyasu Formation, Iwaki City, Fukushima Prefecture, Japan. *Sci. Rep., Yokohama Natn. Univ., Sec. 2*, (36):57-70, pls. 1-2, figs. 1-3, tabs. 1-3.（福島県いわき市の五安層から産出した*Desmostylus*の頭蓋化石について）（J.E.）

1339 SEDLOCK Richard L. and ISOZAKI Yukio (1990): Lithology and biostratigraphy of Franciscan-like chert and associated rocks in west-Baja California, Mexico. *Bull. Geol. Soc. Amer.*, 102(7):852-864, figs. 1-9, tabs. 1-2.

1340 SEILACHER Adolf and CHINZEI Kiyotaka (1989): Selbstbildungs-Mechanismen als Prozessoren organismischer Entwicklung und Evolution. In Bandel et al. (eds.):Intl. Symp. SFB 230, Naturliche Konstruktionen-Leichtbau in Architektur und Natur, Teil 2, Tubingen, 55-63.

1341 SEKIMOTO Katsuhisa and ENDO Kunihiro (1989): Holocene deposits and paleoenvironments based on the benthic foraminiferal assemblages in Paleo-Isumi Bay, Chiba Prefecture, central Japan. *Proc. Inst. Nat. Sci., (Applied Earth Sci.), Nihon Univ.*, (24):65-79, figs. 1-11.（千葉県夷隅川下流域における完新統と底生有孔虫群集に基づく古環境）（J.E.）

1342 SETOGUCHI Takeshi (1986): [Reappraisal of the divergence data between Japanese and rhesus monkeys]. *Jour. Anthropol. Soc. Nippon*, 94:183-188.（ニホンザルとアカゲザルの分岐時期の再考－根井の式に関連して－）（J.）

1343 SETOGUCHI Takeshi (1986): [On the validity of the Nei's formula as a molecular clock]. *Jour. Anthropol. Soc. Nippon*, 94:319-324.（根井の式は分子時計として有効か？）（J.）

1344 SETOGUCHI Takeshi (1986): [Constant rate of molecular substitution?]. *Kagaku*, 56:240-243, tabs. 1-2.（分子進化の速度は一定か？）（J.）

1345 SETOGUCHI Takeshi (1986): [Reappraisal of molecular clock]. *Primate Res.*, 2: 5-8.（古生物学からみた分子時計の問題点）（J.）

1346 SETOGUCHI Takeshi (1986): [Comparative anatomy of teeth]. In M. Goto and N. Ohtaishi (eds.). Ishiyaku-Shuppan, Tokyo, 1-267. (歯の比較解剖学) (J.)

1347 SETOGUCHI Takeshi (1986): Relation between morphology and function of the dentition in the *Stirtonia-Alouatta* lineage (Ceboidea). In D. M. Taub and F. A. King (eds.): Current Perspectives in primate biology. van Nostrand Reinhold Co., New York, 201-213.

1348 SETOGUCHI Takeshi (1987): [Evolution seen through fossils: Part 1. On the geographical distribution of marsupials]. *Life Sci.*, 14(6):68-71. (化石をとおして見た進化論(連載). 1, 有袋類の地理分布について) (J.)

1349 SETOGUCHI Takeshi (1987): [Evolution seen through fossils: Part 2. Fossil hunter's trip to South America]. *Life Sci.*, (7):66-70. (化石をとおして見た進化論(連載). 2, 南米への化石さがしの旅) (J.)

1350 SETOGUCHI Takeshi (1987): [Evolution seen through fossils: Part 3. Reappraisal of "Molecular clock"]. *Life Sci.*, (8):68-71. (化石をとおして見た進化論(連載). 3, 「分子時計説」再考) (J.)

1351 SETOGUCHI Takeshi (1988): [Reappraisal of evolution of social organization of Primates based on the nocturnal status of Aotus]. *Kikan Jinruigaku*, 19:83-114. (ヨザルがはらむ霊長類社会進化論への問題点) (J.)

1352 SETOGUCHI Takeshi (1989): [Translation of "Dinosaur Heresies" into Japanese]. Heibonsha, Tokyo, 1-328. (「恐竜異説」)

1353 SETOGUCHI Takeshi and ROSENBERGER Alfred L. (1987): A fossil owl monkey from La Venta, Colombia. *Nature*, 326:692-694.

1354 SETOGUCHI Takeshi and ROSENBERGER Alfred L. (1988): A fossil owl monkey from La Venta, Colombia. *Overseas Res. Rep., New World Monkeys, Kyoto Univ.*, 6:1-6.

1355 SETOGUCHI Takeshi, SHIGEHARA Nobuo, ROSENBERGER Alfred L. and CADENA Alberto (1986): Primate fauna from the Miocene La Venta, in the Tatacoa Desert, Department of Huila, Colombia. *Caldasia*, 15(71/75):761-773.

1356 SETOGUCHI Takeshi, TAKAI Masanaru and SHIGEHARA Nobuo (1990): A new ceboid primate, closely related to *Neosaimiri*, found in the Upper Red Bed in the La Venta Badlands, Middle Miocene of Colombia, South America. *Overseas Res. Rep., New World Monkeys, Kyoto Univ.*, 7:9-13.

1357 SETOGUCHI Takeshi, VILLARROEL Carlos, SHIGEHARA Nobuo, TAKAI Masanaru and ROSENBERGER Alfred L. (1988): New specimen of *Cebupithecia* from La Venta, Miocene of Colombia, South America. *Overseas Res. Rep., New World Monkeys, Kyoto Univ.*, 6:7-9.

1358 **SHIBATA Hiroshi** (1986): Development of the late Cenoznoic pteropod fauna in central Japan. *Spec. Pap., Palaenotol. Soc. Japan*, (29):119-126, figs. 1-3.

1359 SHIBATA Hiroshi, ISHIGAKI Takehisa and UJIHARA Atsushi (1986): Pteropods from the late Neogene Nishiyatsushiro and Shizukawa Groups of Shimobe, Yamanashi Prefecture, Japan. *Bull. Mizunami Fossil Mus.*, (13):39-55, pls. 7-8.

1360 SHIBATA Hiroshi and KATO Susumu (1988): Miocene molluscs from the Oga Formation of Shimada City, Shizuoka Prefecture, Japan. *Bull. Mizunami Fossil Mus.*, (15):7-38. pls. 2-3, figs. 1-2, tab. 1.

1361 SHIBATA Hiroshi, TAGUCHI Eiji and UJIHARA Atsushi (1989): Pteropods from the Miocene of Chugoku, Japan. *Bull. Mizunami Fossil Mus.*, (16):29-42, pl. 4, figs. 1-2, tab. 1.

1362 SHIBATA Hiroshi and UJIHARA Atsushi (1990): Cenozoic pteropod faunas of Japan. *Monogr. Mizunami Fossil Mus.*, (7):61-82, figs. 1-9, tabs. 1-3. (日本の新生代翼足類相) (J.E.)

1363 SHIDA Chiharu, KAMEO Koji and TAKAYAMA Toshiaki (1989): Lateral and vertical distributions of calcareous nannofossils in the Omma Formation. Prof. H. Matsuo Mem. Vol., Matsuyama, 25-41, figs. 1-11, tab. 1. (大桑層における石灰質ナンノ化石の水平・垂直分布) (J.E.)

1364 SHIGETA Yasunari (1989): Systematics of the ammonite genus *Tetragonites* from the Upper Cretaceous of Hokkaido. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (156):319-342, figs. 1-13, tabs. 1-3.

1365 SHIMAKURA Misaburo and FUJI Norio (1988): Manufactured woods from Mawaki archaeological site, Noto Peninsula, central Japan. *Bull. Japan Sea Res. Inst., Kanazawa Univ.*, (20):1-32, pls. 2, figs. 1-9, tabs. 1-14. (能登半島真脇遺跡からの加工木の包含層と樹種) (J.E.)

1366 SHIMAMOTO Masanori (1986): Shell microstructure of the Veneridae (Bivalvia) and its phylogenetic implications. *Sci. Rep., Tohoku Univ., 2nd Ser.*, 56 (1):1-39, pls. 1-20, figs. 1-48.

1367 SHIMAMOTO Masanori (1988): Shell microstructure in some genera of the Veneridae (Bivalvia) -Coexistence of different shell microstructure types within a single shell layer-. *Saito Ho-on Kai, Spec. Pub.* (*Prof. T. Kotaka Commem. Vol.*), 239-245, pls. 1-5, figs. 1-5.

1368 SHIMAMOTO Masanori and KOIKE Tsukasa (1986): The molluscan assemblage from the Tentokuji Formation, southwest of Mt. Taihei, Akita Prefecture. *Saito Ho-on Kai Mus., Nat. Hist., Res. Bull.*, (54):27-48, pls. 4-6, figs. 1-3, tabs. 1-2.

1369 SHIMIZU Ichiko (1988): Ductile deformation in the low-grade part of the Sanbagawa metamorphic Belt in the northern Kanto Mountains, central Japan. *Jour. Geol. Soc. Japan*, 94(8):609-628, pls. 1-2, figs. 1-14, tabs. 1-3.

1370 SHIMOYAMA Shoichi (1989): Primary information and modification of fossil shell assemblages. *Benthos Res.*, (37):11-34, figs. 1-13, tabs. 1-4. (化石貝殻集団の初期情報と再構成) (J.E.)

1371 SHIMOYAMA Shoichi and HAMANO Tatsuo (1990): The effect of oxygen-deficient water for the molluscan thanatocoenosis in Hakata Bay. In E. Robba (ed.): Proceedings of the fourth symposium on ecology and paleoecology of benthic communities. Sorrento 1-5, Nov. 1988. Meusio Regionale di Scienze Natural di Trino, Italy, 753-772, figs. 1-9, tabs. 1-4.

1372 SHIMOYAMA Shoichi, SATO Yoshio and NOI Hideaki (1986): Holocene deposits and fossil molluscan assemblages from Itoshima lowland in the Itoshima coastal plain, Kyushu. *Sci. Rep., Dept. Geol., Kyushu Univ.*, 14(4):143-162, pl. 1, figs. 1-8, tabs. 1-3. (糸島低地帯の完新統および貝化石集団) (J.E.)

1373 SHINOMIYA Akihiko, HATTORI Mutsuo, HAYASAKA Shozo, TANABE Kazushige, OKI Kimihiko and SUZUKI Hiroshi (1988): Underwater still camera works in the habitat of *Nautilus* off the east coast of Viti Levu, Fiji. *Occas. Pap., Kagoshima Univ. Res. Cent., South Pac.*, (15):24-47, pls. 1-8, figs. 1-2, tabs. 1-3, appends. 1-8.

1374 **SHIOYA Fujihiko** and UJIIE Hiroshi (1987): [Uniboom survey in the "Sekisei-sho" region, Yaeyama-gunto]. *Earth Month.*, 9(3):147-151. (八重山群島・石西礁地域におけるユニブーム探査) (J.)

1375 **SHIRAISHI Tateo**, USUDA Masaro, MATOBA Yasumochi and OKAMOTO Kin'ichi (1989): [Akita area]. In Editorial Committee for Geology of Japan, "Tohoku district" (ed.): Tohoku district. Kyoritsu Shuppan, Tokyo, 163-169, figs. 1-3, tab. 1. (秋田地域) (J.)

1376 **SHIROJI Kotohiro** and MATOBA Yasumochi (1988): [Stratigraphic relationship between the Daijiman and Nishikurosawan strata in the Omori-machi area, Akita Prefecture]. *Jour. Japan. Assoc. Petrol. Tech.*, 53(4):298. (秋田県大森町地域における台島・西黒沢期の地層 の層位関係) (J.)

1377 **SHUTO Tsugio** (1986): Origin and development of the Kakegawa Fauna. *Spec. Pap., Palaeont. Soc. Japan*, (29):200-210, figs. 1-6, tabs. 1-4.

1378 SHUTO Tsugio (1989): *Gemmuloborsonia*, a new genus of the family Turridae (Gastropoda) from the Plio-Pleistocene Cabatuan Formation, northwest Luzon. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (153):48-54, figs. 1-3.

1379 **SOEMODIHARDJO Subagjo** and MATSUKUMA Akira (1989): Ecology of sandy beach bivalves of Pari Island off the coast of Jakarta Bay, Indonesia. *Bull. Natn. Sci. Mus., Tokyo, Ser. A*, 15(4):197-212, figs. 1-6.

1380 **STANLEY Steven M.** (1986): Population size, extinction, and speciation: The fisson effect in Neogene Bivalvia. *Paleobiology*, 12(1):89-110, figs. 1-10, tabs. 1-2.

1381 **STOCKEY Ruth A.**, NISHIDA Makoto and NISHIDA Harufumi (1990): Structure and diversity of the woody conifer seedling-like structures from the Upper Cretaceous of Hokkaido, Japan. *Bot. Gazette*, 151:252-262.

1382 **SUEKANE Tetsuro** and KADOTA Masahito (1986): Miocene limestone in southern Fossa Magna region, central Japan. *Mem. Inst., Field Educ., Yokohama Natn. Univ.*, (4):41-48, pls. 1-4, figs. 1-6, tabs. 1-6. (南部フォッサ・マグナ地域の中新世石灰岩) (J.)

1383 **SUGANO Kozo** (1986): On the redeposition of radiolarian fossil. *NOM, Spec. Vol.*, (7):131-137. (放散虫化石の再堆積の問題について) (J.E.)

1384 SUGANO Kozo (1987): Diatom flora of the Osaka Group at the Toyonaka Campus of Osaka University, Machikaneyama hills, Osaka Prefecture -Studies on the fossil diatom of the Osaka Group (Part 4)-. *Mem. Osaka Kyoiku Univ., Ser. 3*, 36(2):135-145. (大阪大学豊中キャンパスに分布する大阪層群の珪藻化石群集－大阪層群の珪藻化石の研究 その４－) (J.E.)

1385 SUGANO Kozo, NAKASEKO Kojiro and YAMAUCHI Moriyoshi (1986): On the bio-stratigraphic study in the well named "Minato-B", western Osaka plain. *Mem. Osaka Kyoiku Univ., Ser. 3*, 35(1):75-87. (大阪西部で掘削されたボーリング "港－B" における生層序学的研究) (J.E.)

1386 SUGANO Kozo, NISHIMURA Akiko, YAMAUCHI Moriyoshi and NAGATA Kyoichi (1989): Establishment of time axis at the geologic age and fossil radiolarians. Prof. K. Nakaseko Mem. Vol., Osaka, 47-60. (地質時代における時間軸の設定と放散虫化石) (J.)

1387 **SUGIMOTO Mikihiro** (1988): Geological structure in the northern part of the steep dip belt of the western margin of Mt. Iozen -Geological studies of the Nanamagari Formation, Neogene Tertiary, in Hokuriku, central Japan (8).

Bull. Fac. Educ., Kanazawa Univ., Nat. Sci., (37):37-58, pls. 1-4. (医王山西縁急斜帯北部の地質構造－北陸新第三系七曲層の研究(8)) (J.E.)

1388 SUGIMURA Akihiro (1987): Carboniferous bryozoans from the Izuto Limestone, Yamaguchi Prefecture, southwest Japan. *Bull. Akiyoshi-dai Mus., Nat. Hist.*, (22):43-63, pls. 6-12, figs. 1-2, tabs. 1-5.

1389 SUGIMURA Akihiro, FUJII Atsushi, HASHIMOTO Kyoichi, NAGAI Koichi, SUGIYAMA Tetsuo, KIDO Satoru and OKAMOTO Kazuo (1990): Lithologic and solutional features of the Itabashi Limestone found in the Miocene Bihoku Group in Shobara City, Hiroshima Prefecture. *Bull. Mizunami Fossil Mus.*, (17):51-59, pls. 12-13, figs. 1-6. (広島県庄原市の中新世備北層群中の"板橋石灰岩"とその溶食地形) (J.E.)

1390 SUGIMURA Akihiro and SUGIYAMA Tetsuo (1990): Carboniferous bryozoans from the "Chichi-iwa" in Yamaguchi City, southwest Japan. *Bull. Akiyoshi-dai Mus., Nat. Hist.*, (25):27-37, pls. 6-8, figs. 1-2, tabs. 1-2.

1391 SUGIYAMA Tetsuo (1989): Paleontological and biostratigraphical studies on *Heterocorallia* from the Akiyoshi Limestone, southwest Japan. 11^{e} Congres International de Stratigraphie et de Geologie du Carbonifere, Beijing 1987, Compte Rendu, Beijing, 2:344-354, figs. 1-4, tabs. 1-2.

1392 SUGIYAMA Tetsuo, MATSUURA Hirohisa and ISHIBASHI Kiyoshi (1990): Some Carboniferous corals and basalts from the Hasumi Formation, along the middle course of the Gonokawa (River), central Chugoku district, southwest Japan. *Bull. Geol. Surv. Japan*, 41(12):665-667, pls. 1-3. (中国地方, 江の川中流域に分布する羽須美層群の石炭紀珊瑚化石と玄武岩) (J.E.)

1393 SUGIYAMA Tetsuo and NAGAI Koichi (1990): Growth forms of auloporidid corals in the Akiyoshi Limestone Group, southwest Japan. Paleoecological studies of reef-building organisms in the Akiyoshi Organic Reef Complex 1. *Bull. Akiyoshi-dai Mus., Nat. Hist.*, (25):7-25, pls. 3-5. (秋吉石灰岩層群産auloporidid coralsの成長形態について. 秋吉生物礁複合体における造礁生物群の古生態学的研究1) (J.E.)

1394 SUGIYAMA Tetsuo, SUGIMURA Akihiro and HASHIMOTO Kyoichi (1988): Notes on corals and bryozoans from the "Chichi-iwa" in Yamaguchi City, southwest Japan. *Sci. Rep., Fukuoka Univ.*, 18(2):159-168, pls. 1-3. (山口市"乳岩"産サンゴ・こけ虫化石について) (J.E.)

1395 SUGIYAMA Yuichi, SANGAWA Akira, SHIMOKAWA Koichi and MIZUNO Kiyohide (1988): Geology of the Omaezaki district, with geological sheet map at 1:50,000. Geol. Survey Japan, Tsukuba, 1-53. (地域地質研究報告5万分の1地質図幅「御前崎地域の地質」) (J.E.)

1396 SUNOUCHI Ikuo and MAEDA Haruyoshi (1986): Two Triassic ammonites from the Kagoguchi-Owada area, easterly adjacent to the Sakawa basin, Kochi, southwest Japan. *Res. Rep., Kochi Univ., Nat. Sci.*, 35:71-79, pl. 1, fig. 1, tab. 1. (佐川盆地東縁の鹿児口・大和田地域からえられた三畳紀中・後期アンモナイト) (J.E.)

1397 SUYARI Kazumi (1986): Radiolarian assemblages from the Torinosu Group and the cherts of the north subbelt of Shimanto Belt. *NOM, Spec. Vol.*, (7): 245-254, pls, 1-4, figs. 1-2, tabs. 1-2. (鳥巣層群の放散虫群集と四万十帯古期放散虫群集) (J.E.)

1398 SUYARI Kazumi (1986): Restudy of the northern Shimanto subbelt in eastern Shikoku. *Jour. Sci., Coll. Gen. Educ., Univ. Tokushima*, 19:45-54, pls. 1-

21, fig. 1, tab. 1. (四国東部の四万十帯北帯の再検討) (J.E.)

1399 SUYARI Kazumi and KUWANO Yukio (1986): Radiolarian age of the Torinosu Group, Shikoku, Japan. Part 2. *Jour. Sci., Coll. Gen. Educ., Univ. Tokushima*, 19:37-43, pls. 1-5, figs. 1-2, tabs. 1-2. (鳥巣層群の放散虫年代 その2) (J.E.)

1400 SUYARI Kazumi, KUWANO Yukio and YAMASAKI Tetsuji (1989): Distribution of lithofacies and geological ages in the Shimanto south subbelt in eastern Shikoku. *Jour. Sci., Coll. Gen. Educ., Univ. Tokushima*, 22:33-57, pls. 1-8, figs. 1-2, tabs. 1-2. (四国東部の四万十帯南帯の岩相と年代) (J.E.)

1401 SUYARI Kazumi and YAMASAKI Tetsuji (1987): Boundary between the north and south Shimanto subbelts in Tokushima Prefecture -The Aki Tectonic Line reconsidered. *Jour. Sci., Coll. Gen. Educ., Univ. Tokushima*, 20:37-46, pls. 1-9. (徳島県四万十帯北帯と南帯の境界－安芸構造線の再検討) (J.E.)

1402 SUYARI Kazumi and YAMASAKI Tetsuji (1988): Microfossil age of the northern margin of the Shimanto south subbelt in Shikoku. *Jour. Sci., Coll. Gen. Educ., Univ. Tokushima*, 21:107-133, pls. 1-8, figs. 1-3, tab. 1. (四国の四万十帯南帯北縁部の微化石年代) (J.E.)

1403 **SUZUKI Akihiko** (1989): Molluscan fauna from the Setana Formation in the Kuromatsunai district, southwestern Hokkaido, Japan. *Earth Sci.*, 43(5): 277-289, figs. 1-8, tabs. 1-4. (西南北海道黒松内地域の瀬棚層の貝類化石群) (J.E.)

1404 SUZUKI Akihiko (1989): [Fossil chitons from the Setana Formation in southwestern Hokkaido]. *Ezohelix*, (1):23-28, figs. 1-3. (西南北海道瀬棚層からのヒザラガイ化石) (J.)

1405 SUZUKI Akihiko (1990): [Fossil molluscan faunas in Hokkaido -An example of the Setana molluscan fauna-]. *Hokkaido no Shizen to Seibutsu*, (3):29-33, figs. 1-4. (北海道の貝類化石群－瀬棚動物群を例として－) (J.)

1406 **SUZUKI Hideaki** (1987): Stratigraphy of the Miyazaki Group in the southeastern part of Miyazaki Prefecture, Kyushu, Japan. *Contr. Inst. Geol. Paleont., Tohoku Uinv.*, (90):1-24, pl. 1, figs. 1-12, tabs. 1-2. (宮崎層群の層位学的研究) (J.E.)

1407 **SUZUKI Hiroshi** and HAYASAKA Shozo (1987): Studies on *Nautilus* and its associated fauna in Palau and Yap, South Pacific Ocean. *Prom. Rep., 5th Sci. Surv., South Pacific, Kagoshima Univ. Res. Cent., South Pacific*, 24-33, figs. 1-4, tabs 1-5.

1408 **SUZUKI Keiji** (1987): The Pliocene-Pleistocene Series around the Aizu basin northeast Honshu, Japan, with special reference to geohistorical changes of paleovegetation. *Quat. Res., Japan*, 26(2):163-168, tab. 1. (会津盆地周辺の鮮新－更新統と古植生の時代的変遷) (J.)

1409 SUZUKI Keiji (1989): On the plant biostratigraphy of the Middle to Lower Miocene strata in the southern part of northeast Honshu Arc, Japan. *Mem. Geol. Soc. Japan*, (32):197-205, fig. 1, tab. 1. (東北本州弧南部における中～下部中新統の植物化石層位について) (J.E.)

1410 SUZUKI Keiji, HASEGAWA Yoshikazu, OGASAWARA Kenshiro, YOMOGIDA Hiroshi, HIKICHI Katsumasa, TANIGUCHI Satoru, MAKUTA Kazuyoshi, FUJITA Takashi, KAWAMURA Tomoyoshi, YAMAKI Zenbei, KUMASAKA Hiroko and KATO Yoshiaki (1986): New skeleton of *Paleoparadoxia* with stratigraphical and sedimentary environmental remarks in Yanagawa-town, Date-gun, Fukushima Prefecture, Japan. Essey of Geology (Prof. N. Kitamura Commem. Vol.), Sendai,

453-464, pl. 1, figs. 1-4, tab. 1. (福島県伊達郡梁川町産*Paleoparadoxia*の層準と産状) (J.E.)

1411 SUZUKI Keiji and NASU Takayoshi (1988): Plant biostratigraphy of the Plio-Pleistocene Series in Japan. *Mem. Geol. Soc. Japan*, (30):169-180, fig. 1, tabs. 1-2. (日本の鮮新－更新統の植物化石による分帯) (J.E.)

1412 SUZUKI Keiji, SOHMA Kankichi and KOUCHI Osamu (1989): The Pleistocene terrace deposits and the plant fossil assemblages in the western margin of the Aizu basin, Fukushima Prefecture, Japan. *Sci. Rep., Fac. Educ., Fukushima Univ.*, (44):23-30, pl. 1, figs. 1-3, tabs. 1-2. (会津盆地西縁地域の更新世段丘構成層と植物化石群集) (J.E.)

1413 SUZUKI Keiji, SOHMA Kankichi and NIREI Yoshimasa (1989): The Fukazawa Formation and plant fossil assemblages in the eastern margin of the Aizu Basin, northeastern Japan. *Sci. Rep., Fac. Educ., Fukushima Univ.*, (44):13-20, pl. 1, figs. 1-4. (会津盆地東縁の深沢層と植物化石群集) (J.E.)

1414 SUZUKI Keiji, SOHMA Kankichi and NONAKA Toshio (1990): Stratigraphy and paleobotany of the Pleistocene Todera Formation and upper part of Nanaorezaka Formation, the western margin of Aizu basin, northeast Honshu, Japan. *Sci. Rep., Fac. Educ., Fukushima Univ.*, (45):1-49, pls. 1-10, figs. 1-11, tabs. 1-4. (会津盆地西縁地域における更新世塔寺層，七折坂層上部の層位学的・古植物学的研究) (J.E.)

1415 SUZUKI Keiji and TAKEUTI Sadako (1989): Middle-Late Pleistocene Flora in northeast Honshu, Japan. *Quat. Res., Japan*, 28(4):303-316, figs. 1-7, tabs. 1-2. (中－後期更新世における古植物相) (J.E.)

1416 SUZUKI Keiji and WAKO Ryo (1987): On the stratigraphy and geologic structure of the Neogene in the area on the north of Fukushima basin, northeast Honshu, Japan. *Sci Rep., Fac. Educ., Fukushima Univ.*, (49):33-48. (福島盆地北縁地域の新第三系の層位と構造) (J.E.)

1417 SUZUKI Mitsuo and HIRAYA Chiharu (1989): A note on the fossil wood flora in the Miocene of Japan. Prof. H. Matsuo Mem. Vol., Matsuyama, 15-24, fig. 1, tabs. 1-3. (日本の第三紀中新世の材化石フローラについて) (J.E.)

1418 SUZUKI Mitsuo and HIRAYA Chiharu (1989): Fossil wood flora from the pumice tuff of the Yanagida Formation (Lower Miocene) at Mawaki, Noto Peninsula. *Ann. Sci., Coll. Lib. Arts, Kanazawa Univ.*, 26:47-75, pls. 1-7, fig. 1, tabs. 1-2. (能登半島能都町真脇の柳田累層（下部中新統）の木材化石群集) (J.E.)

1419 SUZUKI Mitsuo and NOSHIRO Shuichi (1989): Forest reconstruction from fossil wood assemblages in prehistory. *Quat. Res., Japan*, 27(4):313-329, pl. 1, figs. 1-7, tab. 1.

1420 SUZUKI Seiichi and TOGO Yoshihiro (1987): Application of the shell structure to the study on the molluscan phylogeny. *Jour. Foss. Res.*, 19(2):27-31, figs. 1-3. (殻体構造による軟体動物系統復元の方法) (J.)

1421 SUZUKI Seiichi and TOGO Yoshihiro (1987): Microstructure of the calcified opercula of some turbinid gastropods. *Earth Sci.*, 41(1):48-56, pls. 1-4, fis. 1-7. (腹足類（リュウテンサザエ科）の石灰化蓋の構築構造) (J.E.)

1422 SUZUKI Seiichi and TOGO Yoshihiro (1988): Calcite patches on the growing surface of the aragonitic operculum in *Batillus cornutus* (Archaeogastropoda). *Bull. Fukuoka Univ. Educ.*, 37(3):109-114, figs. 1-4.

1423 SUZUKI Seiichi and TOGO Yoshihiro (1988): Internal structure and mineralogy of the neritid opercula (Archaeogastropoda). *Earth Sci.*, 42(3):147-154,

pls. 1-3, figs. 1-4. (Neritidae 科腹足類における蓋の内部構造と鉱物) (J. E.)

1424 SUZUKI Seiichi, YAMADA Kiyoshi and TOGO Yoshihiro (1990): Strontian aragonite precipitated in the cavities of some molluscan shells from the Middle Miocene Masuda Group, Shimane Prefecture. *Jour. Geol. Soc. Japan*, 96(10): 873-876, figs. 1-5, tab. 1. (島根県の中部中新統益田層群産貝殻化石の内部を充填する高Srアラレ石) (J.)

1425 SUZUKI Shigeyuki (1987): Sedimentary and tectonic history of the eastern part of Maizuru Zone, southwest Japan. *Geol. Rep., Hiroshima Univ.*, (27):1-54. (舞鶴帯東部の堆積史と構造史) (J. E.)

1426 SUZUKI Shigeyuki, NISHIOKA Keizo, MITSUNO Chiharu, SUGITA Munemitsu and ISHIGA Hiroaki (1988): Ultra-Tamba Zone in the Seto area, Okayama Prefecture. *Jour. Geol. Soc. Japan*, 94(4):301-303, pl. 1, figs. 1-2, tab. 1. (岡山県瀬戸地域の超丹波帯) (J.)

1427 SUZUKI Uko (1989): Geology of Neogene basins in the eastern part of the Sea of Japan. *Mem. Geol. Soc. Japan*, (32):143-183. (日本海東部新第三系堆積盆地の地質) (J. E.)

T

1428 TABUKI Ryoichi (1986): Plio-Pleistocene Ostracoda from the Tsugaru basin, north Honshu, Japan. *Bull. Coll. Educ., Univ. Ryukyus*, (29):27-160, pls. 1-20, figs. 1-20, tab. 1.

1429 TABUKI Ryoichi and NOHARA Tomohide (1988): Preliminary study on the ecology of ostracods from the moat of a coral reef off Sesoko Island, Okinawa, Japan. In T. Hanai, N. Ikeya and K. Ishizaki (eds.): Evolutionary biology of Ostracoda -Proceedings of the 9th International Symposium on Ostracoda. Kodansha/Elsevier, Tokyo/Amsterdam, 429-437, pls. 1-2, figs. 1-3, tabs. 1-2.

1430 TABUKI Ryoichi and NOHARA Tomohide (1990): The Ostracoda of the Sekisei-sho area, Ryukyu Islands, Japan. In R. Whatley and C. Maybury (eds.): Ostracoda and gloval events -Proceedings of the 10th International Symposium on Ostracoda, Chapman and Hall, London, 365-377, pls. 1-2, figs. 1-2, tabs. 1-3.

1431 TADA Ryuji and IIJIMA Azuma (1986): Stratigraphy and geology of the Neogene Atsunai Group of the Atsunai and Urahoro areas in southeastern Hokkaido, northern Japan. *Jour. Geol. Soc. Japan*, 92(1):31-45, figs. 1-4, tabs. 1-2. (北海道南東部厚内－浦幌地域新第三系の地質と層序) (J. E.)

1432 TADA Ryuji, WATANABE Yoshio and IIJIMA Azuma (1986): Accumulation of laminated and bioturbated Neogene siliceous deposits in Ajigasawa and Goshogawara areas, Aomori Prefecture, northwest Japan. *Jour. Fac. Sci., Univ. Tokyo, Sec. 2*, 21(3):139-167, pl. 2, figs. 1-6, tabs. 1-5.

1433 Tado Collaborative Diatom Research Group (1988): Fossil diatoms and paleoenvironment of the Upper Age Group in Hokusei district, Mie Prefecture, Japan. *Bull. Mizunami Fossil Mus.*, (15):39-56, pls. 4-6, figs. 1-8, tab. 1. (三重県北勢地域の奄芸層群上部から産した珪藻化石と古環境) (J. E.)

1434 TAGA Miyori and FUJI Norio (1987): Palynological investigation of the Upper Neogene System in Nanao and Notojima areas, Noto Peninsula, central Japan-Palynological investigation of the Neogene System in the Hokuriku region,

central Japan (4)-. *Bull. Fac. Educ., Kanazawa Univ., Nat. Sci.*, (36):35-56, figs. 1-10, tab. 1. (能登七尾・能登島の新第三系の花粉学的研究－北陸新第三系の花粉学的研究(4)－) (J.E.)

1435 TAGUCHI Eiji (1990): A new species of *Vepricardium* (Bivalvia;Mollusca) from the Miocene Katsuta Group in Okayama Prefecture, southweat Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (160):609-617, figs. 1-7, tabs. 1-4.

1436 TAI Yoshiro (1988): Foraminiferal Sharp Line and its microbiostratigraphic significance. *Bull. Mukogawa Women's Univ. Educ.*, (35):87-103.

1437 TAJIKA Jun (1988): Stratigraphy and structure of the Upper Cretaceous Yubetsu Group, Tokoro Belt, eastern Hokkaido. *Jour. Geol. Soc. Japan*, 94 (11):817-836, figs. 1-11, tabs. 1-2. (北海道東部、常呂帯の上部白亜系湧別層群の層序と構造) (J.E.)

1438 TAJIKA Jun and IWATA Keiji (1990): Paleogene melange of the northern Hidaka Belt -Geology and radiolarian age of the Kamiokoppe Formation-. *Mem. Hokkaigakuen Univ.*, 66:35-55, pls. 1-3. (日高帯北部の古第三紀メランジェ－上興部層の地質と放散虫化石年代－) (J.E.)

1439 TAKADA Masaharu and ISOZAKI Yukio (1986): Occurrence of Jurassic radiolarians from the "Mikawa Group" in eastern Yamaguchi Prefecture. *Jour. Geol. Soc. Japan*, 92(6):447-450, figs. 1-4. (山口県東部"美川層群"からのジュラ紀放散虫化石の産出) (J.E.)

1440 TAKAGI Toshio (1986): On some *Dosinia* from the Pliocene and Pleistocene formations in Hokkaido, Japan. *Jour. Fac. Sci., Hokkaido Univ., Ser. 4*, 21(4):599-617, pls. 1-2, figs. 1-11, tabs. 1-2.

1441 TAKAGI Toshio (1990): Taxonomic and paleozoogeographic significance of Cenozoic hunch-back like venerids. Part 1. *Gigantocallista*, gen. nov. (Mollusca; Bivalvia), a new endemic venerid genus from the Pliocene Formation of Sendai City, Miyagi Prefecture, northeastern Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (159):541-553, figs. 1-7, tab. 1.

1442 TAKAHARA Hikaru and TAKEOKA Masaji (1986): Vegetational change since the last glacial maximum around the Hatchodaira moor, Kyoto, Japan. *Japan. Jour. Ecol.*, 36(2):105-116, figs. 1-4, tabs. 1-2. (京都市八丁平湿原周辺における最盛期以降の植生変遷) (J.E.)

1443 TAKAHASHI Akira and SUZUKI Mitsuo (1988): Two new fossil woods of *Acer* and a new combination of *Prumus* from the Tertiary of Japan. *Botan. Mag., Tokyo*, 101(1064):473-481, figs. 1-13, tab. 1.

1444 TAKAHASHI Hirokazu (1986): Characteristics of the molluscan assemblages in the Pliocene Kume Formation in the Hitachi-Ota area, Ibaraki Prefecture, central Japan. *Monogr. Mizunami Fossil Mus.*, (6):91-104, pls. 12-14, figs. 1-5, tabs. 1-2. (茨城県常陸太田地域の鮮新統久米層産貝化石群集) (J.E.)

1445 TAKAHASHI Jiro and OCHI Takanori (1989): On the geology of hills to the east of Niihama City, Ehime Prefecture. *Mem. Fac. Educ., Ehime Univ., Ser. 3*, 9:33-43, pls. 1-4, figs. 1-5. (愛媛県新居浜市東方の丘陵の地質) (J.E.)

1446 TAKAHASHI Jiro, YAMASAKI Tetsuji, YOKOTA Yoshinori, KAWANISHI Jun and INOUE Shuya (1990): Geology of the Iyo City-Futami Town area, Ehime Prefecture *Mem. Fac. Educ., Ehime Univ., Ser. 3*, 10:19-29, pl. 1, figs. 1-3, tab. 1. (愛媛県伊予市および伊予郡双海町付近の地質) (J.E.)

1447 **TAKAHASHI Keiichi** (1990): Proboscidean fossil from the Japan Sea. *Quat. Res., Japan*, 29(3):235-244, pls. 1-3, figs. 1-2, tabs. 1-2. (日本海産長鼻類化石) (J.E.)

1448 TAKAHASHI Keiichi (1990): The Naummann's elephant -Its history of studies and fruits. *Collect. & Breed.*, 52(1):19-22, figs. 1-4. (よみがえるナウマンゾウ) (J.)

1449 TAKAHASHI Keiichi and KOBAYASHI Iwao (1986): Re-examination of three elephant molars from the Pleistocene in Niigata Prefecture, central Japan. *Earth Sci.*, 40(1):39-46, pls. 1-2, figs. 1-4, tab. 1. (新潟県、第四系産長鼻類化石3標本の再検討) (J.E.)

1450 TAKAHASHI Keiichi, NOMURA Masahiro and KOBAYASHI Iwao (1989): A fossil cetacean skull (*Barardius* sp. indet.) from Dogama, Ogi-machi, Sado Island, central Japan. *Earth Sci.*, 43:102-105, figs. 1-3, tab. 1. (佐渡島小木堂釜産鯨類 (ツチクジラ属) 頭骨化石の1標本) (J.)

1451 **TAKAHASHI Kiyoshi** (1986): Stratigraphic significance of triprojectate, oculata and *Callistopollenites* pollen groups in the Late Upper Cretaceous and early Palaeogene. Proceedings of the Symposium on Mesozoic and Cenozoic Geology in connection of the 60th anniversary of the Geological Society of China, 131-136, tabs. 1-3.

1452 TAKAHASHI Kiyoshi (1987): Pollen-spore assemblages from the submarine boring well (Tsu-Ko-1) in the Korea Strait. *Bull. Fac. Lib. Arts, Nagasaki Univ., Nat. Sci.*, 28(1):11-33, pls. 1-6, fig. 1, tab. 1. (朝鮮海峡海底ボーリング(Tsu-Ko-1)試料から得られた花粉・胞子群集) (J.)

1453 TAKAHASHI Kiyoshi (1988): Palynology of the Upper Cretaceous Futaba Group. *Bull. Fac. Lib. Arts, Nagasaki Univ, Nat. Sci.*, 28(2):67-183, pls. 1-19, figs. 1-2, tabs. 1-2.

1454 TAKAHASHI Kiyoshi (1988): Palynostratigraphic study of the coal-bearing formation in Iki Island. *Bull. Fac. Lib. Arts, Nagasaki Univ., Nat. Sci.*, 28(2):25-65, pls. 1-10, figs. 1-5, tabs. 1-5. (壱岐島夾炭層の花粉層位学的研究) (J.)

1455 TAKAHASHI Kiyoshi (1989): Two new *Lycopodium* -spores from the submarine borehole (Tsu-Ke-1) in the northwestern offing of the Goto Island. Prof. H.Matsuo Mem. Vol., Matsuyama, 1-4, pls. 1-2, figs. 1-2.

1456 TAKAHASHI Kiyoshi (1990): *Aquilapollenites* and Normapolles pollen groups -Their distribution and stratigraphic significance-. *Bull. Fac. Lib. Arts, Nagasaki Univ., Nat. Sci.*, 30(2):95-132, figs. 1-4, tabs. 1-8. (*Aquilapollenites* 花粉グループとNorma-polles花粉グループーその分布と層位学的意義ー) (J.E.)

1457 TAKAHASHI Kiyoshi and JUX Ulrich (1986): Sporomorphen aus demparalischen Oberoligozan der sudostlichen Niederrheinischen Bucht (West-Deutschland). *Bull. Fac. Lib. Art, Nagasaki Univ., Nat. Sci.*, 26(2):27-303, pls. 1-31, figs. 1-10, tabs. 1-4.

1458 TAKAHASHI Kiyoshi and JUX Ulrich (1989): Palynologic investigation of Late Eocene to early Oligocene lignites from Fayum Oasis, Egypt. *Bull. Fac. Lib. Arts, Nagasaki Univ., Nat. Sci.*, 29(2):369-463, pls. 1-14, figs. 1-4, tab. 1.

1459 TAKAHASHI Kiyoshi and JUX Ulrich (1989): Palynology of Middle Tertiary lacustrine deposits from the Jos Plateau, Nigeria. *Bull. Fac. Lib. Arts,*

Nagasaki Univ., Nat. Sci., 29(2):181-367, pls. 1-38, figs. 1-4, tabs. 1-2.

1460 TAKAHASHI Kiyoshi and SUGIYAMA Ryozo (1990): Palynomorphs from the Santonian Uge Member of the Taneichi Formation, northeast Japan. *Bull. Fac. Lib. Arts, Nagasaki Univ., Nat. Sci.*, 30(2):133-368, pls. 1-102, figs. 1-3, tabs. 1-3.

1461 TAKAHASHI Kiyoshi and SUGIYAMA Ryozo (1990): Supplemental description of *Pityosporites* from the Uge Member of the Taneichi Formation, northeast Japan. *Bull. Fac. Lib. Arts, Nagasaki Univ., Nat. Sci.*, 31(1):39-43, pl. 1.

1462 TAKAHASHI Kiyoshi and UEDA Yoshiro (1990): Palynostratigraphic investigation of the Akkeshi and Tokotan Formations of the Nemuro Group. *Bull. Fac. Lib. Arts, Nagasaki Univ., Nat Sci*, 31(1):13-37, pls. 1-2, figs. 1-6, tabs. 1-3. (根室層群厚岸層および床潭層の花粉層位学的考察) (J.)

1463 **TAKAHASHI Masaki**, NAGAHAMA Hiroyuki and TANAKA Yuichiro (1989): Age of the Lower part of Neogene sedimentary rocks in the Chichibu basin, as dated by calcareous nannofossils. *Fossils, Palaeont. Soc. Japan*, (46):1-9, figs. 1-6, tab. 1. (石灰質ナンノ化石からみた秩父盆地新第三系最下部の地質年代) (J.E.)

1464 **TAKAHASHI Masashi** and ONO Akira (1989): Determining on the age and hunting season by tooth cementum of Japanese serow from the Choja-iwaya site, Niigata Prefecture, central Japan. *Earth Sci.*, 43(3):172-175, pl. 1, figs. 1-2, tab. 1. (新潟県長者岩屋遺跡産ニホンカモシカの歯のセメント質による年齢および狩猟季節の推定) (J.)

1465 **TAKAHASHI Osamu**, HAYASHI Naoko and ISHII Atsushi (1989): Radiolarian fossils from the Masutomi Group, southwestern part of the Kanto Mountains, central Japan, and their significance. *Jour. Geol. Soc. Japan*, 95(12):953-955, figs. 1-2, tab. 1. (関東山地南西部増富層群から産出した放散虫化石とその意義) (J.)

1466 TAKAHASHI Osamu, IMAI Hideo and ISHII Atsushi (1989): Occurrence of Cretaceous radiolarians from the Otaki Group, Kanto Mountains, central Japan. *Jour. Geol. Soc. Japan*, 95(6):483-485, pl. 1, fig. 1. (関東山地大滝層群から白亜紀放散虫化石の産出) (J.)

1467 **TAKAHASHI Shizuo**, DOMNING Daryl P. and SAITO Tsunemasa (1986): A new ancestor of Steller's sea cow from the Upper Miocene of Yamagata Prefecture, northeastern Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (141):296-321, pls. 53-62, figs. 1-15, tabs. 1-12.

1468 **TAKAHASHI Yutaka** and KOIZUMI Itaru (1987): Diatom thanatocoenoses in Hamana-ko Bay. *Jour. Geol. Soc. Japan*, 93(6):419-429, pl. 1, figs, 1-10, tab. 1. (浜名湖の珪藻遺骸群集) (J.E.)

1469 **TAKAI Fuyuji** (1988): Evolution of Lemuroidea. *Collect. & Breed.*, 50(11):492-497, figs. 1-10, tab. 1. (レムール亜目の進化－化石種と現存種から－) (J.)

1470 **TAKAI Masanaru** and SETOGUCHI Takeshi (1990): Geology and localities of monkey fossils in the La Venta badlands, Colombia, South America. *Overseas Res. Rep., New World Monkeys, Kyoto Univ.*, 7:1-7.

1471 TAKAI Masanaru, SETOGUCHI Takeshi, VILLARROEL Carlos, SHIGEHARA Nobuo and ROSENBERGER Alfred L. (1988): Preliminary report of small mammal fossils from the La Venta Fauna, South America. *Overseas Res. Rep., New World Monkeys, Kyoto Univ.*, 6:11-14.

1472 **TAMAKI Michio**, ISOZAKI Yukio, NISHIMURA Yujiro and ITAYA Tetsumaru (1990): Geochronology of weakly metamorphased Jurassic acrretionary complex (the Kuga Group) in eastern Yamaguchi Prefecture, southwest Japan. *Jour. Geol. Soc. Japan*, 96(8):669-681, figs. 1-7, tabs. 1-2. (山口県東部の弱変成ジュラ紀付加コンプレックス（玖珂層群）の原岩形成年代と変成年代) (J.E.)

1473 **TAKATA Masaharu** and ISOZAKI Yukio (1986): Occurrence of Jurassic radiolarians from the "Mikawa Group" in eastern Yamaguchi Prefecture. *Jour. Geol. Soc. Japan*, 92(6):447-450, fig. 1. (山口県東部、美川層群からのジュラ紀放散虫化石の産出) (J.)

1474 **TAKAYAMA Toshiaki** (1987): Nannofossils as a geological clock. *Earth Month.*, 9(11):655-661, figs. 1-6, tabs. 1-2. (時計としてのナンノ化石) (J.)

1475 TAKAYAMA Toshiaki (1990): [Micropaleontological study of the Arabian sea deposits]. *Kaiyo Month.*, 22(6):343-347, figs. 1-3. (微化石から見たアラビア海の堆積物) (J.)

1476 TAKAYAMA Toshiaki, KATO Michio, KUDO Tetsuro, SATO Tokiyuki, KAMEO Koji (1988): Calcareous microfossil biostratigraphy of the uppermost Cenozoic formations distributed in the coast of the Japan Sea -Pt. 2: Hokuriku sedimentary basin. *Jour. Japan. Assoc. Petrol. Tech.*, 53(1):9-27. (日本海側に発達する最上部新生界の石灰質微化石層序 その２：北陸堆積盆地) (J.E.)

1477 TAKAYAMA Toshiaki and SATO Tokiyuki (1987): Coccolith biostratigraphy of the North Atlantic Ocean, Deep Sea Drilling Project Leg 94. *Initial Rep., DSDP*, 94(2):651-702, pls. 1-8, figs. 1-3, tabs. 1-28.

1478 **TAKAYANAGI Yokichi** (1986): Foraminiferology in Japan -Especially relative to Mesozoic and Cenozoic Foraminifera. *Mar. Sci. Month.*, 18(9):548-551. (日本における有孔虫学－特に中・新生代有孔虫について) (J.)

1479 TAKAYANAGI Yokichi (1986): Phylogenetic system of Planktonic Foraminifera. 1 -Origin of Planktonic Foraminifera. *Aquabiology*, 8(2):93-96, figs. 1-3, tab. 1. (浮遊性有孔虫の系統分類１．浮遊性有孔虫の起源) (J.)

1480 TAKAYANAGI Yokichi (1986): Phylogenetic system of Planktonic Foraminifera. 2 -Phylogenetic development of Planktonic Foraminifera during the Cretaceous period. *Aquabiology*, 8(3):177-181, figs. 4-10. (浮遊性有孔虫の系統分類２．白亜紀における浮遊性有孔虫の発展) (J.)

1481 TAKAYANAGI Yokichi (1986): Phylogenetic system of Planktonic Foraminifera. 3 -Extinction and evolution at the Cretaceous/Tertiary boundary. *Aquabiology*, 8(4):270-273, figs. 11-14. (浮遊性有孔虫の系統分類３．白亜紀／第三紀境界の事件) (J.)

1482 TAKAYANAGI Yokichi (1986): Phylogenetic system of Planktonic Foraminifera. 4 -Extinction and evolution at the Cretaceous/Tertiary boundary (2). *Aquabiology*, 8(5):369-373, figs. 15-19. (浮遊性有孔虫の系統分類４．白亜紀／第三紀境界の事件（続）) (J.)

1483 TAKAYANAGI Yokichi (1986): Phylogenetic system of Planktonic Foraminifera. 5 -Paleogene planktonic foraminiferal zonation. *Aquabiology*, 8(6):442-446, figs 20-22. (浮遊性有孔虫の系統分類５．古第三紀の浮遊性有孔虫化石帯) (J.)

1484 TAKAYANAGI Yokichi (1987): Plankton fossils and paleocean. In Palaeontological Society of Japan (ed.): Science of fossils. Asakura Shoten, Tokyo, 100-101, fig. 1. (プランクトン化石と古海洋) (J.)

1485 TAKAYANAGI Yokichi (1988): Paleoenvironmental analysis by means of microfossils -Problems in approaches-. *Jour. Japan Soc. Eng. Geol.*, 29(4):322-329, figs. 1-2, tabs. 1-3. (微化石による古環境解析－そのアプローチにおける問題－) (J.)

1486 TAKAYANAGI Yokichi (1989): A short history of foraminiferology in Japan, centering upon the Mesozoic and Cenozoic studies. In Y. Takayanagi and K. Ishizaki (eds.): Collected papers on Foraminifera from the Japanese Islands. Toko Print. Pub. Dept., Sendai, 155-174. (日本における有孔虫研究小史－特に中・新生代有孔虫について－) (J.)

1487 TAKAYANAGI Yokichi (1989): [Preface]. In Y. Takayanagi and K. Ishizaki (eds.): Collected papers on Foraminifera from the Japanese Islands, Toko Print. Pub. Dept., Sendai, 3-4. (はしがき) (J.)

1488 TAKAYANAGI Yokichi (1990): Bibliography of the literature on Foraminifera from Japan published during the years 1890 to 1989, including Japanese workers' contributions on materials collected from elsewhere in the world. *Sci. Rep., Tohoku Univ., 2nd Ser., Spec. Vol.*, (7):1-210, fig. 1, appends. 1-2.

1489 TAKAYANAGI Yokichi and HASEGAWA Shiro (1986): Pleistocene Benthic Foraminifera in Well Kashimaoki SK-1. In Y. Matoba and M. Kato (eds.): Studies on Cenozoic Benthic Foraminifera in Japan. Akita Univ., Akita, 95-104, pls. 1-2, figs. 1-2, tab. 1. (鹿島沖ボーリングの第四系底生有孔虫) (J.)

1490 TAKAYANAGI Yokichi and HASEGAWA Shiro (1987): Checklist and bibliography of post-Paleozoic Foraminifera established by Japanese workers, 1890-1986. Tohoku University, Sendai, 1-95.

1491 TAKAYANAGI Yokichi, MARUYAMA Toshiaki, HONDA Nobuyuki, SHIMAMURA Kiyoshi, FUNAYAMA Masaaki, HASEGAWA Yoshikazu and KODA Yoshiki (1988): [Stratigraphic horizon and geologic age of whale fossils from Yotsukura, Iwaki City, Fukushima Prefecture, northeast Japan]. Bull. Iwaki-shi Kyoiku Bunka Jigyodan, (1):23-55, pls. 1-5, figs. 1-8, tabs. 1-4. (いわき市四倉町産鯨類化石の産出層準と地質年代について) (J.)

1492 TAKAYANAGI Yokichi, SAITO Tsunemasa, OKADA Hakuyu, ISHIZAKI Kunihiro, ODA Motoyoshi, HASEGAWA Shiro, OKADA Hisatake and MANICKAM, S. (1987): Mid-Quaternary paleoceanographic trend in near-shore waters of the Northwest Pacific. *Sci. Rep., Tohoku Univ., 2nd Ser.*, 57(2):105-137, pls. 15-17, figs. 1-8, tabs. 1-3.

1493 TAKAYANAGI Yokichi, SUZUKI Keiji, ODA Motoyoshi and HASEGAWA Shiro (1986): [Fossil Foraminifera from Tsuchiyu-toge, Fukushima Prefecture]. *Bull. Geol. Soc. Japan, Tohoku Branch*, (16):13-14. (福島県土湯峠付近より産出した有孔虫化石について) (J.)

1494 **TAKAYASU Katsumi** (1986): Characteristics of the Miocene molluscan assemblages from central San-in district, southwest Honshu, Japan. *Monogr. Mizunami Fossil Mus.*, (6):155-169, figs. 1-6, tab. 1. (山陰地方中部の中新世貝化石群集特性) (J.E.)

1495 TAKAYASU Katsumi (1986): Molluscan fauna and its diversification of the Miocene Izumo Group, San-in district, southwest Japan. *Trans. Proc. Palaeont. Soc. Japan, Spec. Pap.*, (29):173-186, figs. 1-5.

1496 TAKAYASU Katsumi (1988): Predatory Gastropoda boreholes in some bivalves from the Miocene Fujina Formation, southwest Japan. *Saito Ho-on Kai, Spec. Pub. (Prof. T. Kotaka Commem. Vol.)*, (3):425-434, pl. 1, figs. 1-5, tab. 1.

1497 **TAKAYASU Taisuke** (supervision), OGASAWARA Kenshiro, MASUDA Koichiro and MATOBA Yasumochi (1986): Neogene and Quaternary molluscs from the Akita oil-field, Japan. Commem. Assoc. of Prof. T. Takayasu's Retirement/Supporters' Foundation of the Mineral Industry Museum, Mining College, Akita Univ., Akita, 1-310, pls. 1-85, figs. 1-45, tabs. 1-40. (秋田油田地域新第三系・第四系貝類図鑑) (J.)

1498 **TAKEDA Masatsune**, MIZUNO Yoshiaki and YAMAOKA Masatoshi (1986): Some fossil crustaceans from the Miocene Morozaki Group in the Chita Peninsula, central Japan. *Kaseki no Tomo*, (28):12-22, pls. 1-4, figs. 1-2. (師崎層群産の甲殻類化石) (J.)

1499 **TAKEMURA Atsushi** (1986): Classification of Jurassic Nassellarians (Radiolaria). *Palaeontogr., A*, 195:29-74, pls. 1-12, figs. 1-3.

1500 TAKEMURA Atsushi (1990): [Radiolarian biostratigraphy of Paleogene in the Antarctic Sea area]. *Kaiyo Month.*, 22(5):263-270. (南極海地域の古第三紀放散虫化石生層序) (J.)

1501 TAKEMURA Atsushi and NAKASEKO Kojiro (1986): The cephalic skeletal structure of Jurassic *"Eucyrtidium"* (Radiolaria). *Jour. Paleont.*, 60(5):1017-1024, figs. 1-5.

1502 **TAKESHITA Hiroyuki**, WATANABE Teruo and ISHIGA Hiroaki (1987): Discovery of Permian radiolarians and from the Tanoharagawa Formation (the Sangun metamorphic rocks), Gotsu, Shimane Prefecture, Japan. *Jour. Geol. Soc. Japan*, 93(6):435-438, figs. 1-4. (島根県江津市田ノ原川層(三郡変成岩)からのペルム紀放散虫の発見) (J.)

1503 **TAKETANI Yojiro**, AITA Yutaka, OKADA Hisatake, ODA Motoyoshi, HASEGAWA Shiro, MARUYAMA Toshiaki and NEMOTO Naoki (1986): [Microfossils from the Taga Group in Futaba area, Fukushima Prefecture, northeast Japan]. *Bull. Fukushima Pref. Mus.* (12):1-53, pls. 1-7, figs. 1-32. (福島県双葉地域の多賀層群より産する微化石調査報告) (J.)

1504 TAKETANI Yojiro, AITA Yutaka, ONO Toshio, OKADA Hisatake, ODA Motoyoshi, HASEGAWA Shiro, MARUYAMA Toshiaki, NEMOTO Naoki, KURIHARA Soichiro and TAKAYANAGI Yokichi (1990): [Geologic age and sedimentary environment of the Neogene strata distributed in Joban area, northeast Japan]. *Bull. Fukushima Pref. Mus.*, (20):1-99, pls. 1-14, figs. 1-6, tabs. 1-7, map. 1. (常磐地域に分布する新第三系の地質時代と堆積環境) (J.)

1505 **TAKEUTI Sadako** (1986): Pollen analysis of the lower terrace deposits in Sendai City, northeast Japan. In H. Nakagawa, T. Kotaka and Y. Takayanagi (eds.): Essays in Geology Prof. N. Kitamura Commem. Vol., Sendai, 517-526, figs. 1-3, tab. 1. (仙台付近の低位段丘堆積物の花粉分析) (J.E.)

1506 TAKEUTI Sadako and FUNAYAMA Keiko (1990): [Plant fossils surrounding the Sendai Castle site]. Nature of the Sendai Castle Site. The Board of Education of Sendai City, 37-42, pls. 1-3. (仙台城址およびその周辺地域の植物化石) (J.)

1507 TAKEUTI Sadako and OZAKI Hiroshi (1987): Pollen analysis of the Hanaizumi Formation, Iwate Prefecture, northeast Japan. *Saito Ho-on Kai Mus., Nat. Hist., Res. Bull.*, (55):13-20, figs. 1-4, tab. 1.

1508 TAKEUTI Sadako and SUZUKI Keiji (1987): Pollen analysis of the core-samples drilled at the Joko Station on the Ban-etsu Western Line. *Ann. Rep., Synthetic Stud., Fukushima Univ., Nat. Lake Inawashiro*, (4):87-89, fig. 1. (磐越西線上戸駅におけるボーリング試料の花粉分析) (J.)

1509 TAKEUTI Sadako and SUZUKI Keiji (1989): Middle-late Pleistocene flora in northeast Honshu, Japan. *Quat. Res., Japan*, 28(4):303-316, figs. 1-7, tabs. 1-2. (中－後期更新世における古植物相－東北地方を中心として－) (J.E.)

1510 **TAKEYAMA Ken-ichi** (1989): On the fossil deer from the Miocene Kunimi Formation of Fukui Prefecture, Japan. *Bull. Fukui Pref. Mus.*, (3):9-21, pls. 1-2, figs. 1-9. (福井県の中新統国見累層より産出したシカ類化石) (J.E.)

1511 **TALENT John A.**, BROCK Glenn A., ENGELBLETSEN Michael J., KATO Makoto, MORANTE Richard and TARENT Ross C. (1989): Himalayan Palaeontologic database polluted by recycling and other anomalies. *Jour. Geol. Soc. India*, 34:575-586, tabs. 1-3.

1512 TALENT John A., BROCK Glenn A., ENGELBLETSEN Michael J., MORANTE Richard, TALENT Ross C. and KATO Makoto (1990): Indian palaeontology under a cloud, Discussion. *Jour. Geol. Soc. India*, 35(6):657-660.

1513 **Tamba Belt Research Group** (1990): Paleozoic and Mesozoic Systems in the Tamba Belt (Part 7) -The Type I Suite in the southern part of Natasho Village, Onyu-gun, Fukui Prefecture-. *Earth Sci.*, 44(2):77-90, pls. 1-2, figs. 1-6. (丹波帯の中・古生界（その7）－福井県遠敷郡名田庄村南部地域に分布するI型地層群－) (J.E.)

1514 **TAMURA Minoru** (1990): Stratigraphic and palaeontologic studies on nonmarin Cretaceous bivalve faunas in southwest Japan. *Mem. Fac. Educ., Kumamoto Univ., Spec. Vol.*, (39):1-47, pls. 1-17, figs. 1-4, tabs. 1-4. (西南日本非海生白亜紀二枚貝フォーナの層位学的・古生物学的研究) (J.E.)

1515 TAMURA Minoru (1990): Unconformity between Mifune Group and underlying rocks. *Mem. Fac. Educ., Kumamoto Univ., Nat. Sci.*, (39):17-20, pl. 1, fig. 1. (御船層群基底の不整合について) (J.E.)

1516 TAMURA Minoru (1990): The distribution of Japanese Triassic bivalve faunas with special reference to parallel distribution of inner Arcto-Pacific fauna and outer Tethyan fauna in Upper Triassic. In K. Ichikawa, S. Mizutani, I. Hara, S. Hada and A. Yao (eds.): Pre-Cretaceous terranes of Japan. Publication of IGCP Project 224: Pre-Jurassic Evolution of Eastern Asia, Osaka, 347-359, pls. 1-2, figs. 1-4, tab. 1.

1517 TAMURA Minoru and HORIKAWA Haruki (1988): Jomon Transgression Formations in the Kumamoto plain. *Mem. Fac. Educ., Kumamoto Univ.*, (37):19-37, pls. 29-37. (熊本平野への縄紋海進の地層) (J.E.)

1518 TAMURA Minoru and MURAKAMI Koji (1986): Upper Jurassic Kurosaki Formation discovered at Kurosaki, Tanoura Town, Kumamoto Prefecture, Japan. *Mem. Fac. Educ., Kumamoto Univ.*, (35):47-55, pls. 1-2.

1519 TAMURA Minoru and MURAKAMI Koji (1987): Uminoura Formation (Lowest Cretaceous) in the area west of Uminoura. *Mem. Fac. Educ., Kumamoto Univ.*, (36):19-27, pls. 1-2, fig. 1. (海浦西方の海浦層（白亜紀最前期）) (J.E.)

1520 TAMURA Minoru and MURAKAMI Koji (1988): On clinounconformity under Carnian Tanoura Formation. *Mem. Fac. Educ., Kumamoto Univ.*, (37):11-17, pls. 1-2, fig. 1. (三畳紀田浦層基底の傾斜不整合について) (J.E.)

1521 TAMURA Minoru and NISHIDA Noriyuki (1989): Marine bivalves from Lower Cretaceous, Kawaguchi Formation. *Mem. Fac. Educ., Kumamoto Univ.*, (38):19-27, pl. 1, figs. 1-2.

1522 **TANABE Kazushige** (1987): Age and growth rate determinations of an intertidal bivalve, *Phacosoma japonicum*, using internal shell increments. *Lethaia*, 21(3):231-241, figs. 1-10, tab. 1.

1523 TANABE Kazushige (1988): An attempt for age determinaion of bivalves, using shell growth line. *Benthos Res.*, (32):12-17, figs. 1-5. (成長線を利用した二枚貝の年齢推定の試み) (J.E.)

1524 TANABE Kazushige (1989): Endocochliate embryo model in the Mesozoic Ammonitida. *Hist. Biol.*, 2:183-196, figs. 1-7, tabs. 1-2.

1525 TANABE Kazushige (1990): Early Jurassic macrofauna of the oxygen-depleted epicontinental marine basin in the Toyora area, west Japan. *Saito Ho-on Kai, Spec. Pub. (Prof. T. Kotaka Commem. Vol.)*, (3):1147-1161, pls. 1-2.

1526 TANABE Kazushige (1990): Early life history of two Middle Pleistocene species of *Limopsis* (Arcoida: Bivalvia). *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (160):631-640, figs. 1-4.

1527 TANABE Kazushige and ARIMURA Eiichi (1987): Ecology of four infaunal bivalve species in the Recent intertidal zone, Shikoku, Japan. *Palaeogeogr. Palaeoclimat. Palaeoecol.*, 60(3/4):219-230, figs. 1-10, tabs. 1-2.

1528 TANABE Kazushige, FUJIKI Tooru and KATSUTA Takashi (1986): Comparative analysis of living and death bivalve assemblages on the Kawarazu Shore, Ehime Prefecture, west Japan. *Benthos Res.*, (30):17-30, figs. 1-9, tabs. 1-2.

1529 TANABE Kazushige and FUKUDA Yoshio (1987): Mouth part histology and morphology. In W. B. Saunders and N. H. Landman (eds.): *Nautilus*, Plenum Press, New York. 313-322, figs. 1-6.

1530 TANABE Kazushige and FUKUDA Yoshio (1987): The jaw apparatus of the Cretaceous ammonite *Reesidites*. *Lethaia*, 20(1):41-48, figs. 1-5.

1531 TANABE Kazushige and OBA Tadamichi (1988): Latitudinal variation in shell growth patterns of *Phacosoma japonicum* (Bivalvia: Veneridae) from the Japanese coast. *Mar. Ecol., Progress Ser.*, 47:75-82, figs. 1-9, tab. 1.

1532 TANABE Kazushige and SHIGETA Yasunari (1987): Ontogenetic shell variation and streamlining of some Cretaceous ammonites. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (147):165-179, figs. 1-8, tabs. 1-2.

1533 TANABE Kazushige, SHINOMIYA Akihiko and FUKUDA Yoshio (1988): Notes on shell breakage in *Nautilus pompilius* in Fiji. In Marine ecological study on the habitat of *Nautilus pompilius* in Fiji (the second operation) (S. Hayasaka ed.). *Occas. Pap., Kagoshima Univ. Res. Cent., South Pac.*, (15): 24-47, pls. 14-16.

1534 TANABE Kazushige and TSUKAHARA Junzo (1968): [Morphological variation of *Nautilus*]. *Mar. Sci., Month.*, 18(10):649-654. (オウムガイの形態変異)

1535 TANABE Kazushige and TSUKAHARA Junzo (1987): Biometric analysis of *Nautilus pompilius* from the Philippines and the Fuji Islands. In W. B. Saunders and N. H. Landman (eds.): *Nautilus*, Plenum Press, New York. 105-113, figs. 1-7.

1536 TANABE Kazushige, TSUKAHARA Junzo and HAYASAKA Shozo (1990): Comparative morphology of living *Nautilus* (Cephalopoda) from the Philippines, Fiji and Palau. *Malacologia*, 31(2):297-312, figs. 1-12.

1537 TANABE Kazushige and ZUSHI Yoshiki (1988): Larval paleoecology of five bivalve species from the Upper Pliocene of southwest Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (150):491-500, figs. 1-3, tabs. 1-2.

1538 **TANAI Toshimasa** (1986): Phytogeographic and phylogenetic history of the genus *Nothofagus* Bl. (Fagaceae) in the northern Hemisphere. *Jour. Fac. Sci., Hokkaido Univ., Ser. 4*, 21(4):505-582, pls. 1-15, figs. 1-14, tabs. 1-3.

1539 TANAI Toshimasa (1986): Phylogeny of the genus *Acer* L. (Aceraceae). *Collect & Breed.*, 48(10):428-435, figs. 1-6, tabs. 1-2. (化石からみたカエデ属の系統) (J.)

1540 TANAI Toshimasa (1987): A bracket fungus from the Miocene, west of Kobe City, western Japan. *Jour. Japan. Bot.*, 62(1):1-6, pls 1-2, tab. 1.

1541 TANAI Toshimasa (1989): The revision of the so-called *"Alangium"* leaves from the Paleogene of Hokkaido, Japan. *Bull. Natn. Sci. Mus., Tokyo, Ser. C.*, 15(4):121-149, pls. 1-9, figs. 1-3, tabs. 1-2.

1542 TANAI Toshimasa (1990): Euphorbiaceae and Icacinaceae from the Paleogene of Hokkaido, Japan. *Bull. Natn. Sci. Mus., Tokyo, Ser. C.*, 16(3):91-118, pls. 1-6, figs. 1-2.

1543 TANAI Toshimasa (1990): Tertiary vegetational changes in East Asia. *Monogr. Mizunami Fossil Mus.*, (7):117-122, figs. 1-2. (東アジアの第三紀植生の変遷) (J.)

1544 TANAI Toshimasa and UEMURA Kazuhiko (1988): Daijima-type floras (Miocene) in southwestern Hokkaido and northern part of Honshu, Japan. *Mem. Natn. Sci. Mus., Tokyo*, (21):7-16, figs. 1-2, tabs. 1-3. (北海道西南部および本州北端部の台島型植物群 (中新世)) (J.E.)

1545 **TANAKA Hitoshi** (1989): Mesozoic formations and their molluscan faunas in the Haidateyama area, Oita Prefecture, southwest Japan. *Jour. Sci., Hiroshima Univ., Ser. C*, 9(1):1-45, pls. 1-5, figs. 1-21, tabs. 1-13.

1546 **TANAKA Masaaki** and MATSUOKA Keiji (1986): Pliocene freshwater diatoms from the Hino and Minakuchi areas in Shiga Prefecture, central Japan. *Bull. Mizunami Fossil Mus.*, (13):125-130, figs. 1-2, tab. 1. (滋賀県日野・水口地域の鮮新世淡水性珪藻化石) (J.)

1547 **TANAKA Takeshi** (1990): Fossil teeth of the great white shark, *Carcharodon carcharias* (Linnaeus) from the late Miocene Formation. *Chigaku Kenkyu*, 39(3):171-174, fig. 1, tab. 1. (中新世後期の地層から産出したホホジロザメの歯化石) (J.)

1548 **TANAKA Yoshinobu** and KOIZUMI Akihiro (1990): Molluscan fossils from the Shimosueyoshi Formation in Maginu, central part of Kawasaki. *Nat. Hist. Rep. Kanagawa, Kanagawa Pref. Mus.*, (11):45-48, figs. 1-3, tab. 1. (川崎市宮前区馬絹の下末吉層より産出した貝化石) (J.)

1549 **TANIMOTO Masahiro** and OKURA Masatoshi (1989): Plesiosauroid teeth from Daira-gawa, the Kuruma Group (Lower Jurassic), Toyama Prefecture, Japan: A preliminary report. *Bull. Hobetsu Mus.*, (5):27-32, pl. 1, fig. 1. (富山県朝日町大平川 (来馬層群) から発見されたプレシオサウルス上科の歯の化石 (予報)) (J.)

1550 **TANIMURA Yoshihiro** (1989): *Denticulopsis praehyalina*, sp. nov.: An early Middle Miocene pennate diatom from Dogo, Oki Islands, southwest Japan.

Trans. Proc. Palaeont. Soc. Japan, N. S., (155):169-177, figs. 1-4.

1551 TANIMURA Yoshihiro (1989): [Seasonal change in diatom flux: Sediment trap resurts from Japan Trench, JT-01]. *Kaiyo Month.*, 21(4):215-220. (日本海溝のセジメント・トラップＪＴ－０１試料中に見られる珪藻群集の季節変化) (J.)

1552 TANIMURA Yoshihiro, FUKUCHI Mitsuo, WATANABE Kentaro and MORIWAKI Kiichi (1990): Diatoms in water column and sea-ice in Lutzow-Holm Bay, Antarctica, and their preservation in the underlying sediments. *Bull. Natn. Sci. Mus., Tokyo, Ser. C*, 16(1):15-39, figs. 1-7, tab. 1.

1553 TANIMURA Yoshihiro and SAITO Yasuji (1986): Early Middle Miocene marine diatomite from Dogo, Oki Islands. *Mem. Natn. Sci. Mus., Tokyo*, (19):43-54, pl. 2, figs. 1-3. (隠岐島後の中期中新世初期海成珪藻土) (J.E.)

1554 **TARUNO Hiroyuki**, YOSIDA Shiro (1987): Discovery of a fossil molar *Stegodon akasiensis* (Takai) from the Tokai Group in Gifu Prefecture, Japan. *Bull. Osaka Mus., Nat. Hist.*, (41):1-5, pl. 1, Figs. 1-3. (岐阜県の東海層群よりアカシゾウの臼歯化石が産出) (J.E.)

1555 **TASHIRO Masayuki** (1986): Paleobiogeography and paleoecology of the Cretaceous System of southwest Japan. *Fossils, Palaeont. Soc. Japan*, (41):1-16, figs. 1-20. (西南日本白亜系の古地理と古環境) (J.E.)

1556 TASHIRO Masayuki (1987): Cretaceous *Eomiodon* and *Costocyrena* (Bivalvia) from southwest Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (147):91-108, figs. 1-7.

1557 TASHIRO Masayuki (1988): Cenomanian bivalve fauna of the Akaishi Mountains, central Japan. *Saito Ho-on Kai, Spec. Pub. (Prof. T. Kotaka Commem. Vol.)*, (3):285-295, pls. 1-2, figs. 1-3.

1558 TASHIRO Masayuki (1988): Notes on "*Trigonia dekeina* Kubota" from the Cretaceous of Hokkaido. *Mem. Fac. Sci., Kochi Univ., Ser. E, Geology*, 9:11-14, pl. 1, figs. 1-4.

1559 TASHIRO Masayuki (1990): Bivalve fauna from the Kesado Formation of Yatsushiro Mountains in Kyushu. *Mem. Fac. Sci., Kochi Univ., Ser. E, Geology*, 11:1-22, pls. 1-3, figs. 1-12, tabs. 1-2.

1560 TASHIRO Masayuki and KANO Manabu (1989): On a new species of *Yaadia* (Cretaceous trigonian) from Kyusyu, Japan. *Mem. Fac. Sci., Kochi Univ., Ser. E, Geology*, 10:7-12, pls. 1-3, figs. 1-4.

1561 TASHIRO Masayuki and KOZAI Takeshi (1986): Bivalve fossils from the type Monobegawa Group, Part 2. *Res. Rep., Kochi Univ., Nat. Sci.*, 35:23-54, pls. 1-10, figs. 1-3.

1562 TASHIRO Masayuki and KOZAI Takeshi (1988): Bivalve fossils from the type Monobegawa Group, Part 3. *Res. Rep., Kochi Univ., Nat. Sci.*, 37:33-64, pls. 1-4, figs. 1-9.

1563 TASHIRO Masayuki and KOZAI Takeshi (1989): Bivalve fossils from the type Monobegawa Group, Part 4. *Res. Rep., Kochi Univ., Nat. Sci.*, 38:113-144, pls. 1-5, figs. 1-12.

1564 TASHIRO Masayuki and MATSUDA Tomoko (1986): A study of the Pterotrigoninae from Japan (2) Morphological changes. *Mem. Fac. Sci., Kochi Univ., Ser. E, Geology*, 7:1-18, pl. 1, figs. 1-16.

1565 TASHIRO Masayuki and MATSUDA Tomoko (1986): Lower Cretaceous bivalves from the Sakawa area, Shikoku. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (142):366-392, pls. 74-77, figs. 1-6, tab. 1.

1566 TASHIRO Masayuki and MATSUDA Tomoko (1986): Notes on "*Trigonia sawatai* Yehara". *Mem. Fac. Sci., Kochi Univ., Ser. E, Geology*, 7:19-22, pl. 2, figs. 1-3.

1567 TASHIRO Masayuki and MATSUDA Tomoko (1988): Mode of life in Cretaceous trigonians. *Fossils, Palaeont. Soc. Japan*, (45):9-21, figs. 1-10, tab. 1. (白亜紀三角貝の生活様式) (J.E.)

1568 TASHIRO Masayuki and MATSUDA Tomoko (1990): Notes on "*Triogonia toyamai* Yehara". *Mem. Fac. Sci., Kochi Univ., Ser. E, Geology*, 11:35-39, figs. 1-3.

1569 TASHIRO Masayuki, TANIUCHI Yasuhiro, OKAMURA Makoto, YASUDA Hisato and MAEDA Haruyoshi (1986): Sedimentary environments of the lower part of the Himenoura Group, Amakusa-Kamishima, Kumamoto Prefecture, southwest Japan. *Res. Rep., Kochi Univ., Nat. Sci.*, 35:151-167, pls. 1-6, figs. 1-6. (天草・姫浦層群下部亜層群の堆積環境に関する研究) (J.E.)

1570 TASHIRO Masayuki, YANAGISAWA Hideki and KITAMURA Takeharu (1986): Discovery of the Ryoseki Fauna from Todai area, Akaishi Mountains. *Jour. Geol. Soc. Japan*, 92(10):757-759, pl. 1, figs. 1-3. (赤石山地戸台地域からの領石フォーナの発見) (J.)

1571 TAZAWA Jun-ichi (1987): *Attentuatella* (Brachiopoda) from the Upper Permian of northeast Japan and its bipolar distribution. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (148):276-284, figs. 1-3, tab. 1.

1572 TAZAWA Jun-ichi (1987): [Palaeobiogeographical study of Permian brachiopods fauna in Japan]. *Earth Month.*, 9(5):252-255, figs. 1-2, tab. 1. (日本のペルム紀腕足類フォーナの古生物地理的考察) (J.)

1573 TAZAWA Jun-ichi (1988): Palaeozoic-Mesozoic stratigraphy and tectonics of the Kitakami Mountains, northeast Japan. *Earth Sci.*, 42(4):165-178, figs. 1-5. (北上山地－中・古生層の層序と構造) (J.E.)

1574 TAZAWA Jun-ichi (1988): *Zdimir* (Devonian Brachiopoda) from the Kitakami Mountains, northeast Japan and its paleobiogeographical significance. *Jour. Geol. Soc. Japan*, 94(12):1013-1016, figs. 1-3. (北上山地産デボン紀腕足類 *Zdimir* とその古生物地理的意義) (J.)

1575 TAZAWA Jun-ichi (1989): [Brachiopoda from Onimaru]. Ofunato City Mus., Ofunato, 51-66, pl. 1. (腕足類－おにまるの化石) (J.)

1576 TAZAWA Jun-ichi (1989): Comparison between the Palaeozoic formations of the southern Kitakami Mountains, NE Japan and the Hida Marginal Belt, SW Japan: A preliminary note. *Earth Sci.*, 43(4):224-230, fig. 1. (南部北上山地と飛騨外縁帯の古生層の比較（予察) (J.E.)

1577 TAZAWA Jun-ichi and KANEKO Atsushi (1987): Discovery of a Devonian trilobite from the eastern part of the "Hayachine Tectonic Belt", Kitakami Mountains, northeast Japan. *Earth Sci.*, 41(1):65-68, figs. 1-3. (北上山地"早池峰構造帯" 東部よりデボン紀三葉虫化石の発見) (J.)

1578 TAZAWA Jun-ichi and KATO Makoto (1986): *Striatifera* and *Gigantoproductus* from the Lower Carboniferous of Fukuji, central Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (142):393-399, pl. 78, figs. 1-2.

1579 TAZAWA Jun-ichi and KURITA Hiroshi (1986): Brachiopods and correlation of the Lower Carboniferous Shittakazawa Formation, southern Kitakami Mountains, northeast Japan. *Jour. Geol. Soc. Japan*, 92(2):167-170, figs. 1-2. (南部北上山地下部石炭系尻高沢層の腕足類化石と対比) (J.)

1580 TAZAWA Jun-ichi and TAKAIZUMI Yukihiro (1987): *Poikilosakos* (Oldhamida, Brachiopoda) from the Permian of northeast Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (145):10-15, figs. 1-3.

1581 **TEICHERT Curt** and MATSUMOTO Tatsuro (1987): The ancestry of the genus *Nautilus*. In W. B. Saunders and N. H. Landman (eds.): *Nautilus*, Plenum Press, New York, 25-32, fig. 1.

1582 **TERAOKA Yoji** and KURIMOTO Chikao (1986): Cretaceous stratigraphy of the Shimanto terrane in the Uwajima area, west Shikoku, southwest Japan, with reference to the stratigraphic distribution of mega- and radiolarian fossils. *Bull. Geol. Surv. Japan*, 37:417-435, pls. 1-7, figs. 1-8, tabs. 1-7. (宇和島地域の四万十帯白亜系層序－大型化石と放散虫化石の層序的分布に関連して－) (J.E.)

1583 **TIDWELL William D.**, KIM Jong-Heon and KIMURA Tatsuaki (1987): Mid-Mesozoic leaves from near Ida Bay, southern Tasmania, Australia. *Pap. & Proc., Royal Soc. Tasmania*, 121:159-170, pls. 1-3.

1584 TIDWELL William D., NISHIDA Harufumi and WEBSTER Neri (1989): *Oguracaulis banksii* gen. et sp. nov.: A mid-Mesozoic tree-fern stem from Tasmania, Australia. *Pap. & Proc., Royal Soc. Tasmania*, 123:15-25, pls. 1-5, fig. 1.

1585 **TOGO Yoshihiro**, KUSAKA Hajime and SAGAYAMA Tsumoru (1990): [Setana Formation in western Hokkaido. Setana-Imakane, Pirika-Nakazato, Kunnui-Mori.]. In M. Kato, Y. Kitagawa and M. Matsui (eds.): Regional geology of Japan, Part 1. Hokkaido. Kyoritsu Shuppan Co., Ltd., Tokyo. 124-127. (西部北海道の瀬棚層. 瀬棚－今金地域, 美利河－中里地域, 国縫－森地域) (J.)

1586 TOGO Yoshihiro and SUZUKI Seiichi (1987): Non-skeletal aragonite precipitated within conglomerate and altered invertebrate skeletons from the Plio-Pleistocene Setana Formation, Hokkaido. *Jour. Geol. Soc. Japan*, 93 (2):149-151, pl. 1, figs. 1-2.

1587 TOGO Yoshihiro and SUZUKI Seiichi (1987): Fossilization of molluscan shells. Prof. M. Matsui Mem. Vol., Sapporo. 63-69, pls. 1-2, fig. 1. (軟体動物殻体の化石化) (J.)

1588 TOGO Yoshihiro and SUZUKI Seiichi (1988): Shell structure and phylogeny of the Gastropoda. In M. Omori, S. Suga and M. Goto (eds.): Biomineralization and phylogeny of marine organisms. Tokai Univ. Press, Shimizu. 113-134, figs. 1-28. (腹足類の殻体構造と系統発生) (J.)

1589 **TOKUHASHI Shuichi** and KONDO Yasuo (1989): Sedimentary cycles and environments in the middle-late Pleistocene Shimosa Group, Boso Peninsula, central Japan. *Jour. Geol. Soc. Japan*, 95:933-951, fig. 1-17. (下総層群の堆積サイクルと堆積環境に関する一考察) (J.E.)

1590 **TOKUOKA Takao**, TAKAYASU Katsumi, YOSHIDA Mitsuo and HISATOMI Kunihiro (1986): The Churia (Shiwalik) Group of the Arung Khola area, west central Nepal. *Mem. Fac. Sci., Shimane Univ.*, 20:135-210, pls. 1-9, figs. 1-20, appends. 1-3.

1591 TOKUOKA Takao, WATANABE Teruo, ISHIGA Hiroaki, LANDIS Charles A., PILLAI D., Dhana L., NISHIMURA Kouichi and CHOI Jung-yill (1987): Permian Maizuru Group and Yakuno ophiolitic rocks in the northeastern part of Yanahara

area in Okayama Prefecture, southwest Japan. *Mem. Fac. Sci., Shimane Univ.*, 21:189-205, pls. 1-3, figs. 1-8, tab. 1.

1592 **TOMIDA Susumu** (1989): Fossil molluscan assemblage from the Neogene Senhata Formation around Nokogiriyama, Boso Peninsula, Japan. *Bull. Mizunami Fossil Mus.*, (16):85-108, pls. 10-18, figs. 1-3, tabs. 1-3.

1593 TOMIDA Susumu (1989): Occurrence of fossil *Halicardia nipponensis* from the Neogene in the Tanzawa Mountainland, and its paleontological significance. *Venus, Japan. Jour. Malacol.*, 48(3):167-173, figs. 1-6, tab. 1.

1594 TOMIDA Susumu (1990): Occurrence of *Aturia formae* from Kokozura Formation in Kitaibaragi City, Ibaragi Pref., Japan. *Bull. Mizunami Fossil Mus.*, (17):97-103, pl. 1, figs. 1-2, tabs. 1-3.

1595 TOMIDA Susumu and ITOIGAWA Junji (1986): Occurrence of *Hartungia* sp. (Gastropoda: Janthinidae) from the Senhata conglomerate near Nokogiriyama of the Boso Peninsula, Chiba Pref., Japan. *Bull. Mizunami Fossil Mus.*, (13): 115-124, figs. 1-3, tabs. 1-2.

1596 TOMIDA Susumu and ITOIGAWA Junji (1989): Occurrence of *Hartungia* (Gastropoda: Janthinidae) from the Pliocene Hatsuzaki Group in Hitachi City, Ibaragi Pref., Japan. *Bull. Mizunami Fossil Mus.*, 16:125-129. pl. 1, fig. 1, tabs. 1-2.

1597 TOMIDA Susumu and KAMIYA Toshiaki (1990): New occurrence of fossil pleurotomariid gastropod from the Neogene Ochiai Formation. *Chigaku Kenkyu*, 39 (3):151-157, pl. 1, figs. 1-2, tab. 1. (新第三系落合礫岩からのオキナエビスガイ類化石の新産) (J.E.)

1598 **TOMIDA Yukimitsu** (1986): Recognition of the genus *Entelodon* (Artiodactyla, Mammalia) from the Joban Coalfield, Japan, and the age of the Iwaki Formation. *Bull. Natn. Sci. Mus., Tokyo, Ser. C*, 12(4):165-170.

1599 TOMIDA Yukimitsu (1986): Small mammal fossils and correlation of continental deposits, Safford and Duncan basins, Arizona. *Dissert. Abstr. Internat., B*, 46(12), pt. 1:4167-4168.

1600 TOMIDA Yukimitsu (1987): Small mammal fossils and correlation of continental deposits, Safford and Duncan basins, Arizona, USA. *Natn. Sci. Mus., Tokyo*, 10+141, figs. 1-24, tabs. 1-35.

1601 TOMIDA Yukimitsu (1989): A new walrus (Carnivora, Odobenidae) from the middle Pleistocene of the Boso Peninsura, Japan, and its implication on odobenid paleobiogeography. *Bull. Natn. Sci. Mus., Tokyo, Ser. C*, 15(3): 109-119, figs. 1-4.

1602 TOMIDA Yukimitsu (1990): [Classification and evolution of pinnipeds.] In N. Miyazaki and K. Kasuya (eds.): Biology of Marine Mammals, Tokyo. 189-205, figs. 1-4, tabs. 1-3. (鰭脚類の分類と進化) (J.)

1603 TOMIDA Yukimitsu (1990): [Where have the ear ossicles come from ?]. *Otolaryngol. Head & Neck Surg.*, 62(1):82-83, figs. 1-2. (耳小骨はどこから来たか) (J.)

1604 TOMIDA Yukimitsu, OTSUKA Hiroyuki, UYENO Teruya, SAKURA Hajime and BABA Hisao (1990): An outline of vertebrate paleontological and paleoanthropological survey in Tokunoshima and Amami-oshima Islands, southwestern Japan. *Mem. Natn. Sci. Mus. Tokyo*, (23):173-183, figs. 1-7. (徳之島・奄美大島における古脊椎動物学的・古人類学的調査の概要) (J.E.)

1605 TOMIDA Yukimitsu and SAKURA Hajime (1988): Catalogue of large mammal fossils pecimens. National Science Museum, Tokyo, 1-143.

1606 **TOMIKA Hajimu** and ISHIGAMI Tomoyoshi (1987): On an occurrence of fossil *Elaphurus* (Cervinae, Mammalia) from Tondabayashi City, Osaka Prefecture, Japan. *Earth Sci.*, 41(6):320-322, pl. 1, figs. 1-2, tab. 1. (大阪府富田林市よりシフゾウ (*Elaphurus*) 化石の産出) (J.)

1607 **TOMINAGA Ryozo** (1990): Tectonic development of the Chichibu Belt, southwest Japan. *Jour. Sci., Hiroshima Univ., Ser. C*, 9(2):377-413, pls. 1-5, figs. 28, tabs. 1-5.

1608 **TOMITA Suzuomi** and ISHIBASHI Takeshi (1990): Review of the geology and paleontology of the Paleogene coal-fields in north Kyushu. *Sci. Rep., Dept Geol., Kyushu Univ.*, 16(2):99-142, pls. 8-18, figs. 1-9, tabs. 1-3. (北部九州炭田古第三系の地質と化石 (概説)) (J.E.)

1609 **TOMIZAWA Akifumi** (1986): A boreholes correlation in the vicinity of Kashiwazaki, Niigata Prefecture. In Y. Matoba and M. Kato (eds.): Studies on Cenozoic Benthic Foraminifera in Japan. Akita Univ., Akita, 115-118. (新潟県柏崎周辺地域の坑井対比 (鮮新世以降)) (J.)

1610 **TOSHIMITSU Seiichi** (1986): A new inoceramid (Bivalvia) species from the Upper Cretaceous of Hokkaido. *Proc. Japan Acad., Ser. B*, 62(7):227-230.

1611 TOSHIMITSU Seiichi (1988): Biostratigraphy of the Upper Cretaceous Santonian Stage in northwestern Hokkaido. *Mem. Fac. Sci., Kyushu Univ., Ser. D*, 26(2):125-192, pls. 23-29.

1612 TOSHIMITSU Seiichi, KANO Manabu and TASHIRO Masayuki (1990): Oyster reefs from the Upper Himenoura Subgroup, Upper Cretaceous), Kyushu, Japan. *Fossils, Palaeont. Soc. Japan*, (49):1-12, figs. 1-8. (姫の浦層群上部亜層群の化石カキ礁) (J.E.)

1613 TOSHIMITSU Seiichi and MAIYA Seijuro (1986): Integrated inoceramid-foraminiferal biostratigraphy of the Upper Cretaceous of northwestern Hokkaido, Japan. *Cretaceous Res.*, 7(4):307-326.

1614 **TSUBAKIHARA Shin'ichi**, HASEGAWA Shiro and MARUYAMA Toshiaki (1989): Upper Cenozoic in Kuromatsunai area, southwestern Hokkaido-Stratigraphy and biochronology of the Kuromatsunai Formation-. *Jour. Geol. Soc. Japan*, 95(6):423-438, figs. 1-7, tabs. 1-4. (西南北海道黒松内地域の上部新生界－特に黒松内層の層序と微化石年代について－) (J.E.)

1615 **TSUCHI Ryuichi** (1986): Mid-Neogene migration of Tethyan tropical Mollusca and Larger Foraminifera into northern Japan. Proceedings of the International Symposium on Shallow Tethys 2, Wagga Wagga, Austlaria, 455-459, figs. 1-3.

1616 TSUCHI Ryuichi (1986): Late Cenozoic molluscan faunas and their development in southwestern Japan. *Spec. Pap., Palaeont. Soc. Japan*, (29):33-45, figs. 1-4.

1617 TSUCHI Ryuichi (1986): Recent progress in Neogene biochronostratigraphy. *Jour. Geogr.*, 95(7):76-83, figs. 1-4. (新第三紀年代層序学の最近の進歩) (J.)

1618 TSUCHI Ryuichi (1986): [Neogene events and their distribution in time and space]. *Mar. Sci., Month.*, 18(3):132-135, fig. 1. (新第三紀のイベントとその時間空間的広がり) (J.)

1619 TSUCHI Ryuichi (1987):Neogene events in Japan and Pacific. Pacific Neogene Event Studies, IGCP-246, Shizuoka, Japan. 102-103.

1620 TSUCHI Ryuichi (1988): ICGP-246 and its main topics. In R. Tsuchi (ed.): Events of Neogene evolution and development. *Spec. Pub., Osaka Nat. Mus.*, 1-2. (ＩＣＧＰ-２４６とその主題) (J.)

1621 TSUCHI Ryuichi (1988): Conference report. Pacific Neogene event-stratigraphy, Berkley, 1998. *Episodes*, 11:55-56.

1622 TSUCHI Ryuichi (1988): Neogene bio-chronostratigraphy and its bearing on the opening the Sea of Japan. *Jour. Paleont. Soc. Korea*, 4(1):50-54, figs. 1-2.

1623 TSUCHI Ryuichi (1988): Notes on some Pliocene molluscas from the coast of Shirahama, with remarks on the geology of Izu Peninsula. Guidebook for excursion, Oji Int. Seminar for IGCP 246, Tokyo. 26-31.

1624 TSUCHI Ryuichi (1989): [Neogene events in the Pacific regions IGCP-246 Oji Seminar. Shizuoka-1988]. *Gakujyutsu Geppo*, 42(6):480-485. (太平洋地域における新第三紀イベントーIGCP-246王子セミナー・静岡, 1988ー) (J.)

1625 TSUCHI Ryuichi (1989): Neogene marine climatic events in Japan and the Pacific. IGCP-246 International Symposium on Pacific Neogene continental and marine events. Nanjing Univ. Press, China. 1-6.

1626 TSUCHI Ryuichi (1989): Neogene events in Japan and the Indo-Pacific. *Indian Jour. Geol.*, 61:203-223.

1627 TSUCHI Ryuichi (1990): Preface. *Palaeogeogr. Palaeoclimat. Palaeoecol.*, 77: 179-180.

1628 TSUCHI Ryuichi (1990): Neogene events in Japan and the Pacific. *Palaeogeogr. Palaeoclimat. Palaeoecol.*, 77(3/4):355-365, figs. 1-6.

1629 TSUCHI Ryuichi (1990): Neogene events in Japan and southeast Asia. The annual technical meeting 1989 and international geological correlation programme project 246, program and abstracts. Chiang Mai Univ., Chiang Mai. 38.

1630 TSUCHI Ryuichi (1990): Accelerated evolutionary events in Japanese endemic Mollusca during the latest Neogene. In R. Tsuchi (ed.): Pacific Neogene events -Their timing, nature and interrelationship-. Univ. Tokyo Press, Tokyo, 85-97.

1631 TSUCHI Ryuichi and IBARAKI Masako (1988): Biotic evolutionary acceleration during the latest Neogene. Oji International Seminar for IGCP-246, Abst. Vol., Tokyo. 21-22.

1632 TSUCHI Ryuichi and IBARAKI Masako (1988): Notes on neotectonics of southern Boso Peninsula, central Japan, with reference to those of south Fossa Magna. *Rep. Fac. Sci., Shizuoka Univ.*, 22:61-70.

1633 TSUCHI Ryuichi and IBARAKI Masako (1988): Notes on the Omma-Manganji molluscan fauna: Its geologic age and paleoceanographic implications. *Saito Ho-on Kai, Spec. Pub. (Prof. T. Kotaka Commem. Vol.)*, (3):557-565, figs. 1-5, tab. 1.

1634 TSUCHI Ryuichi and International Andean Studies Group (1987): Biochronostratigraphic correlation of Neogene marine sequences on the Pacific coast of south America -A preliminary report. 4th RCPNS Congress, Berke-

ley, 1987, Abst., 123.

1635 TSUCHI Ryuichi and International Andean Studies Group (1988): Trans-Pacific correlation of Cenozoic geohistory. *Rep. Andean Stud., Shizuoka Univ., Spec. Vol.*, 2:1-108.

1636 TSUCHI Ryuichi and International Andean Studies Group (1990): Trans-Pacific correlation of Cenozoic geohistory. *Rep. Andean Stud., Shizuoka Univ., Spec. Vol.*, 3:1-7, figs. 1-2.

1637 TSUCHI Ryuichi, SHUTO Tsugio and IBARAKI Masako (1987): Geologic ages of the Ashiya Group, north Kyushu from a viewpoint of planktonic Foraminifera. *Rep. Fac. Sci., Shizuoka Univ.*, 21:109-119, pls. 1-2.

1638 TSUCHI Ryuichi, SHUTO Tsugio, TAKAYAMA Toshiaki, FUJIYOSHI Akira, KOIZUMI Itaru, IBARAKI Masako and DUQUE-CARO Herman (1988): Fundamental data on Cenozoic biostratigraphy of northern Columbia, South America. *Rep. Andean Stud., Shizuoka Univ., Spec. Vol.*, 2:9-21, pls. 1-2.

1639 TSUCHI Ryuichi, SHUTO Tsugio, TAKAYAMA Toshiaki, FUJIYOSHI Akira, KOIZUMI Itaru, IBARAKI Masako and MARTINEZ-PARDO Ruben E. (1988): Fundamental data on Cenozoic biostratigraphy of Chile. *Rep. Andean Stud., Shizuoka Univ., Spec. Vol.*, 2:71-95, pls. 1-3.

1640 TSUCHI Ryuichi, SHUTO Tsugio, TAKAYAMA Toshiaki, FUJIYOSHI Akira, KOIZUMI Itaru, IBARAKI Masako, RANGEL Z. C. and ALDANA A. Manuel (1988): Fundamental data on Cenozoic biostratigraphy of the Pacific coast of Peru. *Rep. Andean Stud., Shizuoka Univ., Spec. Vol.*, 2:45-70, pls. 1-2.

1641 TSUCHI Ryuichi, SHUTO Tsugio, TAKAYAMA Toshiaki, FUJIYOSHI Akira, KOIZUMI Itaru, IBARAKI Masako and TIRADO-S Rodrigo (1988): Fundamental data on Cenozoic biostratigraphy of the Pacific coast of Ecuador. *Rep. Andean Stud., Shizuoka Univ., Spec. Vol.*, 2:23-43, pls. 1-3.

1642 **TSUDA Karyu**, ITOIGAWA Junji and YAMANOI Tohru (1986): Mangrove swamp fauna and flora in the Middle Miocene Japan. *Spec. Pap., Palaeont. Soc. Japan*, (29):129-134, figs. 1-6, tabs. 1-4.

1643 **TSUJI Yoshihiro**, SUNOUCHI Hisao, YAMAMURA Tsuneo, YUKI Tomoya and IWAMOTO Hiroshi(1989): [Recent carbonate deposits in the sea west of Miyako-jima, Ryukyu Islands and their sedimentary environment]. *Earth Month.*, 11(19): 612-617. (琉球列島宮古島西方海域の現世炭酸塩堆積物とその堆積環境) (J.)

1644 **TSUKAGOSHI Akira** (1990): Ontogenetic change of distributional patterns of pore systems in *Cythere* species and its phylogenetic significance. *Lethaia*, 23(3):225-241, figs. 1-22, tabs. 1-3.

1645 TSUKAGOSHI Akira and IKEYA Noriyuki (1987): The Ostracoda genus *Cythere* O. F. Muller, 1785 and its species. *Trans. Proc. Palaeont. Soc., Japan, N. S.*, (148):197-222, figs. 1-9.

1646 **TSUKAGOSHI Minoru**, SUZUKI Keiji(1990): On the Late Miocene *Cinnamomum* and *Paliurus* from the lower part of the Takamine Formation, western mountainous region of the Yonezawa basin, northeast Honshu, Japan. *Bull. Mizunami Fossil Mus.*, (17):71-78, pl. 14, figs. 1-4, tab. 1.

1647 **TSUNEYAMA Futoshi**, WATANABE Kikuo and SHIMAZU Mitsuo (1989): Geology of the Higashiyama hills, east of the Nagaoka City, Niigata Prefecture, central Japan. *Jour. Japan. Assoc. Petrol. Tech.*, 54(3):202-218, figs. 1-7, tab. 1. (新潟県、長岡市東方、東山丘陵の地質) (J.E.)

1648 **TSUTSUMI Hiroaki** (1989): Environmental changes and evolution of marine invertebrates from the late Precambrian to the Cambrian. *Benthos Res.*, (35/36):3-16, figs. 1-4, tab. 1. (先カンブリア時代末期から古生代カンブリア紀にかけての地球環境の変化と海産無脊椎動物の進化について) (J.E.)

1649 **TUMANDA Fe P.** (1989): Cretaceous radiolarian biostratigraphy in the Esashi mountain area, northern Hokkaido, Japan. *Sci. Rep., Inst. Geosci., Univ. Tsukuba, Sec. B*, 10:1-44, pls. 1-10, figs. 1-9, tabs. 1-5.

1650 TUMANDA Fe P. and SASHIDA Katsuo (1988): On the occurrence of inoceramid bivalves and radiolarians from the Manokawa Formation, Esashi mountain area, northern Hokkaido. *Ann. Rep., Inst. Geosci., Univ. Tsukuba*, (14):56-63, figs. 1-4, tabs. 1-2.

1651 TUMANDA Fe P., SATO Tadashi and SASHIDA Katsuo (1990): Preliminary late Permian radiolarian biostratigraphy of Busuwanga Island, Palawan, Philippins. *Ann. Rep., Inst. Geosci., Univ. Tsukuba*, (16):39-45, pls. 1-2, figs. 1-2.

U

1652 **UCHIYAMA Takanori**, SANO Hiroyoshi and KANMERA Kametoshi (1986): Depositional and tectonic setting of cherts around the Akiyoshi Limestone Group. *Mem. Fac. Sci., Kyushu Univ., Ser. D*, 26(1):51-68, pls. 1-3, tab. 1.

1653 **UEDA Kyoichiro** (1989): A Miocene fossil of long-scarabaeid beetle from Tottori, Japan. *Bull. Kitakyushu Mus., Nat. Hist.*, (9):105-110, pl. 1.

1654 **UEDA Tetsuro** (1986): The Miocene Bihoku Group and its molluscan assemblages in the Shobara district, Hiroshima Prefecture, west Japan. *Earth Sci.*, 40(6):437-448, figs. 1-5, tab. 1. (広島県庄原地域の中新世備北層群とその貝化石群集) (J.E.)

1655 UEDA Tetsuro (1989): The Bihoku Group in the Miyoshi-Shobara area, Hiroshima Prefecture, west Japan -Miocene stratigraphy-. *Jour. Geol. Soc. Japan*, 95(12):919-931, figs. 1-8, tab. 1. (広島県三次・庄原地域の中新統備北層群－層序について) (J.E.)

1656 **UEMURA Kazuhiko** (1986): A note on Tertiary *Sciadoptys* (Coniferopsida) from Japan. *Bull. Natn. Sci. Mus., Tokyo, Ser. C*, 12(2):53-59, pl. 1, fig. 1.

1657 UEMURA Kazuhiko (1986): Late Miocene plants from Onbara in northern Okayama Prefecture, southwestern Honshu, Japan. *Bull. Natn. Sci. Mus., Tokyo, Ser. C*, 12(4):121-130, figs. 1-14, tab. 1.

1658 UEMURA Kazuhiko (1988): Late Miocene floras in northeast Honshu, Japan. *Natn. Sci. Mus., Tokyo*, 1-198, pls. 1-11, figs. 1-36, tabs. 1-30.

1659 UEMURA Kazuhiko (1988): Present status and future problems in Cenozoic paleobotany, with reference to Quaternary plants. *Japan. Jour. Hist. Bot.*, (3):25-31. (新生代植物研究の現状と今後の課題－とくに第四紀植物に関連して) (J.)

1660 UEMURA Kazuhiko (1990): Tertiary conifer in time and space. *Japan. Jour. Hist. Bot.*, (5):27-38, figs. 1-4. (第三紀針葉樹の時空分布) (J.)

1661 **UENO Hikaru**, HISADA Ken-ichiro and IGO Hisayoshi (1990): Imbricate struc-

ture and exotic mass observed in the Ryokami area, Kanto Mountains. *Ann. Rep., Inst. Geosci., Univ. Tsukuba*, (16):46-49, figs. 1-2.

1662 **UENO Jitsuro** (1986): [Palynological significance of dinosaur coprolite]. *Earth Month.*, 8(3):187-192, figs. 1-2. (恐竜糞化石の花粉学的意義) (J.)

1663 **UENO Katsumi** (1989): Carboniferous and Lower Permian foraminiferal biostratigraphy in the Akiyoshi Limestone Group (Studies of the Upper Palaeozoic foraminifers in the Akiyoshi Limestone Group, southwest Japan, Part I). *Bull. Akiyoshi-dai Mus., Nat. Hist.*, (24):1-39, pls. 1-8, figs. 1-6, tabs. 1-4. (秋吉石灰岩層群の石炭系および下部二畳系有孔虫生層序(秋吉石灰岩層群上部古生界有孔虫類の研究, その1)) (J.E.)

1664 **UJIHARA Atsushi** (1986): Pelagic gastropod assemblages from the Kazusa Group of the Boso Peninsula, Japan and Pliocene-Pleistocene climatic changes. *Jour. Geol. Soc. Japan*, 92(9):639-651, pl. 1, figs. 1-3, tabs. 1-2. (鮮新－更新統上総層群産浮遊性貝類群集と古水温変遷) (J.E.)

1665 UJIHARA Atsushi, SHIBATA Hiroshi and SAITO Takashi (1990): Pteropods from the Sagara Group (Mio-Pliocene), Shizuoka Prefecture, Japan. *Venus, Japan. Jour. Malacol.*, 49(4):306-329, pls. 1-2, figs. 1-2, tabs. 1-2.

1666 UJIHARA Atsushi, SHIBATA Koji, INA Haruyuki, WAKAMATSU Hisanori, HOSOYAMA Mitsuya, TSUSHIMA Takako, HOSONO Takao and SAITO Takeshi (1988): Stratigraphy of the Tomikusa Group in the southern part of Nagano Prefecture, Japan and the Miocene paleogeography of the district. *Bull. Mizunami Fossil Mus.*, (14):13-30, figs. 1-9, tab.1. (長野県南部の富草層群の層序と中新世古地理) (J.E.)

1667 **UJIIE Hiroshi** (1986): [Beneath the Ryukyu Island arc -Sedimentology and geology]. Shinsei Tosho Shuppan, Naha, 1-118. (琉球弧の海底－底質と地質) (J.)

1668 UJIIE Hiroshi (1988): Benthic foraminiferal changes related to tectonic development of the Sea of Japan. *Rev. Paleobiol., Vol. Spec.*, (2):895-901.

1669 UJIIE Hiroshi (1988): Geological map of central to southern Okinawa Islands based on planktonic foraminiferal zonation. Kuniken, Co. Ltd., Naha. (沖縄本島中・南部の地質図(浮遊性有孔虫化石帯に基づく)) (J.)

1670 UJIIE Hiroshi (1989): [Development of the Ryukyu Island arc system by revisional discussions on geology of islands]. *Earth Month.*, 11(10):631-640, figs. 1-10. (陸域地質の実証的再検討による琉球弧の地史) (J.)

1671 UJIIE Hiroshi (1989): Eocene foreland thrust-fold belt of the central Ryukyu Island arc: Deduced from sedimentary structures in Kayo Formation. In A. Taira and F. Masuda (eds.): Sedimentary facies in the active plate margin. Terra Pub., Tokyo, 711-722.

1672 UJIIE Hiroshi (1990): Bathyal Benthic Foraminifera in a piston core from east off the Miyako Islands, Ryukyu Island arc. *Bull. Coll. Sci., Univ. Ryukyus*, (49):1-60, pls. 1-32, figs. 1-4.

1673 UJIIE Hiroshi (1990): Bathyal Benthic Foraminifera of the Shimajiri Group, Okinawa. Guidebook for the field trip No. 5, 4th International Symposium on Benthic Foraminifera, Sendai 1990, 27-30.

1674 UJIIE Hiroshi (chief ed.)(1990): [Nature of Okinawa-Its geography and geology-]. Committee of Public Course, Ryukyu University, Okinawa, 1-271. (沖縄の自然－地形と地質) (J.)

1675 UJIIE Hiroshi and IWASAKI Toshio (1987): Imbricated thrust-fold zone recognized in the Eocene Kayo Formation of the northern Okinawa Islands. *Bull. Coll. Sci., Univ. Ryukyus*, (45):253-278, pls. 1-5, figs. 1-4. (沖縄本島北東岸・天仁海岸における嘉陽層の堆積構造と地質構造) (J.)

1676 UJIIE Hiroshi and ONO Tomonori (1989): Late Cenozoic bathyal Benthic Foraminifera from the Ryukyu Island arc region. In Y. Takayanagi and K. Ishizaki (eds.): Collected papers on Foraminifera from the Japanese Islands. Toko Print., Pub. Dept., Sendai, 71-75, figs. 1-4. (琉球列島の後期新生代海溝斜面底生有孔虫フォーナ：序論) (J.)

1677 UJIIE Hiroshi, ONO Tomonori and TANAKA Yuichiro (1988): [Micropaleontological analysis on the piston core (KT84-14, P1) from off Miyako-jima. *Yukochu Kenkyu* (=*Stud. Foraminifera*), (1):19-22, figs. 1-3. (宮古島ピストン・コア (KT84-14·P1) の微古生物学的解析) (J.)

1678 UJIIE Hiroshi and YADA Shigeaki (1987): [Geological background of "Sekiseisho" of the southern Ryukyu Island arc: A barrier reef along the active margin]. *Earth Month.*, 9(3):124-129, figs. 1-4. (活動的大洋縁の大サンゴ礁・石西礁) (J.)

1679 **UMEDA Miyuki** (1986): Permian radiolarians from clastic rocks in the Shirahama, Takasa area of Echizen-cho, Fukui Prefecture, central Japan and its significance. *Bull. Fukui Munic. Mus., Nat. Hist.*, (33):19-29, pls. 1-2, figs. 1-6. (福井県越前町白浜・高佐地区の砕屑岩より見出された二畳紀放散虫化石とその意義) (J.)

1680 UMEDA Miyuki (1987): Permian radiolarians from clastic rocks in the Takasa area of Echizen-cho, Fukui Prefecture, central Japan. *Jour. Geol. Soc. Japan*, 93(3):229-231, pl. 1, figs. 1-2. (福井県越前町高佐地区に分布する砕屑岩から見出された二畳紀放散虫) (J.)

1681 UMEDA Miyuki (1990): Jurassic radiolarians associated with chert arenite in the western part of the Nanjo massif, Fukui Prefecture, central Japan. *Bull. Fukui Munic. Mus., Nat. Hist.*, (37):7-19, pls. 1-5, figs. 1-5. (福井県南条山地の層状チャートアレナイトに伴う中生代ジュラ紀放散虫) (J.)

1682 UMEDA Miyuki and HATTORI Isamu (1987): Permian radiolarians from clastic rocks in the Takasa area of Echizen-cho, Fukui Prefecture, central Japan. *Jour. Geol. Soc. Japan*, 93(3):229-231, pl. 1, figs. 1-2. (福井県越前町高佐地区に分布する砕屑岩から見出された二畳紀放散虫)

1683 **UOZUMI Satoru** and AKAMATSU Morio (1988): Notes on the four diagnostic Miocene mytilids of Hokkaido. *Saito Ho-on Kai, Spec. Pub.* (*Prof. T. Kotaka Commem. Vol.*), (3):325-337, pls. 1-5, figs. 1-4.

1684 UOZUMI Satoru, AKAMATSU Morio and TAKAGI Toshio (1986): Takikawa-Honbetsu and Tatsunokuchi Faunas (*Fortipecten takahashii*-bearing Pliocene faunas). *Spec. Pap., Palaeont. Soc. Japan*, (29):211-226, pls. 19-20, figs. 1-4, tab. 1.

1685 UOZUMI Satoru, TAKAGI Toshio and SUZUKI Akihiko (1986): *Yabepecten tokunagai* and *Mizuhopecten tokyoensis* of Hokkaido -Characteristics of boreal molluscus and paleogeographic position of Hokkaido-. *Monogr. Mizunami Fossil Mus.*, (6):75-89, pls. 8-11, figs. 1-5. (北海道の*Yabepecten tokunagai*と*Mizuhopecten tokyoensis*—北方系貝類の特性と北海道の古海洋生物地理的位置—) (J.E.)

1686 USHIROKAWA Noriko and YAMAGUCHI Toshiyuki (1989): Tidally produced growth

lines in intertidal barnacle shell (*Tetraclita japonica*). *Benthos Res.*, (35/36):61-68, figs. 1-7. (クロフジツボの潮汐による成長線) (J.E.)

1687 **UYENO Teruya** and HASEGAWA Yoshikazu (1986): A new Cretaceous ganopristoid sawfish of the genus *Ischyrhiza* from Japan. *Bull. Natn. Sci. Mus., Ser. C*, 12(2):67-72, figs. 1-4.

1688 UYENO Teruya, KONDO Yasuo and INOUE Kokichi (1990): A nearly complete tooth set and several vertebrae of the lamnid shark *Isurus hastalis* from the Pliocene in Chiba, Japan. *Jour. Nat. Hist. Mus. & Inst., Chiba*, (1):15-20, figs. 1-6. (千葉県鋸南町鮮新統千畑層から産したネズミザメ科イスルス・ハスタリス *Isurus hastalis* (Agassiz)の同一個体の歯群および脊椎骨群化石) (J.E.)

1689 UYENO Teruya, SAKAMOTO Kazuo and FUJII Shoji (1990): Three fish fossils from the Neogene strata at Himi City, Toyama Prefecture, Japan. *Bull. Nat. Sci. Mus., Ser. C*, 16(4):155-165, figs. 1-8.

1690 UYENO Teruya, SAKAMOTO Osamu and SEKINE Hirofumi (1989): Description of an almost complete tooth set of *Carcharodon megalodon* from a Middle Miocene bed in Saitama Prefecture, Japan. *Bull. Saitama Mus. Nat. Hist.*, (7):73-85, pls. 1-16, figs. 1-6, tabs. 1-4. (埼玉県川本町中新統産出カルカロドン・メガロドンの同一個体に属する歯群) (J.E.)

1691 UYENO Teruya and SAKURA Hajime (1990): Catalogue of fish fossil specimens. *Natn. Sci. Mus., Tokyo*, 1-6, 1-70.

V

1692 **VERMEIJ Geerat, J.** (1989): Geographical restriction as a guide to the causes of extinction: The case of the cold northern oceans during the Neogene. *Paleobiology*, 15(4):335-356, tabs. 1-5.

W

1693 **WAKAMATSU Hisanori** (1988): The genus *Ponthocythere* (Ostracoda) from the Toshima Sand in the Atsumi Peninsula, central Japan. *Bull. Mizunami Fossil Mus.*, (14):145-149, pl. 34, figs. 1-2. (渥美半島豊島砂層の貝形虫*Pontocythere* 属) (J.)

1694 WAKAMATSU Hisanori, SUGIYAMA Kazuhiro and FURUTANI Hiroshi (1990): Silurian and Devonian radiolarians from the Kurosegawa Tectonic Zone, southwest Japan. *Jour. Earth Sci., Nagoya Univ.*, 37:157-192, pls. 1-13, figs. 1-9, tab. 1.

1695 **WAKITA Koji** (1987): The occurrence of latest Jurassic-earliest Cretaceous radiolarians at the Hida-Kanayama area in the Mino terrane, central Japan. *Jour. Geol. Soc. Japan*, 93(6):441-443, pl. 1, fig. 1, tab. 1. (美濃帯飛騨金山地域におけるジュラ紀末－白亜紀最前期の放散虫の産出) (J.)

1696 WAKITA Koji (1988): Early Cretaceous melange in the Hida-Kanayama area, central Japan. *Bull. Geol. Surv. Japan*, 39(6):367-421, pls. 1-6, figs. 1-8, tabs. 1-8.

1697 WAKITA Koji and ISOMI Hiroshi (1986): Discovery of Triassic and Jurassic radiolarians from the Sakamoto-toge area, Gifu Prefecture and its signif-

icance. *Bull. Geol. Surv. Japan*, 37(6):325-333, pl. 1, figs. 1-2. (岐阜県坂本峠地域における三畳紀・ジュラ紀放散虫化石の産出とその意義) (J.E.)

1698 **WATANABE Akira** (1987): Neogene and Quaternary *Mya* from Akita Prefecture, northeast Honshu, Japan. *Ann. Rep., Akita Pref. Mus.*, 12:67-78, pls. 1-2, figs. 1-2, tabs. 1-2. (秋田県の*Mya* (オオノガイ属)化石) (J.E.)

1699 WATANABE Akira (1988): A new locality of *Patinopecten yessoensis* in the Katanishi Formation, Oga Peninsula, Akita Prefecture. *Ann. Rep., Akita Pref. Mus.*, 13:21-22, figs. 1-2. (男鹿半島の 潟西層におけるホタテガイ *Patinopecten yessoensis*の新産地) (J.)

1700 WATANABE Akira (1989): *Potamocorbula amurensis* from Holocene deposits of Hachiro-gata, northeast Honshu, Japan. *Ann. Rep., Akita Pref. Mus.*, 14:39-40, figs. 1-2. (八郎潟の完新統産*Potamocorbula amurensis*) (J.)

1701 WATANABE Akira (1990): Molluscan fossils from Holocene deposits of Hachiro-gata, northeast Honshu, Japan. *Ann. Rep., Akita Pref. Mus.*, 15:35-44, pls. 1-2, figs. 1-3, tab. 1. (八郎潟の完新統産軟体動物化石群) (J.)

1702 **WATANABE Kikuo** and YAMADA Masamichi (1986): [Foraminiferal biostratigraphy of the Katagai gas-field]. *Jour. Japan. Assoc. Petrol. Tech.*, 51(4):339. (片貝ガス田の有孔虫化石層序について) (J.)

1703 **WATANABE Mahito** (1990): Stratigraphy of the Neogene sequence in the Himi-Nadaura area, Toyama Prefecture, central Japan -With special reference to the hiatus between the Sugata Formation and overlying formations-. *Jour. Geol. Soc. Japan*, 96(11):915-936, pl. 1, figs. 1-12, tabs. 1-5. (富山県氷見・灘浦地域の新第三系の層序ーとくに姿累層とその上位層との間の時間間隙についてー) (J.E.)

1704 **WATANABE Yasushi** and IWATA Keiji (1986): Miocene stratigraphy around Toyoh mine, southwest Hokkaido. *Jour. Geol. Soc. Japan*, 92(11):817-820. (北海道南西部豊羽鉱山周辺の中新世層序) (J.E.)

1705 WATANABE Yasushi and IWATA Keiji (1987): The Hidaka Supergroup in the Tomuraushi region, Hidaka Belt, Hokkaido, Japan. *Earth Sci.*, 41(1):35-47. (日高帯, トムラウシ地域の日高累層群) (J.)

1706 WATANABE Yasushi, IWATA Keiji and HASAKA Toshikazu (1989): Stratigraphy and structure of the Miocene in the Jozankei area, southwestern Hokkaido. *Earth Sci.*, 43(1):7-15, pl. 1, figs. 1-7, tabs. 1-2. (西南北海道定山渓地域の中新統と地質構造) (J.E.)

1707 **WATANABE Yoshihiro** and ISHIGAKI Takehisa (1986): Stratigraphy and sedimentary environment of the Miocene Bihoku Group in the Tojo area, southwest Japan. *Bull. Mizunami Fossil Mus.*, (13):15-26, pl. 3, figs. 1-6, tabs. 1-4. (広島県東城地域の中新統備北層群の層序と堆積環境) (J.E.)

1708 **WATANABE Yoshiji**, ASANO Hiromasa, INO Masayuki, KIMURA Emiko, TAKAHASHI Osamu, MASHIKO Shin'ichi, MIYACHI Tatsuhiko and ISHII Atsushi (1990): Occurrence of late Cretaceous fossils from the Tochiya Formation, northeastern part of the Kanto Mountains, central Japan. *Jour. Geol. Soc. Japan*, 96(8):683-685, pl. 1, figs. 1-2. (関東山地東北部の栃谷層からの後期白亜紀化石の産出) (J.)

1709 **WINKLER Alisa J.** and TOMIDA Yukimitsu (1988): New records of the small leporid *Aztranolagus agilis* Russell and Harris (Leporidae: Leporinae). *Southwest. Nat.*, 33(4):391-396.

1710 **WOLFE Jack, A.** and TANAI Toshimasa (1987): Systematics, phylogeny and dis-

tribution of *Acer* (maples) in the Cenozoic of western North America. *Jour. Fac. Sci., Hokkaido Univ., Ser. 4*, 22(1):1-246, pls. 1-61, figs. 1-18, tabs. 1-10.

Y

1711 **YABUMOTO Yoshitaka** (1988): Pleistocene clupeid and engraulidid from the Kokubu Group in Kagoshima Prefecture, Japan. *Bull. Kitakyushu Mus., Nat. Hist.*, (8):55-74, pls. 1-2, figs. 1-18.

1712 YABUMOTO Yoshitaka (1987): Pleistocene gobiid fishes of the genus *Rhinogobius* from Kusu basin, Oita Prefecture, Japan. *Bull. Kitakyushu Mus., Nat. Hist.*, (7):11-119, pls. 1-2, figs. 1-6.

1713 YABUMOTO Yoshitaka (1987): Oligocene lamnoid shark of the genus *Carcharodon* from Kitakyushu, Japan. *Bull. Kitakyushu Mus., Nat. Hist.*, (6): 239-264, pls. 1-4, figs. 1-18, tab. 1.

1714 YABUMOTO Yoshitaka (1989): A new Eocene lamnoid shark, *Carcharodon nodai*, from Omuta in northern Kyushu, Japan. *Bull. Kitakyushu Mus., Nat. Hist.*, (9):111-116, pl. 1, figs. 1-3, tab. 1.

1715 YABUMOTO Yoshitaka and UYENO Teruya (1990): [Pleistocene fishes from Katanoyama in Nishinoomote City, Kagoshima Prefecture, Japan]. Nishinoomote-shi Katanoyama Kasekigun no Hakkutsuchosa, (1):17-21, pls. 6-7. (魚類化石) (J.)

1716 **YAHATA Masahiro**, IGARASHI Yaeko, GAUTAM Pitambar and WADA Nobuhiko (1989): Plio-Pleistocene in the eastern part of Toya Lake, southwest Hokkaido: Sedimentary facies, pollen stratigraphy and magnetostratigraphy. *Earth Sci.*, 43(5):261-276, figs. 1-4, tabs. 1-3. (西南北海道洞爺湖東方の鮮新－更新統について－堆積相・花粉層序 ・古地磁気層序－) (J.E.)

1717 **YAJIMA Michiko** (1986):[Introduction of the concept on fossils to "Natural Science I" in the highschool curricula]. *Educ. Earth Sci.*, 39(5):185-191, figs. 1-2, tabs. 1-2. (「理科Ⅰ」で化石をどのように取り扱うか) (J.)

1718 YAJIMA Michiko (1987): Pleistocene Ostracoda from the Atsumi Peninsula, central Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (146):49-76, figs. 1-12, tabs. 1-4.

1719 YAJIMA Michiko (1988): Preliminary notes on the Japanese Miocene Ostracoda. In T. Hanai, N. Ikeya and K. Ishizaki (eds.): Evolutionary biology of Ostracoda, its fundamentals and applications. Kodansha/Elsevier, Tokyo/Amsterdam, 1073-1085, pls. 1-2, figs. 1-4, tabs. 1-4.

1720 YAJIMA Michiko (1988): Preliminary notes on the classification of Trachyleberididae and Hemicytheridae (A historical review). *Bull. Tokyo Seitoku Coll.*, (21):143-153, figs. 1-8. (総説Tracyleberis科とHemicythere科の分類(序論)) (J.)

1721 YAJIMA Michiko and LOAD Alan (1990): The interpretation of Quaternary environments using Ostracoda: An example from Japan. *Proc. Geol. Assoc., U. K.*, 101(2):153-161, figs. 1-5.

1722 **YAMAGATA Osamu**, YAMANOI Tohru, TATEKAWA Masahisa and NAKANO Satoshi (1988): A palynological study of the surface sediments of Lake Biwa, Japan. *Bull. Yamagata Univ., Nat. Sci.*, 12(1):87-94, pl. 1, figs. 1-5, tab. 1. (琵琶湖

底質の花粉学的研究) (J.E.)

1723 **YAMAGATA Takeshi** (1989): Mesozoic chaotic formations of Mino terrane, northwestern Mino Mountains, central Japan. *Jour. Geol. Soc. Japan*, 95(6): 447-462, figs. 1-9, tabs. 1-3.

1724 **YAMAGIWA Nobuo** and HEGURI Shu-ichiro (1987): Corals from the Tsui Formation in the Youra Peninsula, Tsukumi area, Oita Prefecture. *Mem. Osaka Kyoiku Univ., Ser. 3*, 36(1):27-37, pl. 1, figs. 1-4, tab. 1. (大分県津久見地域四浦半島に分布する津井層産出の珊瑚化石について) (J.E.)

1725 YAMAGIWA Nobuo and HISADA Ken-ichiro (1986): *Reichelina* Fauna from the limestone breccias of the Hamadaira Group in the western Kanto Mountains, central Japan. *Mem. Osaka Kyoiku Univ., Ser. 3*, 35(2):177-186, pl. 1, figs. 1-3, tabs. 1-2.

1726 YAMAGIWA Nobuo, ISHII Ken-ichi and HAYASHI Shiro (1988): Two late Paleozoic corals from the Tamba Group at Takatsuki City, Osaka Prefecture. *Mem. Osaka Kyoiku Univ., Ser. 3*, 37(1):49-55, pl. 1, figs. 1-2.

1727 YAMAGIWA Nobuo, OKIMURA Yuji and NAKAGAWA Toshiya (1988): A new fossil locality of the Maizuru Group in the Yakuno district, Kyoto Prefecture. Prof. H. Tazuke Mem. Vol., Yamaguchi, 47-51, figs. 1-2. (京都夜久野地域に分布する舞鶴層群の新化石産地について) (J.)

1728 YAMAGIWA Nobuo, SHIRAISHI Kazuyuki and YOSHIDA Mitsuo (1988): Newly discovered late Triassic Hexacorals from central Nepal. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (152):654-655, fig. 1.

1729 YAMAGIWA Nobuo, TAMURA Minoru and Tanaka Hitoshi (1988): Some Hexacorals from the Shinkai Formation, Oita Prefecture, Kyushu. *Bull. Natn. Sci. Mus., Ser. C*, 14(2):71-78, pl. 1, figs. 1-2.

1730 YAMAGIWA Nobuo and YAMANO Akiko (1990): A new species of *Ipciphyllum* from the Akasaka Limestone, central Japan. *Bull. Natn. Sci. Mus., Ser. C*, 16 (3):119-125, pls. 1-2, fig. 1.

1731 **YAMAGUCHI Bin** (1986): [Consideration on anthropology]. *Kagaku*, 56(4):205-209, figs. 1-3. (化石人類学の考え方) (J.)

1732 **YAMAGUCHI Toshiyuki** (1986): Geographic distributions and specific relationship of Japanese Tetraclita. *Benthos Res.*, (29):25-36. (日本のクロフジツボ類の地理的分布および種間関係) (J.E.)

1733 YAMAGUCHI Toshiyuki (1986): Sexual polymorphism in Cirripedia. *Jour. Geogr.*, 95(2):56-72, figs. 1-5, tabs. 1-2. (蔓脚類に見られる性的多形現象) (J.E.)

1734 YAMAGUCHI Toshiyuki (1986): [Barnacles]. In the Japan Research Group of Marine Fouling Organisms (ed.): Method of study on the fouling organisms -Identification and research-. Koseisya Koseikaku, Tokyo, 107-122. (フジツボ類) (J.)

1735 YAMAGUCHI Toshiyuki (1987): Changes in the barnacle fauna since the Miocene and the intraspecific structure of *Tetraclita* in Japan (Cirripedia; Balanomorpha). *Bull. Mar. Sci.*, 41(2):337-350, figs. 1-4, tabs. 1-2.

1736 YAMAGUCHI Toshiyuki (1988): Distribution in time and space on Japanese barnacles. *Fossils, Palaeont. Soc. Japan*, (44):1-11, figs. 1-5. (日本のフジツボ類の時空分布) (J.E.)

1737 YAMAGUCHI Toshiyuki (1989): Foreign barnacles immigrated to Japan, with special reference to the changes in geographic distribution and ecology. *Nat. Hist. Rep., Kanagawa Pref. Mus.*, (10):17-32, figs. 1-4. (外国から日本に移住したフジツボ類，特に地理的分布および生態の変化) (J.E.)

1738 YAMAGUCHI Toshiyuki and NEWMAN William A. (1990): A new and primitive barnacle (Cirripedia; Balanomorpha) from the north Fiji basin abyssal hydrothermal field, and its evolutionary implications. *Pacific Sci.*, 44(2):135-155, figs. 1-8.

1739 **YAMAKITA Satoshi** (1986): Discovery of late Permian radiolarians including *Follicucullus charveti* from the Kurosegawa terrain in eastern Shikoku. *Jour. Geol. Soc. Japan*, 92(12):909-911, pl. 1, fig. 1. (四国東部黒瀬川帯からの*Follicucullus charveti* を含む後期二畳紀放散虫化石の発見) (J.)

1740 YAMAKITA Satoshi (1987): Stratigraphic relationship between Permian and Triassic strata of chert facies in the Chichibu terrane in eastern Shikoku. *Jour. Geol. Soc. Japan*, 93(2):145-148, figs. 1-3. (四国東部秩父帯中のチャート相二畳－三畳系間の層序関係) (J.)

1741 YAMAKITA Satoshi (1988): Jurassic-early Cretaceous allochthonous complexes related to gravitational slidings in the Chichibu terrane in eastern and central Shikoku, southwest Japan. *Jour. Fac. Sci., Univ. Tokyo, Sec. 2*, 21(5):467-514, figs. 1-26, tabs. 1-7.

1742 **YAMAMOTO Satoshi**, TOKUYAMA Hidekatsu, FUJIOKA Kantaro, TAKEUCHI Akira and UJIIE Hiroshi (1988): Carbonate turbidite depended on the floor of the Palau Trench. *Mar. Geol.*, 82:217-233.

1743 **YAMANOI Tohru** (1986): [A marine climatic event in Neogene from view point of pollen fossils]. *Mar. Sci., Month.*, 18(3):140-145, figs. 1-5. (花粉からみた新第三紀の海岸気候事件) (J.)

1744 YAMANOI Tohru (1989): Neogene palynological zones and event in Japan. Proceedings of international symposium on Pacific Neogene continental and marine events, Nanjing Univ. Press, Nanjing, 83-90, pl. 1, figs. 1-6.

1745 YAMANOI Tohru (1989): Palyno-flora of the Middle Miocene sediments in Noto Peninsula, central Japan. Prof. H. Matsuo Mem. Vol., Matsuyama. 5-12, pls. 1-2, figs. 1-3, tab. 1. (能登における中部中新統の花粉群集) (J.E.)

1746 YAMANOI Tohru (1990): Neogene palynology of northeast Japan. *Monogr. Mizunami Fossil Mus.*, (7):13-23, figs. 1-5. (新第三系の花粉化石－特に中新世前期・後期の花粉群集－) (J.E.)

1747 YAMANOI Tohru and TSUDA Karyu (1986): On the conditions of paleo-mangrove forest in the Kurosedani Formation (Middle Miocene), central Japan. *Mem. Natn. Sci. Mus.*, (19):55-66, pls. 3-4, figs. 1-10. (富山県黒瀬谷層(中部中新統)に見出されるマングローブ林の様相) (J.E.)

1748 **YAMAOKA Masatoshi** (1987): Fossil asteroids from the Miocene Morozaki Group Aichi Prefecture, central Japan. *Kaseki no Tomo*, (31):5-23, pls. 1-7, tabs. 1-3. (中新世師崎層群産ヒトデ化石について) (J.E.)

1749 **YAMASAKI Tetsuji** (1986): Sedimentological study of the Izumi Group in the northern part of Shikoku, Japan. *Sci. Rep., Tohoku Univ., 2nd. Ser.*, 56 (1):43-70, figs. 1-11, tabs. 1-2.

1750 YAMASAKI Tetsuji (1987): Radiolarian assemblages of the Izumi Group in Shikoku and western Awaji Island, southwest Japan. *Jour. Geol. Soc. Japan*,

93(6):403-417, pls. 1-3. (四国・淡路島西部の和泉層群の放散虫群集) (J. E.)

1751 YAMASAKI Tetsuji and SUYARI Kazumi (1990): Microfossil age of the Shimanto South Subbelt in the Sukumo area, Kochi Prefecture. *Mem. Fac. Educ., Ehime Univ., Ser. 3*, 10:7-17, pls. 1-2, figs. 1-2. (高知県宿毛周辺の四万十帯南帯の微化石年代) (J.E.)

1752 YAMASHITA Masayuki and ISHIGA Hiroaki (1990): Correlation between the radiolarian and the fusulinacean biostratigraphy of the upper Middle Permian in Atetsu Plateau, Okayama Prefecture, southwest Japan. *Jour. Geol. Soc. Japan.*, 96(8):687-689, pl. 1, figs. 1-2, tab. 1. (岡山県阿哲台における中部ペルム系上部の放散虫層序と紡錘虫層序の対比) (J.E.)

1753 YAMASHITA Shigeru and KIMURA Masaichi (1990): Occurrence of early Pliocene otariid fossil in Numata-cho, Hokkaido. *Earth Sci.*, 44(2):53-60, pls. 1-2, figs. 1-11, tabs. 1-4. (北海道沼田町における前期鮮新世アシカ科化石の発見) (J.E.)

1754 Yamato Omine Research Group (1989): Paleozoic and Mesozoic Systems in the central area of the Kii Mountains, southwest Japan (Part 3) -Mesozoic of the Miyoshino district in Nara Prefecture-. *Earth Sci.*, 43(3):119-128, figs. 1-5. (紀伊山地中央部の中・古生界(その3)－御吉野地域－) (J.E.)

1755 YAMAUCHI Moriyoshi (1986): The distribution of radiolarian assemblages in surface sediments from the northwestern Pacific. *NOM, Spec. Vol.*, (7):141-156, pls. 1-4, figs. 1-2, tabs. 1-3. (日本近海表層堆積物中の放散虫群集) (J.E.)

1756 YAMAZAKI Haruo (1988): Subsurface geology of Tanna basin in Izu Peninsula, central Japan. *Jour. Geogr.*, 97(7):731-746, figs. 1-8, tab. 1. (ボーリング調査で明らかになった丹那盆地の変形構造) (J.E.)

1757 YAMAZAKI Sumio, KIMURA Tatsuaki and OKADA Kiyoshi (1990): Micro-structures of coalified wood tissues and their palaeobotanical implication. Proceedings of the 3rd conference of international organization of palaeobotany (Melbourne, 1988), 153-154, figs. 1-5.

1758 YANAGIDA Juichi (1989): Carboniferous brachiopods from the Akiyoshi Limestone Group, southwest Japan. 11^{e} Congres International de Stratigraphie et de Geologie du Carbonifere, Beijing 1987. Compte Rendu, Beijing, 2:391-398, figs. 1-3.

1759 YANAGIDA Juichi et al. (1988): Biostratigraphic study of Paleozoic and Mesozoic groups in central and northern Thailand -An interim report-. Department on Mineral Resources, Thailand, 1-47, pls. 1-33.

1760 YANAGIDA Juichi and MATSUSUE Kazuyuki (1990): Biostratigraphical and paleoecological significance of Carboniferous *Weningia* from southwest Japan. In. D. I. Mackinnon, D. E. Lee and J. D. Campbell (eds.): Brachiopods through time. Proceeding of the 2nd International Brachiopod Congress, Univ. Otago, Dunedin, N. Z., 333-340, figs. 1-6.

1761 YANAGISAWA Yukio (1987): Age assignments of dredge and piston core samples based on diatom biostratigraphy. *CCOP Tech. Bull.*, 19:73-87, pls. 1-5, fig. 1, tabs. 1-2.

1762 YANAGISAWA Yukio (1990): Diatom biostratigraphy of the Neogene Sendai Group, northeast Honshu, Japan. *Bull. Geol. Surv. Japan*, 41(1):1-25, pl. 1, figs.

1-22. (仙台層群の地質年代－珪藻化石層序による再検討－) (J.E.)

1763 YANAGISAWA Yukio (1990): Age of fossil Argonautidae (Cephalopoda) from Hokuriku Province (central Honshu, Japan) based on diatom biostratigraphy. *Bull. Geol. Surv. Japan*, 41(3):115-127, pl. 1, figs. 1-4, tabs. 1-3. (珪藻化石からみた北陸産タコブネ類化石の地質年代) (J.E.)

1764 YANAGISAWA Yukio and AKIBA Fumio (1990): Taxonomy and phylogeny of the three marine diatom genera, *Crucidenticula*, *Denticulopsis* and *Neodenticula*. *Bull. Geol. Surv. Japan*, 41(5):197-301, pls. 1-12, figs. 1-25, tabs. 1-9.

1765 YANAGISAWA Yukio, NAKAMURA Koichi, SUZUKI Yuichiro, SAWAMURA Konosuke, YOSHIDA Fumio, TANAKA Yuichiro, HONDA Yutaka and TANAHASHI Manabu (1989): Tertiary biostratigraphy and subsurface geology of the Futaba district, Joban coalfield, northeast Japan. *Bull. Geol. Surv. Japan*, 40(8):405-467, pls. 1-12, figs. 1-18, tabs. 1-6. append-tabs. 1-4. (常磐炭田北部双葉地域に分布する第三系の生層序と地下地質) (J.)

1766 YANAGISAWA Yukio and SUZUKI Yuichiro (1987): Diatom and silicoflagellates from the Oligocene Shirasaka Formation of the Joban coalfield, northeast Japan. *Bull. Geol. Surv. Japan*, 38(2):81-98, pls. 1-4, figs. 1-3, tabs. 1-5. (常磐炭田漸新統白坂層の珪藻及び珪質鞭毛藻化石) (J.E.)

1767 **YANAI Seiji** and GANZAWA Yoshihiro (1988): Discovery and significance of the petrified forest around the piedmont of Komagatake Volcano, southwestern Hokkaido. *Earth Sci.*, 42(1):25-28, figs. 1-3, tab. 1. (北海道駒ケ岳山麓における化石林の発見とその意義) (J.)

1768 **YANAI Shuichi**, KOSEKI Osamu, NIKO Shuji and HAMADA Takashi (1988): Tateishi nappe and Upper Devonian to Lower Carboniferous in northern area of the Abukuma Mountains, NE Japan. *Earth Sci.*, 42(4):179-186, pls. 1-2, figs. 1-4. (阿武隈山地北部の上部デボン系－下部石炭系と立石ナップ) (J.E.)

1769 **YANCEY Thomas E.** and OZAKI Kimiko (1986): Redescription of the genus *Shikamaia*, and clarification of the hinge characters of the family Alatoconchidae (Bivalvia). *Jour. Paleont.*, 60(1):116-125, figs. 1-7.

1770 **YANG Seong-young** (1986): [Dinosaurs and their foot prints in Korea]. *Earth Month.*, 8(3):138-142, figs. 1-5, tab. 1. (韓国の恐竜と足跡化石) (J.)

1771 YANG Seong-young (1989): On the genus *Plicatounio* (Cretaceous non-marine Bivalvia) from Korea. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (154):77-95, figs. 1-7, tabs. 1-7

1772 **YANO Makio** (1987): The plant remains from the latest interglacial deposits Hokkaido. Prof. M. Matsui Mem. Vol., Sapporo. 91-94, fig. 1. (北海道の最終間氷期堆積物の植物遺体) (J.)

1773 **YANO Takao** (1989): Late Cenozoic geohistory in the northern Fossa Magna region, central Japan. *Jour. Sci., Hiroshima Univ., Ser. C*, 9(1):81-132, figs. 1-35, tabs. 1-4.

1774 **YANO Toru** (1986): Stratigraphy, depositional environments and geologic ages of the southern part of the Oiso hills, Kanagawa Prefecture. *Geosci. Rep. Shizuoka Univ.*, (12):191-208. (大磯丘陵南部地域の層序とその地質時代および堆積環境) (J.E.)

1775 **YAO Akira** (1986): Geological age of Jurassic radiolarian zones in Japan and their international correlations. *NOM, Spec. Vol.*, (7):63-74, fig. 1,

tabs. 1-2. (日本のジュラ系放散虫化石帯の年代と国際対比) (J.E.)

1776 YAO Akira (1989): Paleozoic and Mesozoic radiolarian fossils from Japan 1 (Triassic 1-3). *Atlas, Japan. Foss.*, (66):394-396. (日本の古生代・中生代放散虫化石1(トリアス紀1-3)) (J.)

1777 YAO Akira (1990): Triassic and Jurassic radiolarians. In K. Ichikawa, S. Mizutani, I. Hara, S. Hada and A. Yao (eds.): Pre-Cretaceous terranes of Japan. Publication of IGCP 224, Osaka. 329-345, pls. 1-4, tabs. 1-3.

1778 YASUDA Hisato (1986): Cretaceous and Paleocene Foraminifera from northern Hokkaido, Japan. *Sci. Rep., Tohoku Univ., 2nd Ser.*, 52(1):1-101, pls. 1-14.

1779 YASUDA Hisato (1988): [Japanese Cretaceous Foraminifera and their sedimentary environments]. *Yukochu Kenkyu (Stud. Foraminifera)*, (1):10-15, figs. 1-4. (本邦白亜系の有孔虫群と堆積環境) (J.)

1780 YASUDA Hisato (1989): Benthic foraminifers and sedimentary facies of the lower slope basin off Shikoku, Japan. In Y. Takayanagi and K. Ishizaki (eds.): Collected papers on Foraminifera from the Japanese Islands. Toko Print. Publ. Dept., Sendai, 83-92. (四国沖下部斜面海盆の有孔虫群と堆積相) (J.)

1781 YASUDA Mamoru (1989): Equivalents to the Torinosu Group of the Chichibu Belt in the southeastern part of the Kanto Mountains, central Japan. *Jour. Geol. Soc. Japan*, 95(6):463-478, pl. 1, figs. 1-9, tabs. 1-2. (関東山地東南部秩父累帯の鳥巣相群相当層－岩相と放散虫年代－) (J.E.)

1782 YASUDA Yoshinori, AMANO Kazuo and YAMANOI Tohru (1990): Pleistocene climatic changes as deduced from a pollen analysis of Site 717 cores. *Proc. ODP, Sci. Results*, 116:249-253, pls. 1-4, figs. 1-4.

1783 YASUDA Yoshinori and TABATA Hideo (1987): [Climatic change in the Himalayas-Pollen analysis in Lake Rara-]. *Earth Month.*, 9(12):691-695, figs. 1-3, tab. 1. (ヒマラヤ地域の気候変動－ララ湖の花粉分析から－) (J.)

1784 YASUI Satoshi (1988): Molluscan fauna and paleoenvironment of the Pliocene to Pleistocene Uonuma Group in the northwestern part of Chuetsu district, Niigata Prefecture, central Japan. *Jour. Geol. Soc. Japan*, 94(4):243-256, figs. 1-6, tabs. 1-4. (新潟県中越北西部に分布する魚沼層群の軟体動物化石群と古環境) (J.E.)

1785 YASUNO Toshikatsu (1988): Discovery of a fossil stub in the bedrock of Kani River at the Kani City, Gifu Prefecture, central Japan. *Bull. Mizunami Fossil Mus.*, (14):129-132, pl. 31, figs. 1-3. (岐阜県可児市の可児川河床で発見された化石株) (J.)

1786 YASUNO Toshikatsu (1988): Discovery of an Astragalus of the odobenid from the Pliocene Strata in the western part of Joetsu City, Niigata Prefecture, Japan. *Bull. Mizunami Fossil Mus.*, (14):133-138, pl. 32, figs. 1-2, tab. 1. (新潟県上越市西部の鮮新統産セイウチ科の距骨化石) (J.)

1787 YASUNO Toshikatsu (1989): [Fossils from the Lower Miocene Ito-o Lake deposits in Fukui Prefecture]. *Res. Bull., Inst. Educ., Fukui Pref.*, (94):103-110. (福井県の下部中新統・糸生湖成層の化石) (J.)

1788 YASUNO Toshikatsu (1989): A fossil vertebral column of bony fish from the Miocene Kunimi Formation at the Ayukawa coast in Fukui City, Fukui Prefecture, Japan. *Bull. Fukui Munic. Mus., Nat. Hist.*, (36): 7-10, pl. 1,

fig. 1. (福井県鮎川海岸(中新世国見累層)産の硬骨魚類の脊椎骨化石) (J.)

1789 YASUNO Toshikatsu (1989): Fossil cyprinid discovered from the Miocene Hiramaki Formation, Gifu Prefecture, central Japan. *Bull. Mizunami Fossil Mus.*, (16):121-124, pl. 22, fig. 1.

1790 YASUNO Toshikatsu (1989): Miocene specimen of the Genus *Zacco* (Cypriridae) from the Toyooka Formation, Tango Peninsula, Kyoto Prefecture, Japan. Prof. H. Matsuo Mem. Vol., Matsuyama. 75-81, pls. 1-3, fig. 1, tabs. 1-2.

1791 **YOKOMIZO Hiroyoshi**, SATO Yuichiro and NODA Masayuki (1990): [Molluscan fossils from the Lower Cretaceous of the southern area of Mie-machi, Oita Prefecture Part 1]. *Res. Bull., Fac. Educ., Oita Univ.*, 12(1):111-129, pls. 1-4. (大分県三重町南部の下部白亜系化石－I) (J.)

1792 YOKOMIZO Hiroyoshi, SATO Yuichiro and NODA Masayuki (1990): [Molluscan fossils from the Lower Cretaceous of the southern area of Mie-machi, Oita Prefecture Part 2]. *Res. Bull., Fac. Educ., Oita Univ.*, 12(2):295-311, pls. 1-5. (大分県三重町南部の下部白亜系化石－II) (J.)

1793 **YOKOTA Satoshi** and SANO Hiroyoshi (1986): Radiolarian fossils from the Middle Jurassic Ammonites-bearing Formation of Bisho, Yatsushiro district, Kumamoto Prefecture. *NOM, Spec. Vol.*, (7):53-58, pl. 1, figs. 1-4, tab. 1. (熊本県八代郡美生の中期ジュラ紀型アンモナイト産出層からの放散虫化石) (J. E.)

1794 **YOKOYAMA Takuo** and KOIZUMI Itaru (1989): Marine transgressions on the Pleistocene Pecangan Formation in the Sangiran area, central Java, Indonesia. *Palaeogeogr. Palaeoclimat. Palaeoecol.*, 72(1/2):177-193, figs. 1-9, tabs. 1-3.

1795 YOKOYAMA Takuo and NISHIDA Shiro (1989): Age of the Pecangan Formation at Sangiran, central Jawa, Indonesia. *Sci. & Engin. Rev., Doshisha Univ.*, 30:76-86. (インドネシア, ジャワ島中部, サンギラン地域のプチャガン層の年代) (J.)

1796 **YOKOYAMA Tatsuya**, MATSUNAMI Satoshi, OKUMURA Kiyoshi (1990): The fomative process of Alluvial deposits in the Tokushima plain. *Jour. Geogr.*, 99(7): 775-789. (徳島平野の沖積層の形成過程) (J. E.)

1797 **YOON Sun** (1988): The Seoguipo molluscan fauna of Jeju Island, Korea. *Saito Ho-on Kai, Spec. Pub. (Prof. T. Kotaka Commem. Vol.)*, (3):539-545, pls. 1-5, figs. 1-2, tab. 1.

1798 **YOSHIDA Fumio** (1987): Stratigraphy and planktonic foraminiferal biostratigraphy of the Miocene Chikusa Formation at the eastern margin of the Suzuka Mountains, central Japan. *Jour. Geol. Soc. Japan*, 93(10):761-772, pls. 1-2. (鈴鹿山脈東麓の中新統千種層の岩相層序と浮遊性有孔虫化石) (J. E.)

1799 YOSHIDA Fumio (1987): Planktonic Foraminifera from the Miocene Awa Group, Mie Prefecture, central Japan. *Bull. Geol. Surv. Japan*, 38(8):473-483, pls. 1-2. (三重県中新統阿波層群の浮遊性有孔虫化石) (J. E.)

1800 **YOSHIDA Hidekazu** (1986): Upper Triassic to Lower Jurassic radiolarian biostratigraphy in Kagamigahara City, Gifu Prefecture, central Japan. *Jour. Earth Sci., Nagoya Univ.*, 34:1-21, pls. 1-17, figs. 1-5.

1801 **YOSHIDA Ken-ichi**, MIYAZAKI Shigeo, MISHIMA Hiroyuki, KAKINUMA Tomoko and NAKAMURA Kazuko (1989): Discovery of a rhinocerotid fossil from the Mio-

cene Yagii Formation in Kawamoto-machi, Saitama Prefecture, Japan. *Earth Sci.*, 43(1):43-48, figs. 1-6, tabs. 1-2. (埼玉県川本町の中新統楊井層よりサイ化石の発見) (J.)

1802 YOSHIDA Shiro (1987): Planktonic Foraminifera from the Miocene Awa Group, Mie Prefecture, central Japan. *Bull. Geol. Surv. Japan*, 38(8):473-483, pls. 1-2, figs. 1-5. (三重県中新統阿波層群浮遊性有孔虫化石) (J.E.)

1803 YOSHIDA Shizue, KATO Michio and TAI Yoshiro (1986): [Changes of foraminiferal assemblages from the western part of Harimanada, in the Seto Inland Sea (Seto-naikai)]. *Mar. Sci., Month.*, 18(9):577-582. (瀬戸内海播磨灘西方海域における有孔虫群集の変化) (J.)

1804 YOSHIDA Takashi, YOSHII Morimasa, KATADA Masato, TANAKA Keisaku, SAKAMOTO Toru and SATOH Hiroyuki (1987): Geology of the Rikuchu-Ono district. Quadrangle Ser. Scale 1:50,000, Geol. Surv. Japan, 1-70, figs. 1-38, tabs. 1-8. (陸中大野地域の地質) (J.E.)

1805 YOSHIDA Toshihide(1987): A palaeoecological study of molluscan fossil communities of the Takanabe Member, Miyazaki Group, southern Japan -with special reference to community structure. *Palaeogeogr. Palaeoclimat. Palaeoecol.*, 60(3/4):231-247, figs. 1-10, tabs. 1-5.

1806 YOSHIDA Yasuyuki, OKIMURA Yuji, KATO Makoto (1987): Early Carboniferous corals from the Omi Limestone, central Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, (148):228-245, figs. 1-11.

1807 YOSHIKAWA Shusaku, NAKAGAWA Koichi, KAWABE Takayuki, FURUTANI Masakazu and DAISHI Masahiro (1987): Reconsideration of the OD-2 and OD-1 core samples in Osaka City, central Japan. *Jour. Geol. Soc. Japan*, 93(9):653-665, figs. 1-7, tabs. 1-2. (大阪市深層ボーリングOD-2・OD-1コアの再検討) (J.E.)

SUPPLEMENTS

S1 BUJAK Jonathan P. and MATSUOKA Kazumi (1986): Taxonomic reallocation of Cenozoic dinoflagellata cyst from Japan and the Bering Sea. *Palynology*, 10:235-241, fig. 1.

S2 FUJII Shoji and SHIMIZU Masayuki (1990): On the molluscan fossils occurred from Zyono, Fukadani, Yatuo-machi, Nei-gun, Toyama Prefecture, central Japan. *Jour. Coll. Lib. & Arts, Toyama Univ., Nat. Sci.*, 23(1):1-13, pls. 1-3, figs. 1-2, tab. 1. (富山県婦負郡八尾町城生，深谷産の軟体動物化石) (J.E.)

S3 FUKUDA Yoshio (1990): [Recent topics on dinosaurs -Histology of bone supported as a warm-blooded animal-]. *Heredity*, 44(9):18-24, figs. 1-9. (恐竜をめぐる最近の話題－恐竜温血説を支持する骨細胞－) (J.)

S4 GUNJI Yukio (1989): Branching growth of ribbing patterns and the significance of concealed signals. *Jour. Theor. Biol.*, 139:251-270, figs. 1-7, tab. 1.

S5 GUNJI Yukio (1989): Molluscan pigment pattern generation by a dynamic structure with intrinsic time, illustrating subjective autonomy. In Goodwin B. C. et al. (eds.): Dynamical structure in biology. Edinburgh Univ. Press, U. K., 219-235, figs. 1-8.

S6 GUNJI Yukio (1990): Pigment color patterns of molluscs as an autonomous

process generated by asynchronous automata. *Biosystems,* 23:317-334, figs. 1-12, append. A-C.

S7 **HAMADA Takashi** (1990): [Introduction to paleontology]. *Heredity*, 44(9):10-12, figs. 1-2. (古生物学への招待) (J.)

S8 **HASEGAWA Shiro** (1988): Distribution of Recent foraminiferal fauna in Toyama Bay, central Japan. *Rev. Paleobiol., Vol. Spec.*, 803-813, pls. 1-2, figs. 1-8, tabs. 1-3.

S9 HASEGAWA Shiro, SPROVIERI Rodolfo and POLUZZI Angelo (1990): Quantitative analysis of benthic foraminiferal assemblages from Plio-Pleistocene sequences in the Tyrrhenian Sea, ODP Leg 107. *Proc. ODP, Sci. Results*, 107: 461-478, pls. 1-5, figs. 1-5, tabs. 1-6.

S10 **HORAI Satoshi** (1990): [Origin of Japanese based on gene of the ancients]. *Heredity*, 44(9):35-40, figs. 1-3, tabs. 1-2. (古代人の遺伝子で探る日本人の起源) (J.)

S11 **IBARAKI Masako** (1990): Planktonic foraminiferal biostratigraphy of the Neogene of Caleta Herradura de Mejillones, northern Chile. *Rep. Andean Stud., Shizuoka Univ., Spec. Vol.*, 3:9-16, pl. 1, figs. 1-3.

S12 IBARAKI Masako (1990): Eocene through Pleistocene planktonic foraminifers off Peru, Leg 112 -Biostratigraphy and Paleoceanography. *Proc. ODP, Sci. Results*, 31:239-262, pls. 1-3, figs. 1-6, tabs. 1-11.

S13 IBARAKI Masako (1990): Late Pleistocene planktonic foraminiferal assemblages of the coastal upwelling area off Peru (ODP Leg-112). *Rep. Fac. Sci., Shizuoka Univ.*, 24:97-105, figs. 1-5.

S14 IBARAKI Masako (1990): Geologic ages of *Lepidocyclina* in Japan with implications in the northward drift of the Izu Peninsula. In R. Tsuchi (ed.): Pacific Neogene events. Univ. Tokyo Press, 137-149, figs. 1-4, tab. 1.

S15 **KAIHO Kunio** (1990): Late Cretaceous and Paleogene intermediate water benthic Foraminifera of Hokkaido. Guidebook for the field trip no. 1, 4th International Symposium on benthic Foraminifera. Sendai, A1-A26, pls. 1-6, figs. 1-16, tab. 1.

S16 **KANIE Yasumitsu**, SUGIURA Akihiro and EGAWA Kimiaki (1986): Submarine observations on *Mikadotrochus beyrichii* (Archaeogastropoda) in Sagami-nada, central Honshu, Japan. *Venus, Japan. Jour. Malacol.*, 45(3):203-209, pl. 1, figs. 1-2, tabs. 1-2.

S17 **KOBAYASHI Satoru**, MATSUOKA Kazumi and IIZUKA Shouji (1986): Distribution of dinoflagellata cysts in surface sediments of Japanese coastal waters. 1. Omura Bay, Kyushu. *Bull. Plankton Soc. Japan*, 33(2):81-93, pl. 1, figs. 1-3. (日本沿岸表層堆積物中の渦鞭毛藻) (J.E.)

S18 **MASUDA Fujio** (1986): Can the elemental contents in skeletal carbonates be used as paleothermometer ? *Jour. Geogr.*, 95(1):1-26, figs. 1-13, tab. 1. (炭酸塩生物殻中の元素含量は古水温計となりうるか) (J.E.)

S19 MASUDA Fujio, ISHIBASHI Masatoshi and ITO Makoto (1987): A new locality of marine molluscan fossils from the Late Pleistocene on the northern margin of the Paleo-Tokyo Bay: Takasai, Shimozuma City, Ibaraki. *Tsukuba Environ. Stud.*, (10):79-89, pl. 1, figs. 1-2, tab. 1. (下末吉期の古東京湾北縁の貝化石新産地：茨城県下妻市高道祖小渡) (J.E.)

S20 MASUDA Fujio and YOKOKAWA Miwa (1988): [Events read from the Pleistocene beach deposits]. *Earth Month.*, 10(8):523-530, figs. 1-8. (地層の海浜堆積物から読み取れるもの) (J.)

S21 MASUDA Fujio and YOKOKAWA Miwa (1988): Pleistocene beach deposits in Tsukuba upland. *Tsukuba Environ. Stud.*, (11):113-122, pls. 1-2. (筑波台地の更新統の海浜堆積物) (J.E.)

S22 **MATSUOKA Kazumi** and FUKUYO Yasuwo (1986): Cyst and motile morphology of a colonial dinoflagellate *Pheopolykrikos hartmanni* (Zummermann) comb. nov. *Jour. Plankton Res.*, 8(14):811-818, figs. 1-22.

S23 MATSUOKA Kazumi, FUKUYO Yasuwo and ANDERSON Donald M. (1988): The cyst and theca of *Gonyaulax verior* Sournia (Dinophyceae) and their implication for the systematics of genus *Gonyaulax sourui*. *Japan. Jour. Phycology*, 36(4): 311-320, figs. 1-16, tab. 1.

S24 **MURAKAMI Shiori** (1989): Distribution of Japanese living Chitons. *Benthos Res.*, (37):65-71, figs. 1-3. (日本産現生ヒザラガイ類の分布) (J.E.)

S25 **NISHIDA Harufumi** (1990): [What covers the seeds -From Gymnosperm to Angiosperm-]. *Heredity*, 44(9):25-29, figs. 1-5. (何が種子を包んだか－裸子植物から被子植物へ－) (J.)

S26 **NISHIDA Shiro** (1986): Nannoplankton flora in the southern ocean, with special reference to siliceous varieties. *Mem. Natn. Inst. Polar Res., Spec. Issue*, 40:56-68, pl. 1, figs. 1-4, tabs. 1-2.

S27 **NOHARA Tomohide** (1986): Some Cenozoic ostracodes of Okinawa-jima, Japan. International Symposium on Shallow Tethy 2. Wagga Wagga, 15-17, pl. 1, figs. 1-3.

S28 NOHARA Tomohide (1987): Cenozoic ostracodes of Okinawa-jima. *Bull. Coll. Educ., Univ. Ryukyus*, (30) pt. 3:1-105, pls. 1-16, tabs. 1-3.

S29 NOHARA Tomohide, ITOSE Hidetoshi and TABUKI Ryoichi (1988): Ostracodes in the core off Miyakojima in the Ryukyu Islands. *Bull. Coll. Educ., Univ. Ryukyus*, (32) pt. 2:173-183, pls. 1-2, figs. 1-5, tabs. 1-2. (沖縄県宮古島東方沖ピストンコア中の貝形虫について) (J.E.)

S30 **OBATA Ikuo** (1990): [Some interesting fossils from Japan]. *Heredity*, 44(9):13-17, figs. 1-6. (日本から出た興味深い化石) (J.)

S31 **OHANA Tamiko**, KIMURA Tatsuaki and KAWAZOE Akira (1989): Some fossil plants newly found from the Lower Cretaceous of Kochi Prefecture, in the Outer Zone of Japan. *Asian Jour. Pl. Sci.*, 1(2):53-68, figs. 1-24.

S32 **OKI Kimihiko** (1990): Benthic Foraminifera in Kagoshima Bay, south Kyushu, Japan. Guidebook for the field trip no. 5, 4th International Symposium on benthic Foraminifera. Sendai, F1-F25, pls. 1-22, figs. 1-6.

S33 **OMORI Masae** (1990): [Stories on some relict animals. 2. *Lingula unguis*]. *Aquabiology*, 12(6):466-468, figs. 1-4. (レリクト物語 2．シャミセンガイ) (J.)

S34 **ONISHI Ikuo**, WATANABE Masami and UCHIDA Ritsuo (1988): Wood fossils from the Nishikawatsu Site in Matsue City. *Stud. San'in Reg., Nat. Environ., Shimane Univ.*, (7):65-79, figs. 1-3, tab. 1, photos. 1-45. (松江市，西川津遺跡の材化石) (J.E.)

S35 **Oshiro Itsuro** (1987): [Missing animals]. Fossils in Okinawa. Shinsei Tosho-

shuppan, Naha, 1-126. (失われた生物) (J.)

S36 **OSOZAWA Soichi** (1986): Geology of the southern Setogawa Belt; Takakusayama and its western district. In H. Nakagawa, T. Kotaka and Y. Takayanagi (eds.): Essay in geology, Prof. N. Kitamura Commem. Vol., Sendai, 337-350, figs. 1-5, tabs. 1-3.

S37 OSOZAWA Soichi (1988): Accretionary process of the Tertiary Setogawa and Mikasa Groups, southwest Japan. *Jour. Geol.*, 96:199-208, figs. 1-9.

S38 **OZAWA Tomowo** and KOBAYASHI Fumio (1990): Carboniferous to Permian Akiyoshi Limestone Group. Guidebook for the field trip no. 4, 4th International Symposium on benthic Foraminifera. Sendai, E1-E31, pls. 1-13, figs. 1-16.

S39 **SAITO Isao** and ISHIGAKI Takehisa (1988): Stratigraphy and trace fossils of the Neogene Manzawa Formation in the lower Fuji River area, central Japan. *Mem. Fac. Lib. Arts & Educ., Yamanashi Univ.*, (39) pt.2:89-93, pl. 1, figs. 1-2. (富士川下流域の新第三系万沢累層の層序と生痕化石) (J.E.)

S40 **SAITO Toshio**, NEMOTO Masaki, YANAGISAWA Ichiro, NEMOTO Mamoru and MARUYAMA Toshiaki (1989): [Tertiary in the Joban district]. Guidebook at the 96th Annual Meeting of Geological Society of Japan, Mito, 87-103, figs. 1-19. (常磐地域の第三系) (J.)

S41 **SAITO Yasuji** (1986): [Deep-sea siliceous deposits constructed Islands of Japan]. *Kagaku*, 56(3):141-145, figs. 1-5. (日本列島をつくった深海ケイ質堆積物) (J.)

S42 SAITO Yasuji, TIBA Tokiko and MATSUBARA Satoshi (1988): Precambrian and Cambrian cherts in northwestern Tasmania. *Bull. Natn. Sci. Mus., Tokyo, Ser. C*, 14(2):59-70, pls. 1-3, figs. 1-3.

S43 **SAKAI Harutaka** (1988): Toi-misaki olistostrome of the Southern Belt of the Shimanto Terrane, south Kyusyu -2. Deformation structures of the huge submarine slides and their processes of formation. *Jour. Geol. Soc. Japan.*, 94(11):837-853, pls. 1-4, figs. 1-10. (南九州, 四万十帯南帯の都井岬オリストストローム, 2. 巨大海底地辷りによる変形構造とその形成過程) (J.E.)

S44 **SAKAI Kazuhiko** and IKEMA Tomoko (1988): [Observations for coral-reefs and tidal-zones in Sesoko-jima, Okinawa]. Guidebook at the 95th Annual Meeting of Geological Society of Japan. Okinawa, 17-20, figs. 5.1-5.5. (瀬底島サンゴ礁と潮間帯の観察) (J.)

S45 **SAKAI Toyosaburo**, MATSUI Seiichiro, TAKAI Yuki and BAN Atsushi (1989): [Tertiary in the Shiobara district, Tochigi Prefecture]. Guidebook at the 96th Annual Meeting of Geological Society of Japan. Mito, 105-124, figs. 1-17. (栃木県塩原地域の第三系) (J.)

S46 **SATO Tadashi**, SASHIDA Katsuo and KASAI Katsumi (1989): [Mesozoic in the Yamizo Mountains]. Guidebook at the 96th Annual Meeting of Geological Society of Japan. Mito, 31-54, figs. 1-25, tab. 1. (八溝山地の中生界) (J.)

S47 **SATO Tokiyuki** and TAKAYAMA Toshiaki (1990): Age assignment based on calcareous nannofossil. *Jour. Japan. Assoc. Petrol. Tech.*, 55(2):121-128, figs. 1-7. (石灰質ナンノ化石を使うと地質時代はどこまで分かるか) (J.)

S48 **SHIMAMOTO Masanori** (1989): Consideration in ontogeny and phylogeny of bivalves. *Jour. Foss. Res.*, 21:24-29, figs. 1-4. (二枚貝を例とした個体発生と系統発生についての考察) (J.)

S49 **SHUTO Tsugio** (1990): Origin of a subtropical fauna in the Middle lattitude as exemplified by the Kakegawa Fauna. *Bull. Mar. Sci.*, 47(1):10-22, figs. 1-7, tabs. 1-2.

S50 SHUTO Tsugio (1990): Chilean late Miocene turrid fauna in comparison with those of southeast Asia. *Rep. Andean Stud., Shizuoka Univ., Spec. Vol.*, 3: 33-36, tabs. 1-2.

S51 **SPROVIERI Rodolfo** and HASEGAWA Shiro (1990): Plio-Pleistocene benthic foraminifer stratigraphic distribution in the deep-sea record of the Tyrrhemian Sea (ODP Leg 107). *Proc. ODP, Sci. Results.*, 107:429-459, pls. 1-5, figs. 1-19, tab. 1.

S52 **SUZUKI Naoki** and HAMADA Takashi (1990): [Anatomical notes on Living fossil Coelacanth]. *Heredity*, 44(9):30-34, figs. 1-6. (生きている化石シーラカンスの解析) (J.)

S53 **TABUKI Ryoichi**, NAKANO Takayuki and NOHARA Tomohide (1987): Preliminary report on Ostracoda fauna from Sekisei-sho area, Yaeyama Islands. *Bull. Coll. Educ., Univ. Ryukyus*, (31) pt. 2:323-335, pls. 1-2, fig. 1, tabs. 1-3. (八重山群島・石西礁海域の貝形虫群集(予報)) (J.E.)

S54 TABUKI Ryoichi and NOHARA Tomohide (1988): [Foraminifers and ostracodes of coastal deposits in Okinawa]. Guidebook at the 95th Annual Meeting of Geological Society of Japan. Okinawa, 9-12, figs. 3.1-3.5. (沿岸堆積物中の有孔虫および貝形虫) (J.)

S55 **TAKAHASHI Jiro**, YOKOTA Yoshinori, KAWANISHI Jun and INOUE Shuya (1990): Geology of the Iyo City -Futami Town area, Ehime Prefecture. *Mem. Fac. Educ., Ehime Univ., Ser. 3*, 10:19-29, pl. 1, figs. 1-3. (愛媛県伊予市および伊予郡双海町付近の地質) (J.E.)

S56 **TAKAYAMA Toshiaki**, KANEKO Minoru and TANAKA Hiroyuki (1986): On the geological age of Akaya Formation, Gunma Prefecture, based on the calcareous nannofossils. *Bull. Gunma Pref. Mus. Hist.*, (7):1-15, pl. 1, figs. 1-6, tabs. 1-2. (石灰質ナンノ化石からみた赤谷層の地質時代) (J.E.)

S57 TAKAYAMA Toshiaki, SATO Tokiyuki and SPAULDING Stacia A. (1990): [Deposits of Arabian Sea based on microfossils]. *Kaiyo Month.*, 22(6):343-347, figs. 1-3. (微化石から見たアラビア海の堆積物) (J.)

S58 **TAMURA Minoru** (1987): Distribution of Japanese Triassic bivalve faunas and sedimentary environment of Megadont Limestone in Japan. In A. Taira and M. Tashiro (eds.): Historical biogeography and plate tectonic evolution of Japan and Eastern Asia. Terrapub, Tokyo, 97-110, figs. 1-4.

S59 **TASHIRO Masayuki**(1990): Bivalve fossils from the Sanyama Formation in Sanchu, Kwanto Mountains. *Res. Rep., Kochi Univ., Nat. Sci.*, 39:29-37, pl. 2, figs. 1-2. (山中の三山層からの二枚貝化石) (J.E.)

S60 TASHIRO Masayuki and IKEDA Masahisa (1987): Cretaceous System of the Yatsushiro Mountains. *Res. Rep., Kochi Univ., Nat. Sci.*, 36:7-91, figs. 1-9, tab. 1. (熊本県八代山地の下部白亜系) (J.E.)

S61 TASHIRO Masayuki and KATTO Jiro (1986): Upper Jurassic molluscan fauna of the Shimanto Belt in Shikoku. *Res. Rep., Kochi Univ., Nat. Sci.*, 34:121-127, pl. 1, figs. 1-2, tab. 1. (四万十帯のジュラ紀貝化石) (J.E.)

S62 TASHIRO Masayuki and KOZAI Takeshi (1989): Bivalve faunal correlation of the Cretaceous System of northeast Japan with that of southwest Japan. *Earth*

Sci., 43(3):129-139, pl. 1, figs. 1-6, tab. 1. (二枚貝フォーナからみた東北日本と西南日本の白亜系の関連について) (J.E.)

S63 TASHIRO Masayuki, SAKO Motonori and NAKAMURA Akio (1986): On the molluscan fossils from the Izumi Group of Saijo City in Ehime Prefecture, Shikoku. *Res. Rep., Kochi Univ., Nat. Sci.*, 35:55-61, pl. 1, fig. 1. (愛媛県西条市周辺の和泉層群二枚貝化石) (J.E.)

S64 **WATANABE Akira** (1986): Relationship of shell height to shell length of *Peronidea*. *Ann. Rep., Akita Pref. Mus.*, (11):109-118, pls. 1-2, figs. 1-7. (サラガイの殻長と殻高の関係) (J.)

S65 **YAMAMOTO Satoshi** (1988): [Red-clay polutions and coral-reefs]. Guidebook at the 95th Annual Meeting of Geological Society of Japan. Okinawa, 13-16, figs. 4.1-4.3, tab. 4.1. (赤土汚染とサンゴ礁) (J.)

S66 **YAMANA Iwao** (1988): [Recent and Alluvial molluscan shells from San-in coastal areas]. *Res. Rep., Tottori Educ. Train. Cent.*, (42):147-160, pls. 1-2, figs. 1-6, tab. 1. (山陰沿岸の現生貝類と沖積層中の化石貝類) (J.E.)

S67 YAMANA Iwao (1989): [Fossil Arcidae and Potamididae from Tottori Prefecture]. *Res. Rep., Tottori Educ. Train. Cent.*, (43):159-171, pls. 1-3, figs. 1-3. (鳥取県内における化石フネガイ科－ウシニナ科群集について) (J.)

S68 YAMANA Iwao (1989): Significance of a fossil of pisces found from Sangun metamorphic zone. *Bull. Tottori Pref. Mus.*, (26):33-39, pls. 1-2, fig. 1. (三郡変成帯より魚化石の発見とこれに関連する知見) (J.)

S69 YAMANA Iwao and TAKAYASU Katsumi (1987): [Fossils from the Tari Formation in Tottori Prefecture]. Nichinan-cho Educational Boad. Tottori, 1-85, pls. 1-30, figs. 1-12. (多里層の化石) (J.)

S70 YAMANA Iwao and TAKAYASU Katsumi (1987): Shell dredged from the east coast of Yumigahama Peninsula (Takenouchi area), Tottori Prefecture -Note on Recent Mollusca from the San-in district (3)-. *Geol. Rep., Shimane Univ.*, 6:141-147, figs. 1-3, tab. 1. (弓ケ浜東岸（竹内地区）における浚渫砂中の貝類－山陰地方貝類資料－３) (J.E.)

S71 **YAMASHIRO Junichi** (1986): On the molluscan fossils from the Diluvial deposits of Tenneru, Kushiro-cho, Hokkaido. *Bull. Kushiro City Mus., Hokkaido*, (11):71-76, pls. 1-2, figs. 1-3, tab. 1. (北海道釧路町天寧から産出した洪積層貝化石について) (J.)

S72 YAMASHIRO Junichi (1987): On the molluscan fossils from Alluvial deposits of Iwabokki and Musa in Kushiro, Hokkaido. *Bull. Kushiro City Mus., Hokkaido*, (12):31-36, pls. 1-2, figs. 1-3, tab. 1. (北海道釧路町岩保木及び釧路市武佐の沖積層貝化石について（予報)) (J.)

S73 YAMASHIRO Junichi (1988): On the mean value of latitude in the distribution of Quaternary molluscan fossils from Kushiro, Hokkaido. *Bull. Kushiro City Mus., Hokkaido*, (13):35-38, tabs. 1-2. (北海道釧路市から産出した第四紀貝化石の緯度の中央値について) (J.E.)

S74 YAMASHIRO Junichi (1989): On the molluscan assemblage from the Diluvial deposits of Harutori in Kushiro, Hokkaido. *Bull. Kushiro City Mus., Hokkaido*, (14):17-24, pls. 1-3, figs. 1-3, tab. 1. (北海道釧路市春採から産出した洪積層貝化石について) (J.E.)

S75 **YOSHIZU Kenichi** and OKADA Hakuyu (1989): Sedimentological study of Miocene Yuya-wan Group, Yamaguchi Prefecture, southwest Japan. *Sci. Rep., Dept. Geol. Kyushu Univ.*, 16(1):1-17, pls. 1-3, figs. 1-16. (山口県新第三紀油谷湾層群の堆積地質学的研究) (J.E.)

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TERTIARY MOLLUSCAN FAUNA FROM THE YAKATAGA DISTRICT AND ADJACENT AREAS OF SOUTHERN ALASKA

By

Saburo KANNO

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TERTIARY MOLLUSCAN FAUNA FROM THE YAKATAGA DISTRICT AND ADJACENT AREAS OF SOUTHERN ALASKA

By

Saburo KANNO

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ABSTRACT

The Tertiary system developed in the Yakataga District is subdivided into three formations named Yakataga, Poul Creek, and Kulthieth in descending order. These three formations are apparently conformable in the Yakataga Reef area, but the Yakataga overlaps the Poul Creek and Kulthieth with unconformity in the eastern part of the Yakataga District and in the adjacent Malaspina District.

The three formations yield abundant molluscan fossils of 62 genera and 104 species, of which 9 species are new. Each formation yields its own characteristic molluscan fauna. The Kulthieth fauna consists of a few marine and fresh water mollusks suggestive of warm water conditions. The Poul Creek fauna, which includes marine mollusks of 46 genera and 70 species, is characterized by inhabitants of the upper neritic zone of subtropical to temperate marine waters. The Yakataga fauna, which includes marine mollusks of 22 genera and 34 species, is characterized by a shallow and cold water fauna comparable with that which now occupies the littoral to neritic zone in the Gulf of Alaska. However, the Yakataga fauna is represented by rather deeper water dwellers in the western part of the Yakataga District, whereas the littoral fauna is dominant in the eastern part of this district.

Yakataga and Poul Creek faunas consist of 1) Alaskan species, 2) Washington and Oregon species, 3) Asian species, and 4) living species in the northern Pacific region. The percentage of Alaskan, Washington and Oregon, Asian, and living species in the northern Pacific regions in the Yakataga fauna is 38.7/3.3/25.8/32.2, whereas in the Poul Creek fauna it is 34.0/35.8/26.4/3.8. The Kulthieth fauna represents a fresh water to littoral environment with water temperatures of 15° to 25°C. The Poul Creek fauna represents a subtropical (no month cooler than 10°C) fauna that inhabited waters 200 to 20 meters in depth. The Yakataga fauna consists of boreal species that lived mostly in the littoral zone in waters less than 60 meters deep, excepting in the western part of the mapped area.

The Kulthieth formation is of late Paleocene to Eocene age, the Poul Creek formation is possibly Oligocene to early Miocene age, and the Yakataga formation is middle to late Miocene to probably Pliocene age. The Kulthieth formation correlates with the Eocene formations developed around Puget Sound in Washington, the Tigiri group of Kamchatka, and the Ishikari group in Hokkaido of northern Japan. The Poul Creek formation correlates mostly with the Blakeley and Twin River formations in Washington, the Kobatin and Animan formations in Kamchatka and the Poronai and Momijiyama as well as Horomui formations in Hokkaido of Japan. The Yakataga formation correlates with the upper part of the Astoria and Clallam formations in Washington and Oregon, the Bayampoli group in Kamchtka, the Kawabata group (Takinoue, Kawabata, and Oiwake formotions) and possibly the Takikawa formation in Hokkaido of Japan.

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I. INTRODUCTION

PRESENT STUDY

The writer has studied the Tertiary molluscan fauna from the western Pacific regions, mainly the districts of northern Japan, and has been interested in the Oligocene to Pliocene mollusks from the standpoint of faunal changes and migration. In 1968 the writer had an opportunity to study the molluscan fauna of the west coast of North America including the Gulf of Alaska region during a one-year visit to the United States sponsored by the Ministry of Education of Japanese Government. Field work in the Yakataga District was carried out in August of 1968, during which time a fairly large number of molluscan fossils were collected from the Yakataga, Poul Creek, and Kulthieth formations.

Since the summer of 1968, the writer studied the molluscan fauna that he collected from the Tertiary sequence exposed along the coast of the Gulf of Alaska as well as the extensive collections of the U. S. Geological Survey, the California Academy of Sciences, the Pan American Petroleum Corporation, the Standard Oil Company of California, and the Phillips Petroleum Company. Most of the writer's work on the Gulf of Alaska faunas was done at the U. S. Geological Survey in Menlo Park, California, but part of it was completed at the Tokyo University of Education, Japan.

The specimens treated in this report are mostly from the area between Duktoth Mountain in the Yakataga District to Samovar Hills in the Malaspina District, but in part they include those collected elswhere in the Gulf of Alaska region. Namely they are from: 1) Samovar Hills, 2) Chaix Hills, 3) Kaar Hills, 4) Beare Glacier, 5) Big River, 6) Lare Glacier, 7) Little River, 8) Johnston Creek, 9) Munday Creek, 10) Poul Creek, 11) Shokum Creek, 12) White River, 13) Yakataga Reef, 14) Yakataga Glacier, 15) Brower Ridge, 16) Ductoth Mountain, 17) Kayak and Wingham Islands (Text-fig. 1).

The purpose of this report is primarily to describe and illustrate the mollsks from the Yakataga, Poul Creek, and Kulthieth formations of the Yakataga District and adjacent areas along the Gulf of Alaska, and to reconsider their geologic ages, biologic affinities, and stratigraphic implications. The present work is also concerned with the problem of middle Tertiary faunal migration and climatic changes in the northern Pacific region. The writer has furthermore attempted to correlate the middle Tertiary faunal sequence of the Yakataga District with that of Kamchatka, Japan, and Washington and Oregon.

In addition, the type specimens studied by CLARK (1932) and mollusks from the Tertiary formations in Washington, Oregon, and California were restudied, and new materials were obtained from the type localities of those formations.

The molluscan fossils from the Yakataga District deposited at the U. S. Geological Survey and some oil companies were also restudied by the writer.

Specific names proposed by CLARK in 1932 have been used by many authors despite the fact that some types were represented by deformed specimens or their descriptions were very brief. In the present work specific names follows CLARK's 1932 usage as far as possible, but new names are proposed for some specimens.

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HISTORICAL REVIEW

The first systematic geologic investigation of the present area was made by MADDREN in 1913 to study the placer gold deposits and possibilities of petroleum and coal. His results were published by the U. S. Geological Survey in 1914.

During the summer of 1920 TALIAFERRO engaged in a geological survey of the Controller Bay to Icy Bay region, the results of which were published in 1932. He recognized two formations, the Yakataga and Poul Creek (in descending order), in Tertiary sediments of the area. He pointed out that no unconformity occurs in the

sequence, though the Tertiary strata totalled around 2400 to 3000 meters in thickness. Moreover, he emphasized the presence of glacial debris in the sediments, and concluded that the climatic conditions during upper Oligocene time were the same as those at the present time.

CLARK's result of study (1932) of the fossils collected by TALIAFERRO in 1920 from the Poul Creek and Yakataga formations is the first published systematic description of the mollusks from the area. He recognized 42 taxa, including 24 newly described species or subspecies, and concluded that the mollusks indicated a late Oligocene age. Faunas from both the Poul Creek and Yakataga formations were correlated with faunas from the Blakeley "horizon" of western Washington and the Sooke formation of Vancouver Island. According to CLARK there was little faunal change between the Poul Creek and Yakataga formations, moreover, he estimated that the water temperatures were presumed to have been cool, with conditions similar to the present conditions in the Gulf of Alaska.

SCHENCK (1931) described a new subspecies of Cephalopoda, *Aturia angustata alaskensis*, from the upper part of the Poul Creek formation in the Gulf of Alaska. He pointed out that the genus *Aturia* has not been found in rocks younger than middle Miocene on the Pacific coast of North America. He (1936) also described nuculid bivalves of the genus *Acila*, and reviewed three middle Tertiary species from the Gulf of Alaska described by CLARK (1932), one of which he renamed *Acila taliaferroi* instead of *Nucula* (*Acila*) *hamiltonensis* CLARK (1932, p. 806, pl. 14, figs. 11, 14).

MERRIAM (1941) described fossil *Turritella* from the Pacific coast of North America, including *Turritella hamiltonensis* CLARK from the Yakataga District.

A field party representing a group of oil companies made a geologic investigation of the southern part of the Robinson Mountains in the Yakataga District during 1938 and intensive field mapping, geophysical work, and exploratory drilling have been carried out by a number of oil companies since 1951. Except for a report on the regional structural development of the Gulf of Alaska sedimentary rocks by STONELY (1967), the results of the investigations have not been published.

Field studies also have been intermittently conducted by the U. S. Geological Survey between 1944 and 1970 to obtain basic geologic information required to appraise the petroleum possibilities of the Gulf of Alaska Tertiary province. MILLER (1951) reported the preliminary report on the geology and oil possiblities of the Yakataga District. He described the occurrence of a few mollusks of late Eocene age from the Kulthieth formation. He considered the Poul Creek formation to be of middle and late Oligocene age and the Yakataga formation to be Miocene. The former contains mollusks indicative of correlation with the Lincoln and Blakeley formations of Washington. He also pointed out that many of the species listed by CLARK (1932) from the Yakataga formation are actually from the underlying Poul Creek formation. Moreover, he indicated the stratigraphic ranges of some diagnostic mollusks in the Poul Creek and Yakataga formations on a correlation chart.

In 1957, MILLER published a geologic map of the southeastern part of the Robinson Mountains, Yakataga District. According to F. S. MACNEIL's study of the molluscan fauna collected by MILLER and previous workers from the Kulthieth, Poul

Creek, and Yakataga formations in the Yakataga District is of late Eocene, middle(?) and late Oligocene to early Miocene, and of middle to late Miocene and early Pliocene(?) age respectively. MILLER plotted the stratigraphic ranges of 69 significant mollusks from the Poul Creek and Yakataga formations together with taxonomic notes, and he showed the number of collections in a range chart. He also emphasized the environmental characteristics of the respective fauna, e. g., the Poul Creek fauna indicates warm temperate or subtropical water temperatures, and the Yakataga fauna shows much cooler conditions. This interpretation differs markedly from CLARK's (1932), who saw little environmental difference between the Poul Creek and Yakataga faunas.

PLAFKER and MILLER (1957) published the reconnaissance geology of the Malaspina District, just east of the Yakataga District. The sequence of Tertiary and probable Tertiary age is subdivided into an unnamed siltstone sequence of early Tertiary age, the Kulthieth formation of Paleocene and Eocene age, and the Yakataga formation of Miocene and Pliocene(?) age. The authors' early Tertiary siltstone sequence and the Kulthieth formations were correlated by L. G. HERTLEIN with the upper Eocene Cowlitz formation of Washington. They reported the occurrence of *Turritella uvasana sargeanti* ANDERSON and HANNA from the Kulthieth formation in the Samovar Hills which suggests a late Eocene age. *Ostrea iridaensis fettkei* WEAVER also occurs in this bed. More recent work by ADDICOTT and PLAFKER (1971) indicates that the "*Turritella*" is actually the middle Eocene *Cristispira pugetensis* ALLISON and that the Kulthieth formation contains the late Paleocene species *Turritella merriami brevitabulata*. These mollusks, in combination with an abundant flora and sparse microfauna, suggest that the Kulthieth formation ranges in age from late Paleocene through late Eocene and that the unnamed siltstone units is of Paleocene through middle Eocene age. *Mytilus* and *Mya* are abundant in the Yakataga formation of the Malaspina District, which, together with abundant marine tillite deposits, suggest cool climatic conditions.

MILLER, PAYNE, and GRYC (1959) reported the geology of possible petroleum provinces in Alaska. They pointed out that local glaciation started in the middle or late Miocene in the Gulf of Alaska region on the basis of the presence of marine glacial deposits and characteristic mollusks in strata of this age.

MACNEIL (1961) described *Lituyapecten*, a new subgenus of *Patinopecten*, from Alaska, which included three species of *P.* (*L.*) *yakatagensis*, *P.* (*L.*) *lituyaensis*, and *P.* (*L.*) *poulcreekensis*, all from the Gulf of Alaska Tertiary province. In the same publication MILLER (1961b) also reported the stratigraphic occurrence of *Lituyapecten* in southern Alaska, describing the stratigraphic relations of eight Miocene and Pliocene species of *Lituyapecten* and *Patinopecten*. He divided the Tertiary sequence of the Gulf of Alaska into three parts, i. e., the lower Tertiary represented by nonmarine sediment intercalated with marine strata which include marine invertebrates indicative of tropical or subtropical conditions; the middle Tertiary consisting of more marine strata of somewhat deeper conditions, and the upper Tertiary of pure marine of shallow water aspect, including marine tillites.

PLAFKER (1967) published a compilation geologic map of the Gulf of Alaskan Tertiary province with the explanation, in which the occurrence of marine fossils

was indicated. On the basis of molluscan faunas identified by F. S. MACNEIL, he concluded that the Yakataga formation is of middle Miocene to lower Pleistocene age and the Poul Creek formation and its equivalents are of middle(?) and late Oligocene and early Miocene age.

STONELEY (1967) reported the occurrence of a few oyster coquinas in the Kulthieth formation (Eocene) near the head of Malaspina Glacier, interpreting that this coquina-bearing formation may become more marine toward the northern part of its outcrop area.

DENTON and ARMSTRONG (1969) described the Miocene-Pliocene glaciations in southern Alaska, and reviewed the published data on molluscan assemblages from the Yakataga formation. They emphasized the cool conditions during Yakataga time based on the molluscan fauna and the marine tillites which occur stratigraphically well below mollusks of late Miocene age. However, they also pointed out that the molluscan assemblages underlying the Miocene marine tillites suggested subtropical and temperate marine conditions.

TAKEDA (1953) published the Poronai formation of Hokkaido and south Sakhalin and its fossil fauna, mentioning that the Poronai fauna was quite different from the Yakataga and Poul Creek faunas. Namely, there is no occurrence of such genera as *Colus*, *Cancellaria*, and *Echinophoria* in the Poronai formation, whereas these genera are abundant in the Alaskan Tertiary. The first appearance of *Echinophoria* and *Chione* in Hokkaido is the next younger stage above strata of Poronai age.

DURHAM and SASA (1961) compared the fauna of the Poronai formation of Japan with west American middle Tertiary faunas. They pointed out twenty-three mollusks from the Poronai formation of Hokkaido that were very similar to species of "Blakeley stage" of Oregon, Washington, and Alaska and they correlated the Poronai with the Poul Creek of Alaska, and the Blakeley and Yaquina formations of Washington and Oregon.

MACNEIL, WOLFE, MILLER, and HOPKINS (1961) correlated Tertiary formations of Alaska, emphasizing that many Alaskan species were more closely related to Asian stocks.

The only published foraminiferal studies of the Tertiary formations in Alaska are those of RAU (1963) and BANDY et al. (1969). RAU (1963) described the foraminifers from the upper part of the Poul Creek formation of southeastern Alaska. He described and illustrated nineteen species of Foraminifera from the upper part of the Poul Creek formation exposed in the Yakataga District. The assemblage was referred to the Saucesian stage of the Miocene sequence of the Pacific coast. He pointed out that the Poul Creek foraminiferal fauna inhabited moderately shallow and warm marine water, based upon comparison of the assemblage with modern faunas.

BANDY, BUTLER, and WRIGHT (1969) described Foraminifera from the late Tertiary marine glacial deposits in the Yakataga Reef area. They pointed out that the Poul Creek formation of Oligocene and Miocene age contained a fauna of temperate or subtropical aspect and that the overlying Yakataga formation (Miocene to Pliocene) yielded a mostly cool or cold water molluscan fauna. The appearence of the sinistral planktonic foraminifer *Turborotalia pachyderma* in the Yakataga formation is

taken by them as suggestive of the existence of glaciation during the late Miocene.

WOLFE (1969) described the Paleogene floras from the Gulf of Alaska region, in which he noted that the climate during late Eocene time was characterized by a lack of frost, and a mean annual temperature of 22° to 25°C.

ADDICOTT, KANNO, et al. (1971) revised CLARK's type specimens which are deposited in the University of California at Berkeley.

In 1971 MILLER's map of the Yakataga District was published on a scale of 1 : 125.000 with accompanying text and tables showing the stratigraphic range of selected mollusks, foraminifers, and fossil plants collected in the district.

II. Brief Note on the Geology of the Yakataga District and Adjacent Areas

The bedrock exposed in the Gulf of Alaska has been broadly divided into four units (PLAFKER and MILLER, 1957; PLAFKER, 1967) as Mesozoic and older(?) rocks, Jurassic(?) and Cretaceous rocks, Cretaceous or Tertiary rocks, and Tertiary rocks. The oldest rocks consist chiefly of a crystalline complex that includes granitic rocks, schist, gneiss, amphibolite, and marble which are deformed and moderately to intensely metamorphosed. The second unit, the Yakutat group, consists of graywacke, argillite, and slate with minor conglomerate which are strongly deformed and locally metamorphosed; it locally contains sparse megafossils of *Inoceramus* and *Buchia* indicating a late Jurassic(?) and early Cretaceous age, and one foraminifer of probable late Cretaceous or Paleocene age (BRABB and MILLER, 1962). The third unit consists of intrusive igneous rocks mainly quarts diorite and granodiorite with minor quartz monzonite and mafic intrusive rocks, which are believed to be of Cretaceous or earliest Tertiary age. The fourth unit consists mainly of bedded clastic and volcanic rocks ranging from Paleocene to Pliocene, or possibly Pleistocene, in age.

These rock units trend WNW to ESE almost parallel with the sea coast. In general, the older rocks are inland and the younger strata are arranged towards the south (on the outer side, or sea side). The actual relationship between them are commonly obscured by structural complications but there are unconformities at certain places.

The Tertiary rocks exposed in the area of this report are thick sedimentary strata ranging in age from early Tertiary to late Tertiary or in some part of the Pleistocene. The sequence developed along the coast of the Gulf of Alaska has been subdivided by previous workers into Yakataga, Poul Creek, and Kulthieth formations in descending order. In some areas these formations are separated by unconformities, but elswhere they are conformable or are separated by faults.

Kulthieth Formation

The oldest rocks in the Tertiary sequence of the area are represented by the Kulthieth formation which is restricted in a narrow belt on the northern side of Miller Creek Fault and in the Samovar Hills (Text-fig. 1).

The type locality of the Kulthieth formation was designated in the vicinity of the small lake at the head of the northeasternmost branch of the Kulthieth River (MILLER, 1957), where it characteristically has a distinctive banded or striped appearance and consists largely of a yellowish-orange colored coal-bearing sandstone sequence.

In a small area of the Samovar Hills arkosic sandstone and siltstone intercalated with black coal and carbonaceous shale similar to those of the type Kulthieth formation crop out. This rock sequence was correlated with the Kulthieth formation by PLAFKER and MILLER (1957). According to their study, the Kulthieth formation in the Samovar Hills is subdivided into an upper and a lower units separated by an unconformity. Although the lower part of the Kulthieth consists mainly of leaf-bearing terrestrial deposits, it is intercalated with marine strata which yields the marine mollusks *Cristispira pugetensis* ALLISON and *Ostrea* sp., as well as with non-marine *Corbicula* bearing beds.

POUL CREEK FORMATION

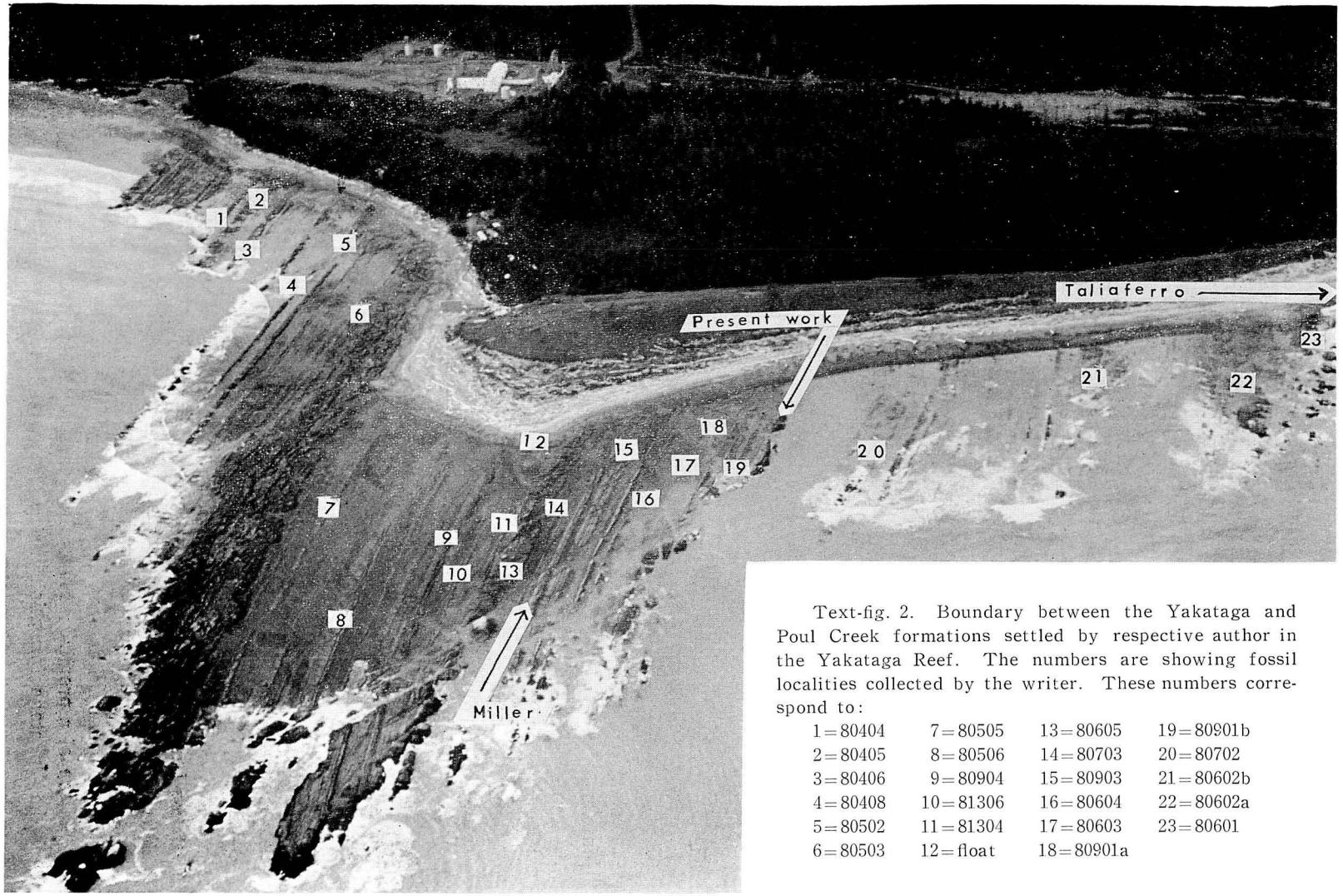
TALIAFERRO (1932, p. 754-756) proposed the name Poul Creek formation for the strata exposed along the Poul Creek in the coastal area of the Robinson Mountains. According to his designation of the formation, the Poul Creek is "fully 3000 feet of dark hard platy shales, in part calcareous and in part sandy, thin-bedded sandstones, conglomerates, occasional thin limestones, and a few beds of glauconitic sandstone. The shales greatly predominated, especially in the lower part, and make up fully 75 percent of the formation. They occur as thin, rather platey beds in the lower part, becoming thicker and more massive toward the top". Moreover, he described the Poul Creek formation is overlain conformable by the Yakataga formation and that the base of the formation was not exposed in the coastal area.

MILLER (1957) redefined the Poul Creek as follows; "the Poul Creek consists of approximately 6100 feet of marine interbedded siltstone and sandstone strata that lie with apparent conformity on the Kulthieth formation. As thus defined, the formation includes in its upper part most of the strata originally assigned to it as the type sequence of the Poul Creek by TALIAFERRO, but it also includes the lower part of the Yakataga Reef section, which he assigned entirely to the overlying Yakataga formation, and excludes the beds he described as glacio-fluvial conglomerates, here assigned to the Yakataga formation".

The Poul Creek formation is fairly well exposed in the type locality, where it is characterized by slabby, greenish gray, or olive-gray fine-grained sandstone. Hard, calcareous siltstone and silty very fine-grained sandstone showing slight stratification predominate at the top of the formation. These rocks are also characterized by a reddish brown weathered color and fossiliferous pebble- to cobble-sized calcareous concretions.

The upper part of this formation consists mainly of massive, fine- to medium-grained, olive-gray sandstone. The middle part is interbedded with arkosic granule to pebble bearing conglomerate (about 10 to 20 meters in thickness) in the type locality.

The lower part of the formation, which is mainly exposed in the southern face



Text-fig. 2. Boundary between the Yakataga and Poul Creek formations settled by respective author in the Yakataga Reef. The numbers are showing fossil localities collected by the writer. These numbers correspond to:

1=80404	7=80505	13=80605	19=80901b
2=80405	8=80506	14=80703	20=80702
3=80406	9=80904	15=80903	21=80602b
4=80408	10=81306	16=80604	22=80602a
5=80502	11=81304	17=80603	23=80601
6=80503	12=float	18=80901a	

of the Robinson Mountains (MILLER, 1957), is represented chiefly by dark-gray, fine grained silty sandstone intercalated with 30 to 100 cm bed of dark-green sandstone consisting of fresh and angular clastic fragments in a glauconitic matrix. Although the Poul Creek formation is characterized by greenish gray, glauconitic sandstone throughout the whole sequence, the typical glauconitic sandstone beds are predominant mainly in the upper part of the formation.

The boundary between the Poul Creek and the overlying Yakataga at Yakataga Reef is rather vague, because that boundary has been placed by authors in different stratigraphic positions as shown in Text-fig. 2.

The uppermost part of the Poul Creek at Yakataga Reef consists mostly of dark gray massive mudstone intercalated with two distinct beds of glauconitic sandstone. This part, except for the glauconitic sandstone, is usually inaccessible because it lies under the sea level except at the time of the maximum low tide. However, this black shale is fairly well exposed in the area between the White River and the Beare Glacier, where this unit makes a characteristic topography of subsequent streams owing to less resistance to erosion than the adjacent beds of the main part of Poul Creek and the Yakataga as pointed out by MILLER. In the upper most part of this unit there is another rather thick, distinct sandstone bed which consists of rather black glauconitic sandstone. The top of the sandstone is designated as the upper limit of the Poul Creek formation (Text-fig. 3).

On the south side of the Robinson Mountains, this formation seems to be underlain conformably by the Kulthieth formation (MILLER, 1957).

Marine molluscan fossils occur commonly through the whole sequence, and especially in the upper part of the formation, in which *Crassatella*, *Cyclocardia*, *Spisula*, *Turritella*, *Liracassis*, *Cancellaria*, and *Aturia* are characterisitically collected.

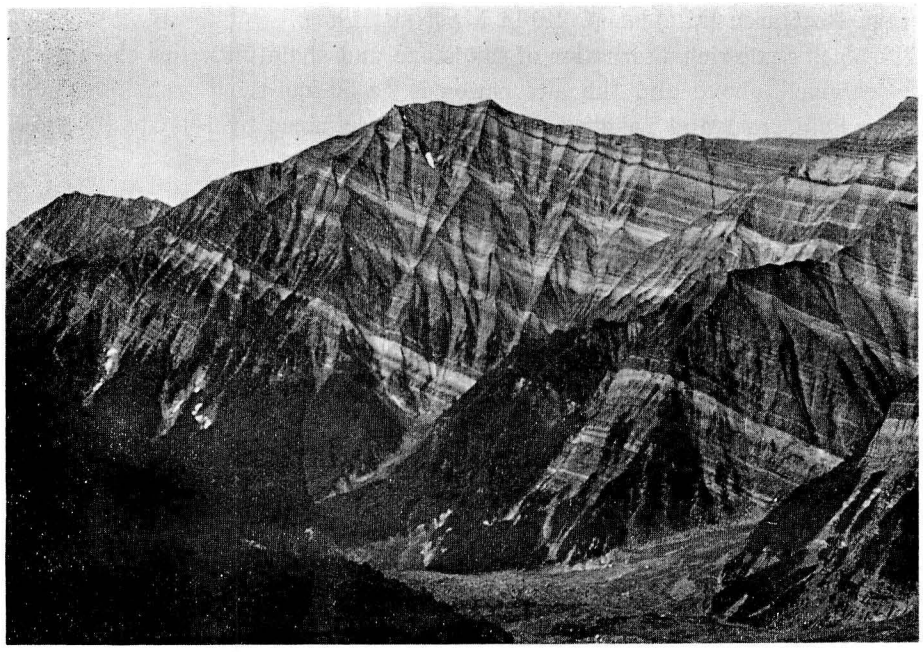
YAKATAGA FORMATION

The Yakataga formation was named by TALIAFERRO (1932, p. 756-772) for the marine sedimentary rocks lying conformably on the Poul Creek formation in the coastal area of the Robinson Mountains, although he did not designate its type locality. However, he stated that "the Yakataga formation is well exposed at Yakataga Reef and on the north and south flanks of Yakataga anticline". This anticline is almost equivalent to the Sullivan Fault as mapped by MILLER (1957), since the fault was formed along the axial plane of the anticline.

In 1957, MILLER redefined the Yakataga formation; i. e., the lower part of the Yakataga Reef section, which was entirely assigned to the Yakataga by TALIAFERRO (1932), was included in the Poul Creek formation. MILLER recognized "a 50-foot-thick transitional unit" between the Poul Creek and Yakataga formations, and their contact was drawn arbitararily above the Pecten-bearing siltstone and silty sandstone.

The present writer draws the boundary between the Poul Creek and Yakataga on the top of a prominent glauconitic sandstone bed, as shown in Text-figs. 2 and 3.

The Yakataga formation in the Yakataga District comprises more than 5000



Text-fig. 4. Out crop of the Yakataga formation, a distant view of Munday Peak (ca. 1460 m).

meters of sedimentary rocks which are mainly siltstone, sandstone, and tillite-like conglomeratic sandy mudstone.

The Yakataga formation is widely distributed in the area to the south and southeast of the Miller Creek fault. The lower part of the Yakataga formation is especially well exposed at Yakataga Reef, where it is about 330 meters in thickness. The upper part of the Yakataga formation in the reef area is predominantly medium-grained, pale brown, massive sandstone which is interbedded with dark gray or black shale, showing an alternation of sandstone and siltstone in part, but locally intercalated with thin beds of shale. The characteristic ripple marks are well developed on the bedding palenes of most sandstone beds in the upper part of the section in the reef area.

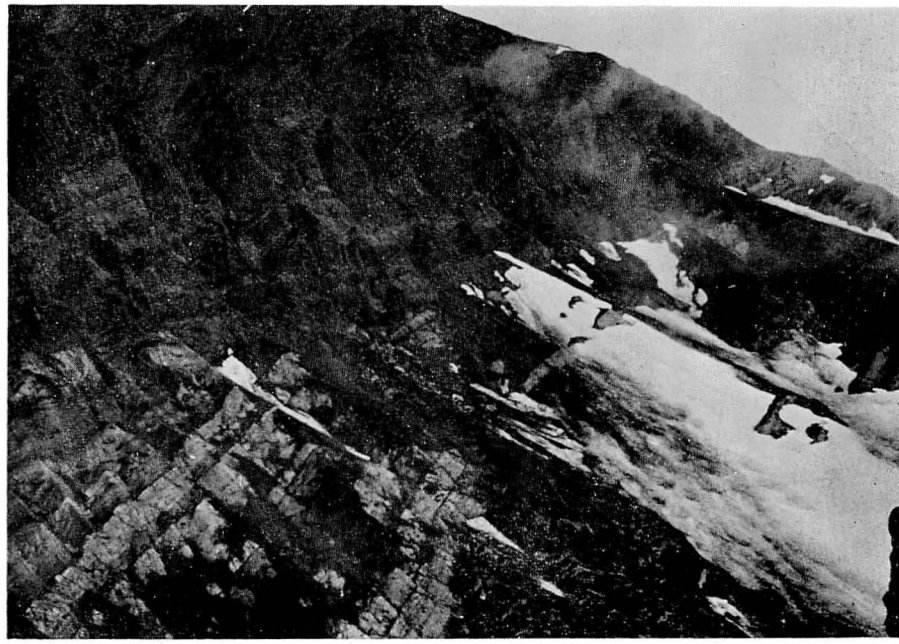
A rather thick black shale (ca. 30 meters in thickness) and a thick conglomeratic sandy mudstone are developed in the upper part of the section. This conglomerate is characterized by various sized rounded or subangular pebbles and a large number of angular blocks in the matrix of black mudstone with some sandy parts. Moreover, glacial striae are found on some pebbles in the conglomerate (MILLER, 1957; PLAFKER and MILLER, 1957). Generally speaking, the pebbles and blocks are not closely-spaced as in the usual stream or beach conglomerate but are scattered through a massive matrix of sandy mudstone or very fine-grained silty sandstone.

Several rather thick sandstone beds and three thin beds of granule and pebble-sized conglomerate are developed in a thick alternation of sandstone and shale immediately beneath the conglomeratic sandy mudstone (Text-fig. 3). The lowest thick sandstone is medium-grained, cross-bedded, pale-brown in weathered color, and greenish blue in the fresh part. This sandstone marks the highest point in the

Yakataga Reef area (MILLER, p. 246 in MACNEIL, 1961).

The black shale-rich alternation of sandstone and shale underlies the thick sandstone described above and the alternation is "a 50-foot-thick transitional unit between the Poul Creek and Yakataga formation" recognized by MILLER (in MACNEIL, 1961) in which small-scale slumping is slightly developed.

Yakataga formation exposed at Yakataga Reef is underlain conformably by the Poul Creek formation, but overlies unconformably the Poul Creek in the eastern part of the mapped area. Namely, in the right side cliff of the head of a glacier, an eastern tributary of the Little River, an irregular erosion surface of the unconformity is rather distinct. The relationship of the Yakataga and the Poul Creek becomes obscure in the area between the Little River and Big River. However, the Yakataga is directly underlain by the Kulthieth with angular unconformity in the Samovar Hills. Judging from the relations among these three formations, the Yakataga seems to be overlapping the underlying formations from west to east or from southwest to northeast (Text-fig. 5). The upper limit of this formation is not clear at the present in the Yakataga District and adjacent areas.



Text-fig. 5. The unconformity between the Yakataga and the Kulthieth formations in the Samovar Hills.

The Yakataga formation is quite fossiliferous. Large sized pectinids such as *Patinopecten* (*Lituyapecten*) *poulcreekensis* MACNEIL, *P.* (*L.*) *lituyaensis* MACNEIL, and *P.* (*L.*) *yakatagensis* (CLARK) occur in sandstone beds at various levels of the formation in this area associated with *Panomya arctata* (LAMARCK) and *Neptunea* cf. *N. tabulata* (BAIRD). *Yoldia* (*Cnesterium*) *ensifera* DALL, *Nuculana* (*Borissia*) *alferovi sakhalinensis* KRISHTOFOVICH, *Acila* (*Truncacila*) *taliaferroi* SCHENCK, and *Turritella hamiltonensis* CLARK are abundant in the black shale of the same formation.

III. Faunal Analysis

The molluscan fauna of the Tertiary system of the Yakataga District and adjacent areas contains 104 species including 67 species of bivalves, 1 species of scaphopod, 35 species of gastropods, and 1 species of cephalopod. Most of the specimens were collected in the Yakataga area, but some of them came from the Samovar Hills, and Kayak and Wingham Island (Text-fig. 1).

Of the total fauna, the Yakataga formation yields 34 species, the Poul Creek 70 species, and Kulthieth only 3 species (including specifically undertermined ones) (Table 1). Eight joint genera of bivalves are found in the Yakataga and the Poul Creek faunas, but no joint genus is found between the Kulthieth and other two faunas. However, only two joint species of bivalves, *Conchocele disjuncta* and *Periploma besshoense*, are found from the Yakataga and Poul Creek faunas. On the other hand, there are two joint genera of gastropod between the Yakataga and Poul Creek faunas. It should be noteworthy that each fauna is represented by its own characteristic elements. Accordingly, each fauna is hereafter referred to as the Yakataga, the Poul Creek, and the Kulthieth faunas.

Table 1. Composition of molluscan fauna from the Yakataga, Poul Creek, and Kulthieth formations.

	Number of genera and species								Total	
	Bivalvia		Scaphopoda		Gastropoda		Cephalopoda			
	Genera	Species	Genera	Species	Genera	Species	Genera	Species	Genera	Species
Yakataga	17	27(3)*	—	—	5	7(2)	—	—	22	34(5)
Poul Creek	26	40(9)	1	1	18	28(11)	1	1	46	70(20)
Kulthieth	2	2(2)	—	—	1	1	—	—	3	3(2)
Total	38	67(14)	1	1	22	35(13)	1	1	62	104(27)

* The numbers in brackets are that of unidentified species.

Kulthieth Fauna

The Kulthieth formation yields marine and fresh water or brackish water mollusks, though its faunal composition is simple. The available molluscan species from the Kulthieth are very sparse, e. g., *Ostrea* sp., *Corbicula* (*Corbicula*) sp., and *Cristispira pugetensis* Allison. These mollusks were all collected from the Samovar Hills where *Corbicula* makes several shell beds and *Ostrea* is also rather abundant in the arkosic sandstone, but *Cristispira* occurs very rarely from the same sandstone.

Poul Creek Fauna

The Poul Creek fauna consists of 46 genera and 70 species. It includes 26 genera and 40 species of bivalves, 1 genus and 1 species of scaphopod, 18 genera and 28 species of gastropods, and 1 genus and 1 species of cephalopod, of which 2 bivalves and 5 gastropods are described as new species.

So far as the writer's observation around the Yakataga District is concerned, the Poul Creek fauna may be subdivided into lower* and upper ones. The upper part of the Poul Creek consists chiefly of olive-green, fine- to medium-grained sandstone in which molluscan fossils occur very abundantly. *Acila* (*Acila*) *gettysburgensis*, *Crassatella*, *Cyclocardia*, *Clinocardium*, *Pitar* (*Katherinella*), *Spisula*, *Thracia*, *Liracassis*, *Cancellaria*, *Turritella* aff. *T. diversilineata blakeleyensis*, *Polinices*, *Scaphander*, and *Aturia* are characteristic of this part.

The lower part of the Poul Creek consists chiefly of rather dark-gray black shale or silty sandstone, which usually includes calcareous concretions of pebble- or cobble-size. Well-preserved fossil specimens commonly occur within the concretions. The lower part of the Poul Creek is characterized by genera such as *Solemya*, *Conchocele*, *Nemocardium*, *Pteropurpura*, and *Ancistrolepis*, which are rather deep water dwellers compared to genera in the upper part.

YAKATAGA FAUNA

The Yakataga fauna consists of 22 genera and 34 species, of which 3 pelecypods and 2 gastropods are specifically undetermined, and 2 bivalves are described as new species. Some specimens from the Yakataga formation are rather well preserved, especially those collected from the calacreous concretions in the dark gray mudstone or sandy siltstone. Hower, specimens from sandstone and black shale are usually somewhat deformed and decorticated.

So far as the exposure on Yakataga Reef is concerned, the faunal sequence is rather clear. *Neptunea*, *Panomya*, and *Turrittella hamiltonensis* occur in the lowest part of the Yakataga formation, though the number of individuals are rather few. Above these small-sized *Nuculana* and *Acila* (*Truncacila*) occur in the dark-gray or black mudstone. Immediately above this assemblage, *Patinopecten* (*Lituyapecten*) *poulcreekensis* occurs in the medium-grained sandstone. This seems to be the lowest stratigraphic occurrence of large-sized pectinids in the mapped area (Text-figs. 2, 8).

There is a thick sandstone bed which makes the highest point on the Reef, with *Macoma arctata* and *Siliqua* sp. in the basal part.

From the two distinct sandstone beds between the above-mentioned thick sandstone and the thick conglomeratic sandy mudstone, the writer collected abundant *Patinopecten* (*Lituyapecten*) *lituyaensis* associated with *Clinocardium* and *Neptunea*. This may mark the lowest occurrence of *P.* (*L.*) *lituyaensis* in the area studied (no. 3 in Text-fig. 8). *Turritella hamiltonensis* and *Neptunea* cf. *N. tabulata* occur immediately above the thick conglomeratic sandy mudstone.

In the uppermost part of the Reef area, a sandy facies becomes dominant, and *Patinopecten* (*L.*) *lituyaensis*, *P.* (*L.*) *yakatagensis*, *Mya truncata*, *Panomya arctata*, and *Turritella hamiltonensis* are abundant.

The faunal sequence obtained from Yakataga Reef provides useful control as a

* The writer did not collect any molluscan fossils from the lowest part of the formation in this area. "The lower part" as used here does not comprise the actual basal part of the formation, but rather signifies the lower part of the Poul Creek formation treated in this report.

horizon marker in the Yakataga area.

The Yakataga developed in the upper reaches of the Leare Glacier and Bare Glacier yields abundant *Clinocardium*, *Swiftopecten*, *Yoldia* (*Cnesterium*), and *Turritella hamiltonensis*. However, *Mytilus* sp., *Pododesmus* (*Monia*) *macroschisma*, and *Neptunea* cf. *N. tabulata* occur in the lowest part of the Yakataga exposed in the Samovar Hills.

On the west side of Kayak Island and at the southern point of Wingham Island, *Calyptogena chitanii* and *Delectopecten peckhami* occur in dark-gray or black shale of the lower part of the Yakataga formation.

FAUNAL CHARACTERISTICS

1. Kulthieth fauna: Although this fauna is very small, it includes very significant species, e. g., *Cristispira pugetensis* which has been reported by ALLISON (1965) from the Eocene formation of Puget Sound, Washington. Another common species is *Ostrea* sp. which probably lived in tropical to temperate waters for the reason that recent species of *Ostrea* of west coast of North America occur south of Puget Sound except for one species, *Ostrea lurida* CARPENTER, which is distributed from Sitka, Alaska, to Cape San Lucas, Lower California. Besides these marine mollusks, this fauna includes fresh water or brackish water mollusks as shown in Plate 17, Figs. 13-15.

2. Poul Creek fauna: The molluscan fauna from the Poul Creek formation consists of 46 genera and 70 species, of which 50 species are determined specifically and 20 species are unidentified, though they are generically distinct. Of the present fauna the living species comprise 3.8 percent, the species reported also from the Asian Tertiary system 26.4 percent, the endemic Alaskan species 34.0 percent, and the species reported from the Tertiary system of Oregon and Washington are 35.8 percent. It is noteworthy that the Poul Creek fauna includes a fairly large number of Oregon and Washington species and distinctly smaller number of living species which are mostly widely distributed in the Pacific region.

The living species from the Poul Creek fauna are *Conchocele disjuncta* GABB and *Macoma incongrua* v. MARTENS. *Conchocele disjuncta* is geographically widely distributed in the Pacific region, but its bathymetric occurrence is highly variable, e. g., this species lives in a shallow part less than 10 meters in the Gulf of Alaska, but it occurs in the depth from 60 to 200 meters or more off Japan (KANNO, 1971). The ecological distribution of this species seems to be controlled by sea-water temperature. *Macoma incongrua* is distributed along the Pacific coast of Japan, ranging from lat. 31°N to lat. 44°N. However, a fossil species is reported from the Crag formation (Pleistocene) in England.

The following species seem to be restricted in geographic occurrence to Alaska: *Cyclocardia yakatagensis* (CLARK), *C. hamiltonensis* (CLARK), *Papyridea hamiltonensis* (CLARK), *Clinocardium hopkinsi* KANNO, n. sp., *Nemocardium alaskense* (CLARK), *Spisula addicotti* KANNO, n. sp., *Mya* (*Mya*) *salmonensis* CLARK, *Bathybembix turbonata* (CLARK), *B. jonesi* KANNO, n. sp., *Euspira ramonensis* (CLARK), *Liracassis durhami*

KANNO, n. sp., *Pteropurpura* n. sp., *Ancistrolepis macneili* KANNO, n. sp., *A. rearensis* CLARK, *Priscofusus clarki* KANNO, n. sp., *Musashia* (*Neopsephaea*) *corrugata* (CLARK), *Cancellaria* (*Crawfordina*) *alaskensis* CLARK, and *Scaphander alaskensis* CLARK.

Among the genera of the above listed species, the living species of *Bathybembix* and *Scanphander* distribute in the northern Pacific region north of Puget Sound (KEEN, 1963, p. 99), ranging from 60 to 1600 meters in depth. However, *Pteropurpura* and *Cancellaria* are essentially restricted in occurrence to temperate to tropical regions.

The following species are reported from the East Asian Tertiary system: *Acila* (*Acila*) *submirabilis* MAKIYAMA, *A.* (*Truncacila*) cf. *A.* (*T.*) *kamtschatica* ILYINA, *Yoldia* (*Yoldia*) *takaradaiensis* KRISHTOFOVICH, *Y.* (*Y.*) *biremis* UOZUMI, *Solemya* (*Acharax*) *dalli* CLARK, *Acesta* cf. *A. yagenensis* (OTUKA), *Lucinoma* cf. *L. tomitensis* KANNO, *Nemocardium* aff. *yokoyamai* TAKEDA, *Spisula equilateralis* (CLARK) [=*S. onnechiuria* (OTUKA, 1937)], *Mya* (*Mya*) *salmonensis* CLARK, *Panomya elongata* KANNO, *Periploma besshoense* (YOKOYAMA), *Dentalium* (*Coccodentalium*) cf. *D.* (*C.*) *nunomae* TAKEDA, and *Aturia alaskensis* SCHENCK [=*A. minoensis* KOBAYASHI, 1954].

The species listed above are mostly from the Tertiary system of the Pacific coast of Japan and Kamchatka, except for those of *Acila* (*Truncacila*) and *Panomya*, which are Recent species in the northern Pacific region. *Solemya* has a geographically wide distribution from the boreal to tropical regions, as already discussed by previous workers (DALL, 1908; KANNO, 1960). *Aturia alaskensis* [=*A. minoensis*] occurs from several lower to middle Miocene localities in Japan associated with subtropical faunal element. *Spisula equilateralis* [=*S. onnechiuria*] is one of the characteristic species in northern Japan, especially in Hokkaido, where it occurs in strata of early to middle Miocene ages; it is not known to occur south of Hokkaido. *Acesta yagenensis* and *Lucinoma tomitensis* are known from the lower to middle Miocene strata of several areas in Japan.

The following species are reported from the Tertiary system of Oregon and Washington, and parts of California: *Acila* (*Acila*) *gettysburgensis* (REAGAN), *Crenella porterensis* WEAVER, *Vertipecten* sp., *Crassatella* cf. *C. washingtoniana* (WEAVER), *Crassatina carmanahensis* (CLARK), *Tellina* cf. *T. cowlitzensis* WEAVER, *Pitar* (*Katherinella*) *arnoldi* (WEAVER), *P.* (*K.*) *arnoldi etheringtoni* (TEGLAND), *P.* (*K.*) sp., *Macrocallista weaveri* CLARK, *Panope snohomishensis* CLARK, *Thracia schencki* CLARK, *T.* cf. *T. condoni* CONRAD, *Epitonium* (*Cirsotrema*) *clallamense* DURHAM, *Turritella* aff. *T. diversilineata blakeleyensis* WEAVER, *Crepidula* cf. *C. praerupta* CONRAD, *Liracassis apta* (TEGLAND), *Colus* aff. *C. jordani* DALL, and *Turricula* cf. *T. washingtoniana* (WEAVER).

3. Yakataga fauna: Of the molluscan fauna from the Yakataga formation, 29 species are determined specifically and 5 undetermined species are identified generically. Of these, the living species in the boreal province of the northern Pacific region constitute 32.2 percent, the species reported also from the Asian Tertiary system 25.8 percent, the Alaskan proper species 38.7 percent, and the species reported from the Tertiary system of Oregon and Washington only 3.3 percent (Table 2). It follows that the total of the living boreal species and the Alaskan Tertiary proper

species occupies about 71 percent of the Yakataga fauna, whereas the Oregon and Washington species constitute only about 3 percent. Thus, the Yakataga mollusks may represent a cold water fauna.

The living species of the Yakataga fauna are; *Yoldia* (*Cnesterium*) *ensifera* DALL, *Conchocele disjuncta* GABB, *Pododesmus* (*Monia*) *macroschisma* (DESHAYES), *Mya* (*Mya*) *truncata* LINNÉ, *Panomya arctica* (LAMARCK), *Hiatella arctica* (LINNÉ), *Beringius* cf. *B. crebricostatus* (GMELIN), and *Neptunea* (*Salcosipho*) cf. *N.* (*S.*) *tabulata* (BAIRD). Besides the above listed species, *Siliqua* sp. and *Antiplanes* sp. are included in this fauna. Although these two are specifically undeterminable, the living species of these genera are usually found in temperate to cold waters.

The following species seem to occur exclusively in the Tertiary of Alaska: *Acila* (*Truncacila*) *taliaferroi* SCHENCK, *Yoldia* (*Cnesterium*) *yakatagensis* KANNO, n. sp., *Swiftopecten donmilleri* (MACNEIL), *Patinopecten* (*Lituyapecten*) *lituyaensis* MACNEIL, *P.* (*L.*) *poulcreekensis* MACNEIL, *P.* (*L.*) *yakatagensis* (CLARK), *P. jonesi* KANNO, n. sp., *Clinocardium yakatagense* CLARK, *C. brooksi* (CLARK), *Securella alaskensis* (CLARK), *Neptunea* (*Neptunea*) *plafkeri* KANNO, n. sp., and *N.* (*N.*) sp..

According to SCHENCK (1936, p. 33), *Acila* (*Truncacila*) prefers a cool temperate habitat, but is not restricted to that environment. *Yoldia* (*Cnesterium*) generally distributes in rather cold waters. *Patinopecten* (*Lituyapecten*) is a typical pectinid of boreal waters. Recent species allied to the fossil species of *Clinocardium* and *Securella* of the Yakataga are also distributed in the northern Pacific regions.

The following species are reported from the Asian Tertiary system, namely: *Nuculana* (*Borissia*) *alferovi sakhalinensis* KRISHTOFOVICH, *Miyagipecten* sp., *Delectopecten peckhami* (GABB), *Calyptogena chitanii* (KANEHARA), *Macoma* cf. *M. incongrua* v. MARTENS, *Mya cuneiformis* (BÖHM), *Periploma besshoense* (YOKOYAMA), and *Turritella* (*Neohaustator*) *hamiltonensis* CLARK [=*T.* (*N.*) *chikubetsuensis* KOTAKA, 1959]. It does not necessarily mean that these species are all originated from Asia, but these are rather common species in the East Asian Tertiary system. Except for *Delectopceten peckhami*, *Calyptogena chitanii*, and *Periploma besshoense*, these Asian species are known mostly from north of central Japan. *Dlectopecten peckhami*, *Calyptogena chitanii*, and *Periploma besshoense* are typical muddy bottom dwellers and the allied living species are mostly reported from rather deep waters.

The following species are also reported from Oregon and Washington: *Macoma arctata* (CONRAD).

Table 2. Faunal composition of Tertiary mollusks of the Yakataga District.

Faunal elements	Yakataga fauna	Poul Creek fauna	Kulthieth fauna
Alaskan species	12(38.7)	18(34.0)	—
Washington-Oregon species	1(3.3)	19(35.8)	—
Asian species	8(25.8)	14(26.4)	—
Living species	10(32.2)	2(3.8)	—

The number shows that of species of each element, and the percentage is shown in brackets.

It is noteworthy that the Yakataga fauna includes far less species from Oregon and Washington than the Poul Creek fauna.

To sum up, the compositions of the respective faunas are distinct from one another (Table 2).

It is clear that the Yakataga fauna is characterized by a rapid increase in living species of cold water regions and also by a rapid decrease in the Washington and Oregon species, which are generally indicative of rather warm water conditions. Moreover, it is very interesting that the Alaskan proper species and Asian species occupy almost the same percentage in both the Poul Creek and the Yakataga faunas.

IV. PALEOECOLOGY

The molluscan fossils collected from the Tertiary system of the Yakataga District and adjacent area consist of 62 genera and 104 species. Of the 62 genera, 51 are stil living along the Pacific coast of North America as well as the Asian side. The generic and specific compositions of the Tertiary molluscan faunas are shown in Table 1 and 2.

Although these species do not represent all of the actually contained mollusks in the respective formation, the species indentified by this study seem to be sufficient for the estimation of the paleoecological condition of the respective fauna.

KULTHIETH FAUNA

Although the available Kulthieth fauna has too few species to discuss their ecological condition, it includes a very important species. Namely, the Kulthieth fauna includes *Ostrea* sp. and *Cristispira pugetensis*, as well as non-marine mollusks of *Corbicula* sp.. These marine mollusks seem to indicate warm water conditions. Moreover, the Kulthieth contains several coal measures which yield plants fossils. According to floral study by WOLFE (1969), the climatic condition of the early Ravenian (early late Eocene) vegetation of the Yakataga District and adjacent areas is stated as "this was the warmest known period in the Alaskan Tertiary; comparisons can not be made, however, to the early and middle Eocene, because assemblages of that age are not yet known in Alaska. The climate during the early Ravenian is indicated to have been paratropical, that is, it was characterized by a lack of frost, mean annual temperature of 22°C to 25°C and abundant precipitation throughout the year," and "the mean temperature of the coldest month could have been as low as about 15°C" (WOLFE, 1969, p. 61).

POUL CREEK FAUNA

The molluscan fauna from the Poul Creek includes 46 genera and 70 species, of which most genera are still living along the Pacific coast of North America as well as the Asian side of the Pacific. Only 5 genera, *Vertipecten*, *Liracassis*, *Eosiphonalia*, *Priscofusus*, and *Aturia*, are extinct.

Vertipecten is known only from the west coast of North America in Oligocene to Miocene age, *Liracassis* is restricted to the northern Pacific regions north of Oregon in the west coast of North America and north of Japan ranging from Oligocene to Pliocene, mostly Oligocene to Miocene age. *Eosiphonalia* is known only from the Oligocene and Miocene of California, Washington, and Oregon in addition to the Yakataga District. *Priscofusus* is also known only from the west coast of North America from Kodiak Island, Gulf of Alaska, to California, in strata of Oligocene and Miocene age, but there are no records from the Asian side. *Aturia* is a cosmopolitan genus essentially distributes in tropical and subtropical regions and ranging from Paleocene to Miocene, except for a few problematical occurrences in the Chico formation (upper Cretaceous) and Pliocene strata of Australia.

As already stated in the preceding chapter, the living species included in the Poul Creek fauna are only two, which are characterized by having wide distributions. However, generically speaking, the Poul Creek fauna includes a large number of warm water genera such as *Anadara* (*Anadara*), *Vertipecten*, *Crassatella*, *Pitar* (*Katherinella*), *Eosiphonalia*, *Priscofusus*, *Cancellaria* (*Crawfordina*), and *Aturia*. Although, *Aturia* floats after death and could be transported for a significant distance by current, the mode of occurrence of this species in the Poul Creek shows an endemic specimens as is remarked in the systematic description.

The living species of genus *Anadara* are shallow water dwellers and do not range north of Gulf of California along the west coast of North America, and moreover, the living species of subgenus *Anadara* (*Anadara*) is distributed south of the southern point of Kyushu Island (lat. 31°N) in the west Pacific region. Tertiary species of the genus are also restricted south of Oregon (SCHENCK and REINHART, 1938; REINHART, 1943). Fossil species of subgenus *Anadara* (*Anadara*) seems to have flourished in great number of species and individuals in Miocene epoch and they were distributed up to the north of Hokkaido (lat. 45°N) in that age.

Vertipecten is restricted along the west coast of North America where it is usually associated with warm water dwellers in strata of Oligocene to Miocene ages.

Recent species of genus *Crassatella* shows world-wide distribution in tropical to subtropical regions in waters 20 to 80 meters in depth. It is found only south of Point Conception, California, in the eastern Pacific and ranging south of lat. 35°N along the Pacific coast of Japan. *Crassatella carmanahensis* (CLARK) has been reported south of Vancouver Island prior to the present paper.

Pitar is one of the warm water dwellers in the world. The living species of the genus are mostly distributed in the regions south of lat. 35°N along the Pacific coast of Japan, and it also seems to be restricted south of the Gulf of California along the coast of the eastern Pacific Ocean.

Eosiphonalia and *Priscofusus* are restricted mostly south of Oregon where they are associated with rather warm water dwellers.

It is noteworthy that a large number of specimens of *Aturia* occur in the upper part of the Poul Creek formation, and that specimens of various growth stages are found there. Although the nautiloid mollusks are said to be distributed far from their original habitat by floating after death, the occurrence in the Poul Creek seems to be autochthonous. SCHENCK (1931, p. 447) inferred that "these cepalopods were

vagile benthonic organisms, that they inhabited the nertic zone of the oceans, and were more apt to be sublittoral than littoral".

The species belonging to the above-mentioned genera are generally typical of the neritic zone less than 100 meters in depth. It may be very significant that the Poul Creek fauna which is represented by more than sixty species includes a fairly large number of tropical and subtropical forms that lived in rather shallow waters. Moreover, these mollusks are represented not only by adult specimens but also by younger ones.

As already discussed by DURHAM (1950, 1960), the presence of thermophilic (warm-limited) organisms seems to be much more important than the presence of cool water elements.

From the above discussion, the marine climate during late Poul Creek time may be fairly warm compared with that of the present day.

This interpretation, which is based on the molluscan fauna, is also supported by RAU (1963) with his study of foraminifers. According to his results, the upper Poul Creek yields shallow and warm water dwellers such as *Siphogenerina*, *Cancris*, *Uvigerina*, *Sphaeroidina*, *Bolivina*, *Cibicides*, *Buliminella*, and *Cassidulina*. Based on these foraminifers he concluded that those in the upper part of the Poul Creek formation, would, as a group, prefer moderately warm water temperatures at rather shallow depths. Probably they would thrive in temperatures between 7.2° and 12.8°C at depths between 60 and 250 meters (RAU, 1963, p. 137).

In connection with the ecological conditions inferred from the fauna, reference data may be available from the recent studies on the glauconite. As previously described, the upper part of the Poul Creek formation is characterized by glauconitic sandstone. According to the review given by CLOUD (1955) and recent data by EHLMANN et al. (1963) and new data based on offshore southern California by PRATT (1963), galuconite is commonest at depths ranging from 30-700 meters. Moreover, it should not occur in tropical waters shallower than 50 meters and may be more abundant at about 250 meters. It is noteworthy that temperatures lower than about 15°C would favour the generation of glauconite.

A molluscan fauna which consists of *Conchocele*, *Solemya*, *Nemocardium*, *Bathybembix*, *Liracassis*, *Pteropurpura*, *Ancistrolepis*, and *Musashia* (*Neopsephaea*), characterized by muddy bottom dwellers, occurs from somewhat lower part of the Poul Creek compared with the section discussed above. Moreover, these genera are associated in some places with *Aturia*, although *Aturia* occurs more abundantly in the upper part of the Poul Creek. As described in the preceding line, *Aturia* is considered as one of vagile benthonic mollusks lived in the tropical and subtropical regions. Accordingly, the fauna in question may have lived in waters affected by warm surface water currents. Judging from the ecological evidence of living species of *Conchocele disjuncta*, (KANNO, 1971), and *Solemya* (*Acharax*), (DALL, 1908; KANNO, 1960) these mollusks may have lived in a muddy bottom in a somewhat deeper part of the neritic zone.

YAKATAGA FAUNA

The Yakataga fauna includes 22 genera and 34 species, of which 20 genera are still living along the Pacific and Asian coasts. Two genera, *Miyagipecten* and *Securella*, are extinct one, of which *Miyagipecten* is known only from the middle Miocene and *Securella* is restricted to the Miocene and Pliocene.

The species collected from the Yakataga formation are characterized by distinct cold water dwellers now living in the northern Pacific region. They include the following species:

Yoldia (*Cnesterium*) *ensifera*, which lives in silty bottoms of the littoral zone to 50 meters depth and ranges from north of California through Alaska.

Pododesmus (*Monia*) *macroschisma*, which lives very commonly in the northern Pacific region where it is found attached to rocks and wharf piling from low-tide mark to about 20 meters in depth.

Conchocele disjuncta, which lives in the silty bottom of the littoral zone to more than several hundreds of meters, but the shallow bottom dweller of this species is known only from the boreal region.

Mya truncata, which lives on the silty and fine-grained sandy bottom of the littoral zone in the circumpolar region including the Bering Sea, Alaska, Kamchatka, and the Pacific coast north of Hokkaido and California.

Panomya arctica [=*P. trugida* DALL, 1916], which usually lives in muddy bottoms in cold offshore waters and distributes in the north of Hokkaido, Kamchatka, Bering Sea, Canada, and north of California.

Hiatella arctica, which lives in borings in clay or limestone of the littoral zone of Arctic seas to deep waters off Panama, and north of Honshu (main island of Japan).

Siliqua sp. is large and is similar to recent species of *S. patula* DIXON and *S. alta* (BRODERIP and SOWERBY) which distribute from northern Japan to Kamchatka and from Alaska down to Monterey, California. Such large-sized species of *Siliqua* seem to be restricted to temperate to cold waters.

Beringius crebricostatus, which distributes in Unalaska, Alaska, to British Columbia, and has been collected from 160 to 200 meters in depth.

Neptunea (*Sulcosipho*) *tabulata*, which distributes in British Columbia to San Diego, California, and has been reported from 60 to 400 meters in depth.

Antiplanes (*Antiplanes*) has been reported from the Pacific coast of Japan north of lat. 35°N in water 30 to 250 meters in depth.

Alaskan proper elements of the Yakataga fauna include *Yoldia* (*Cnesterium*), *Swiftopecten*, *Patinopecten* (*Lituyapecten*), *Clinocardium*, *Securella*, *Neptunea* (*Sulcosipho*) and *Neptunea* (*Neptunea*). Generally speaking, these genera now distribute in temperate to cold waters, and none of these genera are reported from shallow water in tropical or subtropical regions.

Asian species among the Yakataga fauna are represented by *Miyagipecten* sp., *Delectopecten peckhami*, *Calyptogena chitanii*, *Mya cuneiformis*, *Periploma besshoense*,

and *Turritella* (*Neohaustator*) *hamiltonensis* [=*T.* (*N.*) *chikubetsuensis*]. Teese species are muddy bottom dwellers in deep waters and sandy bottom dwellers in shallow water. *Miyagipecten*, *Mya cuneiformis*, *Turritella* "*chikubetsuensis*" are restricted to northern Japan where they are associated with shallow water dwellers. However, *Delectopecten peckhami*, *Calyptogena chitanii*, and *Periploma besshoense* are, in contrast, widely distributed in muddy deposits where they are associated with deep water dwellers.

Oregon and Washington species in the Yakataga fauna such as *Macoma arctata*, is few in number. This species is distributed in Oregon and Washington, as well as California in the strata of "lower" to middle Miocene age.

The above discussion was essentially based on the biogeographical and bathymetrical distribution. The next problem is the range of each species in the present area. Of course, the writer's collections are not sufficient to cover the whole area. On the basis of the data available to him, however, the following interpretation may be made.

The deep water, muddy bottom dwellers are distributed in the western part of the area on Kayak and Wingham Islands, where *Calyptogena chitanii* and *Delectopecten peckhami* occur abundantly. *Calyptogena* is a gregarious mollusk that tends to form large colonies. Some living species of this genus are usually collected from muddy bottoms about 700 to 1000 meters in depth of central Japan as well as off Oregon and Washington (oral information from Prof. M. KEEN, 1969). Both the living and fossil species occur in densely crowded clusters. The living species of *Delectopecten* is usually restricted to depths greater than 20 meters and are more common in depths greater than 200 meters. Accordingly, the *Calyptogena chitanii-Delectopecton peckhami* fauna may represent muddy bottom conditions in deep and cold waters less than hundreds of meters in depth in the Gulf of Alaska area (lat. 60°N).

In the eastern part of the mapped area, the Yakataga formation is well exposed in the Karr Hills, Chaix Hills, and Samovar Hills, where *Mytilus* sp.,* *Pododesmus* (*Monia*) *macroschisma*, *Mya cuneiformis*, and *Neptunea* cf. *N. tabulata* occur with *Conchocele disjuncta*. Except for the last one, all these species or genera are usually typical shallow and cold water dwellers as discussed in the systematic description. It is noteworthy that *Conchocele disjuncta* is associated with such shallow forms. This is one of the clear indication that the shallow water temperature was fairly cool and comparable to the present littoral zone of the Gulf of Alaska (KANNO, 1971).

As previously described, the molluscan faunal sequence at the Yakataga Reef is subdivided into the following three parts. The lowest part is represented by *Panomya arctica*, *Turritella hamiltonensis*, and *Neptunea* sp.. It is succeded by the fauna with *Nuculana* and *Acila* (*Truncacila*) in dark-gray or black mudstone. The upper part is characterized by *Patinopecten* (*Lituyapecten*), *Panomya*, *Mya truncata*, *Clinocardium*, and *Turritella hamiltonensis* which are associated with *Macoma arctata* and *Siliqua* sp.. Judging from the sequence of molluscan fauna at Yakataga Reef, the water temperature seems to be as cool as the present waters of that area throughout the time of Yakataga Reef section, but the bathymetric conditions of the

* All represented by fragmental specimens.

three faunas seem to be somewhat different. Thus, the basal part of the Yakataga fauna at the reef may represent water 60 to 100 meters in depth, but the overlying *Nuculana* and *Acila* (*Truncacila*) fauna seems to represent deeper water conditions. According to SCHENCK (1936, p. 33), most living species of *Acila* live in water having a temperature between 4.4° to 21°C, and *Truncacilla* prefers a cool temperature habitat, although it is not restricted to such conditions. Moreover, this subgenus is found in the neritic or bathyal, though it has not been collected in water deeper than about 1600 meters or in the intertidal zone (SCHENCK, 1936).

In contrast, the upper part of the Yakataga in the reef area is characterized by rather shallow water conditions as indicated by large number of *Mya truncata* which is restricted to the littoral zone in the circumpolar region north of Pugest Sound and north of Hokkaido in Japan.

In summary, the bathymetric conditions of the Yakataga fauna in the reef section seems to change from neritic (60 to 100 meters) at the base, through the lower nertic or bathyal in the middle part, to littoral at the top.

It is noteworthy that the bathymetric environments of the basal part of the Yakataga are very different from west to east. Thus, the fauna in the western part at Kayak and Wingham Islands is represented by cold and deep water dwellers, whereas it is represented by neritic dwellers at Yakataga Reef and a shallow and littoral fauna in the eastern part of the area on the Samovar Hills.

The ecological differences inferred from the respective faunal elements seem to be supported by lithologic and stratigraphic data. The Yakataga formation at Kayak and Wingham Islands consists mainly of thick, dark-gray mudstone underlain by the Poul Creek formation with conformity (PLAFKER, 1971). However, the Yakataga consists chiefly of granule-bearing conglomeratic sandstone in the Samovar Hills where the Yakataga is underlain by the Kulthieth with angular unconformity.

The available data suggest that the Yakataga formation may conformably overlie the Poul Creek in the Yakataga Reef area as well as in the area west of the Reef, whereas it is deposited unconformably on the underlying strata in the eastern part of the area, though there is no available evidence to show the change from south to north.

In addition to the above-mentioned data, attention should be directed to the existence of "conglomeratic sandy mudstone" in the Yakataga formation (MILLER, 1953, 1957; PLAFKER and MILLER, 1957). As pointed out by MILLER and PLAFKER, the conglomeratic sandy mudstone originated as ice-transported debris. The thick conglomeratic sandy mudstone appears about 190 meters above the base of the Yakataga at Yakataga Reef, although tillite-like thin beds occur immediately above the massive sandstone (no. 13 in Text-fig. 2) and between that sandstone and the thick conglomeratic sandy mudstone. Moreover, the cold water fauna appears at the base of the Yakataga formation. This may indicates the time necessary for development of tidal glaciers during a rapid climatic cooling between Poul Creek and Yakataga time. Glaciers may have developed on the mountains during the deposition of the basal part of the Yakataga after which ice-transported debris began to reach the sea.

SUMMARY: From the above discussion the paleoecologic conditions of the Tertiary faunas in the Yakataga District and adjacent areas may be summarized in Table 3.

Table 3. Paleoecologic conditions of the respective fauna.

Based on / Faunas	Molluscan fauna	Foraminiferal fauna	Glauconite	Flora	Estimated shallow water marine climate[1]
Yakataga	W ← 0–10 m more than 200 m 100–200 50–60	→ E 0–20 m			Cold[2] (Arctic)
Poul Creek	20–60 m 100–200 m	60–270 m 7.2°–12.8°C	50–250 m less than 15°C		Warm temperate, no month cooler than 10°C[3]
Kulthieth	Fresh water or marine (less than 20 m)			15°–25°C	Outer to inner tropical[4]

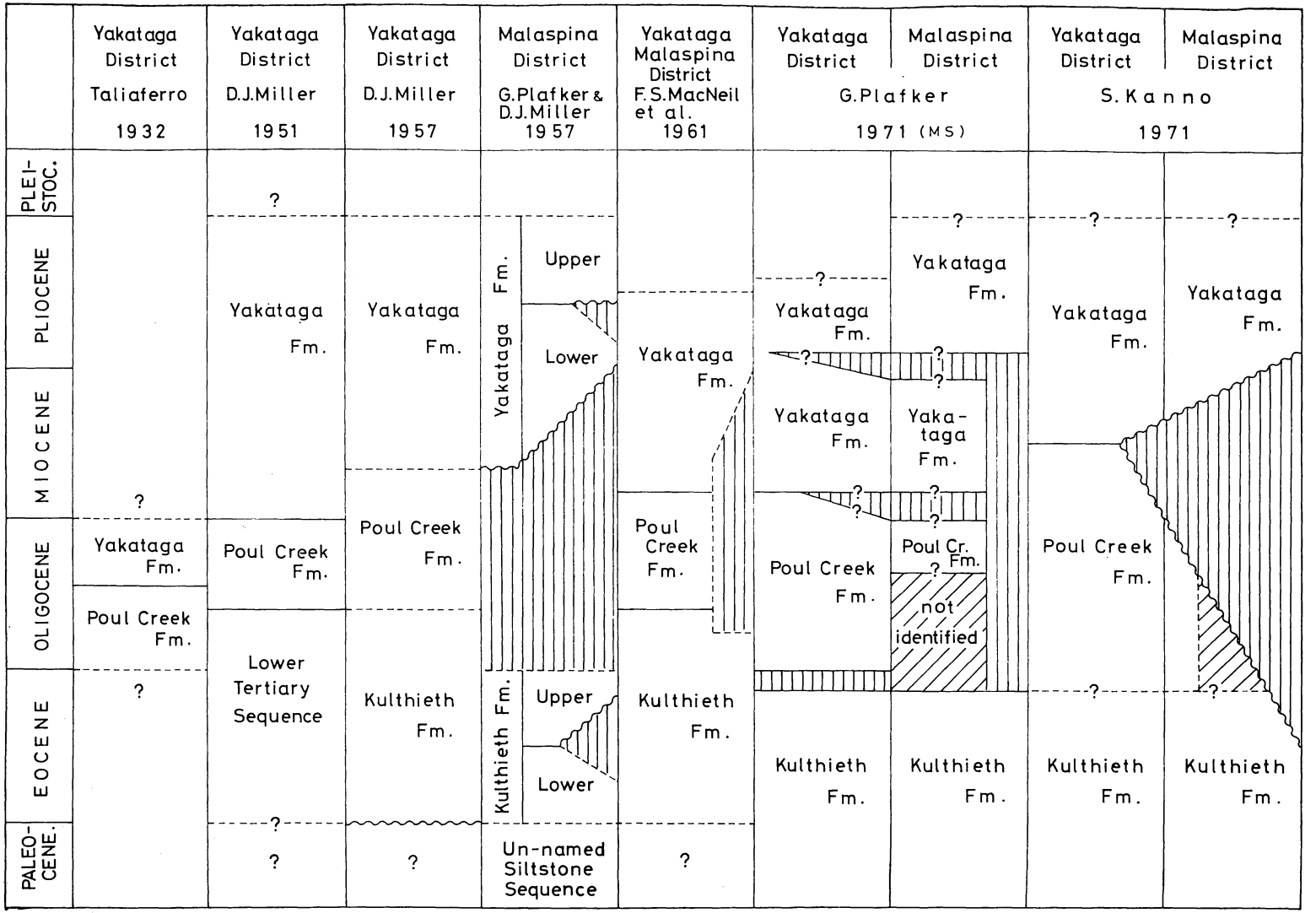
1) Marine climates defined by the duration of critical or near critical temperatures which apparently limit the northern range of shallow water marine mollusks in the northern Pacific along the west coast of North America (HALL, 1964).
2) Southern boundary is near the southern limit of winter ice.
3) Northern range lat. 34°N. No months cooler than 10°C, 4 months at 18°C.
4) Northern range of the outer tropical is lat. 28°N, approximate 4 months 20°C and no months cooler than 10°C. Northern range of inner tropical is lat. 24°N, and no months cooler than 18°C and 8 months 20°C.

V. GEOLOGICAL AGES

The geological ages of the Tertiary formations of the Yakataga and Malaspina Districts has been considered as Oligocene or Eocene to Pliocene by most previous workers. However, as indicated in Text-fig. 6, they have been assigned in somewhat different ways by various workers.

KULTHIETH FORMATION

The Kulthieth yields a few marine mollusks from the Malaspina District as *Ostrea* sp. and *Cristispira pugetensis*. According to ALLISON (1956) and ADDICOTT and PLAFKER (1971), *C. pugetensis* suggests that the Kulthieth is in part of middle Eocene age. Moreover, ADDICOTT and PLAFKER (1971) pointed out that the Kulthieth also contains marine invertebrate assemblages of undoubted late Paleocene to late Eocene ages suggested by the occurrence of turritellid mollusks resembling *Turritella buwaldana crooki* MERRIAM and TURNER. Although the fauna at hand is too small to discuss the geological age, it may be said that the available data indicate that the Kulthieth formation ranges in age from late Paleocene to late Eocene.



Text-fig. 6. Geological ages of the Tertiary formations in the Yakataga District and adjacent area.

POUL CREEK FORMATION

As already stated in the preceding chapter, the Poul Creek fauna includes about 36 percent of Washington and Oregon species and 26 percent of Asian Tertiary species.

Table 4 shows the species found in the Tertiary formations of Washington and Oregon.

Table 4. Poul Creek mollusks found in the Tertiary formations of Washington and Oregon.

Species	Eoc.-Olig.	Low. Mioc. Blakeley & Twin River	Mid. Mioc. Astoria & Clallam	Up. Mioc. or younger formations
Acila (Acila) gettysburgensis		+	+	
Crenella porterensis		+		
Vertipecten sp.			+	
Crassatella cf. *C. washingtoniana*	+			
Crassatina carmanahensis		+		
Tellina cf. *T. cowlitzensis arnoldi*	+			
Pitar (Katherinella) arnoldi		+		
P. (K.) arnoldi etheringtoni			+	
Macrocallista weaveri	+	?		
Panope snohomishensis	+			
Thracia schencki		+		
T. cf. *T. condoni*	+			
Epitonium (Cirsotrema) clallamense			+	
Turritella aff. *T. diversilineata blakeleyensis*		+		
Crepidula cf. *C. praerupta*			+	+
Liracassis apta	+	+		
Colus aff. *C. jordani*				+
Turricula cf. *T. washingtoniana*	+			

The Washington and Oregon species in the Poul Creek fauna are mostly similar to those of the Blakeley, and Twin River formations, and these mollusks are characteristically warm water inhabitants. Moreover, *Liracassis apta* was designated as a marker of the "*Echinophoria apta* zone" by DURHAM (1944). This zone represents the upper part of the Twin River formation. The Twin River formation is herein accepted as the equivalent to the upper part of the Blakeley formation, which is considered to be of early Miocene age (ADDICOTT, 1967).

The Poul Creek fauna also includes *Liracassis durhami* KANNO, n. sp., which is characterized by having the ancestral form of *L. petrosa* (CONRAD). *L. petrosa* is one of the characteristic species of the Astoria fauna which is accepted as the typical middle Miocene one along the west coast of North America.

Table 5 shows a list of the Poul Creek molluscan species found also in the Tertiary formations of Asian districts.

Table 5. Poul Creek mollusks found in the Asian Tertiary system.

Species	Eoc.-Olig.	Earl. Mioc.	Mid. Mio.	Lat. Mioc. or younger
Acila (Acila) submirabilis		+	+	
Acila (Truncacila) cf. *A. (T.) kamtschatica*				+
Yoldia (Yoldia) takaradaiensis	+			
Y. (Y.) biremis		+	+	
Solemya (Acharax) dalli		+	+	
Acesta cf. *A. yagenensis*		+	+	
Lucinoma cf. *L. tomitensis*		+		
Nemocardium aff. *yokoyamai*		+	+	
Spisula equilateralis		+	+	
Mya (Mya) salmonensis		+		
Panomya elongata	+	+		
Periploma besshoense	+	+	+	
Dentalium cf. *D. nunomae*	+		+	
Aturia alaskensis [=*A. minoensis*]		+	+	

Although *Acila (Truncacila) kamtschatica* occurs in the Pliocene Etron formation (upper part of the Kabran group, west Kamchatka), most of the species are reported from the early to middle Miocene age of the Horomui and the Takinoue formation or its equivalent in Hokkaido (KANNO et al., 1960, 1964, 1968). *Aturia alaskensis* [=*A. minoensis* KOBAYASHI, 1954] had been reported from several localities in Japan, where it is associated with distinctly subtropical mollusks. The type locality of "*Aturia minoensis* KOBAYASHI" seems to be in the *Globorotalia fohsi barisanensis* zone (lower part of the Burdigalian) (SAITO, 1963).

As already discussed in the preceding chapters, the Poul Creek fauna is characterized by warm water dwellers. Paleoclimatological studies by previous workers such as DURHAM (1950, 1960) and ADDICOTT (1969, 1970), indicate that the marine temperature of the west coast of North America reached the warmest during middle Miocene time in the mid-Tertiary. Judging from the above discussion, the upper part of the Poul Creek fauna may range in age from early to middle Miocene. However, the geologic age of the lowest part of the Poul Creek is not clear because of the molluscan fauna from the lowest part of the Poul Creek is inaccessible in the area studied by the writer.

YAKATAGA FORMATION

The Yakataga fauna includes about 39 percent of the Alaskan proper species and 32 percent of species now living in the northern Pacific region. Thus, about 70 percent of the fauna is boreal or cold water dwellers.

The species listed in Table 6 are also found in the Tertiary formations of the Asian districts.

Although *Delectopecten peckhami* ranges from Oligocene to Pliocene, it shows a somewhat wide variation in size with geologic age. UTASHIRO (1954) pointed out that *D. peckhami* becomes large during Miocene to Pliocene times. The Yakataga specimens are of UTASHIRO's Miocene type. *Calyptogena chitanii* from middle Miocene

Table 6. Yakataga mollsks found in the Asian Tertiary system.

Species	Eoc.-Olig.	Miocene			Pliocene or younger
		Early	Mid.	Late	
Nuculana alferovi sakhalinensis				+	
Miyagipecten sp.			+		
Delectopecten peckhami	+	+	+	+	+
Calyptogena chitanii			+		
Macoma cf. *M. incongrua*			+	+	+
Mya cuneiformis			+	+	
Periploma besshoense	+	+	+	+	
Turritella (Neohaustator) hamiltonensis [=*T. chikubetsuensis*]			+		

mudstones in Japan shows such a rapid increase in shell size and so remarkable changes in shell shape with time that it is one of the very useful Miocene molluscan horizon markers (KANNO et al., 1967). The specimens from the Yakataga at Kayak Island are very large and are strongly arcuate in form. Judging from their size and shape, the Kayak specimens may be of upper middle or late Miocene age (Text-fig. 12).

Mya cuneiformis ranges from the middle Miocene to early Pliocene, although it is most common in the middle to late Miocene in Japan. *Periploma besshoense* is reported from the late Oligocene to late Miocene in Japan and Sakhalin. *Turritella hamiltonensis* [=*T. chikubetsuensis*] is also reported from middle to late middle Miocene in Hokkaido.

Although the above listed species are chiefly restricted to the lower part of the Yakataga formation, they are known to range from middle to late Miocene in Japan.

Macoma arctata is reported from the Tertiary formations of Washington and Oregon. *M. arctata* seems to be restricted to the Astoria formation on the west coast of North America. *Macoma lorenzoensis arnoldi* and *Cryptonatica clausa* are reported from Oligocene to Pliocene in Washington and Oregon, though the Yakataga specimens are not well identified.

It is noteworthy that the Yakataga includes a large number of living cold water dwellers in contrast with the warm inhabitants of the Poul Creek fauna. ADDICOTT (1969, 1970) pointed out that the marine water temperature was rapidly decreasing in post middle Miocene time along the west coast of North America. Such a distinct faunal change in the mid-Tertiary was also pointed out by MATSUNO and the writer (KANNO and MATSUNO, 1960) in western Hokkaido, where the Sankebetsu formation which is characterized by a warm water fauna is unconformably overlain by the Chikubetsu formation which contains a distinct cold water fauna. The Sankebetsu and the Chikubetsu are almost equivalent to the Takinoue formation in central Hokkaido (Text-fig. 7).

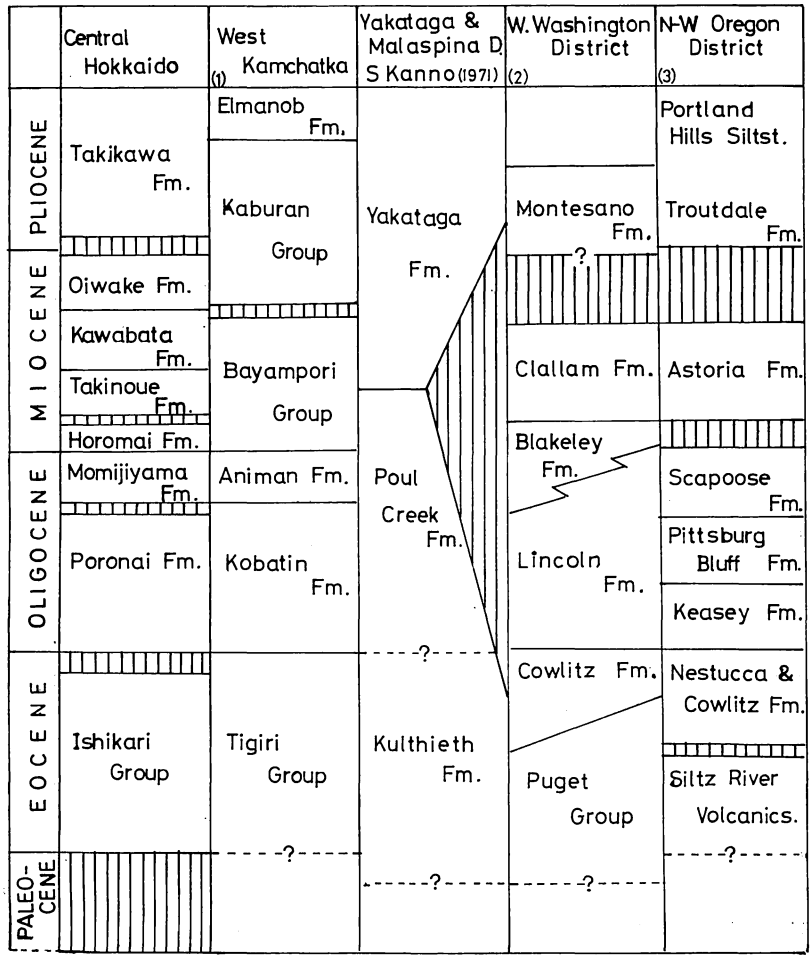
Judging from the above discussion, it seems probable that the lower part of the Yakataga formation is of late middle Miocene age, although the upper part of the Yakataga may range up into the Pliocene.

VI. Correlation

The opinions of the various workers on the correlation of Tertiary formations developed around the northern Pacific regions as well as the geological ages of the respective formations differ. This difference is apparently due to various factors such as lack of detailed paleontological work, direct comparison of specimens, misconception in interpretation of the stratigraphic sequence of the established units, and to the lack of data concerning the exact stratigraphic positions of the fossils in the geological column.

The writer's suggested correlation of Tertiary stratigraphic units in Hokkaido, west Kamchatka, Washington, Oregon, and the Yakataga District is shown in Text-fig. 7.

WASHINGTON AND OREGON: The Kulthieth formation may be correlated



Text-fig. 7. Correlation chart of the Tertiary formations in the northern circum-Pacific regions.

(1) L.B. Krishtofovich, 1960; (2) and (3) Weaver et al., 1944; Durham, 1944; Brown, Snavely, and Grower, 1956; Youngquist, 1961; Addicott, 1967.

with Eocene strata developed around Puget Sound in Washington based on the occurrence of *Cristispira pugetensis*. The upper part of the Poul Creek formation is also correlated with the lower part of the Astoria and Clallam formations, but it may be correlated with Twin River formation and also the Blakeley formation, as stated in preceding chapters.

As already discussed the geologic age of the Yakataga formation, the lowest part of the Yakataga includes the characteristic late middle or late Miocene species. Moreover, the Yakataga is underlain conformably by the Poul Creek in the Yakataga area. Thus, the lowest part of Yakataga seems to be correlated with the upper most part of Astoria and Clallam formations. However, the Yakataga may include younger Pliocene strata. The geologic age of the upper part of the Yakataga requires further work.

KAMCHATKA: The Tertiary system of Kamchatka has recently studied by L. V. KRISHTOFOVICH (1960, 1963), L. V. KRISHTOFOVICH and A. P. ILYINA (1962), and U. V. GRADENKOV (1966, 1969).

The Tigiri group, the lowest Tertiary system of western Kamchatka, consists mainly of non-marine coal-bearing deposits that are locally intercalated with marine strata. This group seems to correlate stratigraphically with the Kulthieth formation in the Gulf of Alaska.

The Kobatin and Animan formations consist mainly of muddy strata containing *Yoldia olympiana, Modiolus restrationensis, Lima twinnensis*, and *Aforia clallamensis* (KRISHTOFOVICH, 1960). This fauna seems to correlate with that of the Poul Creek, Twin River, and Blakeley formations in the west coast of North America.

The Bayampoli group also consists of muddy rocks or siliceous strata and contains rather deep water dwellers such as *Delectopecten, Nuculana*, and *Yoldia*. This fauna is roughly comparable to the lower part of the Yakataga formation at Kayak Island, but precise comparison between them is difficult owing to the inadequate data on the molluscan fauna. The Kaburan group and Elmanob formation may corrrelate stratigraphically with the upper part of the Yakataga formation.

HOKKAIDO: The Ishikari group is definitely correlated with the Kulthieth formation based on the lithological and paleontological evidence. Like the Kulthieth formation, the Ishikari is underlain by the upper Cretaceous system with unconformity, and consists mainly of terrestrial or non-marine deposits intercalated with coal measures and also a few marine beds. Moreover, it yields plant fossils including such as the Eocene species of *Sabalites*, some marine mollusks, and a large number of fresh-water mollusks.

It is difficult to correlate directly between the Poronai and Poul Creek formations owing to the limited collections available to the writer from the lower part of the Poul Creek. However, the lower part of the Yakataga contains the same species as the Takinoue which overlies the Poronai and the Momijiyama with unconformity. Namely, the occurrence of *Calyptogena chitanii* and *Turritella* (*Neohaustator*) *hamiltonensis* [=*T. chikubetsuensis*] from the lower Yakataga may support correlation of the Yakataga and the upper part of Takinoue in Hokkaido. Moreover, the writer collected *Liracassis petrosa* from the strata equivalent to the Takinoue in southern Hokkaido. This evidence may be sufficient to permit correlation of the Takinoue

with the lower part of the Astoria formation, though it is not equivalent to the entire Astoria formation.

The Kawabata formation overlies the Takinoue with conformity and consists chiefly of conglomerate and thick alternation of sandstone and mudstone. This sedimentary facies closely resembles some parts of the Yakataga formation.

The Takikawa formation is one of the typical Pliocene units in Hokkaido in which *Fortipecten takahashii* occurs. The "*Fortipecten takahashii*" fauna is characterized by cold water dwellers in northern Japan, Sakhalin, and Kamchatka, although it has not been reported from the Gulf of Alaska. However, two species of *Fortipecten* were reported from the Alaskan Peninsula (MACNEIL, 1968, and MACNEIL, et al., 1943).

VII. Systematic Descriptions

Class Bivalvia

Subclass Palaeotaxodonta

Order Nuculoida

Superfamily Nuculacea

Family Nuculidae

Genus *Acila* H. and A. Adams, 1858

Acila H. and A. Adams, Gen. Rec. Moll., vol. 2, p. 545, 1858; *Acila* H. and A. Adams. Stoliczka, Mem. Geol. Surv. India, Paleont. Indica, vol. 3, p. 325, 1871; *Acila* H. and A. Adams. Grant and Gale, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 112-113, 1931; *Acila* H. and A. Adams. Schenck, Geol. Soc. Am., Spec. Pap., no. 4, p. 22-23, 1936; *Acila* H. and A. Adams. Kanno, Tert. Sys. Chichibu Basin, p. 189, 1960; *Acila* H. and A. Adams. Moore, U. S. Geol. Surv. Prof. Pap., 419, p. 54, 1968; *Acila* H. and A. Adams. Moore et al., Treat. Invert. Paleont., pt. N, vol. 1, p. 231, 1969.

Type-species (by subsequent designation, Stoliczka, 1871):—*Nucula divaricata* Hinds, Recent, China Sea.

Remarks:—This genus is characterized by the divericated radial ribs and marginal crenulations in the young stage. All known species of the genus are marine in habitat and chiefly live in fine-grained sediments.

Geographic distribution:—Temperate Indo-Pacific waters, rare in tropical and boreal Pacific.

Geologic range:—Cretaceous to Recent.

Subgenus *Acila* s. s. H. and A. Adams, 1858

Acila s. s. H. and A. Adams, Gen. Rec. Moll., vol. 2, p. 545, 1858; *Acila* s. s. H. and A. Adams. Schenck, Geol. Soc. Am., Spec. Pap., no. 4, p. 23, 1936; *Acila* s. s. H. and A. Adams. Kanno, Tert. Syst. Chichibu Basin, p. 190, 1960; *Acila* s. s. H. and A. Adams. Moore et al., Treat. Invert. Paleont., pt. N, vol. 1, p. 231; 1969.

Type-species (by subsequent designation, Stoliczka, 1871):—*Nucula divaricata* Hinds, Recent, China Sea.

Remarks:—This subgenus can be distinguished from the other subgenera of the genus by having a posterior rostrum. It has rather restricted distribution, i. e., the representatives of this subgenus range from off Hokkaido to the Bay of Bengal and the Arabian Sea (Schenck, 1936).

Geologic range:—Upper Oligocene to Recent.

Acila (*Acila*) *gettysburgensis* (Reagan), 1909

Plate 1, figs. 4, 7

1909. *Nucula (Acila) gettysburgensis* REAGAN, Trans. Kans. Acad. Sci., vol. 22, p. 171, 175. 177, pl. 1, fig. 3.
1912. *Nucula gettysburgensis* REAGAN. WEAVER, Wash. Geol. Surv., Bull. no. 15, p. 18.
1916. *Acila gettysburgensis* (REAGAN). WEAVER, Univ. Wash. Publ. Geol., vol. 1, no. 1, p. 28, 35.
1922. *Nucula (Acila) gettysburgensis* (REAGAN). DALL, Am. Jour. Ser. 5, vol. 4, no. 22, p. 306.
1927. *Acila gettysburgensis* (REAGAN). SCHENCK, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 16, p. 458-459.
1932. *Nucula (Acila) gettysburgensis* REAGAN, Bull. Geol. Soc. Am., vol. 43, p. 804, pl. 14, fig. 12.
1932. *Nucula (Acila) gettysburgensis* var. *alaskensis* CLARK, Bull. Geol. Soc. Am., vol. 43, p. 804-805, pl. 14, fig. 5.
1933. *Nucula (Acila) gettysburgensis* (REAGAN). TEGLAND, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, p. 105.
1934. *Acila (Acila) gettysburgensis* (REAGAN). SCHENCK, Bull. Mus. Roy. Hist. Belg., vol. 10, no. 20, p. 42.
1936. *Acila (Acila) gettysburgensis* (REAGAN). SCHENCK, Geol. Soc. Am., Spec. Pap., no. 4, p. 78-81, pl. 12, figs. 1-15; pl. 13. figs. 4, 7, 9, text-fig. 81.
1942. *Acila (Acila) gettysburgensis* (REAGAN). WEAVER, Univ. Wash. Publ. Geol., vol. 5, p. 32-34, pl. 7, figs. 1-4; pl. 8, fig. 1.
1963. *Acila (Acila) gettysburgensis* (REAGAN). MOORE, Geol. Surv. Prof. Pap., 419, p. 54, pl. 12, figs. 5, 10, 12, 13.
1964. *Acila (Acila) gettysburgensis* (REAGAN). L. V. KRISHTOFOVICH, BNIGRI., no. 232, p. 30, pl. 1, figs. 20, 20a, 20b.
1971. *Acila (Acila) gettysburgensis* (REAGAN). ADDICOTT et al., U.S. Geol. Surv. Prof. Pap., 750-C, fig. 3, g, k, m.

Remarks:—This species is common in the faunas of the Twin River formation (type locality) as well as the Blakeley formation on Bainbridge Island, Washington, and the Nye shale at Newport, Oregon. This species is more or less similar to *Acila (A.) submirabilis* MAKIYAMA (1926, p. 151-152, pl. 2, fig. 9) from North Korea, which is also rather widely distributed in lower to middle Miocene strata in Japan. However, the latter is more finely sculptured and has a shorter posterior side than the former. *Acila (Acila) gettysburgensis* var. *alaskensis* (CLARK, 1932) is a varietal form of the present species. Some specimens from the type locality of CLARK's variety collected by the writer have the same characters as CLARK's type-specimen, but the others show just same as REAGAN's and SCHENCK's descriptions. Accordingly, the writer concludes that CLARK's taxon is a varietal form of the present species.

This species occurs in the Twin River formation (type locality) as well as lower Miocene in Washington and Oregon. Moreover, it ranges upward into the Astoria and "Monterey Miocene", but is unknown from older strata such as the Lincoln and Scappoose formations, nor known to occur in the *Acila shumardi* zone. Accordingly, this species ranges from the late Oligocene to middle Miocene.

This species has not been reported from Japan, however, the allied species, *A. (Acila) submirabilis* MAKIYAMA, and *A. (A.) iwadonozawensis* KANNO are known from the Tertiary system of the Chichibu Basin, central Japan (KANNO, 1960), and the Ashiya group in Kyushu (HATAI and NISIYAMA, 1952). These strata may represent some part of the "Aquitanian" age in Japan.

Localities:—81201, olive-green, fine-grained sandstone, upper part of the Poul Creek formation; 81404, olive-green, silty sandstone, lower part of the Poul Creek

formation.

Reg. No. TUE 8341.

Acila (*Acila*) cf. *A.* (*A.*) *submirabilis* MAKIYAMA. 1926

Plate 1, fig. 2

1926. *Acila submirabilis* MAKIYAMA, Kyoto Imp. Univ. Mem. Coll. Sci., ser. B, no. 3, p. 151–153, pl. 12, fig. 9.
1928. *Nucula* (*Acila*) *mirabilis* var. *ashiyaensis* NAGAO, Tohoku Imp. Univ. Sci. Rep. ser. 2, vol. 12, no. 1, p. 21–22, pl. 7, figs. 6–10.
1931. ?*Nucula mirabilis* ADAMS et REEVE. KOMENKO, Geol. Proc. Ser. USSR, Tr., Fasc. 79, p. 65–66, pl. 10, fig. 3.
1934. *Acila* (*Acila*) *submirabilis* MAKIYAMA. SCHENCK, Mus. Roy. Hist. Nat. Belg., Bull., vol. 10, no. 20, p. 42.
1936. *Acila* (*Acila*) *divaricata* (HINDS) var. *submirabilis* MAKIYAMA. SCHENCK, Geol. Soc. Am., Spec. Pap., no. 4, p. 88–90, pl. 11, figs. 9–11; pl. 14, figs. 1, 5, 8–11; pl. 18, figs. 8, 9, 13–15; text-fig. 8.
1960. *Acila* (*Acila*) *submirabilis* MAKIYAMA. KANNO, Tert. Sys. Chichibu Basin, p. 190–192, pl. 31. figs. 3–7.

Remarks:—*A.* (*A.*) *divaricata* is characterized by the ribless escutcheonal area, whereas on *A.* (*A.*) *submirabilis* the escutcheon is sculptured by radial ribs.

The living species ranges from the southern part of central Japan to Celebes Island. The specimens are usually collected from 95–160 meters, where bottom temperature ranges from 12.5°–23.8°C (SCHENCK, 1936). The fossil species is reported from northern Korea (type locality), Japan, and the Gulf of Alaska. This species ranges from the upper Oligocene to Recent.

Locality:—81202, dark-gray mudstone, upper part of the Poul Creek formation.

Reg. No. TUE 8342.

Acila (*Acila*) sp.

Plate 1, fig. 3

Remarks:—Several specimens at hand are characterized by a rather low shell and narrow apical angle, but most of the specimens are represented by internal moulds or are poorly preserved. Specific identification, therefore, is difficult.

Localities:—80905, olive-green, fine-grained sandstone, upper part of the Poul Creek formation; 81404, olive-green silty sandstone, lower part of the Poul Creek formation.

Reg. No. TUE 8343.

Subgenus *Truncacila* GRANT and GALE, 1931

Truncacila GRANT and GALE, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 115, 1931; *Truncacila* GRANT and GALE. SCHENCK, Geol. Soc. Am., Spec. Pap., no. 4, p. 23–24, 1936; *Truncacila* GRANT and GALE. MOORE, U.S. Geol. Surv. Prof. Pap. 419, p. 54, 1963; *Truncacila* GRANT and GALE. HICKMAN, Mus. Nat. Hist., Univ. Oregon. Bull., no. 16, p. 24; 1969; *Truncacila* GRANT and GALE. MOORE et al., Treat. Invert. Paleont., pt. N, p. 231, 1969.

Type-species (by original designation):—*Nucula castrensis* HINDS, Recent, Sitka, Alaska.

Remarks:—This subgenus is characterized by divaricating radial sculpture, but it lacks the rostrum on the posterior part of the ventral margin.

Geologic range:—Lower Cretaceous to Recent.

Acila (*Truncacila*) cf. *A.* (*T.*) *kamtschatica* ILYINA, 1964

Plate 1, fig. 8

1964. *Acila* (*Truncacila*) *kamtschatica* ILYINA, Moll. Neog. Kamchatka, p. 91, pl. 34, figs. 1-2.

Remarks:—This species was originally reported by ILYINA (1964, op. cit.) from the Etron formation (middle Pliocene) of Kamchatka, associated with *Swiftopecten swiftii* var. *etchegoini* (ANDERSON). This species is characterized by rather small shell for the genus, more or less roundly ovate in outline, a narrow apical angle, double divaricating radial ribs on the central part of disk, and rather distinct concentric growth lines which are densely crowded on the ventral margin.

This species seems to range from the Miocene to the Pliocene.

Locality:—20525-1, dark-gray, siltstone, lower part of the Yakataga formation.

Reg. No. TUE 8344.

Acila (*Truncacila*) *taliaferroi* SCHENCK, 1936

Plate 1, figs. 5, 6

1932. *Nucula* (*Acila*) *hamiltonensis* CLARK, Bull. Geol. Sci. Am., vol. 43, p. 806, pl. 14, figs. 11, 14.
1936. *Acila* (*Truncacila*) *taliaferroi* SCHENCK, Geol. Soc. Am., Spec. Pap., no. 4, p. 81.
1971. *Acila* (*Truncacila*) *taliaferroi* SCHENCK. ADDICOTT et al., U.S. Geol. Surv., Prof. Pap., 750-C, fig. 3, h, j.

Remarks:—This species was originally described by B. L. CLARK (1932), from the Yakataga District. Subsequently, the new name *A.* (*T.*) *taliaferroi* was introduced by SCHENCK (1936), because CLARK's name was preocupied by d'ORBIGNY's *Nucula hamiltonensis*, 1849. The present species is characterized by a shell which is small for the genus, secondary bifurcation which starts two-thirds of the distance from the beak and which is closely situated to the primary bifurcation, and having almost no radials on the gerontic stage where very fine concentric growth lines are developed.

The present species is more or less similar to *A.* (*T.*) *shumardi* (DALL) from Oligocene formations of California, Oregon and Washington, but the former differs from the latter by rather rough radial ornamentation and no radial ribs near the ventral margin in the gerontic stage. *A.* (*T.*) *empirensis* HOWE from the upper Miocene and Pliocene formations of Washington and Oregon (SCHENCK, 1936, p. 85-86, pl. 9, figs. 3, 4, 6-10, 12) is also similar to this species, but is distinguished by its larger size (about twice as large) and higher shell.

Locality:—80604, dark-gray or black mudstone, lower part of the Yakataga

formation.

Reg. No. TUE 8345.

Superfamily Nuculanacea

Family Nuculanidae

Genus *Nuculana* LINK, 1807

Nuculana LINK, Beshr. Natur. Samml. Univ. Rost., Abth. 3, p. 155, 1807; *Nuculana* LINK. STOLICZKA, Mem. Geol. Surv. India, Paleont. 1871; *Nuculana* LINK. GRANT and GALE, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 118, 1931; *Nuculana* LINK. KEEN, Sea Shells Trop. West Am., p. 17, 1958; *Nuculana* LINK. HICKMAN, Mus. Nat. Hist., Univ. Oregon, Bull. no. 16, p. 27, 1969; *Nuculana* LINK. MOORE et al., Treat. Invert. Paleont., pt. N, no. 1, p. 235, 1969.

Type-species (by original designation):—*Arca rostrata* CHEMNITZ, [=*Arca pernula* MÜLLER, 1771], Recent, northern coast of Europe.

Remarks:—The characteristic features of the genus are the pointed posterior end, curved posterior dorsal margin, and the small and rounded pallial sinus. Most species of the genus are deeper water forms, and are characteristic of the cold northern waters.

Geographic distribution:—World-wide, abundant in cold seas.

Geologic range:—Triassic to Recent.

Subgenus *Borissia* SLODKEVICH, 1938

Borissia SLODKEVICH, Tertiary pelecypods, Far East, p. 79, 1938; *Borissia* SLODKEWITSCH. KRISCHTOFOVICH, Moll. Tert. Sakhalin. p. 69-70, 1964; *Borissia* SLODKEVICH. MOORE et al., Treat. Inver. Paleont., pt. N, vol. 1, p. 285, 1969.

Type-species:—*Nuculana alferovi* SLODKEVICH, Miocene of Sakhalin and Kamchatka.

Remarks:—This subgenus is characterized by the less rostrate shell with low, broad concentric ribs covering the median portion of valve.

Nuculana (Borissia) alferovi sakhalinensis KRISHTOFOVICH, 1964

Plate 1, figs. 19-22

1932. *Leda fossa* BAIRD. CLARK, Bull. Geol. Soc. Am., vol. 43, p. 806, pl. 14, fig. 3.
1964. *Nuculana (Borissia) alferovi sakhalinensis* KRISHTOFOVICH, Tert. Moll. Sakhalin, p. 70, pl. 5, fig. 14.
1971. *Nuculana (Borissia) alferovi sakhalinensis* KRISHTOFOVICH. ADDICOTT et al., U.S. Geol. Surv. Prof. Pap., 750-C, fig. 3, i.

Description:—Shell small, elongate, convex beaks situated anteriorly, orthogyrous; postero-dorsal margin rather concave, and longer than the antero-dorsal one which is steeply down to the anterior border; posterior end narrow and truncated; anterior end short and evenly rounded; surface sculptured with distinct regular concentric growth lines which are more clear on the umbonal area and becoming

obsolete toward the ventral margin; escutcheon long, smooth, and separated from the disk by a blunt ridge; a blunt ridge running from beak to postero-ventral corner making a small narrow area; an elongate process distinct on the middle of interior of posterior end; hinge with a small interior cartilage-pit, and numerous teeth on each side.

Measurements (in mm):—

Specimens	Length	Height	Thickness	H/L×100
No. 1	10.0	6.0	4.3	60.0
„ 2	9.9	6.2	4.2	62.6
„ 3	9.4	6.5	4.3	69.1
„ 4	9.0	6.3	4.6	70.0
„ 5	8.2	5.0	3.8	60.9
„ 6	7.3	5.0	3.0	68.4

Remarks:—This species is characterized by small and inflated valves which have distinct concentric sculpture. This species may be same as the CLARK's specimens identified as "*Leda fossa* BAIRD" (CLARK, 1932). However, *Nuculana fossa* (a Recent species living from Alaska to Puget Sound) is ornamented with only a few discernible concentric lines. Although eroded specimens of the present species do not clearly show such a concentric sculpture, it is very distinct on well-preserved specimens. Moreover, the present species differs from *N. fossa* by having small and inflated shell. The present species is also somewhat similar to *N.* (*N.*) *tatarica* KOGAN, 1936 (KRISHTOFOVICH, 1964, p. 56, pl. 4, figs. 14, 16, 18-20) from the upper Miocene Sertonai formation of Sakhalin, but it is distinguished by its smaller shell, more rostrated posterior margin and higher shell.

This species is characteristic in the black shale of the lower part of Yakataga formation and makes a horizon marker.

Localities:—80604, 80703, 80802, 81304, 20424-20, 20503-5, Sc-6*, Sc-8*, all consisted of black shale, lower part of the Yakataga formation.

Reg. No. TUE 8346.

Genus *Yoldia* MÖLLER, 1842

Yoldia MÖLLER, Index Molluscorum groenlandiae, p. 18, 1842; *Yoldia* MÖLLER. H. and A. ADAMS, Gen. Rec. Moll., vol. 2, p. 548, 1858; *Yoldia* MÖLLER. OLDROYD, Stanf. Univ. Publ., Univ. Ser. Geol. Sci., vol. 1, no. 1, p. 27, 1924; *Yoldia* MÖLLER. STEWART, Acad. Nat. Sci. Phila., Spec. Publ., no. 3, p. 59, 1930; *Yoldia* MÖLLER. GRANT and GALE, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 126, 1931; *Yoldia* MÖLLER. HIRAYAMA, Sci. Rep. Tokyo Univ. Educat., sec. C, vol. 4, no. 29, p. 78, 1955; *Yoldia* MÖLLER. KANNO, Tert. Sys. Chichibu Basin, p. 198, 1960; *Yoldia* MÖLLER. MOORE, U.S. Geol. Surv. Prof. Pap., 419, p. 58, 1963; *Yoldia* MÖLLER. HICKMAN, Mus. Nat. Hist., Univ. Oregon, Bull. no. 16, p. 31, 1969; *Yoldia* MÖLLER. MOORE et al., Treat. Invert. Paleont., pt. N, vol. 1, p. 239, 1969.

Type-species (by subsequent designation, ICZN, 1966):—*Nucula arctica* MÖLLER and GRAY, Recent, circumboreal region.

* Upper reaches of the Shokum Creek.

Remarks:—The present genus is closely related to the genus *Nuculana* LINK, 1807, but it can generally be distingished therefrom by the strong keel on the posterior dorsal margin, and by its gape at both ends.

Geographic distribution:—World-wide, especially, arctic and boreal regions.

Geologic range:—Cretaceous to Recent.

Subgenus *Yoldia* s. s.

Remarks:—This subgenus is characterized by an almost smooth surface excepting for the weakly developed concentric growth lines.

Yoldia (*Yoldia*) *takaradaiensis* KRISHTOFOVICH, 1954

Plate 1, figs. 13-15

1954. *Yoldia takaradaiensis* KRISHTOFOVICH, Tert. Moll. Fauna, South Sakhalin, p. 65, pl. 2, figs. 10-11.
1957. *Yoldia* (*Yoldia*) *akanensis* UOZUMI, Jour. Fac. Sci., Hokkaido Univ., ser. 4, vol. 9, no. 4, p. 550-551, pl. 4, figs. 1-3, 10.
1964. *Yoldia* (*Yoldia*) *takaradaiensis* KRISHTOFOVICH, BNIGRI, no. 232, p. 78-79, pl. 6, figs. 1-9.

Remarks:—This species was originally described by KRISHTOFOVICH (1954) from the Takaradi formation (Oligocene) of southern Sakhalin. According to his report, he recognized two forms, i. e., *Y.* (*Y.*) *takaradaiensis* forma *bruta* and *Y.* (*Y.*) *t.* forma *acuta*. The former one has a rather blunt posterior end, and the latter has a rather acute and rostrate posterior end. However, these two forms seem to intergrade and the present writer prefers to consider them as one species. UOZUMI (1957) reported *Y.* (*Y.*) *akanensis* from the Onbetsu formation of eastern Hokkaido. His specimens also show variation in outline of shell similar to the Takaradai specimens. *Y.* (*Y.*) *akanensis* may be represented by some varietal from of *Y.* (*Y.*) *takaradaiensis*.

Yakataga specimens at hand also show a rather broad range of variation, i. e., one is a rather low shell with a rostrate posterior end, but the other one has a distinctly higher shell with a blunt posterior end. However, there are many intermediate forms between these two extremes.

Localities:—80902, 81001, 81201, 81401, all fine-grained, olive-green sandstone, upper part of the Poul Creek formation.

Reg. No. TUE 8347.

Yoldia (*Yoldia*) *biremis* UOZUMI, 1957

Plate 1, figs. 16-17

1957. *Yoldia* (*Yoldia*) *biremis* UOZUMI, Jour. Fac. Sci., Hokkaido Univ., ser. 4, vol. 9, no. 4, p. 552-553, pl. 4, figs. 4-6, 12.
1968. *Yoldia* (*Yoldia*) *biremis* UOZUMI, KANNO, OHARA, and KAITEYA, Sci. Rep. Tokyo Univ. Education. sec. C, vol. 10, no. 94, pl. 1, fig. 1 (no description).

Remarks:—This species was originally reported from the Chikubetsu formation (middle Miocene) of Hokkaido, Japan (UOZUMI, 1957). It is characterized by an elongate shell and posteriorly situated, rather inconspicuous beaks. The present species ranges from the lower to middle Miocene in Hokkaido.

Localities:—81001, 81201, all olive-green, medium- to fine-grained sandstone, upper part of the Poul Creek formation.

Reg. No. TUE 8348.

Subgenus *Cnesterium* DALL, 1898

Cnesterium DALL, Trans. Wagner Free Inst. Sci., Philad., pt. 4, p. 595, 1898; *Cnesterium* DALL. GRANT and GALE, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 130, 1931; *Cnesterium* DALL. MOORE et al., Treat. Invert. Paleont., vol. 1, pt. N, p. 240, 1969.

Type-species (by original designation):—*Yoldia scissurata* DALL, 1898 [=*Y. ensifera* DALL, 1897], Recent, Arctic Ocean to Puget Sound, Washington.

Remarks:—The subgenus is characterized by surface ornamentation of obliquely incised and not inharmony with the growth lines. GRANT and GALE (1931, p. 130) believed that this character could not be relied upon as of systematic importance. However, the present writer inclines to believe that the oblique sculpture is a valid as subgeneric character.

This subgenus is widely distributed in temperate to cold waters. Subgenus *Cnesterium* ranges from the upper Miocene to Recent along the west coast of North America, but from the lower Miocene to Recent in Japan. It is also rather common in Sakhalin and Kamchatka, where it probably ranges from the upper Miocene to Recent, i. e., upper Miocene Sertonai and Okobikai formations (Sakhalin) and upper part of the Pachatinsk formation of the eastern Kamchatka, Pliocene Nutobo formation of Sakhalin and Etoron formation of Kamchatka yield some species of *Cnesterium*.

Yoldia (Cnesteium) ensifera DALL, 1897

Plate 1, figs. 10, 11

1897. *Yoldia ensifera* DALL, Nat. Hist. Soc. Brit. Col., Bull. no. 2, Art. 1, p. 9, pl. 2, fig. 4.
1898. *Yoldia scissurata* DALL, Trans. Wagner Free Inst. Sci., vol. 3, pt. 4, p. 595.
1924. *Yoldia ensifera* DALL. OLDROYD, Stanf. Univ. Publ., Univ. Ser., Geol. Sc., vol. 1, no. 1, p. 32, pl. 5, fig. 3; pl. 37, fig. 6.
1924. *Yoldia scissurata* DALL. OLDROYD, Stanf. Univ. Publ., Univ. Ser., Geol. Sci., vol. 1, no. 1, p. 31, pl. 5, fig. 2.
1931. *Yoldia scissurata* DALL. GRANT and GALE, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 131, pl. 1, fig. 1.
1965. *Yoldia (Cnesterium) ensifera* DALL. HABE and ITO, Shells on the World (in clor), vol. 1, p. 106, pl. 34, fig. 22.

Remarks:—This species is characterized by having a rostrated posterior end and rather conspicuous beaks. *Y. (C.) strigata* DALL (1909, p. 104, pl. 14, figs. 9, 9a) is somewhat similar to the present species, but differs from the present one by having the truncated posterior end and higher shells.

Measurements (in mm.):—

Specimens	Length	Height	Anterior portion	H/L×100	A/L×100
No. 1	13.4	6.5	6.4	46.4	47.7
" 2	22.5	10.5	11.5	46.6	51.1
" 3	18.7	9.0	9.0	48.1	48.1
" 4	30.6	14.3	13.7	46.7	44.7
" 5	35.8	19.0	20.8	53.0	58.0
" 6	37.3	18.5	21.5	49.5	57.6

A ··· Length measured from the beak to the anterior end of shell. Nos. 5–6 ··· *Y.* (*C.*) *strigata* DALL figured by WEAVER (1942, pl. 9, figs. 15, 20); No. 4 ··· *Y.* (*C.*) *scissurata* DALL figured by OLDROYD (1924, pl. 5, fig. 2).

This species has been reported from the Empire and Montesano formation (latest Miocene to Pliocene) and the living species distributes in the inner neritic north of California as well as Alaska.

Localities:—80802, 20503-5, 20523-3, black shale of the lower part of the Yakataga formation.

Reg. No. TUE 8349.

Yoldia (*Cnesterium*) *yakatagensis* KANNO, n. sp.

Plate 1, figs. 12, 18

Description:—Shell thin, rounded-ovate in outline, inequilateral, equivalve; beaks situated in almost central part of the shell; antero-dorsal margin gently arcuate and merging into the anterior border with a broad angle; postero-dorsal margin slightly concave, with a narrow, elongate and lanceolate escutcheon; lunule hardly developed; posterior end somewhat rostrate, almost pointed; posterior basal margin evenly arcuate merging into the broadly rounded basal one; surface ornamented with obscure incremental lines of growth and numerous sharp, slightly elevated, oblique ridges; these ridges run obliquely from the antero-dorsal part to the posterior-ventral border, and somewhat crowded at the umbonal area, but showing rather wider interspaces in the adult stage; oblique ridges somewhat flexous in the antero-ventral area.

Measurements (in mm):—

Specimens	Length	Height	Thickness	H/L×100
Holotype	15.4	9.4	—	61.0
Paratype	18.1	11.4	—	62.9

Remarks:—This species is characterized by a rounded-ovate form. It is very similar to *Y.* (*C.*) *strigata* DALL (1909). However, the two taxa are easily distinguishable by their shell outline. The development of the oblique surface ornamentation may be slightly varying on each specimen, but it almost covers the disk except for the antero-dorsal part and on the rostrum.

Locality:—80802, rather massive black shale, lower part of the Yakataga formation.

Reg. No. TUE 8350 (holotype); TUE 8407 (paratype).

Yoldia sp.

Plate 1, fig. 9

Remarks:—An internal mould at hand is characterized by the transversely elongated lanceolate form, and an inconspicuous beak situated close to the central part of shell. This specimen is more or less similar to *Y. limatula* SAY (OLDROYD, 1924, p. 31, pl. 19, figs. 1, 1a-b), a living species ranging from the Arctic to San Diego, California, and into the Atlantic, but this specimen differs from the living one by a somewhat higher shell, and a more broadly rounded anterior margin. Moreover, according to GRANT and GALE (1931, p. 131), *Y.* (*Y.*) *limatula* may be one of the varietal forms of *Y.* (*Y.*) *scissurata* DALL, 1898 [=*Y. ensifera* DALL, 1897]. The present specimen is also somewhat similar to *Y.* (*Y.*) *biremis* UOZUMI, 1957, but it may be distinguished by the more posterior position of its beak.

This specimen may perhaps represent a new species, but a new name can not proposed until more well-preserved specimens are collected.

Locality:—81102, a float specimen, possibly from the upper part of the Poul Creek formation.

Reg. No. TUE 8408.

Subclass Cryptodonta

Order Solemyoida

Superfamily Solemyacea

Family Solemyidae

Genus *Solemya* LAMARCK, 1818

Solemya LAMARCK. Hist. Nat. Anim. Sans. Vert., vol. 5, p. 488, 1818; *Solemya* LAMARCK. H. and A. ADAMS, Gen. Rec. Moll., vol. 2, p. 482, 1858; *Solemya* LAMARCK. CLDROYD, Stanf. Univ. Publ., Univ. Ser., Geol. Sci., vol. 1, no. 1, p. 9, 1924; *Solemya* LAMARCK. GRANT and GALE, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 109, 1931; *Solemya* LAMARCK. TEGLAND, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, no. 3, p. 100-102, 1933; *Solemya* LAMARCK. VOKES, Jour. Paleont., vol. 29, no. 3, p. 534-538, 1955; *Solemya* LAMARCK. KANNO, Tert. Sys. Chichibu Basin, p. 184, 1960; *Solemya* LAMARCK. MOORE, U.S. Geol. Surv. Prof. Pap., 419, p. 51, 1963; *Solemya* LAMARCK. MOORE et al., Treat. Invert. Paleont., pt. N, p. 242, 1969.

Type-species (by subsequent designation, CHILDREN, 1823):—*Solemya mediterranea* LAMARCK, 1818, Recent, Adriatic and Mediterranean Seas, Atlantic Ocean of Spain, Madera, west Africa, and North Pacific Ocean.

Remarks:—This genus is characterized by an elongated solenshaped shell, a radially grooved surface sculpture, an epidermis which is extending beyond the ventral margin of the valve, and an edentulous hinge.

Species of this genus range from very small to large in size. It is noteworthy that large-sized species range from shallow water in boreal regions to deep water in tropical regions (DALL, 1908; KANNO, 1960).

Geographic distribution:—World-wide.

Geologic range:—Lower Paleozoic to Recent.

Subgenus *Acharax* DALL, 1908

Acharax DALL, Nautilus. vol. 1, no. 1, p. 1-2, 1908; *Acharax* DALL. TEGLAND, Univ. Calif. Publ. Bull. Dept. Geol. Sci., vol. 23, no. 3, p. 102, 1933; *Acharax* DALL. HABE, Gen. Jap. Shells, p. 17, 1951; *Acharax* DALL. KANNO, Tert. Sys. Chichibu Basin. p. 185, 1960; *Acharax* DALL. MOORE et al., Invert. Paleont., pt. N, p. 243, 1965.

Type-species (by original designation):—*Solemya johnsoni* DALL, Recent, deep water off Oregon to Panama.

Remarks:—The characteristic features of this subgenus are generally large-sized shell with an external and opisthodetic ligament.

Geographic distribution:—Pacific Ocean.

Geologic range:—Possibly lower Paleozoic to Recent.

Solemya (Acharax) dalli CLARK, 1925

Plate 1, fig. 1

1909. *Solemya ventricosa* CONRAD, REAGAN, Trans. Kans. Acad. Sci., vol. 22, p. 174, pl. 1, fig. 1.
1925. *Solemya dalli* CLARK, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, no. 4, p. 73. pl. 22, fig. 3.
1925. *Solemya tokunagai* YOKOYAMA, Jour. Coll. Sci., Imp. Univ. Tokyo, vol. 45, art. 5, p. 31, pl. 6, figs. 1-3.
1933. *Solemya (Acharax) dalli* CLARK. TEGLAND, Univ. Calif. Pul., Bull. Dept. Geol. Sci., vol. 23, p. 103-104, pl. 4, figs. 1-10.
1942. *Solemya (Acharax) dalli* CLARK. WEAVER, Univ. Wash. Publ., vol. 5, pt. 1, p. 20-21, pl. 4, figs. 6-8; pl. 5, figs. 4-8.
1955. *Solemya dalli* CLARK. VOKES, Jour. Paleont., vol. 29, no. 13, p. 540.
1960. *Solemya (Acharax) dalli* CLARK. KANNO, Tert. Sys. Chichibu Basin, p. 186-187, pl. 31, fig. 1.

Remarks:—According to TEGLAND (1933, p. 103-104), topotypes of *S. dalli* show the following characters: "ligament external, parivincular, and opisthodetic, characteristics of the subgenus". However, VOKES (1955, p. 540) commented upon interior characters of specimens from the Keasey formation as follows; "there was also a considerable amount of the ligament that was internal and amphidetic in position, indicating its reference to *Solemya (Solemya)* of DALL's classification". Moreover, he noted that "there is also an internal rib supporting the condrophore and bounding the posterior adductor".

The present writer observed topotypes of *S. dalli*, but was unable to find any specimens with an amphiditic ligament and internal radial rib. Therefore the writer considers that *S. dalli* belongs to subgenus *Acharax* DALL, 1908. *"S. dalli"* described by VOKES (1955, p. 540) from the Keasey formation probably is a different species.

The present writer collected some specimens of *Solemya* from the type Keasey formation, but, unfortunately, was unable to find any one corresponded to specimens described by VOKES (1955, p. 540).

The present species seems to be restricted to the lower part of the Poul Creek formation of the Yakataga District from the dark-gray silty mudstone characterized by abundant calcareous concretions.

This species is very similar to *S.* (*A.*) *tokunagai* YOKOYAMA, 1925, from the Japanese Miocene (YOKOYAMA, 1925, p. 31, pl. 6, figs. 1-3). According to WEAVER (1942, p. 20), *S.* (*A.*) *dalli* has the length of the anterior dorsal margin averages about 75 percent of that of the shell, and the height of the shell is 35 percent of the length. The writer (1960, p. 186-187) discussed the distinction of *S.* (*A.*) *tokunagai* and *S.* (*A.*) *dalli* according to the results of WEAVER's measurements. However, the writer's measurement on topotypes of *S.* (*A.*) *dalli* from the Twin River formation, Restoration Point (type area of the Blakeley formation), and the Lincoln formation, show the following values;

Localities	Length	Height	Length of antero-dorsal border	H/L×100	Ad/L×100
Twin River	49.4	16.2	34.2	32.7	69.4
Restration Point	62.5	17.2	45.0	27.5	72.0
Lincoln formation	46.8	17.0	35.4	36.4	75.6
Poul Creek formation	64.0	19.0	45.7	28.1	71.4

Ad ··· The length of antero-dorsal border.

According to these data, although based on very few specimens, it seems clear that these ratios are considerably variable. In addition such inclination is very distinct on individual of *S.* (*A.*) *tokunagai* as already reported (KANNO, 1960). Namely, the ratios of height to length and the anterior portion to length of *S.* (*A.*) *tokunagai* range from 24.2 or 33.5 and from 74.7 to 77.3. These ratios are almost the same as those for *S.* (*A.*) *dalli*. So far as the form ratio is concerned, *S.* (*A.*) *tokunagai* can not be distinguished from *S.* (*A.*) *dalli*. The present writer feels that these species can not be distinguished and he is inclined to consider them conspecific.

This species distributes in Puget Sound Basin, and north slope of the Olympic Peninsula, Washington, and the Gulf of Alaska area in the west coast of N-America, and ranges from upper Oligocene to Miocene.

Localities:—80906, 81203 black mudstone, lower part of the Poul Creek formation.

Reg. No. TUE 8409.

Subclass Pteriomorphia

Order Arcoida

Superfamily Arcacea

Family Arcidae

Genus *Anadara* GRAY, 1847

Anadara GRAY, Proc. Zool. Soc. London, vol. 15, p. 198, 1847; *Anomalocardia* (KLEIN) H. and A. ADAMS, Gen. Rec. Moll., vol. 3, p. 535-536 (type species not designated. *Arca antiquata* LINNÉ cited as an example), 1858; *Arca* s.s. GRANT and GALE, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 137, 1931; *Anadara* GRAY. REINHART, Mus. roy. d'Hist. nat., Belg., Bull., T. 11, no. 13, p. 39, 1935; *Anadara* GRAY. SCHENCK and REINHART, ditto, Mem. 2nd ser., fasc. 14, p. 10, 1938; *Anadara* GRAY. HABE, Gen. Jap. Shells, p. 36, 1951; *Anadara* GRAY. KANNO, Tert. Sys. Chichibu Basin, p. 203, 1960; *Anadara* GRAY. MOORE, U. S. Geol. Surv. Prof. Pap., 419, p. 59, 1963; *Anadara* GRAY. HICKMAN, Mus. Nat. Hist., Univ. Oregon, Bull. no. 16, p. 33, 1969; *Anadara* GRAY. MOORE et al., Treat. Invert. Paleont., pt. N, p. 254, 1969.

Type-species (by original designation):—*Arca antiquata* LINNÉ, Recent, eastern America, probably West Indies.

Remarks:—The genus is characterized by a rotund and moderately heavy shell ornamented with strong costae which correspond to crenulations on the internal shell margin, and narrow cardinal area with an almost straight series of taxodont teeth.

Geographic distribution:—World-wide, generally in warm waters.

Geologic range:—Upper Cretaceous to Recent.

Subgenus *Anadara* s. s.

1969. *Anadara* (*Anadara*) GRAY. MOORE et al., Treat. Invert. Paleont., pt. N, p. 254.

Remarks:—This subgenus is characterized by a thick, equivalved shell, a more or less produced posterior margin, and radial ribs which are almost flat and sometimes bear shallow grooves.

Anadara (*Anadara*) sp.

Plate 1, figs. 23, 24

Remarks:—There are many poorly preserved specimens of *Anadara* in the collection. The specimens figured in this report definitely belong to the genus *Anadara* GRAY, 1847, but most are strongly deformed making it difficult to determine the natural form. However, the present specimens are clearly equivalved and inequilateral, and they have about twenty-four radial ribs which are almost as wide as their interspaces. The radial ribs are slightly grooved, rather squarish in cross section, and more or less granular near the ventral margin where they are sculptured with fine concentric growth lines.

The specimens are similar to *Anadara osmonti* (DALL), (REINHART, 1943, p. 50-53, pl. 4, figs. 9, 11-17; pl. 6, fig. 4; pl. 10, figs. 12, 15), but differ from the latter by having fewer radial ribs. Moreover, the present specimens have a lower shell than *A. osmonti* (DALL). *A. mediaimpressa mediaimpressa* (CLARK) (REINHART, 1943, p. 39, pl. 4, figs. 1, 5, 6) is more or less related to the present specimens, but differs in having a larger number of radials and a higher shell. Present specimens are more closely related to *A. mediaimpressa submontereyana* (CLARK), (REINHART, 1943, p. 40, pl. 4, fig. 7). Typical form of the latter has twenty-four radial ribs, but it seems to be more higher shell than the present one.

The specimens figured in this report may be apparently represent a new species, but the state of preservation does not permit to establish a new species until better preserved materials are collected.

It is noteworthy that the Recent species of genus *Anadara* range no farther north than the Gulf of California, Mexico. Moreover, the Tertiary species of genus *Anadara* occurred from the west coast of North America are also restricted south of Oregon from where *Anadara*? sp. c was reported by SCHENCK and REINHART (1938, p. 40) and REINHART (1943, p. 83, pl. 4, fig. 10) from the Eugene formation (Oligocene). The present locality represents, therefore, the northernmost limit of distribution in the Tertiary formations along the west coast of North America.

EAMES (1967, p. 303) pointed out that *A.* (*Scapharca*) appeared prior to *Anadara* (*Anadara*) and he rejects all claims that *Anadara* (*Anadara*) occurs in the Oligocene.

In the western Pacific, Recent species of *Anadara* (*A.*) occurs no farther north than lat. 31°N (south of Tanegashima Island, Japan), but *Anadara* (*Scapharca*) is restricted to south of lat. 41°N. Fossil species of *Anadara* (*A.*) may be represented in the early Neogene (or Aquitanian age) of Japan where *A.* (*A.*) *chichibuensis* KANNO occurs associated with subtropical gastropods such as *Conus* sp. In middle Miocene *A.* (*A.*) increases both in the number of species and individuals, and they range as far north as the northern part of Hokkaido. It occurs in southern Sakhalin in the upper Miocene and reached Kamchatka in the Pliocene (ILYINA, 1963).

Locality:—20503-19, olive-green, medium-grained sandstone, lower part of the Poul Creek formation.

Reg. No. TUE 8410.

Order Mytiloida

Superfamily Mytilacea

Family Mytilidae

Genus *Modiolus* LAMARCK, 1799

Modiolus LAMARCK, Mém. Soc. Hist. Nat. Paris, vol. 1, p. 87, 1799; *Modiolus* LAMARCK. DALL, Trans. Wagner Free Inst. Sci., vol. 3, pt. 4, p. 790-791, 1898; *Volsella* SCOPOLI. STEWART, Acad. Nat. Sc., Phila., no. 3, p. 98-99, 1930; *Volsella* SCOPOLI. GRANT and GALE, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 248, 1931; *Volsella* SCOPOLI. ABBOTT, American Seashells, p. 351, 1954; *Modiolus* LAMARCK. PALMER, Geol. Soc. Amer., Mem., 79, p. 73, 1958; *Modiolus* LAMARCK. KANNO, Tert. Sys. Chichibu Basin, p. 209, 1960; *Modiolus* LAMARCK. MOORE, U.S. Geol. Surv. Prof. Pap., 419, p. 63, 1963; *Modiolus* LAMARCK. HICKMAN, Mus. Nat. Hist., Univ. Oregon, Bull., no. 16, p. 34, 1969; *Modiolus* LAMARCK. MOORE et al., Treat. Invert. Paleont., pt. N, p. 278, 1969.

Type-species (by subsequent designation, GRAY, 1847):—*Mytilus modiolus* LINNÉ, Recent in northern seas.

Generic diagnosis:—Shell small to large, obliquely oblong, thin, expanded posteriorly and inflated along an oblique medial line from the umbonal end to the posterior ventral margin; anterior end of the shell extends in front of the beak; hinge edentulous in adult (KANNO, 1960).

Geographic distribution:—World-wide.
Geologic range:—Possibly lower Paleozoic to Recent.

Modiolus sp.

Plate 17, figs. 3, 4

Description:—Shell very thin, rather small, somewhat elongate, interior surface nacreous; hinge line nearly straight and about two-thirds the length of shell; postero-dorsal margin broadly arcuate merging gradually into a rather narrowly rounded posterior border; ventral margin almost straight or very slightly convex making a narrowly rounded small circle with the posterior margin; anterior margin is slightly extending from the beak; beak low, pointed anteriorly, situated very near the anterior end; a blunt umbonal ridge runs from the beak to the posterior-ventral margin, becoming less conspicuous at the posterior end; surface ornamented with weakly developed concentric lines of growth.

Measurement (in mm):—

Specimens	Maximum length*	Width**	Thickness	Valve
No. 1	27.7	4.8	4.7	Left
„ 2	ca.45.0	22.4	ca.7.0	„
„ 3	ca.44.0	ca.22.0	ca.7.0	„

* Measured from beak to the postero-ventral margin.
** Measured at the posterior angulation.

Remarks:—The present specimens are somewhat similar to *M. porterensis* CLARK (1925, p. 85, pl. 9, fig. 11) from the Oligocene Lincoln formation of Chehalis River Valley, Washington, which differs by having a more strongly arcuate anterior ventral margin. *M. restorationensis* VAN WINKLE (WEAVER, 1942, p. 109, pl. 24, figs. 10-11) is also more or less similar to *Modiolus* sp., but differs by the broader posterior part measured at the posterior angulation, more narrowly rounded posterior dorsal-ventral corner, and slightly arcuate ventral margin.

Localities:—80906, 81404, lower part of the Poul Creek formation.

Reg. No. TUE 8411.

Genus *Crenella* BROWN, 1827

Crenella BROWN, Illus. Conchol. Great Britain. vol. 1, p. 31, fig. 12-14, 1827; *Crenella* BROWN. DALL, Trans. Wagner Free Inst. Sci,, vol. 3, p. 801-802, 1897; *Crenella* BROWN. GRANT and GALE, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 254, 1931; *Crenella* BROWN. MOORE, U.S. Geol. Surv. Prof. Pap., 419, p. 63, 1963; *Crenella* BROWN. HICKMAN, Mus. Nat. Hist., Univ. Oregon, Bull. no. 16, p. 33, 1969; *Crenella* BROWN. MOORE et al., Treat. Paleont., pt. N, vol. 1, p. 275, 1969.

Type-species (by monotypy):—*Mytilus decussatus* MONTAGU, 1808, Recent, Scottish coast.

Remarks:—This genus is characterized by a small- to medium-sized shell with

prothogyrous or orthogyrous beaks, surface sculpture of radial ribs which are sometimes cancellated by concentric striae, denticulate cardinal border, and crenulated inner ventral margin.

This genus distributes widely from boreal to tropical seas mainly off-shore ranging from 4 to 500 meters in depth.

Geographic distribution:—World-wide.

Geologic range:—?Cretaceous to Recent.

Crenella porterensis WEAVER, 1912

Plate 1, fig. 27

1912. *Crenella porterensis* WEAVER, Wash. Geol. Surv., Bull., vol. 15, p. 18, pl. 14, fig. 116.
1916. *Crenella porterensis* WEAVER, Univ. Wash. Publ. Geol., vol. 1, p. 36–37, pl. 3, figs. 41–42.
1933. *Crenella porterensis* WEAVER. TEGLAND, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, p. 112, pl. 4, fig. 2.
1942. *Crenella porterensis* WEAVER, Univ. Wash. Publ. Geol., vol. 5, p. 115–116, pl. 25, figs. 3, 14.

Remarks:—Only two specimens are at hand. The present species was originally reported by WEAVER (1912) from the Lincoln formation (middle Oligocene) in Washington. Subsequently, TEGLAND (1933) reported it from the type Blakeley formation (late Oligocene to early Miocene) in Washington. This species is characterized by a subrectangular-ovate outline and fine, well developed dichotomous radial ribs.

Though the present genus ranges from tropical to boreal waters in the Pacific and the Atlantic Oceans, these species are rather common in temperate to cold waters.

Localities:—81201, 80905, olive-green, medium-grained sandstone, upper part of the Poul Creek formation.

Reg. No. TUE 8412.

Order Pterioida

Superfamily Pectinacea

Family Pectinidae

Genus *Delectopecten* STEWART, 1930

Delectopecten STEWART, Acad. Nat. Sci. Phila., Spec. Publ. no. 3, p. 118–119, 1930; *Delectopecten* STEWART. MOORE et al., Treat. Invert. Paleont., pt. N, vol. 1, p. 354, 1969.

Type-species (by original designation):—*Pecten* (*Pseudamusium*) *vancouverensis* WHITEAVES, 1893, Recent, Vancouver Island, Canada.

Remarks:—This genus is characterized by a thin and delicate shell which has radial or reticulate surface ornamentation, and on which the posterior ear is not differentiated.

This genus is somewhat similar to *Hyalopecten* VERRILL, 1897, which differs in having more distinct undulations and in almost lacking the reticulate surface ornamentation.

The living species of this genus seem to be muddy bottom dwellers usually restricted to depths greater than 20 meters and are more common in depths greater than 200 meters.

Geographic distribution:—Northern Pacific region, northern Europe, and Australia.

Geologic range:—Upper Eocene to Recent.

Delectopecten peckhami (GABB), 1869

Plate 17, fig. 5

1869. *Pecten peckhami* GABB, Pal. Calif. vol. 2, p. 59, pl. 16, figs. 19, 19a.
1906. *Pecten (Pseudamusium) peckhami* GABB. ARNOLD, U. S. Geol. Surv. Prof. Pap., 47, p. 56, pl. 3, figs. 6-8.
1930. *Palliolum (Delectopecten) peckhami* (GABB). STEWART, Acad. Nat. Sci. Phila., Spec. Pap., no. 3, p. 119-120, pl. 13, fig. 4.
1938. *Hyalopecten (Delectopecten) peckhami* (GABB). WOODRING, U. S. Geol. Surv. Prof. Pap., 190, p. 35-40.
1954. *Palliolum (Delectopecten) peckhami* (GABB). OMORI and UTASHIRO, Shinseidai-no-kenkyu (The Study of Cenozoic), no. 19, p. 1-10, pl. 1, figs. 1-3, 10-12; pl. 2, figs. 1-7; pl. 3, fig. 1.
1957. *Palliolum peckhami* (GABB). UTASHIRO, Bull. Faculty of Educat., Niigata Univ., Takada, no. 1, p. 161-174, pl. 1-4.
1958. *Palliolum peckhami* (GABB). UTASHIRO, Jub. Publ. Commemorat. Prof. H. FUJIMOTO Sixtieth Birthday, p. 320-326, pl. 12-14.
1964. *Delectopecten peckhami* (GABB) of ARNOLD. MOORE, U. S. Geol. Surv. Prof. Pap., 419, p. 67-68, pl. 18, figs. 2, 3; pl. 20, figs. 1, 3-5; pl. 21, fig. 2.

Remarks:—Many specimens from the calcareous concretions in the Yakataga formation are at hand, but they are so crowded that it is rather difficult to find the complete specimens. This species is characterized by small and thin shell with fairly weak concentric undulations. Most of the right valves in the collections have almost smooth shells excepting for concentric undulations. The surface ornamentation of left valve is inaccessible. The largest specimen at hand is 16.0 mm in length, 16.2 mm in height, and 6.4 mm along the hinge line.

The present species is widely distributed in Japan, Sakhalin, and Kamchatka ranging in age from Oligocene to Pliocene. UTASHIRO (1957, 1958) and OMORI and UTASHIRO (1954) studied the Japanese *Delectopecten peckhami* from the evolutionary standpoint of view. According to their results, the size of present species seems to have increased from the Miocene to the Pliocene; the present specimens are similar to their middle Miocene type*.

Locality:—20459-24, calcareous concretion in dark-gray mudstone, the Yakataga formation of southern point of Wingham Island.

Reg. No. TUE 8413.

Genus *Swiftopecten* HERTLEIN, 1936

* Utashiro (1958) calculated the value of (Length×Height/2). According to his results, the middle Miocene form shows values of about 120, as almost the same as the present one's 128.

Swiftopecten HERTLEIN, California Acad. Sci. Proc., 4th ser., vol. 21, no. 25, p. 319, 1936; *Swiftopecten* HERTLEIN. MACNEIL, U.S. Geol. Surv., Prof. Pap., 553, p. 11, 1967; *Swiftopecten* HERTLEIN. MOORE et al., Treat. Invert. Paleont., pt. N, p. 363, 1969.

Type-species (by original designation):—*Pecten swiftii* BERNARDI, 1858, Recent, Japan.

Remarks:—This subgenus is characterized by being inequivalved, and having strong, more or less prominently folded radial ribs; four in the right valve and five in the left valve.

Geographic distribution:—Northern Pacific region.

Geologic range:—Miocene to Recent in Japan; upper Miocene to middle Pliocene in California.

Swiftopecten donmilleri (MACNEIL), 1967

Plate 1, figs. 25, 26

1967. *Chlamys* (*Swiftopecten*) *donmilleri* MACNEIL, U.S. Geol. Surv. Prof. Pap., 553, p. 12, figs. 1, 4, 6.

Remarks:—This species was originally described by MACNEIL (1967) from the Yakataga formation of southeastern Alaska. The present specimens were collected from the dark-gray to rather black, sandy siltstone containing scattered granule- or pebble-sized pebbles near the base of the Yakataga formation near the type locality. The present specimens are represented by an incomplete right valve and other valves from which the umbonal part is missing. They are characterized by strongly plicated sculpture. This species is closely related to *S. swiftii* (BERNARDI, 1858), an extant species in the northern Pacific regions, but its strongly plicated and nodulose radial ribs serve to distinguish it from the living species. However, *S. swiftii* is rather variable in outline and radial ribbing, then it would be desirable to study specific variation within their species.

Localities:—81105, 81403, dark-gray, sandy siltstone, lower part of the Yakataga formation.

Reg. No. TUE 8414.

Genus *Miyagipecten* MASUDA, 1952

Miyagipecten MASUDA, Trans. Proc. Paleont. Soc. Japan, N.S., no. 8, p. 251, 1952; *Miyagipecten* MASUDA, Sci. Rep. Tohoku Univ., 2nd ser., vol. 33, no. 2, p. 226, 1962; *Miyagipecten* MASUDA. MACNEIL, U.S. Geol. Prof. Pap., 553, p. 44, 1967; *Miyagipecten* MASUDA. MOORE et al., Treat. Invert. Paleont., pt. N, vol. 1, p. 360, 1969.

Type-species (by original designation): *Miyagipecten matsumoriensis* MASUDA, 1952, Miocene Nanakita formation of Miyagi Prefecture, northern Honshu (main island of Japan).

Remarks:—This genus has no radial ribs and concentric sculpture on the right valve and radial ribs in the younger stage of the left which tend to become obsolete in the adult stage. Moreover, this genus has prominent auricular crurae and lacks internal ribs.

Geographic distribution:—Northern Honshu, Hokkaido, Alaska Peninsula, and the Yakataga District.

Geologic range:—Middle Miocene in Japan, and Miocene to lower Pliocene in Alaska.

Miyagipecten sp.

Plate 5, figs. 2, 3

Remarks:—Several specimens have been examined, but most are too poorly preserved to determine specifically. However, the right valve has no sculptures excepting fine concentric growth lines, and has auricles which show a rather distinct gape anteriorly. The left valve is sculptured with fine radial ribs in the juvenile stage, but they tend to become obsolete in the adult. The interior surfaces of both valves are almost smooth with no visible radial ribs or threads. These characters may be sufficient to assign the present specimens to *Miyagipecten* MASUDA 1952, although the present specimens are too poorly preserved to allow specific determination.

The present specimens occur in pebble-sized conglomerate (about 30-70 cm in thickness) which interbedded in alternating sandstone and black shale (Text-fig. 8).

Locality:—80904, pebble-sized conglomerate, lower part of the Yakataga formation.

Reg. No. TUE 8415.

Genus *Vertipecten* GRANT and GALE, 1931

Vertipecten GRANT and GALE, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 188, 1931; *Vertipecten* GRANT and GALE. MOORE, U.S. Geol. Surv. Prof. Pap., 419, p. 66, 1963; *Vertipecten* GRANT and GALE. MACNEIL, Prof. Pap., 553, p. 38. 1967. *Vertipecten* GRANT and GALE. MOORE et al., Treat. Invert. Paleont., pt. N, vol. 1, p. 364, 1969.

Type-species (by original designation):—*Pecten nevadanus* CONRAD. Early and middle Miocene of California.

Remarks:—This genus is characterized by much greater inflation of the left valve over its right valve. Primitive species of the genus have weakly inflated left valves and fine ribs, but the more advanced species of the genus have strongly inflated left valves and very coarse ribs similar to *Patinopecten*. The more finely ribbed primitive species are similar to *Chlamys*, which usually has finely reticulate or metal lath-like microsculpture.

The genus *Vertipecten* is peculiar to western North America. As already pointed out by MACNEIL (1967), it is noteworthy from the standpoint of zoogeography that this genus has not been reported from the Asiatic side of the Pacific, though it was widespread and flourished during the Miocene in the west coast of North America.

Geographic distribution:—West coast of North America.

Geologic range:—Lower Miocene in California.

Vertipecten sp.

Plate 2, fig. 4

Description:—Shell of medium size and moderately inflated; left anterior ear rather long and very borad, sinus weak on the anterior margin; left posterior ear short, steeply sloping at its margin; anterior dorsal margin somewhat longer than the postero-dorsal one; hinge line straight, as long as about three-fifths of the length of shell; surface covered with reticulate microsculpture and with about seventeen radial ribs, of which four radials are distinctly stronger than the others; these four strong radials are round-topped, and intercalated with two rather weak radials which are almost roof-shaped in section; all of the interspaces are wider than the width of radial ribs.

Remarks:—A single external mould of a left valve and its rubber cast are at hand. The present specimen is similar to *Vertipecten* n. sp.? (MACNEIL, 1967, p. 40, pl. 2, fig. 2) from middle Oligocene strata of Chichagof Bay, Alaska Peninsula, but it differs by having a narrower apical angle and four distinct strong radial ribs in the left valve.

Locality:—81401, olive-green, fine- to medium-grained sandstone, upper part of the Poul Creek formation.

Reg. No. TUE 8416.

Genus *Patinopecten* DALL, 1898

Patinopecten DALL, Trans. Wagner Free Inst. Sci., Phila., vol. 3, p. 695, 1898; *Patinopecten* DALL. ARNOLD, U.S. Geol. Surv., Prof. Pap., 47, p. 48-49, 1906; *Patinopecten* DALL. GRANT and GALE, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 192, 1931; *Patinopecten* DALL. KANNO, Tert. Sys. Chichibu Basin, p. 220, 1960; *Patinopecten* DALL. MACNEIL, U.S. Geol. Surv. Prof. Pap., 354-J, p. 225-227, 1961; *Patinopecten* DALL. MASUDA, Sci. Rep. Tohoku Univ., Ser. 2, vol. 33, no. 2, p. 203, 1962; *Patinopecten* DALL. MOORE, U.S. Geol. Surv., Prof. Pap., 419, p. 63-64, 1963; *Patinopecten* DALL. MACNEIL, U.S. Geol. Surv., Prof. Pap., 553, p. 40, 1967; *Patinopecten* DALL. MOORE et al., Treat. Invert. Paleont., pt. N, p. 370, 1969.

Type-species (by original designation):—*Pecten caurinus* GOULD, Recent, Wrangell, Alaska, to Humboldt Bay, California.

Remarks:—This genus is characterized by its large, circular outline, and almost equivalve, low convex shells which have radial sculpture consisting of distinct ribs without minor striation, though sometimes with microscopic cross-hatching. Moreover, ribs of the right valve are comparatively broad and squarish whereas those of the left valve are narrow and roof-shaped in cross section.

This genus is distinguished from *Mizuhopecten* MASUDA, 1963, (MASUDA, 1963, p. 151) by having auricular crurae, narrow and rather squarish radial ribs in cross section, rather small auricles and a narrow and deep byssal notch.

This genus is particularly characteristic of the Pacific coast fauna from the Miocene to the present day.

Geographic distribution:—Northern Pacific region.

Geologic range:—Miocene to Recent.

Subgenus *Lituyapecten* MACNEIL, 1961

Lituyapecten MACNEIL, U.S. Geol. Surv. Prof. Pap., 354-J, p. 227, 1961; *Lituyapecten* MACNEIL, U.S. Geol. Surv. Prof. Pap., 553. p. 41, 1967; *Lituyapecten* MACNEIL. MOORE et al., Treat. Invert. Paleont., pt. N, p. 371, 1969.

Type-species (by original designation):—*Patinopecten* (*Lituyapecten*) *lituyaensis* MACNEIL, late Miocene (?), Lituya Bay, Alaska.

Remarks:—The present subgenus is characterized by medium to large shells with an elongated anterior ear on the right valve, and rather strong radial ribs which tend to be undercut on the sides, flat to rounded or irregular on top, and are sculptured with thin concentric raised lines (in juveniles) and scales on the left valve of adults.

This subgenus is a typical pectinid of the west coast of North America, but it has never been found on the Asian side. It ranges from middle to late Miocene, and possibly early Pliocene in Alaska, and from the middle Miocene to the Pliocene in California.

Patinopecten (*Lituyapecten*) *lituyaensis* MACNEIL, 1961

Plate 2, fig. 1; Plate 3, fig. 3; Plate 5, fig. 1

1961. *Patinopecten* (*Lituyapecten*) *lituyaensis* MACNEIL, U.S. Geol. Surv. Prof. Pap., 354, p. 231-233, pl. 29, figs. 1, 3; pl. 40, figs. 1-5; pl. 41, fig. 1; pl. 42, figs. 1, 2, 4; pl. 43, figs. 1-4.

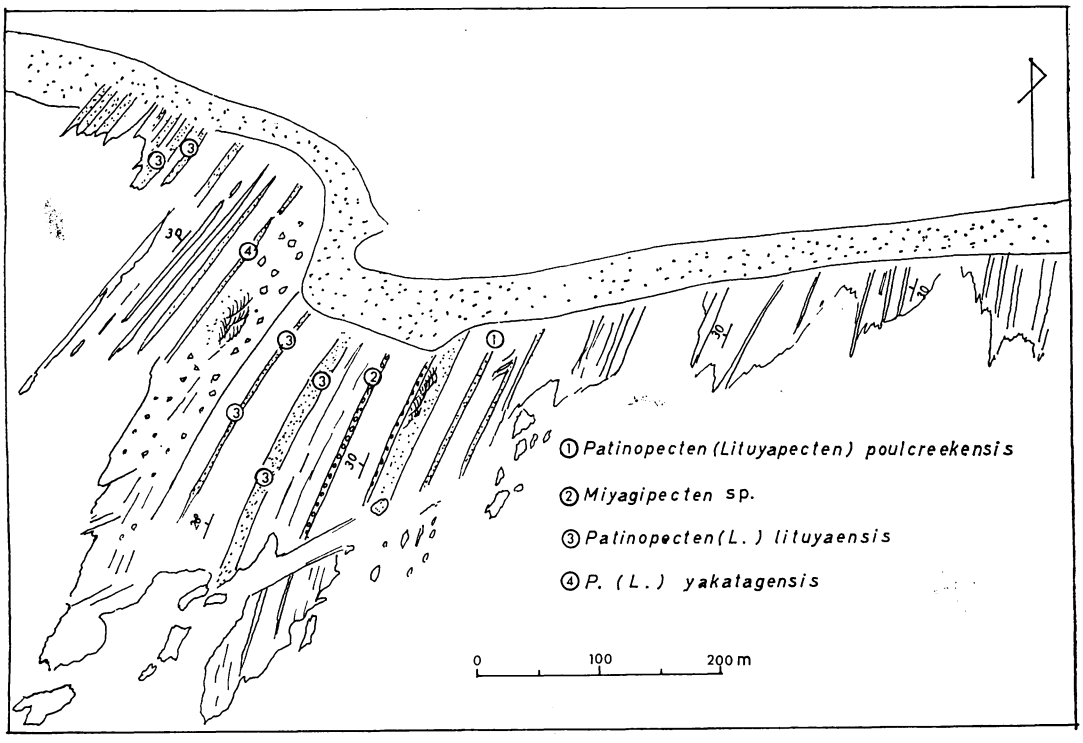
Remarks:—The present species is characterized by large, prosocline shells with 23 or 24 broad radial ribs which have frills on the both sides of ribs of the left valve. According to MACNEIL's original description, the present species is prosocline in form, but the holotype of this species (MACNEIL, 1961, pl. 39, fig. 1) is opisthocline. However, on specimens collected by the writer from Yakataga Reef the inclination of the median lines is variable, e.g., some specimens are strongly opisthocline (Pl. 2, fig. 1), but others are almost acline or prosocline. Therefore, it is not certain, whether the opisthocline shell of the holotype (MACNEIL, 1961) is an extreme variant or whether its shape is due to deformation after the deposition.

The present species occurs in both the lower sandstone-siltstone unit and the upper mudstone unit of late Miocene(?) and (or) early Pliocene of the Lituya Bay district, Alaska. However, it occurs abundantly in medium-grained sandstones (1-10 meters in thickness, loc. 80506) with dark-gray or black shale of the Yakataga formation (about 114 meters above the base of the Yakataga formation, Text-fig. 8). The phylogeny and the geologic range of the present species will be descussed under remarks on *P.* (*L.*) *poulcreekensis* (MACNEIL).

This species seems to be restricted to the Yakataga formation of the Yakataga and Lituya Bay districts.

Localities:—80404, 80405, 80406, 80505, 80506, all from medium-grained sandstone interbedded with dark-gray or black shale in the lower part of the Yakataga formation.

Reg. No. TUE 8417.



Text-fig. 8. Pectinid fossil localities in the Yakataga Reef.

Patinopecten (*Lituyapecten*) *yakatagensis* (CLARK), 1932

Plate 3, figs. 1, 2; Plate 6, fig. 3

1932. *Pecten* (*Patinopecten*) *yakatagensis* CLARK, Geol. Soc. Am. Bull. vol. 43, no. 3, p. 807, pl. 15, fig. 8; pl. 16, fig. 1.
1961. *Patinopecten* (*Lituyapecten*) *yakatagensis* (CLARK). MACNEIL, U.S. Geol. Surv. Prof. Pap., 354. p. 229-231, pl. 37, figs. 1-7; pl. 38, figs. 4, 6; pl. 39, fig. 2; pl. 41, figs. 2(?), 3; pl. 42, fig. 3.
1971. *Patinopecten* (*Lituyapecten*) *yakatagensis* (CLARK). ADDICOTT et al., U.S. Geol. Surv. Prof. Pap., 750-C, fig. 3, p, q.

Remarks:—This species was originally described by CLARK (1932) from the Tertiary of the Yakataga District. Subsequently, MACNEIL (1961) re-examined this species and gave a detailed description of it. The characteristic features of the present species are its medium-sized, suborbicular shell sculptured with 26 to 31 radial ribs which are subrounded in juveniles but become flattened or bear a median groove in adults, and the well-defined denticles on both sides of left valve. Moreover, the present species is characterized by having two rows of frills or flanges on the radial ribs of the central parts of the left valve, but the both ribs of the anterior and posterior margins have only a single frill. The interspaces have rarely a scale-like interstitial riblet.

This species is rather similar to *Patinopecten* (*L.*) *lituyaensis* MACNEIL, 1961, but differs by having a large number of radial ribs. In addition, the radial ribs on the

left valve of the latter sometimes have or bear a strong third beaded riblet on some of the middle ribs.

Localities:—7011-68, medium-grained sandstone, about 420 meters above the base of the Yakataga formation in the Duktoth Mountains, the lower part of the Yakataga formation; 81001, float specimens in the upper reaches of Poul Creek; 80503, fine-grained sandstone, Yakataga formation.

Reg. No. TUE 8418.

Patinopecten (Lituyapecten) poulcreekensis MACNEIL, 1961

Plate 2, figs. 2, 3

1961. *Patinopecten (Lituyapecten) poulcreekensis* MACNEIL, U.S. Geol. Surv. Prof. Pap., 354, p. 228-229, pl. 35, figs. 1-6; pl. 36, figs. 1, 2 (?), 3, 4, 6, 7; pl. 38, fig. 2.

Remarks:—This species was originally described by MACNEIL (1961) from the uppermost part of the Poul Creek formation* at Yakataga Reef.

This species is characterized by having about 23 strong radial ribs and frilled interstitial ribs. It is rather similar to *P. (L.) yakatagensis* (CLARK) (1932) from the same district, but the number of radial ribs and development of interstitial ribs serve to distinguish it from the latter. *P. (L.) lituyaensis* is an allied species, but it differs from the present one by having no interstitial ribs on the right valve, or rarely, very weakly developed ones. Moreover, the terminal ribs at both ends of the right valve of the *P. (L.) poulcreekensis* may have weak frills along one side or a single frill extending entirely across them.

The type locality of this species is USGS locality M271 on Yakataga Reef, along the strike of a bed that intersects the shoreline at a point "700 feet N. 30°E of the highest rock on the reef" (MACNEIL, 1961, p. 246). (Text-fig. 8).

The holotype of the present species is from the light brown, medium-grained sandstone (about 3 meters in thickness) which crops out about 40 meters east of a thick sandstone. *P. (L.) poulcreekensis* has never been collected from below this sandstone, indicatingly that this sandstone is the lowest limit of occurrence of this species as well as other large pectinids in this area.

The present species was also collected by KENNETH CIRIACKS and ALAN ORMISTON of Pan American Oil Co., from the eastern slope of the Ductoth Mountain where rather light brown, medium-grained sandstone occurs about 460 meters above the base of the Yakataga formation. This specimen, though it represented by a fragment of right valve, has the characteristic features of *P. (L.) poulcreekensis* (pl. 2, fig. 2); namely, the frilled main radials and distinct interstitial ribs are clear. Moreover, it is noteworthy that the present specimen occurs from about 38 meters higher stratigraphic occurrence of *P. (L.) yakatagensis* in the Ductoth Mountain.

The relationship between *P. (L.) poulcreekensis*, *P. (L.) yakatagensis*, and *P. (L.) lituyaensis* had been pointed out by MACNEIL (1961, p. 232-233). According to his opinion, *yakatagensis* was probably the direct ancestor of *lituyaensis*, and the latter

* This is the type locality (USGS loc. M271) of this species, but the locality is included in the lower part of the Yakataga formation by the writer (fig. 2, 8).

species occurs in beds believed to be equivalent to the upper part of the Yakataga formation, but so far no representatives of *Lituyapecten* are known from the highest part of the Yakataga formation (MACNEIL, 1961, p. 230-231). He also pointed out that *P.* (*L.*) *poulcreekensis* occurred abundantly only in the uppermost part of the Poul Creek formation at Yakataga Reef, and that it ranges into beds equivalent to the lowest part of the Yakataga formation, and was presumably coexisted with the earlist specimens of *P.* (*L.*) *yakatagensis*.

The present writer examined in detail the occurrence of *Patinopecten* (*Lituyapecten*) along the shoreline at Yakataga Reef, where the Poul Creek and the Yakataga are continuously well exposed. *P.* (*L.*) *poulcreekensis* seems to be restricted to sandstone in the lowest part of the Yakataga including USGS locality M271 and 17733. However, *P.* (*L.*) *yakatagensis* and *P.* (*L.*) *lituyaensis* have not yet been recorded from this horizon, but they have been collected from higher horizons (Text-fig. 8), where *P.* (*L.*) *lituyaensis* occurs abundantly whereas *P.* (*L.*) *yakatagensis* is very rare. According to MACNEIL (1961, p. 231), this species occurs at two localities along the shoreline of Yakataga Reef (UC loc. 3859, the type locality, and CAS loc. 29257). The present writer made detailed collections from this area, but unfortunately, found only a few fragments of *P.* (*L.*) *yakatagensis* along with a large number of *P.* (*L.*) *lituyaensis*. Although *P.* (*L.*) *yakatagensis* occurs in this horizon, it seems to be very rare.

The range of *P.* (*L.*) *poulcreekensis*, as already described, is from the lowest part of the Yakataga formation to about 460 meters above the base of formation, and *P.* (*L.*) *yakatagensis* occurs about 40 meters stratigraphically below the highest stratigraphic occurrence of *P.* (*L.*) *poulcreekensis*. Stratigraphically speaking, *P.* (*L.*) *poulcreekensis* seems to have appeared prior to the other two species, and *P.* (*L.*) *lituyaensis* possibly evolved from that species and is occasionally associated with *P.* (*L.*) *yakatagensis* which seems to be more abundant in the upper horizon, although a few *P.* (*L.*) *poulcreekensis* also survived.

Morphologically speaking, *P.* (*L.*) *poulcreekensis* is more similar to *P.* (*L.*) *lituyaensis* than to *P.* (*L.*) *yakataensis*. Namely, the former two have almost the same number of radial ribs which are undercut and squarish on the right valve. One of the distinct difference between two species is development of interstitial ribs, i. e., *P.* (*L.*) *poulcreekensis* has a distinct interstitial rib whereas one or more interstitials appear only in the terminal interspaces of *P.* (*L.*) *lituyaensis*. However, the development of interstitial radials on *P.* (*L.*) *poulcreekensis* seems to be very variable, i. e., as described by MACNEIL (1961, p. 230), some specimens have weakly flanged interstitial ribs in some of the interspaces but most of the interspaces are without them. He considered the latter specimen tentatively to be of subspecific rank.

P. (*L.*) *yakatagensis* differs strongly from *P.* (*L.*) *poulcreekensis* and *P.* (*L.*) *lituyaensis* by having a larger number of radial ribs.

From the above discussion the writer concludes that the phylogenetic relations between these three species are as follows; *P.* (*L.*) *poulcreekensis* appeared prior to the other species in the lower part of the Yakataga formation, and is of rather variable form; this species may be the stock of the subgenus *Lituyapecten* MACNEIL. *P.* (*L.*) *lituyaensis* branched from this stock and is characterized by a decreasing number of interstitial ribs. This seems to be a reversal of evolutional trends in this

group. Another descendant of this stock may be *P.* (*L.*) *yakatagensis* which is characterized by extremely well-developed interstitial ribs and it has a large number of radial ribs. The stratigraphic occurrence and phylogenetic features show that *P.* (*L.*) *lituyaensis* is descendant of *P.* (*L.*) *poulcreekensis*, and *P.* (*L.*) *yakatagensis* may also be a descendant that appeared later than the *P.* (*L.*) *lituyaensis*. The writer is now estimating the geologic age of the *Lituyapecten* may be ranging from middle(?) to late Miocene in Alaska and also to Pliocene in California.

Localities:—USGS M271 (type locality), 7011-68, all medium-grained, light brown sandstone, lower part of the Yakataga formation.

Reg. No. TUE 8419.

Patinopecten jonesi KANNO, n. sp.

Plate 4, figs. 1-4; Plate 6, figs. 1, 2

Description:—Shell large, thick, suborbicular; strongly inequivalved, almost equilateral; dorsal margin weakly concave; no visible ctenolium along margin of byssal notch; both valves with about 25 strong radial ribs. Right valve distinctly convex with strong rather square, undercut radial ribs sculptured with very fine, raised concentric lines which continue across the interspaces; interspaces are round-bottomed and narrower than the width of radial ribs and have no interstitials; anterior ear somewhat produced providing a rather deep byssal gape, and sculptured with distinct growth lines; posterior ear rather small, terminal margin concave. Left valve almost flat, but undulating near the ventral margin; surface lacking microscopic sculpture; radial ribs are rather flat-topped, separated by more gently rounded interspaces than that of the right valve.

Length, 147 mm; height, more than 130 mm; length of hinge line, more than 78 mm on the holotype.

Remarks:—This species has not been found outside of the Lare Glacier area in the upper reaches of Little River, where the Yakataga formation is underlain unconformably by the Poul Creek formation. The present species occurs in the lowest part of the Yakataga formation which consists of pebble-bearing gray, medium-grained sandstone. The present new species occurs rather abundantly with valves oriented with the convex-side upward. Associated molluscs include *Clinocardium yakatagensis* (CLARK) and *Crepidula* sp.

This new species has the characteristic features of the genus *Patinopecten* DALL (1898). It is inequivalved and has a strongly inflated right valve and an almost flat left one, and distinct radial ribs. However, the right valve is sculptured with microscopic fine, silky concentric threads. This sculpture is rather similar to that of the juvenile left valve of *P.* (*L.*) *yakatagensis* (MACMEIL, 1961, pl. 37, figs. 3, 5). However, the left valve of the present species has almost no sculptures other than radial ribs whereas the subgenus *Lituyapecten* is characterized by raised, fine concentric growth lines in juvenile specimens and frill-like flanges on the radial ribs. Accordingly, the present new species can not be included in the subgenus *Lituyapecten* MACNEIL, 1961, or *Patinopecten* (*Patinopecten*) DALL, 1898. However, the general features show

that it belongs to the genus *Patinopecten* DALL. The present new species may represent a new subgenus of *Patinopecten*, although the existing specimens are not sufficient to justify the proposal of a new subgenus at this time.

The new specific name is dedicated to Mr. RICHARD, L. JONES, a geologist of the Standard Oil Co., who co-operated in the field and assissted the present writer in collecting the present specimens.

Locality:—81402, gray pebble-bearing, medium-grained sandstone, lowest part of the Yakataga formation.

Reg. No. TUE 8420 (holotype); TUE 8421 (paratype).

Superfamily Anomiacea

Family Anomiidae

Genus *Pododesmus* PHILLIPPI, 1837

Pododesmus PHILIPPI. WIEGMANN'S Arch. f. Naturg., p. 385, 1837; *Pododesmus* PHILIPPI. OLDROYD, Stanf. Univ. Publ., Geol. Sci., vol. 1, no. 1, p. 65, 1924; *Pododesmus* PHILIPPI. GRANT and GALE, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 241, 1931; *Pododesmus* PHILIPPI. MOORE et al., Treat. Invert. Paleont., pt. N, vol. 1, p. 385, 1969.

Type-species (by monotype):—*Pododesmus decipiens* PHILIPPI, Recent, Cuba.

Remarks:—This genus is characterized by irregularly corrugated radial sculpture, and the shell attached by the right valve, which has a byssal foramen. There is a large byssal retractor scar on the left valve. *Anomia* LINNÉ is distinguished from the *Pododesmus* in having thin shell and two byssal scars.

Geographic distribution:—North America, South America, Europe, Australia, and Japan.

Geologic range:—?Oligocene, Miocene to Recent.

Subgenus *Monia* GRAY, 1850

Monia GRAY, Proc. Zool. Soc. London, p. 121, 1850; *Monia* GRAY. GRANT and GALE, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 241, 1931; *Monia* GRAY. MOORE et al., Treat. Invert. Paleont., pt. N, vol. 1, p. 385, 1969.

Type-species (by subsequent designation, KOBELT, 1881):—*Anomia zealandica* GRAY, 1843, Recent, New Zealand.

Remarks:—The large byssal retractor scar and moderate to large-sized foramen serve to distinguish *Monia* from the allied subgenera.

Pododesmus (*Monia*) *macroschisma* (DESHAYES), 1839

Plate 17, fig. 1

1839. *Anomia macroschisma* DESHAYES, Rev. Zool. Soc. Cuvierienne, p. 359.
1924. *Pododesmus macroschisma* DESHAYES. OLDROYD, Stanf. Univ. Publ. Univ. Ser., Geol. Sci., vol. 1, no. 1, p. 65, pl. 26, figs. 1a-b.
1926. *Placunanomia macroschisma* DESHAYES. YOKOYAMA, Jour. Fac. Sci., Imp. Univ. Tokyo, sec. 2, vol. 1, pt. 8, p. 301, pl. 25, figs. 7-8.

1931. *Pododesmus macroschisma* (DESHAYES). GRANT and GALE, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 241, pl. 12, figs. 3, 4.
1937. *Pododesmus* (*Monia*) *macroschisma* (DESHAYES). NOMURA and HATAI, Saito Ho-on Kai Research Bull., no. 13, p. 131, pl. 19, figs. 7-8.
1943. *Pododesmus* (*Monia*) *macroschisma* (DESHAYES). MACNEIL, MERTIE, and PILSBRY, Jour. Paleont., vol. 17, no. 1, p. 87, pl. 13, figs. 6, 7.
1960. *Monia macroschima* (DESHAYES). KANNO, Sci. Rep. Tokyo Univ. Education. sec. C, vol. 8, no. 73, pl. 5, fig. 1 (no description).

Remarks:—A single right valve is at hand. The rounded shell outline, rather solid shell, rudely plicated radial ribs, and large perforation are the characteristics of the present species. This is a very common species in the northern Pacific region where it is found attached to stones and wharf piling from low-tide mark to about 70 meters in depth.

The living species ranges from north of lat. 39°N on the Japanese coast, and also ranges from Alaska to Lower California on the west coast of North America. The geologic range is from upper Miocene to Recent.

Localities:—20541-1, 20540, 20525, 20521, dark-gray, granule pebble-bearing conglomeratic sandstone, lower part of Yakataga formation.

Reg. No. TUE 8422.

Superfamily Limacea

Family Limidae

Genus *Acesta* H. and A. ADAMS, 1858

Acesta H. and A. ADAMS, Gen. Rec. Moll., vol. 2, p. 558, 1858; *Acesta* H. and A. ADAMS. OYAMA, Conch. Asiatica, vol. 1, p. 37, 1943; *Acesta* H. and A. ADAMS. KANNO, Tert. Sys. Chichibu Basin, p. 228, 1960; *Acesta* H. and A. ADAMS. MOORE et al., Treat. Invert. Paleont., pt. N, vol. 1, p. 386, 1969.

Type-species (by monotype):—*Ostrea excavata* FABRICIUS, 1779.

Remarks:—This genus is characterized by a large, thin, ovate shell with an indistinct anterior ear whereas the posterior one is distinct, although the boundary between the ear and disc is indistinct. The resilifer pit is situated posteriorly from the beak. This genus occurs or lives in cold waters or at great depths (about 100 to 1000 meters in the Pacific and the Atlantic Oceans).

Geographic distribution:—World-wide.

Geologic range:—Upper Jurassic to Recent.

Acesta cf. *A. yagenensis* (OTUKA), 1939

Plate 7, figs. 1-2

1925. *Lima goliath* YOKOYAMA (non SOWERBY), Jour. Coll. Sci., Imp. Univ. Tokyo, vol. 45, art. 5, p. 25, pl. 3, figs. 1, 4.
1925. *Lima goliath* YOKOYAMA (non SOWERBY), Jour. Fac. Sci., Imp. Univ. Tokyo, sec. 2, vol. 1, pt. 3, p. 123, pl. 14, fig. 11.
1939. *Lima* (*Acesta*) *goliath yagenensis* OTUKA, Jour. Geol. Soc. Japan, vol. 46, no. 544, p. 27.
1943. *Lima* (*Acesta*) *yagenensis* OTUKA. OYAMA, Conch. Asiatica, vol. 1, p. 43, pl. 4, fig. 2;

pl. 5, fig. 4.

1960. *Lima (Acesta) yagenensis* OTUKA. KANNO, Tert. Sys. Chichibu Basin. p. 228-229, pl. 37, figs. 1-4; pl. 38, fig. 1.

Remarks:—Several specimens have been examined, but most are rather poorly preserved for specific determination. However, the large and thin shell, almost smooth surface ornamentation excepting for the gently undulating concentric ridges, the indistinct anterior ear and strongly anteriorly situated beaks serve to distinguish it from the allied species. The present specimens have very fine radial striations on the posterior ear. According to the original description by OTUKA (1939), this species has almost no radial ribs. Then the present specimens may represent a varietal form. These specimens are very similar to *Lima (Acesta) yagenensis* OTUKA from the Chichibu Basin (lower Miocene, KANNO, 1960), central Japan, but they differ somewhat from the Chichibu specimens by the fine radial striations on the surface of the posterior ear. Only the fine striations, it permit to be distinguished from *L. yagenensis* Otuka.

Localities:—81002, rather dark-gray silty sandstone, upper part of the Poul Creek formation; USGS loc. 1833 (western part of the Dahlgram Ridge), Poul Creek formation.

Reg. No. TUE 8423.

Superfamily Ostreacea

Family Ostreidae

Genus *Ostrea* LINNÉ, 1758

Ostrea LINNÉ, Syst. Nat., Ed. 10, p. 696, 1758; *Ostrea* LINNÉ. OLDROYD, Stanf. Univ. Publ., Geol. Sci., vol. 1, p. 50, 1924; *Ostrea* LINNÉ. WOODRING, Carnegie Inst. Wash. Publ., no. 366, p. 59, 1925; *Ostrea* LINNÉ. STEWART, Acad. Nat. Sci., Phila., Spec. Pap., no. 3, p. 126, 1930; *Ostrea* LINNÉ. GRANT and GALE, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 149, 1931; *Ostrea* LINNÉ. KANNO, Tert. Sys. Chichibu Basin. p. 231-232, 1960.

Type-species (by subsequent designation, GRAY, 1847):—*Ostrea edulis* LINNÉ, Recent, European seas.

Remarks:—This genus is characterized by an inequilateral shell, a strongly convex left valve, an almost flat right valve, and crenulations near the hinge-line. This genus is a typical shallow dweller of tropical to temperate waters.

Geographic distribution:—Cosmopolitan, tropical to temperate waters.

Geologic range:—Triassic to Recent.

Ostrea sp.

Plate 18, figs. 1, 2

Remarks:—Several specimens were examined, but most are incomplete. The present specimens have rather small and thin shells for the genus, the right valve is almost flat and subovate in outline and the left valve is strongly convex. The hinge and hinge line are inaccessible.

These specimens resemble somewhat *Ostrea lurida* CARPENTER, 1864, a Recent species from the west coast of North America in general shape, but are difficult to compare exactly with the latter owing to their poor preservation.

Locality:—81502, medium-grained, arkosic sandstone, Kulthieth formation.

Reg. No. TUE 8424.

Subclass Heterodonta

Order Veneroida

Superfamily Lucinacea

Family Lucinidae

Genus *Lucinoma* DALL, 1901

Lucinoma DALL, U.S. Nat. Mus., vol. 23, p. 806, 1901; *Lucinoma* DALL. GRANT and GALE, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 286, 1931; *Lucinoma* DALL. HABE, Gen. Jap. Shells, p. 129, 1941; *Lucinoma* DALL. HIRAYAMA, Jap. Jour. Geol. Geogr., vol. 25, nos. 1-2, p. 103, 1954; *Lucinoma* DALL. OLSSON, Moll. Trop. East. Pacif., p. 208, 1961; *Lucinoma* DALL. MOORE, U.S. Geol. Surv, Prof. Pap., 419, p. 70, 1963; *Lucinoma* DALL. MOORE et al., Treat. Invert. Paleont., pt. N, p. 500, 1969.

Type-species (by original designation):—*Lucina filosa* STIMPSON, Recent, Newfoundland to North Florida and Gulf Strait.

Remarks:—The present genus differs from *Lucina* LAMARCK, 1799, by the character of hinge teeth, i.e., *Lucinoma* has two cardinals while on *Lucina* they are lacking or are weakly developed. *Phacoides* BLAINVILLE, 1824, is said to be a vernacular name, but OLSSON (1961, p. 208) used it as a subgeneric name under the present genus.

Geographic destribution:—West coast of North America, Japan, Australia, Red Sea, and Europe.

Geologic range:—Oligocene to Recent.

Lucinoma cf. *L. tomitensis* KANNO, 1960

Plate 4, fig. 8

1958. *Lucinoma tomitensis* KANNO, Sci. Rep. Tokyo Univ. Educat., Sec. C, vol. 6, no. 55, p. 174, pl. 2, figs. 1-2.

1960. *Lucinoma tomitensis* KANNO, Tert. Sys. Chichibu Basin, p. 253, pl. 39, figs. 1-2.

Remarks:—One specimen is at hand. It is characterized by a high shell, whereas the usual form of the genus is almost orbicular. Though most of the surface ornamentation could not be observed because the specimen is an internal mould, it does show feebly developed rhythmic concentric growth lines and an elongated anterior muscle scar. These characters are strongly similar to *L. tomitensis* KANNO (1960, p. 253, pl. 39, figs. 1-2) from the Tertiary system of the Chichibu Basin, central Japan.

Locality:—81001, gray, fine-grained silty sandstone, upper-most of the Poul Creek formation.

Reg. No. TUE 8425.

Family Thyasiridae

Genus *Conchocele* GABB, 1866

Conchocele GABB, Geol. Surv. Calif., Paleont., vol. 2, p. 27, 1866; *Conchocele* GABB. STEWART, Acad. Nat. Sci., Phila. Spec. Publ., no. 3, p. 194, 1930; *Conchocele* GABB. GRANT and GALE, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 281, 1931; *Conchocele* GABB. OMORI, Sci. Rep. Tokyo Univ. Education, sec. C, vol. 3, no. 20, p. 65, 1954; *Conchocele* GABB. KANNO, Tert. Sys. Chichibu Basin, p. 242, 1960; *Conchocele* GABB. MOORE et al., Treat. Invert. Paleont., pt. N, p. 508, 1969.

Type-species (by original designation):—*Conchocele disjuncta* GABB, 1866, Pliocene Deadman's Island, San Pedro, California.

Remarks:—The present genus is characterized by its large size, radial striations on the inner surface, a posterior furrow, and edenturous hinge structure.

The living species of this genus are reported from 6 to 2200 meters (KEEN, 1963), but geographically speaking, they live in the deep sea bottom in warm waters and in shallow sea bottom of cold waters. According to PARKER (1963, p. 159), the present genus occurs in depths of 57 to 320 meters in the Gulf of California where the water temperature is 12° to 19°C, and the sediments consist of mud, silty sand and sand. Specimens preserved at the California Academy of Sciences in San Francisco were collected from Puget Sound and the north side of Vancouver Island where the average temperature is about 10°C. Most of specimens collected from the Vancouver Island were from shallow water. Moreover, according to oral information from D. G. HANNA*, he collected many Recent specimens from the shoreline of Montague Island, Alaska, just after the 1964' Earthquake. These specimens clearly lived in very shallow waters before uplift by that big earthquake, because most of the specimens collected by HANNA are represented by articulated valves. NAKAJIMA (1958) reported living species dredged from the southern Japan Sea at a depth of 230 meters.

From the above discussion, this genus (or at least, species) seems to be restricted to cool water environments occurring in deeper water in low latitudes and rather shallow water in high latitudes. These ecological problems were discussed by KANNO (1971).

Geographic distribution:—Pacific Ocean.

Geologic range:—Oligocene to Recent.

Conchocele disjuncta GABB, 1869

Plate 7, fig. 3

1869. *Conchocele disjuncta* GABB, Geol. Surv. Calif. Paleont., vol. 2, p. 28, 99, pl. 7, figs. 48a, 48b.
1924. *Thyasira bisecta* (CONRAD). YOKOYAMA, Jour. Coll. Sci., Imp. Univ. Tokyo, vol. 45, art. 8, p. 18, pl. 3, fig. 2.
1924. *Thyasira bisecta* (CONRAD). OLDROYD, Stanf. Univ. Publ., sci., vol. 1, no. 1, p. 120.
1925. *Thyasira bisecta* (CONRAD). YOKOYAMA, Jour. Coll. Sci., Imp. Univ. Tokyo, vol. 45,

* Academy of Sciences, San Francisco.

art. 5, pl. 24, pl. 6, fig. 5.
1925. *Thyasira bisecta* (CONRAD). YOKOYAMA, Jour. Fac. Sci., Imp. Univ. Tokyo, sec. 2, vol. 1, pt. 3, p. 122, pl. 15, figs. 1-2.
1925. *Thyasira bisecta* (CONRAD). YABE and NOMURA, Sci. Rep. Tohoku Imp. Univ., ser. 2, vol. 7, no. 4, p. 84, pl. 23, figs. 2, 7-10.
1925. *Thyasira bisecta* var. *nipponica* YABE and NOMURA, ditto, p. 84, pl. 23, fig. 3; pl. 24, figs. 2-4.
1926. *Thyasira bisecta* (CONRAD). YOKOYAMA, Jour. Fac. Sci., Imp. Univ. Tokyo, vol. 1, pt. 8, p. 294, pl. 35, figs. 1-3.
1926. *Thyasira bisecta* var. *nipponica* YABE and NOMURA. YOKOYAMA, ditto, vol. 2, pt. 7, p. 243, pl. 31, fig. 12.
1930. *Thyasira disjuncta* (GABB). STEWART, Acad. Nat. Sci. Phila., Spec. Publ., no. 3, p. 194.
1931. *Thyasira* (*Conchocele*) *bisectoides* KURODA in HONMA's Geol. Central Shinano, p. 50, pl. 12, figs. 95-96.
1931. *Thyasira* (*Conchocele*) *bisecta nipponica* YABE and NOMURA. ditto, pl. 15, fig. 28.
1931. *Thyasira bisecta* (CONRAD). GRANT and GALE, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 281, pl. 13, fig. 15.
1932. *Thyasira bisecta* CONRAD. CLARK, Bull. Geol. Soc. Am., vol. 43, p. 810, pl. 14, fig. 2.
1933. *Thyasira disjuncta* (GABB). TEGLAND, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, no. 3, p. 114.
1943. *Thyasira bisecta* (CONRAD). MAKIYAMA, Mem. Coll. Sci., Kyoto Imp. Univ., ser. b, vol. 10, no. 2, art. 6, p. 147-151.
1942. *Thyasira bisecta* (CONRAD). WEAVER, Univ. Wash. Publ. Geol., vol. 5, p. 142, pl. 34, figs. 5-6.
1960. *Conchocele disjuncta* GABB. KANNO, Tert. Sys. Chichibu Basin, p. 242-245, pl. 38, figs. 9-13.
1971. *Conchocele disjuncta* GABB. ADDICOTT et al., U.S. Geol. Surv. Prof. Pap., 750-C, Fig. 3, a, b.

Remarks:—Several specimens have been examined. However, most of the specimens are from a huge erratic boulder containing a large number of individuals of the present species. This boulder seems to be a concretion consisting of calcareous mudstone, but it is not certain where it was derived from because this boulder is situated along the shoreline near thick sandstone at Yakataga Reef (no. 12 in Text-fig. 8), and this point is also close to the boundary between the Poul Creek and the Yakataga formations. The specimens collected from this locality are represented by rather variable forms, e. g., some have a rather broad apical angle similar to "*C. nipponica* (YABE and NOMURA)" but others have rather narrow ones as in the typical "*C. disjuncta* GABB". Judging from the variable form, the writer considers that the specimens might be from the Poul Creek formation (KANNO, 1960, p. 244).

Localities:—20551, dark-gray mudstone, Yakataga formation; 80606, a huge erratic boulder of calcareous mudstone, questionably from Poul Creek formation; 81203, calcareous concretion, lower part of the Poul Creek formation.

Reg. No. TUE 8426.

Superfamily Carditacea

Family Carditidae

Genus *Cyclocardia* CONRAD, 1867

Cyclocardia CONRAD, Amer. Jour. Conch., vol. 3, p. 191, 1867; *Cyclocardia* CONRAD. STE-

WART, Acad. Nat. Sci., Phila., Spec. Publ., no. 3, p. 150, 1930; *Cyclocardia* CONRAD. HABE, Gen. Jap. Shells, p. 108, 1951; *Cyclocardia* CONRAD. HIRAYAMA, Sci. Rep. Tokyo Univ. Education, sec. C, vol. 4, no. 29, p. 86, 1955; *Cyclocardia* CONRAD. KANNO, Tert. Sys. Chichibu Basin, p. 236, 1960; *Cyclocardia* CONRAD. MOORE et al., Treat. Invert. pt. N, p. 551, 1969.

Type-species (by subsequent designation, STOLICZKA, 1871):—*Cardita borealis* CONRAD, 1832, Recent, Labrador to Cape Hatteras, Eastern United States.

Remarks:—This genus is characterized by an orbicular, more or less inflated shell sculptured with strong radial ribs and covered with velvety epidermis. There is no right anterior cardinal.

Geographic distribution:—World-wide.

Geologic range:—Upper Cretaceous to Recent.

Cyclocardia yakatagensis (CLARK), 1932

Plate 3, figs. 7a-b; Plate 4, figs. 9a-b

1932. *Venericardia yakatagensis* CLARK, Bull. Geol. Soc. Am., vol. 43, p. 809, pl. 14, figs. 6, 7.
1971. *Cyclocardia yakatagensis* (CLARK). ADDICOTT et al., U.S. Geol. Surv. Prof. Pap., 750-C, Fig. 3, d, n. o.

Remarks:—This specimen is characterized by fairly heavy, equilateral shell sculptured with 23 to 25 broadly rounded radial ribs with shallow interspaces which are somewhat narrower than the width of the rib. CLARK (1932) did not describe the hinge of this species, but the present specimens show that the right valve has a strong posterior cardinal tooth with a shallow groove on top and a faint posterior lateral one. The left cardinal teeth consist of an anterior one which is short and rather stout and a posterior one which is thin and elongate.

This species is closely related to *Venericardia tokunagai* YOKOYAMA, 1924 from the Asagai formation (Oligocene) of the Joban coal-field, Japan.

This species is one of the characteristic species of the upper part of the Poul Creek formation in which it occurs abundantly.

Localities:—80905, 81002, 81201, 81401, olive-green, fine- to medium-grained sandstone, upper part of the Poul Creek formation.

Reg. No. TUE 8427.

Cyclocardia hamiltonensis (CLARK), 1932

Plate 3, fig. 6; Plate 4, figs. 10, 11

1932. *Venericardia hamiltonensis* CLARK, Bull. Geol. Soc. Am., vol. 43, p. 810, pl. 14, figs. 9-10.
1971. *Cyclocardia hamiltonensis* (CLARK). ADDICOTT et al., U.S. Geol. Surv. Prof. Pap., 750-C, Fig. 3, e, f.

Remarks:—This species was originally reported by CLARK, 1932, from the upper reaches of Hamilton Creek about 6.5 kilometers east of Yakataga Reef, Alaska.

It is somewhat similar to *C. yakatagensis* (CLARK), but the smaller number of radial ribs (about 15 to 19), and higher shell serve to distinguish it from the allied species.

Localities:—81002, 81401, 81104 (float), olive-green, fine- to medium-grained sandstone, upper part of the Poul Creek formation.

Reg. No. TUE 8428.

Cyclocardia sp.

Plate 3, figs. 8, 9

Remarks:—Two right and left valves are at hand, of which the right one is mostly decorticated. The specimens are characterized by a shell which is extremely high for the genus, a small number of radial ribs (about 19), and a rather small shell. These characteristics serve to distinguish it from the associated *C. yakatagensis* and *C. hamiltonensis*.

Locality:—81401, olive-green, fine- to medium-grained sandstone, upper part of the Poul Creek formation.

Reg. No. TUE 8429.

Superfamily Crassatellacea

Family Crassatellidae

Genus *Crassatella* LAMARCK, 1799

Crassatella LAMARCK, Mem. Soc. Historie Nat. Paris, vol. 1, p. 85, 1799; *Crassatella* LAMARCK. H. and A. ADAMS, Gen. Rec. Moll., vol. 2, p. 458, 1857; *Crassatellites* KRÜGER. DALL, Trans. Wagner Free Inst. Sci., vol. 3, p. 1468, 1903; *"Crassatellites"* STEWART, Acad. Nat. Sci. Phila., Spec. Publ., no. 3, p. 136, 1930; *Crassatellites* KRÜGER. GRANT and GALE, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 270, 1931; *Crassatella* LAMARCK. KEEN, Sea Shells Trop. Am., p. 82, 1958; *Crassatellites* KRÜGER. KANNO, Tert. Sys. Chichibu Basin, p. 233, 1960; *Crassatella* LAMARCK. MOORE et al., Treat. Invert. Paleont., pt. N, vol. 2, p. 573, 1969.

Type-species (by subsequent designation, SCHMIDT, 1818):—*Mactra cygnaea* LAMARCK, 1799.

Remarks:—Some authors have KRÜGER's *Crassatellites* instead of *Crasstella*. The validity of KRÜGER's generic name has been discussed by several previous workers (STEWART, 1930; KANNO, 1960; KEEN 1958). According to KEEN (1958, p. 82), *Crassatellites* is invalid because KRÜGER, 1823, did not propose a type or give any description. Therefore, it seems best to retain the name *Crassatella* provisionally.

This genus is characterized by triangular, rather compressed shells which are more or less rostrated posteriorly. The species of this genus are restricted to south of Point Conception, California, in the eastern Pacific, and they are also restricted to waters south of lat. 35°N on the Pacific coast of Japan. They are shallow (0-80 meters in depth), sandy to fine-grained silty bottom dwellers.

Geographic distribution:—Europe, North America, and the west Pacific region.

Geological range:—Middle Cretaceous to Miocene. The fossil species of the genus extensively distributes in the northern hemisphere, where it is abundant in virtually all Eocene, Oligocene, and Miocene faunas. However, it is note-worthy the present genus seems to be restricted to middle Eocene to upper Oligocene

formations in Washington and Oregon districts but ranges into the lower to middle Miocene in Alaska.

Crassatella cf. *C. washingtoniana* (WEAVER), 1912

Plate 4, figs, 5, 7

1912. *Crassatellites washingtoniana* WEAVER, Wash. Geol. Surv., Bull., no. 15, p. 32, pl. 4, fig. 42; pl. 5, fig. 51.
1925. *Crassatellites washingtoniana* WEAVER. CLARK, Univ. Calif. Publ., Bull. Geol. Sci., vol. 15, p. 87, pl. 12, figs. 1-5.
1942. *Crassatellites washingtoniana* WEAVER, Univ. Wash. Publ. Geol., vol. 5, pl. 126, pl. 30, figs. 1, 2, 4-8.

Remarks:—Two specimens are at hand. This species was originally reported by WEAVER (1912) from the Cowlitz formation (upper Eocene) in Washington. This species is characterized by an elongate, sub-trigonal, thick, equivalved shell with anteriorly situated beaks which are about one-fourth of the length of the shell from the anterior end. In addition the present species has the strong and nearly equally developed muscle scars, and fine crenulations on the interior ventral margin. Moreover, the type of species is sculptured by distinct concentric lines. Although the present specimens are strongly similar to *C. washingtoniana* in shape, the surface sculpture is unknown owing to poor preservation. Precise identification wait until well preserved specimens are collected.

Locality:—80905, olive-green, medium-grained sandstone, upper part of the Poul Creek formation.

Reg. No. TUE 8430.

Genus *Crassatina* KOBELT, 1881

Crassatina KOBELT. MOORE et al., Treat. Invert. Paleont., pt. N, vol. 2, p. 754, 1969.

Type-species (by original designation):—*Crassatella triquetra* "SOWERBY" REEVE, 1842.

Remarks:—The genus is somewhat similar to the aforementioned *Crassatella* LAMARCK, but differs by having small lateral teeth on the posterior side of resilifer pit.

Geographic distribution:—Europe, Africa, Japan, and the Gulf of Alaska.

Geologic range: Paleocene to Recent.

Crassatina carmanahensis (CLARK), 1925

Plate 4, figs. 6a-b

1925. *Crassatellites carmanahensis* CLARK, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, p. 88, pl. 12, fig. 6.
1942. *Crassatellites carmanahensis* CLARK. WEAVER, Univ. Wash. Publ. Geol., vol. 5, p. 128-129, pl. 29, fig. 14.

Remarks:—This species is distinguished from allied species by having nearly

equal, steeply sloping anterior- and posterior-dorsal borders, a relatively small umbonal angle, and a greater height of the shell compared with the length.

Three specimens are at hand which show the following characters; the surface of leached specimen is sculptured with numerous fine radial striations; the ligament is completely internal; the anterior cardinal of the left valve is rather heavy and short, the posterior cardinal is thin and elongate and unconnected dorsally; the posterior lateral tooth of the right valve is rather distinct and occurs just behind the resilifer pit.

These specimens are somewhat similar to some species of *Astarte* in outline but the internal ligament and lack of a nymph on the hinge line serve to distinguish it from *Astarte*.

The present species has been previously reported only from south of Vancouver Island. The occurrence of this species may be very significant for the interpretation of paleoclimatic conditions in the Gulf of Alaska area during deposition of the Poul Creek formation.

Locality:—80905, olive-green, fine- to medium-grained sandstone, upper part of the Poul Creek formation.

Reg. No. TUE 8431.

Superfamily Cardiacea

Family Cardiidae

Genus *Clinocardium* KEEN, 1936

Clinocardium KEEN, Trans. San Diego Soc. Nat. Hist., vol. 8, no. 17, p. 119–120, 1936; *Clinocardium* KEEN. HABE, Gen. Jap. Shells, p. 150, 1951; *Clinocardium* KEEN, Bull. Am. Paleont., vol. 35, no. 153, p. 14–21, 1954; *Clinocardium* KEEN. HIRAYAMA, Sci. Rep. Tokyo Univ. Educat., sec. C, vol. 4, no. 29, p. 92, 1955; *Clinocardium* KEEN. KANNO, Tert. Sys. Chichibu Basin, p. 255, 1960; *Clinocardium* KEEN. MOORE, U.S. Geol. Surv. Prof. Pap., 419, p. 72, 1963; *Clinocardium* KEEN. MOORE et al., Treat. Invert. Paleont., pt. N, vol. 2, p. 590, 1969.

Type-species (by original designation):—*Cardium nuttallii* CONRAD, 1837, Recent, Bering Sea to San Diego, California.

Remarks:—The present genus is characterized by the markedly forward-pointing beaks, long, narrow, low ligament, arched hinge-line, and a large number of radial ribs. Recent species of this genus occur in temperate to cold waters, ranging from the intertidal zone to 130 meters (KEEN, 1963) on sandy bottoms.

Geographic distribution:—Recent species occurs north of lat. 34°N in Japan, and north of lat. 33°N in the eastern Pacific.

Geologic range:—Oligocene to Recent in Japan, upper Miocene to Recent in west coast of North America.

Clinocardium yakatagense (CLARK), 1932

Plate 8, figs. 1–3

1932. *Cardium (Cerastoderma) yakatagensis* CLARK, Bull. Geol. Soc. Am., vol. 43, p. 813, pl.

18, fig. 8.
1971. *Clinocardium yakatagensis* (CLARK). ADDICOTT et al., U.S. Geol. Surv. Prof. Pap., 750-C, Fig. 4, a.

Description:—Shell rather large for the genus, subtrigonal, ventricose, thick; umbo prominent, situated anteriorly, prosogyrous; surface ornamented with about twenty-four radial ribs which are regular, rather low, noded by incremental ridges on their surface, and separated by wider interspaces; radial ribs almost obsolete anteriorly and posteriorly; ventral side of surface distinctly ornamented with rugose concentric lines, which become less prominent near the anterior and posterior margins; ventral margin roughly crenulated; ligament external; each valve with two cardinal teeth, of which the posterior of the right and the anterior of the left are prominent; anterior laterals short, heavy, and strong, but the posterior one rather small and weak compared with the anterior one; muscle scars prominent.

Measurements (in mm.):—

Specimens	Length	Height	Obliquity*	Thickness	Valve
No. 1	ca.62.0	60.0	72.0	—	Left
„ 2	55.0	50.0	64.4	20.0	Right
„ 3	58.0	51.0	62.0	—	Right

* Length measured from the beak to the maximum length to the ventral margin.

Remarks:—More than ten specimens are at hand, but most are incomplete. According to CLARK's (1932) description, there are about thirty radial ribs on this species, but the specimens at hand have about twenty-four, however the anterior and posterior ribs are almost obsolete. The present species is similar to *Clinocardium sookense* (CLARK and ARNOLD), 1923, from the Sooke formation (upper Oligocene) of Vancouver Island, but differs by having more conspicuous umbo, a prosogyrous beak, fewer radial ribs which are lower and finer than those of *C. sookense*. Moreover, the present species is characterized by the distinct rugose surface on adult shells, and more heavy and stout anterior lateral teeth. *Cerastoderma scapoosense* (CLARK), (CLARK, 1925, p. 91, pl. 22, fig. 5), from the Scappoose formation (upper Oligocene) of Oregon, is easily distinguished from *C. yakatagense* by having less prominent and almost orthogyrous beaks, and a smaller number of radial ribs.

Localities:—7011, 20484, 81402, 20521, 20526, 20523, conglomeratic sandstone, or dark-gray sandy siltstone, lowest part of the Yakataga formation.

Reg. No. TUE 8432.

Clinocardium brooksi (CLARK), 1932

Plate 5, fig. 9; Plate 6, fig. 4; Plate 7, figs. 7a-b

1932. *Cardium (Papyridea) brooksi* CLARK, Bull. Geol. Soc. Am., vol. 43, p. 812, pl. 18. fig. 5.
1971. *Clinocardium brooksi* (CLARK). ADDICOTT et al., U.S. Geol. Surv. Prof. Pap., 750-C, Fig. 4, f.

Remarks:—The type specimen was collected from the upper reaches of Hamilton Creek, east of Yakataga Reef, where the upper part of the Poul Creek and the

lowest part of the Yakataga are exposed. According to the original description, the type specimens shows following characters; "shell semiquadrate; beaks well anterior to the median line; apical angle about 113 degrees; surface with the line of greatest convexity extending from the beaks to the lower part of the rounded posterior end; sculptured by about 32 prominent radial ribs with interspaces averaging about equal to the width of the ribs. This ribbing is somewhat finer near the posterior end and becomes obsolete on the posterior dorsal margin; the ribs appear to have been originally V-shaped, becoming to a sharp edge, and probably were somewhat spinose. Incremental lines very fine."

Some specimens of the writer's show the same characters as the original description, but the others are somewhat different from CLARK's description, i. e., there are about 43 radial ribs which are separated by narrower interspaces than the width of radial ribs. In addition, there are many intermediate forms between the CLARK's type specimens and the specimen sculptured with many radial ribs. The present species seems to have a wide range of variation.

Localities:—80506, 81306, 81403, gray or dark-gray, granule conglomeratic sandstone, lower to lowest part of the Yakataga formation.

Reg. No. TUE 8433.

Clinocardium hopkinsi KANNO, n. sp.

Plate 5, figs. 6, 7

Description:—Shell rather thin, ovate-trigonal, equivalve, inequilateral, higher than long or obliquely elongated shell; beaks situated anteriorly, prosogyrous; surface sculptured with about 40 radial ribs which are separated by narrow interspaces, and with cross-threads which tend to crowd toward the ventral margin; hinge with two cardinals, of which the right posterior and the left anterior one are stout; lateral tooth distinct, well separated from the cardinals; inner ventral margin crenulated corresponding to the surface sculpture.

Measurements (in mm):—

Specimens	Length	Height	Thickness	Oliquity*	Valve
Holotype	50. 0	42. 0	ca.13. 0	50. 5	Left
Paratype	43. 0	44. 0	ca.14. 0	ca.48. 0	Right

* Length measured from the beak to the maximum length to the ventral margin.

Remarks:—Several specimens are at hand, but most are somewhat deformed. Although some deformed specimens are more or less similar to *Clinocardium yakatagense*, they differ distinctly by their inequilateral and higher shells.

This name is dedicated to Dr. DAVID M. HOPKINS, U.S. Geological Survey, who gave valuable suggestions and encouragement to the writer during the present work.

Locality:—81401 (type locality), olive-green, fine- to medium-grained sandstone, upper part of the Poul Creek formation.

Reg. Nos. TUE 8434 (holotype); TUE 8435 (paratype).

Genus *Papyridea* SWAINSON, 1840

Papyridea SWAINSON, Treat. Malac., p. 374, 1840; *Papyridea* SWAINSON. STOLICZKA, Mem. Geol. Surv. India, vol. 3, p. 208, 1874; *Papyridea* SWAINSON. DALL, Trans. Wagner Free Inst. Sci., vol. 3, p. 1075, 1900; *Papyridea* SWAINSON. GRANT and GALE, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 311, 1931; *Papyridea* SWAINSON. MOORE et al., Treat. Invert. Paleont., pt. N, vol. 2, p. 588, 1969.

Type-species (by subsequent designation, GRAY, 1847):—*Cardium soleniforme* BRUGUIÉRE, 1789, Recent, west Indies.

Remarks:—The elongate and equilateral shell, spinose radial ribs, and with gaping at both ends serve to distinguish it from the other genera of Cardiidae.

Geographic distribution:—Subtropical to tropical regions in the Pacific Ocean.

Geologic range:—Oligocene to Recent in Japan, and Miocene to Recent on the west coast of North America.

Papyridea hamiltonensis (CLARK), 1932

Plate 3, fig. 4; Plate 5, figs. 4, 5, 8

1932. *Cardium* (*Serripes*?) *hamiltonensis* CLARK, Bull. Geol. Soc. Am., vol. 43, p. 813-814, pl. 18, figs. 6, 7, 10.

1971. *Papyridea*? *hamiltonensis* (CLARK). ADDICOTT et al., U. S. Geol. Surv. Prof. Pap., 750-C, Fig. 4, b, g, k.

Description:—Shell rather thin, equivalve, almost subequilateral, longer than high, without appreciable posterior gape; beaks slightly prosogyrate; surface sculptured with about 45 radial ribs; ribs with cross-threads but no spines, separated by narrow and shallow, round-bottomed interspaces; complete hinge armature consisting of an anterior and posterior lateral tooth in both valves; anterior lateral tooth situated apart from the beak, but the posterior ones elongate and thin rising from the umbonal cavity; margin crenulate corresponding to the surface ornamentation.

Measurements (in mm):—

Specimens	Length	Height	Thickness	Valve
No. 1	48.8	39.7	ca.11.0	Right
„ 2	55.0	45.8	ca.12.0	„
„ 3	29.5	22.8	11.5	Both valves

Remarks:—The present species was reported originally by CLARK (1932) from the Yakataga District (perhaps from type locality at Bear Glacier, and Hamilton Creek, near the Yakataga Reef). It is characterized by the large number of flat-topped radial ribs with narrow interspaces which are crossed by several distinct rough concentric ridges or constrictions. However, it is difficult to determine details of surface ornamentation owing to poor preservation. According to CLARK's original description, there are about 62 radial ribs but specimens collected from near the type locality have only 45 radial ribs. As CLARK pointed out, the outline of the shell is variable, e. g., some specimens have a rather equilateral shell, but others are

rather inequilateral. These variations may depend on in part deformations after burial, but it may be due to original variation of the shell, because the original shell outlines almost all of the associated pelecypods are hardly deformed.

The present species was placed provisionally in *Serripes* by CLARK, but the surface ornamentation and shape serve to distinguish it from genus *Serripes* GOULD, 1941.

Localities:—81003, 81201, 81401, 20503, olive-green, fine- to medium-grained sandstone, upper part of the Poul Creek formation; 81404, olive-green, silty sandstone, lower part of the Poul Creek formation.

Reg. No. TUE 8436.

Genus *Nemocardium* MEEK, 1876

Nemocardium MEEK, Rept. U.S. Geol. Surv. Territories, vol. 9, p. 167, 1876; *Nemocardium* MEEK. GRANT and GALE, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 310, 1931; *Nemocardium* MEEK. MAKIYAMA, Mem. Coll. Sci., Kyoto Imp. Univ., ser. B, vol. 10, no. 2, art. 6, p. 142–143, 1934; *Nemocardium* MEEK. HABE, Gen. Jap. Shells, p. 151–152, 1952; *Nemocardium* MEEK. TAKEDA, Studies Coal Geol., no. 3, p. 82, 1953; *Nemocardium* MEEK. KEEN, Bull. Am. Paleont., vol. 35, no. 153, p. 10, 1954; *Nemocardium* MEEK. KANNO, Tert. Sys. Chichibu Basin, p. 262, 1960; *Nemocardium* MEEK. MOORE, U.S. Geol. Surv. Prof. Pap., 419, p. 72, 1963.

Type-species (by subsequent designation, SACCO, 1899):—*Cardium semiasperum* DESHAYES, 1858, Eocene of the Paris Basin.

Remarks:—The characteristic features of this genus are the medium- or small-sized shell with distinct but fine radial ribs on the surface and the change in ribbing on the posterior part of the shell where the ribs become spinose, tuberculate or cancellate instead of simple.

Geographic distribution:—The Recent species of the genus occur south of lat. 36°N along the Pacific coast of Japan, but south of Puget Sound, lat. 48°N on the eastern side of the Pacific Ocean.

Geologic range:—Lower Cretaceous to Recent.

Nemocardium alaskense (CLARK), 1932

Plate 17, fig. 2

1932. *Cardium* (*Laevicardium*) *alaskensis* CLARK, Bull. Geol. Soc. Am., vol. 43, p. 814, pl. 18, fig. 4.

1971. *Nemocardium alaskensis* (CLARK). ADDICOTT et al., U.S. Geol. Surv. Prof. Pap., 750-C, Fig. 4, c.

Remarks:—The present species is characterized by a rather small (about 10 to 15 mm in height), almost equilateral shell, and finely sculptured surface ornamentation of about 70 radial ribs. Though a large number of specimens have been examined, most of the specimen are deformed and have leached shell surfaces. Accordingly, the detailed characters of this species are difficult to observe. The specimens at hand are rather small, inflated shells with fine silky radial ribs. The shape of shells and surface ornamentation seem to be sufficient to determine the generic

characters.

Localities:—80906, 81002, dark gray, fine-grained sandstone, lower part of the Poul Creek formation.

Reg. No. TUE 8437.

Nemocardium aff. *N. yokoyamai* TAKEDA, 1953

Plate 4, figs. 12a-b

1960. *Nemocardium yokoyamai* TAKEDA. KANNO and MATSUNO, Jour. Geol. Soc. Japan, vol. 66, no. 772, pl. 4, fig. 9 (no description).

Description:—Shell of medium size for the genus, suborbicular, swollen, subequilateral; beaks slightly prosogyrous, umbo prominent; postero-dorsal margin more convex than the antero-dorsal one which slopes abruptly downward; postero-ventral margin more or less angulated; surface ornamented with about 80 radial ribs separated by narrow interspaces, of which the posterior radials number about 20 and are somewhat coarser than the main radials.

Remarks:—One well preserved specimen is at hand. It is closely related to *Nemocarium yokoyamai* from the Poronai formation (Oligocene) of Hokkaido, Japan, which differs somewhat by having a more rounded shell. The present specimen seems to be conspecific with "*N. yokoyamai* TAKEDA" (KANNO and MATSUNO, 1960) from the Chikubetsu formation (middle Miocene) of Hokkaido.

Locality:—81401, olive-green, fine- to medium-grained sandstone, upper part of the Poul Creek formation.

Reg. No. TUE 8438.

Superfamily Mactracea

Family Mactridae

Genus *Spisula* GRAY, 1837

Spisula GRAY, LOUDON's Mag. Nat. Hist., New Series, vol. 1, p. 372, 1837; *Spisula* GRAY. PACKARD, Univ. Calif. Publ., Bull. Dept. Geol., vol. 9, no. 16, p. 283, 1916; *Spisula* GRAY. OLDROYD, Stanf. Univ. Publ., Univ. Ser. Geol. Sci., vol. 1, no. 1, p. 192, 1924; *Spisula* GRAY. STEWART, Acad. Nat. Sci. Phila., Spec. Publ., no. 3, p. 266, 1930; *Spisula* GRAY. GRANT and GALE, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 393, 1931; *Spisula* GRAY. HABE, Gen. Jap. Shells, p. 194, 1952; *Spisula* GRAY. KANNO, Tert. Sys. Chichibu Basin, p. 290, 1960; *Spisula* GRAY. MOORE, U.S. Geol. Surv. Prof. Pap., 419, p. 82, 1963; *Spisula* GRAY. KANNO and OGAWA, Sci. Rep. Tokyo Univ. Ed., vol. 8, no. 81, p. 286, 1964; *Spisula* GRAY. MOORE et al., Treat. Invert. Paleont., pt. N, vol. 2, p. 601, 1969.

Type-species (by subsequent designation, GRAY, 1847):—*Cardium solidum* LINNÉ, Recent, seas of Europe.

Remarks:—The present genus is closely similar to *Mactra* LINNÉ, 1717, which differs from the present one by having a shelly ridge between the chondrophore and the ligamental cavity. *Mulinia* GRAY, 1837, is somewhat similar to the present one, but differs by having an internal ligament, rather strong and stout teeth, and a

small and short pallial sinus. *Pseudocardium* GABB, 1866, is also rather similar to the present one, but as discussed by KANNO and OGAWA (1964, p. 81), it may be better to treat it as a subgenus of *Spisula*.

Geographic distribution:—World-wide, especially, within the tropics.

Geologic range:—Eocene to Recent.

Spisula equilateralis (CLARK), 1932

Plate 6, fig. 7; Plate 8, fig. 9; Plate 9, figs. 1, 4, 5, 7-8

1932. *Mactra (Mactrotoma) californica equilateralis* CLARK, Bull. Geol. Soc. Am., vol. 43, p. 819-820, pl. 14, fig. 8.
1937. *Mactra (Mactrotoma) californica onnechiuria* OTUKA, Jap. Jour. Geol. Geogr., vol. 14, nos. 3-4, p. 168, pl. 16, fig. 2.
1940. *Mactra (Spisula) onnechiuria* OTUKA, ditto, vol. 17, nos. 1-2, p. 94, pl. 11, fig. 2.
1960. *Spisula onnechiuria* (OTUKA). KANNO and MATSUNO, Jour. Geol. Soc. Japan, vol. 66, no. 722, pl. 4, fig. 7.
1966. *Spisula onnechiuria* (OTUKA). UOZUMI, Jour. Fac. Sci., Hokkaido, Univ., ser. 4, vol. 13, no. 2, p. 130-131, pl. 10, figs. 1, 6.
1968. *Spisula onnechiuria* (OTUKA). KANNO et al., Sci. Rep. Tokyo Univ. Educat., sec. C, vol. 10, no. 94, p. 11, pl. 2, figs. 1-2.
1971. *Spisula californica equilateralis* (CLARK). ADDICOTT et al., U. S. Geol. Surv. Prof. Pap., 750-C, Fig. 4, 1.

Remarks:—The original description by CLARK was based on a specimen from Oil Creek, east of Yakataga Reef, presumably from the upper part of the Poul Creek formation. This species is characterized by having an almost equilateral, elongate, and low shell.

The specimens at hand are more or less variable in form. Some of them have higher shells than the type specimen, but most are equilateral. The typical form of this species is very similar to *Spisula onnechiuria* (OTUKA), 1937, from early to middle Miocene strata exposed in the northern part of Hokkaido, Japan. "*S. onnechiuria*" is also rather variable in shell outline (KANNO et al., 1967). However, the equilateral and low shell strongly suggests that these species might be conspecific, or at least, have a close relationship to each other. The migrational and dispersal trend of these mollusks are very interesting problems.

Localities:—81201, 81401, 20503, olive-green, fine- to medium-grained sandstone, upper part of the Poul Creek formation.

Reg. No. TUE 8439.

Spisula addicotti KANNO, n. sp.

Plate 8, fig. 10; Plate 9, figs. 2-3, 6

1932. *Spisula ramonensis* PACKARD. CLARK, Bull. Geol. Soc. Am., vol. 43, p. 820, pl. 14, fig. 5 (non figs. 1, 4).
1971. *Spisula* aff. *S. ramonensis* PACKARD. ADDICOTT et al., U. S. Geol. Surv. Prof. Pap., 750-C, Fig. 4, j, m.

Description:—Shell medium-sized, equivalve, longer than high, strongly inequilateral, somewhat compressed; umbones prominent, sharply pointed, prosogyrous,

situated posteriorly; antero-dorsal margin short, gently curving, and makes a rather acute angle with ventral margin; postero-dorsal border long, slightly concave and merges into the posterior end with narrowly rounded angle; posterior end somewhat produced; ventral margin broadly rounded; surface almost smooth excepting fine concentric growth lines; an indistinct low ridge running from umbo to the postero-ventral corner; hinge plate wide, chondrophore deep; left cardinal prominent, the posterior one bearing an indistinct lamella; lateral teeth long, the anterior one arising from the ventral edge of the plate; the hinge of the right valve as well as the pallial sinus inaccessible.

Measurements (in mm):—

Specimens	Length	Height	Thickness	H/L×100	Valve
No. 1 Holotype	57.7	48.4	ca. 9.0	83.6	Right
„ 2 Paratype	47.0	39.0	ca. 7.0	83.0	„
„ 3 „	49.0	41.3	ca. 8.0	84.0	Left
„ 4 „	59.5	42.8	ca.10.5	72.0	„
„ 5 „	28.7	22.3	—	78.0	„

Remarks:—This species was initially identified by CLARK as *Spisula ramonensis* PACKARD (CLARK, 1932). However, it is strongly inequilateral, and has a produced posterior end, whereas the *S. ramonensis* (PACKARD, 1916, p. 291, pl. 23, fig. 5; pl. 25, figs. 1-2) is characterized by a roundly trigonal form. The new species is also somewhat similar to *S. merriami longifrons* TURNER, (TURNER, 1938, Geol. Soc. Am., Spec. Pap., no. 10, p. 65, figs. 10-11), from the lower Umpqua formation (middle Eocene) of southwestern Oregon, but the Eocene species differs by having a more convex antero-dorsal margin, a more concave postero-dorsal border, and a rather smooth surface.

The new species is somewhat variable in form, some specimens have a rather low shell compared to the type, but these lower shells seem to be deformed.

The present specific name is dedicated to Dr. WARREN O. ADDICOTT, U. S. Geological Survey, who gave invaluable suggestions to the writer during the present work.

Localities:—81201, 81401, olive-green, fine- to medium-grained sandstone, upper part of the Poul Creek formation; 81404, olive-green silty sandstone, lower part of the Poul Creek formation.

Reg. No. TUE 8440 (holotype); TUE 8441 (paratype).

Superfamily Solenacea

Family Solenidae

Genus *Siliqua* MEGERLE von MÜHLFELD, 1811

Siliqua MEGERLE von MÜHLFELD, Gesells. Naturf. Freu. Mag., p. 44, 1811; *Siliqua* MÜHLFELD. H. and A. ADAMS, Gen. Rec. Moll., vol. 2, p. 345, 1856; *Siliqua* MEGERLE von MÜHLFELD. DALL, Proc. U. S. Nat. Mus., vol. 22, p. 108, 1899; *Siliqua* MEGERLE. OLDROYD, Stanf. Univ. Publ. Ser., Geol. Sci., vol. 1, no. 1, p. 189, 1924; *Siliqua* MEGERLE von MÜHLFELD.

GRANT and GALE, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 386-387, 1931; *Siliqua* MEGERLE von MÜHLFELD. HABE, Gen. Jap. Shells, p. 230, 1952; *Siliqua* MEGERLE von MÜHLFELD. KANNO, Tert. Sys. Chichibu Basin, p. 309-310, 1960; *Siliqua* MEGERLE von MÜHLFELD. MOORE et al., Treat. Invert. Paleont., pt. N, vol. 2, p. 612-613, 1969.

Type-species (by monotypy):—*Solen radiata* LINNÉ, 1758, Recent, East Indies.

Remarks:—This genus is somewhat similar to other genera in Solenidae, but it can be distinguished from them by the presence of an internal rib or ridge running vertically or obliquely from the beak to the ventral margin.

Geographic distribution:—World-wide occurring along the shore of Sitka, Ochotsk, Bering Strait, and Newfoundland as well as on the tropical shores of India and China Seas, and also around Japan. The Recent species of the genus range from the intertidal zone to 60 meters in sandy to silty bottoms.

Geologic range:—Eocene to Recent.

Siliqua sp.

Plate 17, fig. 6

Remarks:—Two specimens were collected from the basal part of thick sandstone which forms the highest rock on the Yakataga Reef. They are represented by internal moulds of the right and left valves. Although detailed observation is impossible owing to their poor preservation, the unique form indicated by the remaining part seems to be sufficient to distinguish it from the known species, i.e., both the dorsal and ventral margins are almost parallel, and the ventral margin is not broadly arcuate but is nearly straight. The internal radial ridge is almost perpendicular to the dorsal and ventral margins. Estimated length, ca. 80 mm; height, 33 mm; length from beak to anterior end, 28 mm.

This specimens differ from *S. patula* DIXON var. *oregonia* DALL from the Miocene Astoria formation of southwestern Oregon (WEAVER, 1942, p. 230, pl. 54, fig. 1) by the different ratio (length measured from the beak to the anterior end/height×100) of length to height, i.e., *S. patula* var. *oregonia* shows about 37 percent whereas 84 percent of *Siliqua* sp. *S. patula* DIXON, a Recent species ranging from Alaska to Monterey, California, is distinguished from the present one by the higher shell, broadly arcuated ventral margin, and more slanting internal radial ridge (or rib). *S. alta* (BRODERIP and SOWERBY), a Recent species ranging from northern Japan to Sakhalin, Kamchatka, and Alaska, is rather similar to the present specimens in having a perpendicular interior ridal rib, but differs by the lower ratio of length measured from beak to anterior end to height, namely, on *S. alta* the ratio is about 62 percent whereas it is 84 percent on *Siliqua* sp.

The living species of *Siliqua* are of world-wide distribution and are especially abundant in temperate to cold waters. However, fossil species of the genus are rather rare in Tertiary deposits of the northwest coast of North America.

Locality:—80605, rather greenish brown, medium-grained sandstone, Yakataga formation.

Reg. No. TUE 8442.

Superfamily Tellinacea

Family Tellinidae

Genus *Tellina* LINNÉ, 1758

Tellina LINNÉ, Syst. Nat., Ed. 10, p. 674, 1758; *Tellina* LINNÉ. H. and A. ADAMS, Gen. Rec. Moll., vol. 2, p. 394, 1856; *Tellina* LINNÉ. OLDROYD, Stanf. Univ. Publ. Univ. Ser., Geol. Sci., vol. 1, no. 1, p. 163-164, 1924; *Tellina* LINNÉ. WOODRING, Carnegie Inst. Wash., Publ., no. 336, p. 166, 1925; *Tellina* LINNÉ. STEWART, Acad. Nat. Sci. Phila., Spec. Publ., no. 34, p. 199, 1930; *Tellina* LINNÉ. GRANT and GALE, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 357, 1931; *Tellina* LINNÉ. KANNO, Tert. Sys. Chichibu Basin, p. 305, 1960; *Tellina* LINNÉ. MOORE, U. S. Geol. Surv. Prof. Pap., 419, p. 78, 1963; *Tellina* LITNÉ. HICKMAN, Mus. Nat. Hist., Univ. Oregon, Bull. no. 16, p. 54, 1969; *Tellina* LINNÉ. MOORE et al., Treat. Invert. Paleont., pt. N, vol. 2, p. 613, 1969.

Type-species (by subsequent designation, CHILDREN, 1823):—*Tellina radiata* LINNÉ, Recent, West Indies.

Remarks:—The present genus is characterized by a very wide and deep pallial sinus which is the same shape in the both valves.

Geographic distribution:—World-wide.

Geologic range:—?Cretaceous, Tertiary to Recent.

Subgenus *Oudardia* MONTEROSATO, 1884

Oudardia MONTEROSATO, Nomencl. Gen. Spec. Conch. Medit., p. 22, 1884; *Oudardia* MONTEROSATO. GRANT and GALE, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 361, 1931; *Oudardia* MONTEROSATO. MOORE et al., Treat. Invert. Paleont., pt. N, vol. 2, p. 619, 1969.

Type-species (by original designation):—*Tellina oudardii* PAYRAUDEAU.

Remarks:—This genus is characterized by a thick internal rib, radiating from beak to ventral margin in front of mid-line.

Geographic distribution:—Europe and west coast of North America, but this seem to be no record on the living species from the Japanese coast of the Pacific. However, fossil species are recorded from both sides of the Pacific.

Geologic range:—?Eocene, Oligocene to Recent.

Tellina (*Oudardia*) sp.

Plate 10, figs. 4, 5

Remarks:—Two specimens are at hand. These are characterized by an equilateral, slightly opisthogyrous shell that is elongate-ovate in outline, and a depressed and beveled area along the posterior dorsal margin which is set off by a ridge extending from the umbo to the posterior end. Moreover, there is a blunt internal ridge running from the beak to the anterior-ventral margin, although it tapers toward the antero-ventral margin.

Tellina (*Oudardia*) *t-matumotoi* OTUKA (1940, p. 96) from the middle Miocene strata of northern Hokkaido is more or less similar to the present specimens, but it

differs by having an inequilateral shell.

Locality:—81401, olive-green, fine- to medium-grained sandstone, upper part of the Poul Creek formation.

Reg. No. TUE 8443.

Tellina cf. *T. cowlitzensis* WEAVER, 1916

Plate 6, fig. 5

1916. *Tellina cowlitzensis* WEAVER, Univ. Wash. Publ. Geol., vol. 1, p. 42, pl. 2, fig. 14.
1938. *Tellina* cf. *cowlitzensis* WEAVER. TURNER, Geol. Soc. Am., Spec. Pap., no. 10, p. 61, pl. 7, fig. 7.
1942. *Tellina cowlitzensis* WEAVER, Univ. Wash. Publ. Geol., vol. 5, p. 198, pl. 51, fig. 13; pl. 57, fig. 12.

Remarks:—Three specimens have been examined. One is represented by a well preserved right valve, the others are articulated but are imcomplete and crushed. This species is characterized by an anteriorly situated beak, a convex antero-dorsal margin, and an attenuated posterior end. The present specimens are very similar to, but smaller than WEAVER's (1916) type species from the Cowlitz formation (upper Eocene).

Localities:—81102, 81401, 20503, olive-green, fine- to medium-grained sandstone, upper part of the Poul Creek formation.

Reg. No. TUE 8444.

Genus *Macoma* LEACH, 1819

Macoma LEACH, in John Ross, A voyage of discovery for the propose of exploring Buffins Bay and inquiring into the probability of a northwest passage, appendix, 11, p. 62, 1819; *Macoma* LEACH. DALL, Proc. Univ. Stat. Mus., vol. 23, p. 292, 1900; *Macoma* LEACH. OLDROYD, Stanf. Univ. Publ., Univ. Ser. Geol. Sci., vol. 1, no. 1, p. 179, 1924; *Macoma* LEACH. GRANT and GALE, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 365, 1931; *Macoma* LEACH. HABE, Gen. Jap. Shells, p. 219, 1952; *Macoma* LEACH. ABBOTT, American Seashells, p. 430, 1954; *Macoma* LEACH. KANNO, Tert. Sys. Chichibu Basin, p. 298, 1960; *Macoma* LEACH. MOORE, U. S. Geol. Surv. Prof. Pap., 419, p. 80, 1963; *Macoma* LEACH. HICKMAN, Mus. Nat. Hist., Univ. Oregon, Bull. no. 16, p. 58, 1969; *Macoma* LEACH. MOORE et al., Treat. Invert. Paleont., pt. N, vol. 2, p. 623, 1969.

Type-species (by monotypy):—*Macoma tenera* LEACH [=*Macoma calcarea* GMELIN], Recent, North American and boreal seas to Japan in the Pacific, and Long Island Sound in the Atlantic.

Remarks:—This genus is distinguished from *Tellina* LINNÉ by 1) lacking lateral teeth; 2) there is usually a strong posterior twist; 3) the pallial sinus is larger in one valve than the other.

Geographic distribution:—World-wide, generally in temperate to cold waters.

Geologic range:—Eocene to Recent.

Macoma aff. *M. lorenzoensis arnoldi* TEGLAND, 1933

Plate 10, figs. 1, 2

Remarks:—Two articulated specimens are at hand, one of which is represented by an internal mould. The present species is moderately compressed, roundly trigonal in shape, and has a slightly twisted posterior end. Moreover, the pallial sinus has a unique form, i. e., in the left valve it runs anteriorly from the posterior muscle scar toward the anterior one, but it does not meet the latter, and then descend posteriorly in a rounded circle to meet the pallial line almost in the central part of the lower margin of the shell (Text-fig. 9). The present specimens are close to



Text-fig. 9. Pallial sinus of *Macoma* aff. *M. lorenzoensis arnoldi* TEGLAND.

TEGLAND's subspecies *M. lorenzoensis arnoldi* in general shape, but precise comparison is difficult because the pallial sinus of TEGLAND's type is inaccessible. *Macoma brota lipara* DALL, living from south of Bering Strait to the Puget Sound, is more or less similar to the present specimen in general outline, but differs by having a smaller and narrower pallial sinus.

Locality:—80506, dark gray or black mudstone, lower part of the Yakataga formation.

Reg. No. TUE 8445.

Macoma incongrua (v. MARTENS), 1865

Plate 6, fig. 6; Plate 9, figs. 9, 10, 12

1865. *Tellina incongrua* v. MARTENS. Ann. Mag. Nat. Hist., Ser. 3, vol. 16, p. 430–431.
1924. *Macoma incongrua* v. MARTENS. OLDROYD, Stanf. Univ. Publ., Univ. Ser. Geol. Sci., vol. 1, p. 170, pl. 42, fig. 10.
1931. *Macoma incongrua* v. MARTENS. GRANT and GALE, San Diego Soc. Nat. Hist., vol. 1, p. 373.
1932. *Macoma* cf. *M. middendorfii* DALL. CLARK, Bull. Geol. Soc. Am., vol. 43, p. 816, pl. 16, fig. 4.
1965. *Macoma incongrua* v. MARTENS. HABE and ITO, Shells of the World (in color), vol. 1, p. 145, pl. 50, figs. 9–10.
1971. *Macoma* cf. *M. incongrua* (v. MARTENS). ADDICOTT et al., U. S. Geol. Surv. Prof. Pap., 750-C, Fig. 5, d, h, n, o.

Remarks:—Three specimens are at hand. This species is characterized by a small shell which is trigonal in shape, convex, and has concentrically and irregularly striated surface ornamentation. Moreover, this species has a more or less twisted posterior margin which is shorter than the anterior one. The pallial sinus of the present specimens is not accessible.

This species ranges from the Arctic Ocean to Washington in the eastern Pacific

and north of Kyushu (lat. 31°N) in the western Pacific, where it lives in muddy bottoms ranging from the intertidal zone to about 10 meters in depth.

According to HABE and ITO (1965, p. 145), the American specimen described by ABBOTT (1954, p. 431, fig. 88b) differs from the type of Japanese species in the shape of pallial sinus, e. g., the pallial sinus of the left valve of American specimen does'nt reach to the anterior adductor muscle scar, while that of the Japanese type species does reach the anterior muscle scar. Thus the so-called *Macoma incongrua* MARTENS living along the east coast of North America should be re-examined taxonomically.

This species ranges from the upper Oligocene(?), and Miocene to Recent.

Localities:—81201, 81401, olive-green, fine- to medium-grained sandstone, upper part of the Poul Creek formation.

Reg. No. TUE 8446.

Macoma cf. *M. incongrua* (v. MARTENS), 1865

Plate 9, fig. 11

1932. *Heterodonax*? sp. CLARK, Bull. Geol. Soc. Am., vol. 43, p. 819, pl. 15, figs. 6, 7.

Remarks:—Clark reported *Heterodonax*? sp. from the upper part of the Hamilton Creek. The writer also collected a specimen, presumably from the same locality as CLARK's collection. This specimen is somewhat deformed, accordingly its original shape is unknown.

Locality:—80802, black mudstone, Yakataga formation.

Reg. No. TUE 8447.

Macoma arctata (CONRAD), 1849

Plate 2, figs. 5, 6

1849. *Tellina arctata* CONRAD, U. S. Explor. Exped. Geol., p. 725, figs. 3, 3a.
1909. *Tellina arctata* CONRAD. REAGAN, Trans. Kansas Acad. Sci., vol. 22, p. 184, pl. 2, figs. 16a, 16b.
1932. *Macoma arctata* (CONRAD). LOEL and COREY, Calif. Univ.. Publ., Bull. Dept. Geol. Sci.. vol. 22, no. 3, p. 227, pl. 43, figs. 1-2.
1932. *Tellina* sp. CLARK, Bull. Geol. Soc. Am., vol. 43, p. 818, pl. 15, fig. 10.
1942. *Macoma arctata* (CONRAD). WEAVER, Univ. Wash. Publ. Geol., vol. 5, p. 208-209, pl. 49, figs. 3, 5, 12; pl. 59, fig. 15.
1960. *Macoma arctata* (CONRAD). KANNO, Tert. Sys. Chichibu Basin, p. 301, pl. 44, figs. 3-4.
1963. *Macoma arctata* (CONRAD). ILYINA, BNIGRI., no. 202, p. 81, pl. 27, fig. 3.
1963. *Macoma arctata* (CONRAD). MOORE, U. S. Geol. Surv. Prof. Pap., 419, p. 81, pl. 28, figs. 6, 7, 10, 11, 13; pl. 29, fig. 8.
1971. *Macoma*? cf. *M. arctata* (CONRAD). ADDICOTT et al., U. S. Geol. Surv. Prof. Pap., 750-C, Fig. 5, f.

Remarks:—Eight specimens are at hand, all of which are represented by internal moulds. Although most of the specimens are poorly preserved, the slightly concave, sloping anterior margin, obliquely truncated anterior end, and straight, rather long posterior margin serve to distinguish these specimens from the known species of *Macoma*. The pallial sinus of *M. arctata* has not been previously described. The

pallial sinus of a topotype collected from the Astoria formation of Oregon by the writer is very deep reaching seven-tenths of the length from the posterior end of the shell. However, the present specimens at hand are too poorly preserved to show the precise shape of the pallial line.

This species ranges from the lower Miocene (Vaqueros formation in California) to the upper Miocene (Ilinsk formation in Kamchatka), and is distributed from the north of west coast of California to southeastern Alaska, and central Japan.

Locality:—80605, brownish-gray in weathered and bluish green in fresh, medium-grained sandstone, lower part of the Yakataga formation.

Reg. No. TUE 8448.

Macoma sp.

Plate 10, fig. 3; Plate 11, fig. 1

1932. *Macoma* cf. *secta* CONRAD. CLARK, Bull. Geol. Soc. Am., vol. 43, p. 818, pl. 16, figs. 3, 3a.

Remarks:—CLARK (1932) described this species from UC loc. 3854 (the right side of Big River) and loc. 3861 (not plotted on CLARK's map). The writer also collected a specimen, presumably same as CLARK's, from float in the middle reaches of Poul Creek. Although this specimens is represented by articulated valves, each valve is so strongly deformed that its natural shape is unknown.

Localities:—80901 (float), 81106 (float), olive-green, medium-grained sandstone, presumably Poul Creek formation.

Reg. No. TUE 8449.

Superfamily Glossacea

Family Vesicomyidae

Genus *Calyptogena* DALL, 1891

Calyptogena DALL, Proc. U. S. Nat. Mus., vol. 14, p. 189, 1891; *Calyptogena* DALL, Trans. Wagner Free Inst. Sci., vol. 3, p. 1410, 1435, 1903; *Calyptogena* DALL. OLDROYD, Stanf. Univ. Publ., Univ. Ser. Geol. Sci., vol. 1, p. 116, 1924; *Calyptogena* DALL. GRANT and GALE, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 278, 1931; *Calyptogena* DALL. HABE, Gen. Jap. Shells, p. 109, 1953; *Calyptogena* DALL. OKUTANI, Jap. Jour. Malacol., vol. 24, no. 4, p. 297-301, 1966; *Calyptogena* DALL. MOORE et al., Treat. Invert. Paleont., pt. N, vol. 2, p. 664, 1969.

Type-species (by monotypy):—*Calyptogena pacifica* DALL, Recent, Pacific coast of North America.

Remarks:—This genus is characterized by an ovate or elongate-ovate shell without a lunule but with a long excavated escutcheon, a strong deep-seated, external ligament, and a hinge with a large, triangular posterior cardinal and a weak anterior one in the right valve, and a triangular anterior cardinal and a weak posterior one as well as anterior lateral tooth in the left valve. According to DALL (1903), "the teeth become more or less obsolete in the adult, and in the young specimens retain the link between laterals and cardinals, which in most bivalves is lost at a

very early age".

This genus is closely related to *Akebiconcha* KURODA and *Hubertschenckia* TAKEDA. These relations may be discussed in another paper in near future.

Geographic distribution:—Living species of the genus range from Clarence Strait, Alaska, to Santa Barbara Channel, California, on the Pacific coast of North America, and Sagami Bay in the central Japan. Fossil species distributes from Japan to Alaska, Washington, and California.

Geologic range:—Oligocene to Recent.

Calyptogena chitanii (KANEHARA), 1937

Plate 7, figs. 5, 6a-b; Plate 17, fig. 12

1937. *Adulomya chitanii* KANEHARA, Bull. Imp. Geol. Surv. Japan, vol. 27, no. 1, p. 19-20, pl. 5, figs. 1, 6-9.
1954. *"Adulomya" chitanii* KANEHARA. AOKI, Sci. Rep. Tokyo Univ. Education, sec. C, vol. 3, no. 17, p. 31, pl. 1, figs. 9-11.
1962. *Adulomya chitanii* KANEHARA. KAMADA, Paleont. Soc. Jap., Spec. Pap., no. 8, p. 39, pl. 1, figs. 4-7.
1964. *Akebiconcha chitanii* (KANEHARA). KANNO and OGAWA, Sci. Rep. Tokyo Univ. Educat., sec. C, vol. 8, no. 81, p. 285, pl. 1, figs. 17-18.
1967. *Akebiconcha chitanii* (KANEHARA). KANNO, Prof. H. SHIBATA Mem. vol., p. 401-402, pl. 1, figs. 9-11, 15.

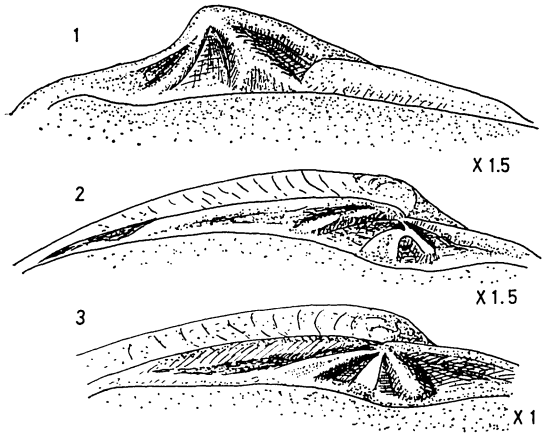
Description:—Shell elongate-ovate or elongate, rounded at both ends, ventral margin slightly convex or broadly rounded in young and straight to broadly concave in adult; antero-dorsal slope short, sloping abruptly and merging into the anterior border; postero-dorsal margin long and gently sloping toward posterior border; beaks low, small, pointed, situated about one-fourth or one-fifth of shell length from the anterior end; surface sculptured with fine incremental growth lines; ligament external, deeply seated on a nymph, about one-fourth or one-third of the shell length; hinge with a large triangular posterior cardinal and a weak thin anterior one in the right valve, and a large triangular anterior cardinal and a thin elongated posterior one and an anterior lateral one in the left valve; inner side of the ventral margin smooth; pallial line entire; anterior muscle scar extremely distinct.

Measurement (in mm):—

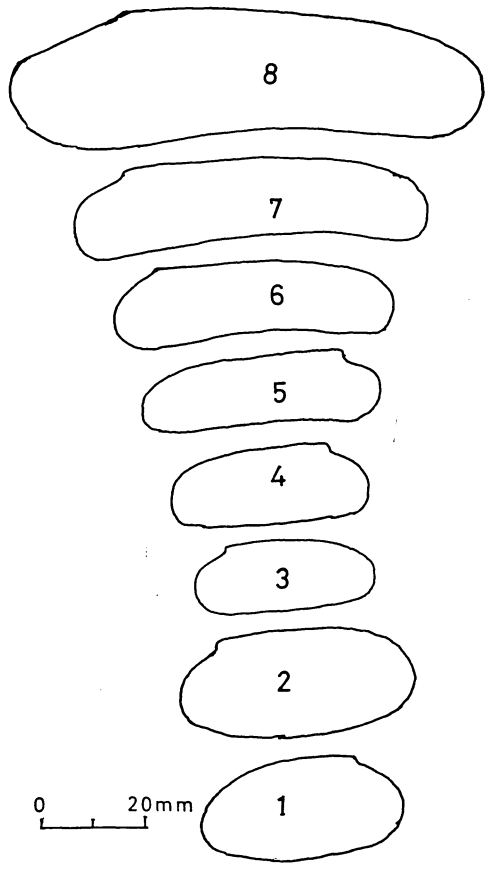
Specimens	Length	Height	H/L×100	Valve
No. 1	39.5	16.0	41.0	Left
„ 2	44.5	18.2	41.0	Right
„ 3	ca.92.0	ca.26.0	28.3	Left

Remarks:—This species is characterized by an extremely elongate and somewhat arcuate form in adult shells, and a broad range of variation in shape and hinge apparatus according to its growth stage, e.g., the anterior cardinal tooth and the anterior lateral one of the left valve link together and show Λ-shaped in young stages, but they are separated in the adult stage (Text-fig. 10). The younger specimens are more rounded ovate than adult ones, which are of an elongate and somewhat

arcuate form as shown in Text-fig. 11. It is noteworthy that the size of the present species becomes to large with geologic age and approaches the elongate and arcuate form. Namely, the present species is extremely variable in shell form both in the phylogenetic and ontogenetic stages. KAMADA (1962) had been described the present species under genus *Adulomya* from the Kamenoo and Honya formations* of the Yunagaya group (Miocene) in the Joban coal-field, Japan. According to his report, the ratio of height to length of this species is 31.1 percent in 12 specimens from the Honya and 38.9 percent in 6 specimens from the Kamenoo formation. The variation



Text-fig. 10. Cardinal teeth of *Calyptogena chitanii* (KANEHARA) from the Kayak Island. 1-2. Young specimens; 3. Adult specimen.

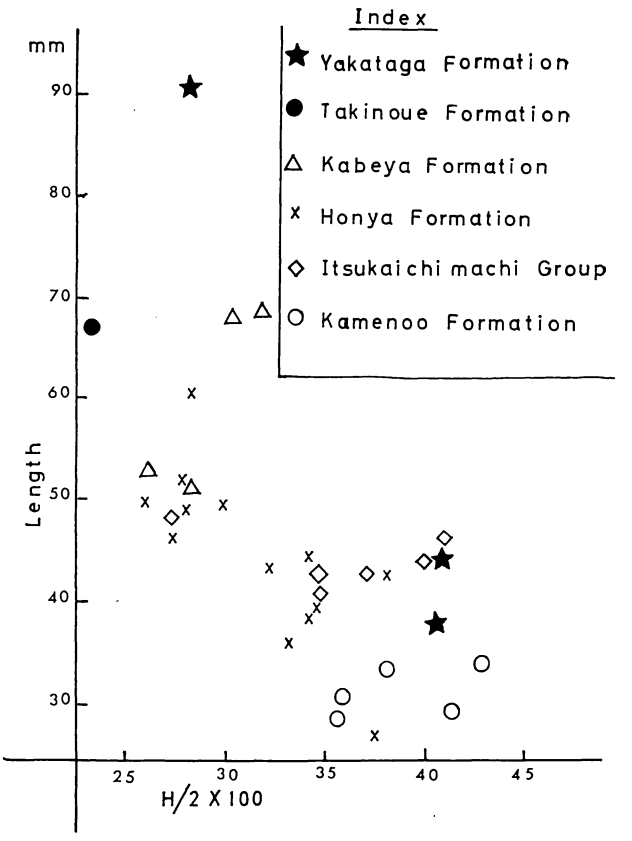


Text-fig. 11. Variation of *Calyptogena chitanii* (KANEHARA). 1-2. Tateya mudstone, middle Miocen, Itsukaichi-machi, Tokyo. 3-6. Honya formation, middle Miocene, Joban coal-field, Fukushima Prefecture, Japan (after KAMADA, (1962). 7. Takinoue formation, middle Miocene, Hokkaido, Japan. 8. Yakataga formation, Kayak Island, Alaska.

of the present species from various formations has been discussed by the writer (KANNO, 1967). So far as my knowledge is concerned, the Alaskan specimens are the largest fossil specimens known from the northern Pacific region. This fact seems to be suggesting the geologic age of the Yakataga formation, i. e., the Yakataga specimens seem to represent upper middle Miocene or upper Miocene. (Text-fig. 11, 12).

This species is somewhat similar to *C. elongata* DALL (OLDROYD, 1924, p. 116, pl. 22, fig. 6) from California, but the larger, more elongate and arcuate form serve to distinguish it from the Californian species. *C. pacifica* DALL (OKUTANI, 1966, pl. 27, figs. 1, 3) from the Clarence Strait, Alaska, is also similar to *C. chitanii*, but it dif-

* The Kamenoo shale is overlain conformably by the Honya shale.



Text-fig. 12. Variation of form ratio of *Calyptogena chitanii* (KANEHARA).

fers by having a more rounded-ovate shell outline.

This seems to be the first report of this species from the west coast of North America, but it is rather abundant in Japan where it is restricted to the middle Miocene.

Locality:—M 1769 (USGS locality number, Kayak Island), black shale, Yakataga formation.

Reg. No. TUE 8450.

Superfamily Corbiculacea

Family Corbiculidae

Genus *Corbicula* MEGERLE von MÜHLFELD, 1811

Corbicula MEGERLE von MÜHLFELD, Gesels. Naturf. Freu. Berlin, Magaz. Jahrg. 5, pt. 1, p. 56, 1811; *Corbicula* MÜHLFELD. WOODWARD, Man. Moll., p. 462, 1910; *Corbicula* MEGERLE. HABE, Gen. Jap. Shells, p. 112, 1952; *Corbicula* MEGERLE von MÜHLFELD. MOORE et al., Treat. Invert. Paleont., pt. N, vol. 2, p. 666, 1969.

Type-species (designated by ICZN, 1955):—*Tellina fluminalis* MÜLLER, 1774, Recent, Asia Minor.

Remarks:—This genus is characterized by a rounded-trigonal shell outline, concentric surface sculpture, and usually serrate lateral teeth. The species of the

genus inhabit brackish or fresh waters.

Geographic distribution:—Cosmopolitan.

Geologic range:—Lower Cretaceous to Recent.

Subgenus *Corbicula* s. s.

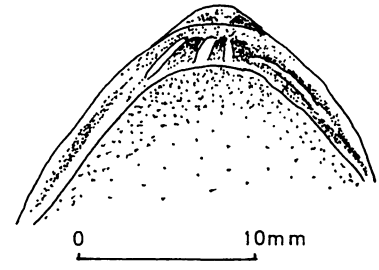
Corbicula s. s., MOORE et al., Treat. Invert. Paleont., pt. N, vol. 2, p. 666, 1969.

Remarks:—The long lateral teeth, and entire pallial line serve to distinguish this from the other subgenera. This subgenus ranges from the upper Cretaceous to Recent.

Corbicula (*Corbicula*) sp.

Plate 17, figs. 13-15

Description:—Shell rather small for the genus, thick, rounded subtrigonal in outline, somewhat longer than high, more or less inequilateral, slighly short and rounded in anteriorly, subtruncated and obliquely produced posteriorly; beaks rather small and low; surface ornamented with the irregular concentric lines of growth; a blunt ridge runs from the beak to postero-ventral corner; hinge teeth of the left valve well developed, typical of the genus; anterior and middle cardinal teeth of almost equal shape and strength, the posterior one very narrow, and longer than the other cardinals, both anterior and posterior laterals fairly long but weak (Text-fig. 13); hinge of the right valve inaccessible; pallial line entire; length, 23.5 mm; height, 19.0 mm; thickness, about 7.0 mm (in a right valve).



Text-fig. 13. Cardinal teeth of *Corbicula* (*Corbicula*) sp.

Remarks:—The present specimens are from near the Oily Lake in the Samovar Hills, where the present specimens make several beds of 20 to 30 centimeters in thickness. However, they are so crowded that it is difficult to collect a well preserved specimens.

The present specimens are close to *Corbicula* (*Corbicula*) *atrata tokudai* (YOKOYAMA), (1932, p. 240, pl. 2, figs. 3, 4), from the Eocene Ishikari and Uryu group of Hokkaido, but the Hokkaido species differs slightly in having a more rounded outline. However, the writer supposes that this difference may fall within the variation range of individual. Accordingly, even if the specimens from the Kulthieth and Ishikari are not conspecific, they are quite closely related.

Locality:—81501, gray, fine- to medium-grained arkosic sandstone, upper part of the Kulthieth formation.

Reg. No. TUE 10007.

Superfamily Veneracea

Family Veneridae

Genus *Pitar* RÖMER, 1857

Pitar RÖMER, Krit. Untersuch. Art. Mollsk. geschi. Venus, p. 15, 1857; *Pitar* RÖMER. WOODRING, Carnegie Inst. Publ., no. 366, p. 152, 1925; *Pitar* RÖMER. GRANT and GALE, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 344, 1931; *Pitar* RÖMER. HABE, Gen. Jap. Shells, p. 161, 1951; *Pitar* RÖMER. ABBOTT, Amer. Seashells, p. 414, 1954; *Pitar* RÖMER. KANNO, Tert. Sys. Chichibu Basin, p. 263, 1960; *Pitar* RÖMER. MOORE et al., Treat. Invert. Paleont., pt. N, vol. 2, p. 675, 1969; *Pitar* RÖMER. HICKMAN, Mus. Nat. Hist., Univ. Oregon, Bull., no. 16, p. 46, 1969.

Type-species (by monotypy):—*Venus tumens* GMELIN, 1791, Recent, west coast of Africa.

Remarks:—This genus is characterized by its hinge apparatus, namely, the hinge of the right valve consists of two distinct anterior lateral lamellae flanking a deep socket, and three cardinals, of which the anterior and the middle ones are almost perpendicular to the hinge margin, and the posterior one is bifid. The hinge of left valve consists of a heavy anterior lateral and three cardinals, of which the anterior one resembles the right anterior cardinal, the middle one is very heavy and obscurely bifid, and the posterior one is slender and partly joined to the nymph.

Geographic distribution:—World-wide in warm water.

Geologic range:—Eocene to Recent.

Subgenus *Katherinella* TEGLAND, 1929

Katherinella TEGLAND, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 28, p. 276, 280, 1929; *Katherinella* TEGLAND. MOORE, U. S. Geol. Surv. Prof. Pap., 419, p. 76-77, 1963; *Katherinella* TEGLAND. MOORE et al., Treat. Invert. Paleont., pt. N, vol. 2, p. 675, 1969.

Type-species (by original designation):—*Callocallista arnoldi* WEAVER, 1916, Blakeley formation (upper Oligocene, Washington). According to TEGLAND (1929, p. 280), *C. arnoldi* was not collected from the type locality of the Lincoln formation in Washington, but it came from the Blakeley formation, from either Restration Point, Bainbridge Island, or Alki Point, Seattle, Washington.

Remarks:—The present subspecies is characterized by having an anterior lateral teeth in the left hinge plate parallel to the anterior cardinal tooth and situated midway between the middle cardinal tooth and the anterior margin of the shell (pl. 8, fig. 7). This anterior lateral tooth is not parallel to the hinge plate and can not be considered as a true lateral. In addition, this subgenus has a thin shell and an elongate-ovate outline. These characteristics seem to be sufficient for the distinguishment from allied subgenera.

According to TEGLAND's study, there is no direct relationship between *P.* (*K.*) *arnoldi*, type of the subgenus, and other earlier species inhabiting the Tertiary embayments of America. She suspected that it might have migrated from northern or western waters, or probably originated from the Japanese fauna. This consideration is noteworthy for the development of the Alaskan molluscan fauna.

Geographic distribution:—West coast of North America.

Geologic range:—Oligocene to Recent.

Pitar (Katherinella) arnoldi (WEAVER), 1916

Plate 8, figs. 6, 7

1916. *Callocallista arnoldi* WEAVER, Univ. Wash. Publ. Geol., vol. 1, p. 40, 41, pl. 2, fig. 13.
1929. *Pitaria (Katherinella) arnoldi* (WEAVER). TEGLAND, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 18, no. 10, p. 280-282, pl. 23, figs. 1-11.
1932. *Pitaria (Katherinella) arnoldi* (WEAVER). CLARK, Bull. Geol. Soc. Am., vol. 43, p. 817.
1933. *Pitaria (Katherinella) arnoldi* (WEAVER). TEGLAND, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, p. 118.
1942. *Pitar (Katherinella) arnoldi* (WEAVER). WEAVER, Univ. Wash. Publ., Geol., vol. 5, pt. 1, p. 185-186, pl. 44, figs. 1-8, 12; pl. 104, fig. 10.

Remarks:—The present species is characterized by having a thin shell which is subquadrate to ovate in outline, and ornamentation of evenly developed concentric lines of growth. As pointed out by TEGLAND (1929), the left anterior lateral tooth is very characteristic of this species, namely, it is parallel to the anterior cardinal tooth and situated midway between the middle cardinal tooth and the anterior margin of the shell whereas the other subgenera of the genus provide the left anterior lateral tooth almost parallel to the shell margin or hinge plate. Moreover, the pallial sinus of this species is rather narrowly pointed and reaches the center of the shell.

This species occurs in the Puget Sound Basin and southwestern Washington as well as in the Gulf of Alaska.

Localities:—80602, 80905, 81102, 81201, olive-green, fine- to medium-grained sandstone, upper part of the Poul Creek formation.

Reg. No. TUE 10008.

Pitar (Katherinella) arnoldi etheringtoni (TEGLAND), 1929

Plate 8, figs. 4, 5

1929. *Pitaria (Katherinella) arnoldi* (WEAVER) subsp. *etheringtoni* TEGLAND, Univ. Calif. Publ., Bull., Dept. Geol. Sci., vol. 18, p. 213, pl. 23, figs. 12-14.
1942. *Pitar (Katherinella) arnoldi* (WEAVER) subsp. *etheringtoni* TEGLAND. WEAVER, Univ. Wash. Publ. Geol., vol. 15, pt. 1, p. 186, pl. 44, figs. 9, 10, 13.

Remarks:—This subspecies is distinguished from *Pitar arnoldi* (s. s.) by a slight dorsal flattening of the valves, a low ridge extending from the umbo to the postero-ventral margin, and somewhat rounder outline. This subspecies was originally reported by TEGLAND (1929) from the middle Miocene of Clallam Bay, Washington.

Localities:—81003, 81102, 81401, 20503, olive-green, fine- to medium-grained sandstone, upper part of the Poul Creek formation.

Reg. No. TUE 10009.

Pitar (Katherinella) sp.

Plate 7, figs. 4a-b

Remarks:—A right valve is at hand. This specimen shows a unique form and is more or less produced anteriorly. The hinge has a rather stout and heavy pos-

terior cardinal tooth which is more or less grooved on top, the middle and anterior ones are thin and rather small. The anterior and posterior cardinals are connected under the beak and make an arch, but the middle cardinal is close to the anterior one and is separated from that arch. There is a socket corresponding to the anterior lateral tooth on the left valve.

Judging from the hinge apparatus, the present specimen may surely be assigned to *Pitar* RÖMER, 1857, and to the subgenus *Katherinella* TEGLAND, 1929, but no species with such a particular shell outline is known. This form, of course, may be the result of deformation in some degree after burial, but the writer believed that this specimen has not been deformed so hard because associated molluscs from the same locality are mostly undeformed.

Locality:—81001, olive-green, fine- to medium-grained sandstone, upper part of the Poul Creek formation.

Reg. No. TUE 10010.

Genus *Securella* PARKER, 1949

Securella PARKER, Jour. Paleont., vol. 23, no. 6, p. 587, 1949; *Securella* PARKER. KANNO, Tert. Sys. Chichibu Basin, p. 277, 1960; *Securella* PARKER. MOORE, U.S. Geol. Surv. Prof. Pap., 419, p. 74, 1963; *Securella* PARKER. MOORE et al., Treat. Invert. Paleont., pt. N. vol. 2, p. 686, 1969.

Type-species (by original designation) :—*Venus securis* SHUMARD, 1858, Coast Range of California, Oregon and Washington.

Remarks:—This genus is characterized by a deeply sunken ligament wedging out between hinge plate, and a short, pointed pallial sinus. This genus is closely similar to *Chione* MEGERLE von MÜHLFELD, 1811, which differs from *Securella* because the ligament barely penetrates the valve to meet the nymph plate and the pallial sinus is shallow with a rounded apex or is sometimes lacking.

Geographic distribution:—*Securella* is recorded from as far south as the Transverse Range in southern California (lat. 34°30′N), northward to the Gulf of Alaska (lat. 60°N). This genus may have been a boreal type, while *Chione* is a warm water dweller. Fossil species of the genus are also recorded from Japan.

Geologic range:—Oligocene to Pliocene (MOORE et al., 1969).

Securella alaskensis (CLARK), 1932

Plate 8, figs. 8a-c

1932. *Chione securis alaskensis* CLARK, Geol. Soc. Am. Bull., vol. 43, p. 815, pl. 18, figs. 2, 3.
1944. *Chione* sp. DURHAM, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 27, p. 146.
1949. *Securella alaskensis* (CLARK). PARKER, Jour. Paleont., vol. 23, no. 6, p. 587-588, pl. 95, fig. 1.
1971. *Securella alaskensis* (CLARK). ADDICOTT et al., U.S. Geol. Surv. Prof. Pap., 750-C, Fig. 5, r, s.

Remarks:—This species was originally described by CLARK (1932) as a subspecies of *C. securis*, but the hinge structure was not described. The writer examined several

specimens. A right valve shows the following hinge characters (pl. 8, fig. 8b): Ligament rather long, deeply sunken, right posterior cardinal grooved, and anterior cardinal rather small and thin and situated close to the middle cardinal.

This species occurs in the basal part of the Yakataga formation. Although the type locality is not plotted on CLARK's map, no securellid mollusks have been collected from the Poul Creek formation, but it occurs rather abundantly in the lowermost part of the Yakataga. Judging from the writer's observation, the type specimen might have been collected from the lowermost part of the Yakataga.

Localities:—80801 (float), 81402, gray, conglomeratic sandstone, lowest part of the Yakataga formation.

Reg. No. TUE 10011.

Genus *Macrocallista* MEEK, 1876

Macrocallista MEEK, Rept. U.S. Geol. Surv. Terretories. vol. 9, p. 179, 1876; *Macrocallista* MEEK. DALL, Trans. Wagner Free Inst. Sci., Phila., vol. 3, pt. 4, p. 1251-1252, 1903; *Macrocallista* MEEK. GRANT and GALE, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 343, 1931; *Macrocallista* MEEK. THIELE, Handb. Syst. Weicht., Band 2, p. 886, 1935; *Macrocallista* MEEK. MOORE et al., Treat. Invert. Paleont. pt. N, vol. 2, p. 677, 1969.

Type-species (by monotypy):—*Venus gigantea* GMELIN, 1791 [=*Venus nimbosa* LIGHTFOOT, 1786], Recent, Cape Hatteras south to Cuba and the Gulf coast of the United States.

Remarks:—This genus is sometimes confused with *Callista* POLI, 1791 (type species: *Venus chione* LINNÉ, by MEEK, 1876). However, according to THIELE (1931), *Callista* is a synonym of *Paradione* DALL, 1909, a section of subgenus *Macrocallista* MEEK. DALL (1903) also poined out that "the name *Macrocallista* of MEEK was intended to designate the *Venus gigantea* of GMELIN [=*nimbosa* SOLANDER], but this is only sectionally distinct from the forms which have been called *Dione* and *Callista*, and MEEK's name will therefore have to be taken as covering them both".

The present genus is characterized by three cardinals of which the right posterior one is slightly grooved or bified on top, an anterior lateral in the left valve and a corresponding socket in the right valve, and a moderately deep pallial sinus.

Geologic range:—Eocene to Recent, but apparently ranging from in Eocene to lower Miocene on the west coast of North America.

Geographic distribution:—East and west coast of North America and East Indies.

Macrocallista weaveri CLARK, 1918

Plate 17, figs. 7-11

1918. *Macrocallista weaveri* CLARK, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 11, p. 146, pl. 12, figs. 4, 7.
1925. *Macrocallista weaveri* CLARK, ditto, vol. 15, p. 92, pl. 18, figs. 10-12.
1932. *Macrocallista? rearensis* CLARK, Bull. Geol. Soc. Am., vol. 43, p. 816-817, pl. 18, fig. 1.
1932. *Macrocallista pittsburgensis* DALL. CLARK, ditto, p. 816, pl. 19, figs. 1-2.
1942. *Macrocallista weaveri* CLARK. WEAVER, Univ. Washing. Publ., Geol., vol. 5, p. 176-177,

pl. 41, figs. 1-3.

1971. *Macrocallista pittsburgensis* (DALL). ADDICOTT et al., U.S. Geol. Prof. Pap., 750-C, Fig. 5, e, j, k.

Remarks:—Many rather well preserved specimens are at hand. Some of these show extreme variation in general outline. The writer believes that this extreme variation may be due to deformation of the specimens after burial. Actually, well preserved specimens which hardly show any variation occur at some localities, but at other localities the specimens are strongly variable.

The present specimens are characterized by a rather small, thick, inflated shell, strongly incurved beaks, and an ample and deep pallial sinus which is narrowly rounded anteriorly. The general features and teeth of the present specimens agree well with DALL's diagnosis of *Macrocallista*, excepting the shape of pallial sinus which is rounded anteriorly rather than pointed. However, the writer tentatively assigns the specimens to *Macrocallista*.

CLARK (1932) reported *Macrocallista? rearensis* CLARK from the Reare Glacier. He also described *M. pittsuburgensis* DALL from the same locality as *M.? rearensis*, but *M. pittsburgensis* differs from the present specimens by having a large, thin shell which is elongated posteriorly and lower than the present one. Moreover, the pallial sinus of the *M. pittsburgensis* is deeper and more pointed than the Poul Creek specimens. CLARK's specimens (1932, p. 816, pl. 19, figs. 1-2) seem to represent a deformed specimens of *M. weaveri*.

Localities:—9002-3 and 9002-5 (about 3.5 km east of loc. 81203, left side of the Yakataga Glacier), 81201, gray, fine-grained sandstone, upper part of the Poul Creek formation.

Reg. No. TUE 10012.

Order Myoida

Suborder Myina

Superfamily Myacea

Family Myidae

Genus *Mya* LINNÉ, 1758

Mya LINNÉ, Sys. Nat. 10th Ed., p. 670, 1758; *Mya* LINNÉ. WOODWARD, Man. Moll., p. 489, 1910; *Mya* (LINNÉ) LAMARCK. OLDROYD, Stanf. Univ. Publ., Univ. Ser., Geol. Sci., vol. 1, no. 1, p. 197, 1924; *Mya* LINNÉ. GRANT and GALE, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 410, 1931; *Mya* LINNÉ. HABE, Gen. Jap. Shells, p. 237, 1952; *Mya* LINNÉ. ABBOTT, American Seashells, p. 454, 1954; *Mya* LINNÉ. MACNEIL, U.S. Geol. Surv. Prof. Pap., 483, p. 25, 1965; *Mya* LINNÉ. HICKMAN, Mus. Nat. Hist., Univ. Oregon, Bull. no. 16, p. 64, 1969; *Mya* LINNÉ. MOORE et al., Treat. Invert. Paleont., pt. N, vol. 2, p. 691, 1969.

Type-species (by subsequent designation, CHILDREN, 1822):—*Mya truncata* LINNÉ, Recent, north Atlantic, north Pacific, and Arctic Ocean.

Remarks:—The characteristic features of this genus are the oblong, inequivalved shell gaping posteriorly, and left valve with a large flattened projecting spoon-like chondrophore, and large pallial sinus.

The species of the genus are rather frequent in soft bottoms, especially in sandy and silty muds of river mouths or bays. They range from low water to 40 meters.

Geographic distribution:—Temperate and cold waters of Europe, North America and Japan.

Geologic range:—Eocene to Recent in Japan, and Oligocene to Recent in the west coast of North America.

Subgenus *Mya* s. s.

Remarks:—This subgenus is characterized by the truncated posterior end, and chondrophore with triangular anterior portion in front of anterior ridge.

Mya (Mya) truncata LINNÉ, 1758

Plate 10, figs. 6, 7; Plate 11, figs. 4a-b

1924. *Mya truncata* LINNÉ. OLDROYD, Stanf. Univ. Publ. Geol. Sci., vol. 1, no. 1, p. 197, pl. 10, fig. 4.
1931. *Mya truncata* LINNÉ. GRANT and GALE, San Diego Soc. Nat. Hist., Mem. vol. 1, p. 414.
1932. *Mya truncata* LINNÉ, n. subsp.? CLARK, Geol. Soc. Am., Bull., no. 43, p. 822, pl. 17, fig. 5.
1941. *Mya truncata* LINNÉ. NAGAO and INOUE, Hokkaido Imp. Univ. Fac. Sci. Jour., vol. 6, no. 273, p. 155, pl. 33, figs. 5, 9, 10.
1957. *Mya truncata* LINNÉ. FUJIE, ditto, vol. 4, no. 4, p. 399, pl. 3, figs. 1-4.
1965. *Mya (Mya) truncata* LINNÉ. MACNEIL, U.S. Geol. Surv., Prof. Pap., no. 483-G, p. 38-40, pl. 8, figs. 1-12; pl. 9, figs. 1-3, 5-20.
1965. *Mya truncata* LINNÉ. ADDICOTT, U.S. Geol. Surv. Prof. Pap., 525-C, pl. 3, fig. 6.
1971. *Mya (Mya) truncata* LINNÉ. ADDICOTT et al., U.S. Geol. Surv. Prof. Pap., 750-C, Fig. 5, i, p, q, t, w.

Remarks:—This species has rugose shell and has several varietal forms, apparently caused by contact with objects in the substratum. However, *Mya (M.) truncata* has a short, truncated shell, and the shortest pallial sinus of any *Mya*, e.g., the pallial line extends from the posterior muscle scar to that of the ventral margin, and the point of maximum depth of pallial sinus is the juncture at the ventral margin. The spoon of the left valve is rather symmetrical and the dorsal part of the anterior ridge is broad and there is a narrow posterior furrow.

This species is very abundant in the middle and upper part of the Yakataga formation of this area where the dark-gray siltstone or black shale is the dominant lithology. The specimens from these rocks are all of small size whereas associated mollusks such as *Neptunea* are of normal size. However, specimens from the lowest part of the Yakataga where it consists of pebble-bearing sandstone are represented by full grown specimens (Plate 11, figs. 4a-b).

This species lives in the boreal regions such as the northern Pacific, northern Atlantic, and Arctic Ocean, and ranges southward to southern Hokkaido and Puget Sound.

The fossil specimens are recorded since the middle Miocene in the Pacific region and are also known from northern Europe throughout the Pleistocene time.

Localities:—80404, 80405, 80406, dark-gray or black shale, Yakataga formation;

80801, black mudstone, lower part of the Yakataga formation; 81402, brownish-gray, pebble-bearing sandstone, lowest part of the Yakataga formation.

Reg. No. TUE 10013.

Mya (Mya) salmonensis CLARK, 1932

Plate 11, fig. 5

1932. *Mya salmonensis* CLARK, Geol. Soc. Am., Bull., vol. 43, p. 822, pl. 17, figs. 3, 4, 8.
1941. *Mya grewingki* var. *elongata* NAGAO and INOUE, Jour. Fac. Sci., Imp. Univ. Hokkaido, Ser. 4, vol. 6, no. 2, p. 150, pl. 33, figs. 1-4.
1941. *Mya grewingki* var. *kusiroensis* NAGAO and INOUE, ditto, p. 150, pl. 32, figs. 2-6.
1958. *Mya grewingki nagaoi* OYAMA and MIZUNO, Bull. Jap. Geol. Surv., vol. 9, no. 9, p. 603 (no figure).
1965. *Mya (Mya) salmonensis* CLARK. MACNEIL, U.S. Geol. Surv., Prof. Pap., 483-G, p. 35, pl. 7, figs. 1-4.

Remarks:—This species was originally described by CLARK (1932) from the Yakataga District (the exact locality was not designated on his map and the type specimens were collected as float). However, according to MACNEIL's (1965) report, this species might be from the Poul Creek formation. The writer examined three specimens collected from float believed to have been derived from the upper part of the Poul Creek formation.

According to MACNEIL (1965), some specimens from the Oligocene and the lowest part of the Miocene in Japan are synonym of *M. (M.) salmonensis*.

Locality:—80906 (float), olive-green, medium-grained sandstone, presumably Poul Creek formation.

Reg. No. TUE 10014.

Mya (Mya) cuneiformis (BÖHM), 1915

1915. *Pleuromya cuneiformis* BÖHM, Jahrb. d. königl. Preussisch. Geol. Landesanst., vol. 26, p. 577, pl. 29, figs. 1a-c.
1925. *Mya arenaria* LINNÉ var. *japonica* JAY. YOKOYAMA, Jour. Coll. Sci., Imp. Univ. Tokyo, vol. 45, art. 5, p. 16, pl. 16, fig. 4.
1926. *Mya arenaria* LINNÉ. YOKOYAMA, Jour. Fac. Sci., Imp. Univ. Tokyo, sec. 2, vol. 1, pt. 7, p. 241, pl. 30, fig. 1.
1927. *Mya arenaria* LINNÉ. YOKOYAMA, ditto, vol. 2, pt. 4, p. 198, pl. 51, fig. 2.
1929. *Mya arenaria* LINNÉ. YOKOYAMA, ditto, vol. 2, pt. 9, p. 385, pl. 74, fig. 3.
1931. *Mya donaciformis* KURODA. HOMMA's Geol. Central Shinano, pt. 4, p. 63, text-fig. 7.
1941. *Mya cuneiformis* (BÖHM). NAGAO and INOUE, Jour. Fac. Sci., Hokkaido Imp. Univ. Ser. 4, vol. 6, no. 2, p. 151-155, pl. 34, figs. 1-6.
1962. *Mya cuneiformis* (BÖHM). KAMADA, Paleont. Soc. Japan, Spec. Pap., no. 8, p. 141, pl. 16, figs. 14-16.
1965. *Mya (Mya) cuneiformis* (BÖHM). MACNEIL, U.S. Geol. Surv., Prof. Pap., 483-G, p. 35, pl. 7, figs. 2, 3, 5-8, 12, 15.

Remarks:—This species is characterized by the wedge-shaped shell outline. It occurs in northern Honshu (main island of Japan), Hokkaido, Sakhalin (type locality), and the Gulf of Alaska. This species ranges from the middle Miocene to lower Pliocene, although it flourished in the middle Miocene in Japan.

This species seems to be restricted to the lower part of the Yakataga formation.

Localities:—80802, 20525-1, dark-gray mudstone, lower part of the Yakataga formation.

Reg. No. TUE 10015.

Superfamily Hiatellacea

Family Hiatellidae

Genus *Hiatella* Bosc, 1801

Hiatella Bosc, Hist. Nat. Buffon, Coquilles, vol. 3, p. 120, 1801; *Saxicava* Fleuriau. Oldroyd, Stanf. Univ. Publ. Geol. Sci., vol. 1, no. 1, p. 208, 1924; *Saxicava* Fleuriau de Bellevue. Grant and Gale, San Diego Soc. Nat. Hist., vol. 1, p. 427, 1931; *Hiatella* Daudin. Habe, Gen. Jap. Shells, p. 232, 1953; *Hiatella* Bosc. Keen, Marine Moll. Gen. West. North Am., p. 92, 1963; *Hiatella* Bosc. Moore et al., Treat. Invert. Paleont., pt. N, vol. 2, p. 700, 1969.

Type-species (by subsequent designation, Winckworth, 1932):—*Hiatella monoperta* Daudin.

Remarks:—The present genus is characterized by a small, elongate-quadrate shell, anteriorly situated beaks, a distinct ridge running from the beak to the postero-ventral margin, and a discontinuous pallial line.

Geographic distribution:—Most species of the genus occur in boreal waters, but some species live in more southern areas such as Kyushu and Shikoku (about lat. 33°N) in the Pacific coast of Japan. This genus also distributes in Europe and North America.

Geologic range:—Upper Jurassic to Recent.

Hiatella arctica (Linné), 1767

Plate 10, figs. 11a-b

1767. *Saxicava arctica* Linné, Syst. Nat. Ed. 12, p. 113.
1924. *Saxicava arctica* Linné. Oldroyd, Stanf. Univ. Publ., Geol. Sci., vol. 1, no. 1, p. 208, pl. 9, fig. 6; pl. 51, fig. 4.
1931. *Saxicava arctica* Linné. Grant and Gale, San Diego Soc. Nat. Hist., vol. 1, p. 427.
1943. *Saxicava arctica* Linné. MacNeil, Mertie and Pilsbry, Jour. Paleont., vol. 17, no. 1, p. 93, pl. 15, fig. 6.
1965. *Hiatella arctica* (Linné). Habe and Ito, Shells of the World (in color), vol. 1, p. 155, pl. 54, figs. 3-4.

Description:—Shell rather small, oblong, subquadrate, more or less thick for its size; ligament external, opisthodetic; equivalve, strongly inequilateral; beaks inconspicuous, situated one-fifth of the length from the anterior end; antero-dorsal border short, steeply sloping and merging into a narrowly rounded antero-ventral corner; postero-dorsal border long, almost parallel to the ventral margin; posterior end bluntly truncated, somewhat gaping; surface ornamented with concentric, irregular, rather weak undulations; a distinct but blunt ridge runs from umbo to postero-ventral margin; hinge and inner surface inaccessible. Length, 24.5 mm;

height, 12.5 mm; thickness, ca. 10.0 mm (articulated valves).

Remarks:—A single specimen is at hand. This species is living in the Arctic Ocean along the west coast of North America (north of California) in the eastern Pacific and to northern Honshu (north of lat. 37°N) in the western Pacific, and also occurs in the Atlantic Ocean.

The Recent species ranges from the intertidal to 130 meters, and is found in rock crevices and among the roots of seaweed. Accordingly the shape of shell is rather variable owing to its habitats.

According to F. STRAUCH (1968), shell size of Recent population of this species has been directly compared with temperature, and the results have been quantitively applied to fossil specimen. Although a single specimen is at hand, it is measured as 24 mm in length and about 9.5 mm in thickness (articulated valve). Granting that the present specimen represents an adult specimen, this value seems to represent the marine temperature of about 12°-13°C in August and about 0°C in February (F. STRAUCH, 1968, p. 220, fig. 2; p. 225, fig. 4). However, the Poul Creek specimen is extremely large size compared with the specimens occurred from other localities of the same geologic age (F. STRAUCH, 1968, p. 224, fig. 3; p. 225, fig. 4).

Locality:—80802, dark-gray siltstone, Yakataga formation.

Reg. No. TUE 10016.

Genus *Panope* MENARD, 1807

Panopea MENARD, Ann. Mus. Nat. Hist. Paris, vol. 9, p. 135, 1807; *Panopea* MENARD. STOLICZKA, Paleont. Indica, ser. 4, vol. 3, p. 85, 1871; *Panope* MENARD. DALL, Proc. Malac. Soc., vol. 10, pt. 1, p. 34-35, 1912; *Panopaea* MENARD. OLDROYD, Stanf. Univ. Publ. Univ. Ser. Geol. Sci., vol. 1, no. 1, p. 205, 1924; *Panopea* MENARD. STEWART, Acad. Nat. Sci. Phila., Sepec. Publ., no. 3, p. 294, 1930; *Panope* MENARD. GRANT and GALE, Mem. San Diego Nat. Hist., vol. 1, p. 423, 1931; *Panope* MENARD. HABE, Gen. Jap. Shells, p. 233, 1952; *Panope* MENARD. KANNO, Tert. Sys. Chichibu Basin, p. 311-312, 1960; *Panope* MENARD. MOORE, U. S. Geol. Surv. Prof. Pap., 419, p. 83, 1963; *Panope* MENARD. MOORE et al., Treat. Invert. Paleont. N, vol. 2, p. 700, 1969.

Type-species (by monotypy):—*Panope aldrovandi* MENARD [=*Panopea glycimeris* Born], Recent, Mediterranean Sea.

Remarks:—This genus is characterized by having an equivalve, thick, oblong shell with gaping at both end, a subcentral beak, a rudely concentric undulated surface, a deep pallial sinus, and a hinge with one small cardinal tooth in each valve.

The generic name of this genus is rather controversial. Many authors (STOLICZKA, 1871; STEWART, 1930; KANNO, 1957, etc.) have discussed the spelling of the generic name. However, this problem may be still pending in the International Committee of Zoological Nomenclature. Therefore, the writer is following his previous work (KANNO, 1957).

Geographic distribution:—North Sea, Mediterranean, Australia, New Zealand, Patagonia, northwest coast of North America, and Japan.

Geologic range:—Lower Cretaceous to Recent.

Panope snohomishensis CLARK, 1925

Plate 11, figs. 2a-b

1925. *Panope snohomishensis* CLARK, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 15, p. 105, pl. 10, fig. 1; pl. 11, fig. 2.
1942. *Panope snohomishensis* CLARK. WEAVER, Univ. Wash. Publ. Geol., vol. 5, pt. 1, p. 261-262, pl. 59, figs. 3, 19.

Remarks:—This species was originally described by CLARK (1925) from the middle Oligocene of Snohomish County, Puget Basin, Washington. This species is rather common in the Poul Creek formation and several specimens were collected from the upper part of that formation.

This species is more or less similar to the Japanese species *P. japonica* (A. ADAMS) and the American species *P. generosa* GOULD, but its more slender posterior portion may serve to distinguish it from these two species.

Localities:—81201, 81401, olive-green, fine-grained sandstone, upper part of the Poul Creek formation.

Reg. No. TUE 10017.

Panope n. sp.?

Plate 11, figs. 3a-b

Description:—Shell subquadrate, ventral and dorsal margins approximately parallel; beaks prominent, slightly prosogyrous, strongly inturned, situated a little in front of median line; antero-dorsal margin steeply sloping and making a rather narrowly rounded anterior margin with the postero-ventral one; postero-dorsal border almost straight but slightly concave in its posterior portion; posterior end broadly truncated and widely gaping; surface ornamented with irregularly rounded undulattions on and between which are fine incremental lines; concentric undulations on umbones and for considerable distance below fairly regular; below this they become irregular and on the marginal part of gerontic specimen becomes almost obsolete; a fairly broad, shallow depression runs from the umbo to the posterior ventral margin, where the depression becomes shallow, wide, and almost obsolete; connecting this depression a blunt ridge runs from umbo to the truncated posterior end; nymph plate rather short, and small. Length, 64.1 mm; height, 42.0 mm; thickness of articulated valves, 25.2 mm (more or less compressed specimen).

Remarks:—A well preserved specimen is at hand. It is characterized by a high shell, steeply sloping antero-dorsal margin, and a shallow depression on disc and a blunt ridge running from umbo to postero-ventral margin. These characteristics are somewhat similar to *P. abrupta* (CONRAD), (HICKMAN, 1969, p. 65, pl. 8, fig. 15), from Oligocene and younger formations of west coast of North America, but it differs from the present one by the lower shell with more gently sloping antero-dorsal margin. This specimen may represent a new species, but a new name can not be proposed until more specimens are available.

Locality:—81401, olive-green, fine- to medium-grained sandstone, upper part of the Poul Creek formation.

Reg. No. TUE 10018.

Genus *Panomya* GRAY, 1857

Panomya GRAY, Fig. Moll. Anim., vol. 5, p. 29, 1857; *Panomya* GRAY. H. and A. ADAMS, Gen. Rec. Moll., vol. 2, p. 351, 659, 1858; *Panopaea* MENARD. STOLICZKA, Paleont. Indica, ser. 4, vol. 3, p. 85, 1871; *Panomya* GRAY. DALL, Trans. Wagner Inst. Sci., Phila., vol. 3, pt. 4, p. 832, 1898; *Panomya* GRAY. GRANT and GALE, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 425, 1931; *Panomya* GRAY. HABE, Gen. Jap. Shells, no. 3, p. 233, 1952; *Panomya* GRAY. KANNO, Trans. Proc. Paleont. Soc. Jap., no. 25, p. 12-13, 1957; *Panomya* GRAY. KANNO, Tert. Sys. Chichibu Basin, p. 313-314, 1960; *Panomya* GRAY. MOORE et al., Treat. Invert. Paleont., pt. N, vol. 2, p. 700, 1969.

Type-species (by monotypy):—*Mya norvegica* SPENGLAR, 1793, Recent, northern Atlantic Ocean.

Remarks:—This genus is distinguished from *Panope* MENARD, 1807, by having a medial depression, prominent radial folds, and disconnected oval pallial impressions. *Mya* LINNÉ, 1758, is also more or less similar to *Panomya*, but differs in lacking the radial ridges running from beak to antero-ventral margin, and in having an entire pallial line, and a chondrophore in the left valve.

Panomya seems to be a boreal genus and usually lives offshore buried in muddy bottoms in comparatively cold water.

Geographic distribution:—Europe, North America, northern Asia, and Arctic regions. North of Puget Sound and north of Hokkaido in the northern Pacific ranging from 60 to 110 meters in depth.

Geologic range:—Tertiary to Recent.

Panomya arctica (LAMARCK), 1818

Plate 10, figs. 8-10

1818. *Glycimeris arctica* LAMARCK, Hist. Anim. s. Vert., vol. 5, p. 458.
1916. *Panomya turgida* DALL, Bull. U.S. Nat. Mus., no. 112, pl. 2, fig. 1.
1924. *Panomya turgida* DALL. OLDROYD, Stanf. Univ. Publ., Geol. Sci., vol. 1, no. 1, p. 206.
1931. *Panope* (*Panomya*) *arctica* (LAMARCK). GRANT and GALE, San Diego Nat. Hist., vol. 1, p. 426.
1932. *Panomya* (*Arctica*) *turgida* DALL. CLARK, Bull. Geol. Soc. Am., vol. 43, p. 823, pl. 17, figs. 6, 9.
1963. *Panomya arctica* (LAMARCK). HABE and ITO, Shells of the World, vol. 1, p. 153, pl. 53, figs. 4, 5.
1971. *Panomya arctica* (LAMARCK). ADDICOTT et al., U.S. Geol. Surv. Prof. Pap., 750-C, Fig. 6, e, g, f, k.
1971. *Panomya* cf. *P. arctica* (LAMARCK). ADDICOTT et al., ditto, Fig. 6, a. b, d.

Remarks:—Many specimens are at hand. All are articulated and some were collected in a position perpendicular to the bedding plane. It seems clear that they were preserved almost in the living state. This species was previously reported by CLARK (1932) as *Panomya* (*Arctica*) *turgida* DALL, 1917, living in Aleutian Islands, but HABE and ITO (1963) referred it to *P. arctica* (LAMARCK), and they pointed out that *P. turgida* DALL, 1916, is a synonym of the *P. arctica* (LAMARCK), 1818.

This species is characterized by having a rather short, quadrate, and swollen shell, which has a broad gape at the truncated posterior end. Crushed specimens

of this species are apt to be misidentified as species of *Panope*, but the hinge structure (pl. 10, fig. 9) and pallial line serve to distinguish it from similar genera.

This species lives in the northern Pacific from north of Hokkaido, Japan, in the western Pacific, and north of Puget Sound, Washington, in the eastern Pacific.

Localities:—80404, 80405, 80406, 80503, 80603, 80802, 81105, dark-gray siltstone or black shale, Yakataga formation; 80801, fossil float, possibly derived from the Yakataga formation.

Reg. No. TUE 10019.

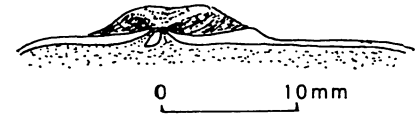
Panomya elongata KANNO, 1958

Plate 11, figs. 6, 7

1932. *Saxicava pholadis* LINNÉ. CLARK, Bull. Geol. Soc. Am., vol. 43, p. 824, pl. 18, fig. 9.
1958. *Panomya elongata* KANNO, Sci. Rep. Tokyo Univ. Education, sec. C, vol. 6, no. 55, p. 195-196, pl. 4, fig. 19.
1960. *Panomya elongata* KANNO, Tert. Sys. Chichibu Basin, p. 314, pl. 46, fig. 3.
1963. *Saxicava* cf. *pholadis* LINNÉ. ILYINA, Moll. Neog. Kamchatka, BNIGRI., no. 202, p. 85, pl. 18, fig. 6.

Remarks:—Four specimens are at hand. This species was originally reported by the writer from the Chichibu Basin, central Japan. Subsequently, ILYINA (1963) reported it from the Kurben formation (possibly middle Miocene) in Kamchatka.

This species is characterized by a rather small shell for the genus. It is elongate-subquadrate in outline, moderately inflated, and has gaping posterior end. Moreover, the surface is ornamented with irregular concentric undulations, and the depressed medial portion is bounded by two radial folds which run from the beak to the antero- and postero-ventral margins.



Text-fig. 14. Hinge structure of *Panomya elongata* KANNO.

The present specimens are more or less similar to some species of *Panope* MENARD, 1807, or *Hiatella* BOSC, 1801, but the surface sculpture and hinge structure (Text-fig. 14) serve to distinguish it from the other genera.

Locality:—81041, fine- to medium-girained sandstone, upper part of the Poul Creek formation.

Reg. No. TUE 10020.

Subclass Anomalodesmata

Order Pholadomyoida

Superfamily Pandoracea

Family Periplomatidae

Genus *Periploma* SCHUMACHER, 1817

Periploma SCHUMACHER, Ess. Nouv. Syst. Habit. Vers. Test., p. 115-116, 1817; *Periploma* SCHUMACHER. OLDROYD, Stanf. Univ. Publ. Geol. Sci., vol. 1, no. 1, p. 81, 1924; *Periploma*

SCHUMACHER. GRANT and GALE, San Diego Soc. Nat. Hist. Mem., vol. 1, p. 255, 1931; *Periploma* SCHUMACHER. HABE, Gen. Jap. Shells, p. 264, 1953; *Periploma* SCHUMACHER. ABBOTT, American Seashells, p. 472, 1954; *Periploma* SCHUMACHER. KEEN, Sea Shells Trop. West. Am., p. 228, 1958; *Periploma* SCHUMACHER. MOORE et al., Treat. Invert. Paleont., pt. N, vol. 2, p. 849, 1969.

Type-species (by monotypy):—*Periploma inaequivalvis* SCHUMACHER.

Remarks:—The present genus is characterized by an inequilateral, and nacreous shell with fissured beaks and with an oblique, spoon-shaped process in each valve, and an internal rib (lithodesma) extending from under the hinge to the posterior margin. Moreover, the anterior muscle scar is long and narrow, whereas the posterior one is small and semi-lunar.

This genus is very similar to *Cochlodesma* COUTHOUY, 1839, in general shape, but it differs by having a distinct lithodesma, whereas *Cochlodesma* either lacks it, or if present, it is only slightly developed. *Laternula* RÖDING, 1798, is also very similar to the *Periploma* but the elongate and swollen shell, and rostrated and truncated posterior margin which has a disinct gape, serve to distinguish it from allied genera.

Geographic distribution:—Cosmopolitan. Living species are collected along the seacoast of Japan from the intertidal zone to 200 meters. They seem to be fond of muddy or silty bottom.

Geologic range:—Upper Cretaceous to Recent.

Subgenus *Aelga* SLODKEWITSCH, 1934

Aelga SLODKEWITSCH, Ann. Soc. Paleont. USSR., no. 10, p. 55, 1934; *Aelga* SLODKEWITSCH. Paleont. USSR., vol. 10, pt. 3, Fasc. 18, p. 260, 1938; *Aelga* SLODKEWITSCH. HABE, Gen. Jap. Shells, p. 265, 1953; *Aelga* SLODKEWITSCH. MOORE et al., Treat. Invert. Paleont., pt. N, vol. 2, p. 849, 1969.

Type-species (by original designation):—*Tellina besshoensis* YOKOYAMA, 1924, Oligocene, Japan.

Remarks:—This subgenus is characterized by having rather large-sized shell for the genus. The shell is compressed and is somewhat twisted in the posterior portion. This subgenus seems to be restricted in Oligocene to Miocene age in the northern Pacific region.

Periploma (*Aelga*) *besshoense* (YOKOYAMA), 1924

Plate 3, fig. 5; Plate 11, fig. 10

1924. *Tellina besshoensis* YOKOYAMA, Jour. Coll. Sci., Imp. Univ. Tokyo, vol. 45, art. 3, p. 14, pl. 2, figs. 1-5.
1934. *Periploma besshoensis* (YOKOYAMA). MAKIYAMA, Mem. Coll. Sci., Kyoto Imp. Univ. ser. B, vol. 10, no. 2, (art. 6), p. 153.
1938. *Periploma besshoensis* (YOKOYAMA). SLODKEWITSCH, Paleont. USSR., vol. 10, pt. 3, Fasc. 19, pp. 260-264, pl. 55, figs. 1-3.
1953. *Periploma besshoensis* (YOKOYAMA). TAKEDA, Studies on Coal Geol., no. 3, pl. 3, fig. 6, (no description).
1955. *Periploma besshoensis* (YOKOYAMA). HIRAYAMA, Sci. Rep. Tokyo Univ. Education, Ser. C, vol. 4, no. 29, p. 107, pl. 4, fig. 31.
1962. *Periploma* (*Aelga*) *besshoense* (YOKOYAMA). KAMADA, Paleont. Soc. Japan, Spec. Pap., no. 8, p. 75-77, pl. 6, figs. 1-4.

Remarks:—This species was described by YOKOYAMA (1924) from the Oligocene of Jo-ban coal-field in Japan. It has rather variable outline as pointed out by KAMADA (1962, p. 76), e. g., although the typical form has a rather equilateral and broadly rounded posterior margin as shown in YOKOYAMA's figures 4 and 5, the other individuals are somewhat rostrate posteriorly and have a depressed posterior area as indicated by YOKOYAMA's figures 1-3. The specimens at hand are also variable in outline (Pl. 3, fig. 5; Pl. 11, fig. 10). As far as the present specimens are concerned, YOKOYAMA's typical form seems to be restricted to the upper part of the Poul Creek formation, but the elongate and rather rostrate form seems to occur in the muddy facies of the lower part of the Yakataga formation. However, this conclusion must remain tentative until a larger number of specimens from each unit level is studied.

Localities:—80404, 81104, black shale, Yakataga formation; 80905, olive-green, fine- to medium-grained sandstone, upper part of the Poul Creek formation.

Reg. No. TUE 10022.

Family Thraciidae

Genus *Thracia* SOWERBY, 1823

Thracia LEACH. H. and A. ADAMS, Gen. Rec. Moll., vol. 2, p. 364, 1856; *Thracia* BLAINVILLE. DALL, Trans. Wagner Free Inst. Sci., vol. 3, pt. 6, p. 1522, 1903; *Thracia* (LEACH) BLAINVILLE. WOODWARD, Man. Moll., p. 495, 1910; *Thracia* (LEACH) BLAINVILLE. OLDROYD, Stanf. Univ. Publ. Geol. Sci., vol. 1, no. 1, p. 83, 1924; *Thracia* BLAINVILLE. GRANT and GALE, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 256, 1931; *Thracia* BLAINVILLE. HABE, Gen. Jap. Shells, p. 262, 1952; *Thracia* BLAINVILLE. KANNO, Tert. Sys. Chichibu Basin, p. 319, 1960; *Thracia* BLAINVILLE. MOORE, U. S. Geol. Surv. Prof. Pap., 419, p. 84, 1963; *Thracia* SOWERBY. KEEN, Marine Moll. Gen. West. N. Am., p. 93, 1963; *Thracia* SOWERBY. MOORE et al., Treat. Invert. Paleont., pt. N, vol. 2, p. 850, 1969.

Type-species (by subsequent designation, ANTON, 1839):—"*Thracia pubescens* LAMARCK", Recent, England.

Remarks:—This genus is characterized by a rather thin shell with a bluntly rostrated posterior margin, a blunt ridge running from beak to postero-ventral margin and separating the main disk from the elongate-trigonal posterior depressed area, and perforated beaks (one or both valves, usually the right one).

Living species are reported from the intertidal zone to 200 meters in silty sand or muddy bottoms.

Geographic distribution:—Cosmopolitan.

Geologic range:—Jurassic to Recent.

Thracia schencki CLARK, 1932

Plate 11, figs. 8, 9

1932. *Thracia schencki* TEGLAND (MS). CLARK, Bull. Geol. Soc. Am., vol. 43, p. 808, pl. 15, figs. 2, 3, 5.

1933. *Thracia schencki* TEGLAND, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, p. 112-113,

pl. 6, figs. 6-11.

1942. *Thracia schencki* TEGLAND. WEAVER, Univ. Wash. Publ. Geol. vol. 5, p. 118, pl. 25, figs. 5, 22.

1971. *Thracia schencki* CLARK. ADDICOTT et al., U.S. Geol. Surv. Prof. Pap., 750-C, Fig. 6, h-j, l, n.

Remarks:—More than ten specimens are at hand. These specimens are rather variable in outline owing in part to preservation and possibly also to individual variation.

This species is rather similar to *T. trapezoides* CONRAD, 1849, from the Astoria formation (middle Miocene) of Oregon, and to *T. condoni* DALL, 1909, from the Eugene formation (upper Oligocene) in Oregon. As pointed out by previous workers (CLARK, 1932; TEGLAND, 1933; WEAVER, 1942; MOORE, 1963), this species can be distinguished from allied species by the absence of the second flexure on the anterior third of the shell surface (from *T. trapezoides*), and by having smaller and relatively shorter shell (from *T. condoni*).

This species was first introduced by CLARK (1932) as a manuscript name of TEGLAND. However, he described the repository of the type specimens and comparison between the allied species together with figured specimens. A detail description was given by TEGLAND (1933).

Localities:—80602, 80902, medium-grained calcareous sandstone in the alternating sequence of sandstone and siltstone in the upper part of the Poul Creek formation; 20511, 80905, 81201, 81401, olive-green, fine- to medium-grained sandstone, upper part of the Poul Creek formation.

Reg. No. TUE 10024.

Thracia cf. *T. condoni* CONRAD, 1909

Plate 17, figs. 16, 17

1909. *Thracia condoni* DALL, U.S. Geol. Surv., Prof. Pap., no. 59, p. 135-136, pl. 9, fig. 5.

1933. *Thracia condoni* DALL, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 23, no. 3, pl. 6, fig. 5.

1938. *Thracia condoni* DALL. SLODKEWITSCH, Paleont. USSR., vol. 10, pt. 3, Fasc. 18, p. 267-269, pl. 58, figs. 1-3.

1942. *Thracia condoni* DALL. WEAVER, Univ. Wash. Publ. Geol., vol. 5, pt. 1, p. 119, pl. 25, fig. 10; pl. 29, fig. 15.

Remarks:—Several specimens are at hand. Most are well preserved, but there are some variation in shape, e.g., although this species is characterized by having a lower shell than *T. trapezoides* and *T. schencki*, the ratio of length to height ranges from 64.2 to 72.3 whereas it is 74.1 in the holotype.

Localities:—81201, 81401, olive-green, fine- to medium-grained sandstone, middle to upper part of the Poul Creek formation.

Reg. No. TUE 10020.

Class Scaphopoda

Family Dentaliidae

Genus *Dentalium* LINNÉ, 1758

Dentalium LINNÉ, Syst. Nat., Ed. 10, p. 785, 1758; *Dentalium* LINNÉ. H. and A. ADAMS, Gen. Rec. Moll., vol., p. 456, 1854; *Dentalium* LINNÉ. WOODRING, Carnegie Inst. Wash. Publ., no. 366, p. 197, 1925; *Dentalium* LINNÉ. OLDROYD, Stanf. Univ. Publ., Geol. Sci., vol. 2, pt. 1, p. 99, 1927; *Dentalium* LINNÉ. GRANT and GALE, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 436, 1931; *Dentalium* LINNÉ. HABE, Gen. Jap. Shells, p. 292, 1953; *Dentalium* LINNÉ. MOORE et al., Treat. Invert. Paleont., pt. I, Moll. I, p. 37, 1960; *Dentalium* LINNÉ. EMERSON, Jour. Paleont., vol. 36, no. 3, p. 467-471, 1962; *Dentalium* LINNÉ. MOORE, U.S. Geol. Surv. Prof. Pap., 419, p. 50, 1963.

Type-species (by subsequent designation, MONTFORT, 1810):—*Dentalium elephantium* LINNÉ, 1758. Recent, Amboynaland and Philippine Islands.

Remarks:—The genus is characterized by longitudinal ribs, riblets, or striae, at least on the posterior portion of tube in juvenile stage. These riblets are straight, then often increase anteriorly by intercalation.

Most living species inhabit shallow water.

Geographic distribution:—Cosmopolitan.

Geologic range:—Middle Triassic to Recent.

Subgenus *Coccodentalium* SACCO, 1896

Coccodentalium SACCO. MOORE et al., Treat. Invert. Paleont., pt. I, Moll. I, p. 38, 1960; *Coccodentalium* SACCO. EMERSON, Jour. Paleont., vol. 36, no. 3, p. 468-469, 1962.

Type-species (by original designation):—*Dentalium radula* (SCHRÖTER), 1784, Miocene, Piemonte Basin, Italy.

Remarks:—This subgenus is distinguished by the surface ornamentation of many, almost equal longitudinal ribs crossed by circular riblets forming granules at the intersections to give a rasp-like appearance. Species of this subgenus occur as fossils in the East Indies, Europe, and Japan and Alaska, but living species are known from the East Indies.

Dentalium (*Coccodentalium*) cf. *D.* (*C.*) *nunomae* TAKEDA, 1953

Plate 12, figs. 1, 2

1953. *Dentalium nunomae* TAKEDA, Studies of Coal Geol., no. 3, p. 62, pl. 4, fig. 8; pl. 5, fig. 12.

Description:—Shell rather large for the genus, cylindrical, curved and tapering posteriorly; surface sculptured with dense, distinct annulated incremental lines and longitudinal ribs; annulated lines are very dense but are of variable strength; longitudinal ribs broad and flat-topped, about 30 ribs occur on the central part of shell; ribs separated by narrower interspaces; annulated incremental lines spaced closer than logitudinal ribs making a microscopic cancellate sculpture on the posterior two-thirds of the shell, anterior part sculptured only with indistinct annulated lines; figured specimen (Pl. 12, fig. 2) measures; 57.0 mm in length (incomplete, posterior part missing); maximum diameter, 10.2 mm; minimum diameter, 7.0 mm.

Remarks:—The type species was described by H. TAKEDA (1953) from the Poronai formation (Oligocene) in Hokkaido. This species is characterized by the can-

cellate surface sculpture, i. e., the specific name "nunome" means cancellate sculpture of the surface of cloth in Japanese.

The present specimens are closely similar to the type species, but the number of radial ribs are somewhat less than on the type, i. e., there are about 40 radial ribs on the type but about 30 on the present specimens. However, the writer suspects that these differences are due to individual variation or possibly due to the stage of growth. However, this problem must remains unsolved until more complete specimens are examined, because both the type and the Alaskan specimens are represented by incomplete specimens.

This species ranges from the Oligocene Poronai formation to the middle Miocene Takinoue formation in Hokkaido, Japan.

Localities:—80905, 81002, 81401, 81404, olive-green, fine-grained sandstone, lower and upper parts of the Poul Creek formation.

Reg. No. TUE 10025.

Class Gastropoda

Order Diotocardia

Suborder Rhipidoglossa

Family Trochidae

Genus *Bathybembix* CROSSE, 1893

Bembix WATSON. TRYON, Man. Conchol., vol. 11, p. 162-163, 1879; *Bathybembix* CROSSE. REHDER, Proc. Malacol. Soc. London, vol. 31, p. 5-6, 1955; *Bathybembix* CROSSE. MOORE et al., Treat. Invert. Paleont., pt. I, Moll. I, p. 253, 1960; *Bathybembix* CROSSE. KEEN, Mar. Moll. Gen. West. North Am., p. 21, 1963.

Type-species:—*Bembix aeola* WATSON, 1879, Recent, Pacific coast of Japan (north of lat. 36°N, ranging from 60 to 100 meters).

Remarks:—This genus is characterized by a thin and somewhat inflated shell with spirally nodose to smooth sculpture, an apressed to channeled suture, a smooth columella, and a pearly or nacreous interior surface.

Most species of this genus live in rather deep waters (50 to 100 meters).

Turcicula DALL, 1881, is closely related to *Bathybembix*, but differs by having a reflexed outer lip and vermiculate radial sculpture. *Bembix* WATSON, 1879, is preoccupied by *Bembix* FABRICIUS, 1775, a generic name of an insect.

Geographic distribution:—Japan, Bering Sea, and west coast of North America.

Geologic range:—Oligocene to Recent.

Bathybembix turbonata (CLARK), 1932

Plate 12, figs. 4a-b

1932. *Turcicula turbonata* CLARK, Bull. Geol. Soc. Am., vol. 43, p. 826-827, pl. 20, fig. 11.
1971. *Bathybembix turbonata* (CLARK). ADDICOTT et al., U. S. Geol. Surv., Prof. Pap., 750-C, Fig. 1, l, o.

Remarks:—This species was described by CLARK (1932) as *Turcicula turbonata* from the Yakataga District. The writer also collected the specimens from the same area, some of which are well preserved. As pointed out by TEGLAND (1933, p. 141), these trochiids show a fairly wide variation in outline as well as ornamentation. Some specimens at hand reached more than 70 mm. in maximum diameter, but their heights are very variable. However, this species is characterized by the flat-sided, cone-like shell with an almost obsolete spiral ribs situated a little below the middle of the penultimate and body whorl, and several heavy spiral ribs on the base.

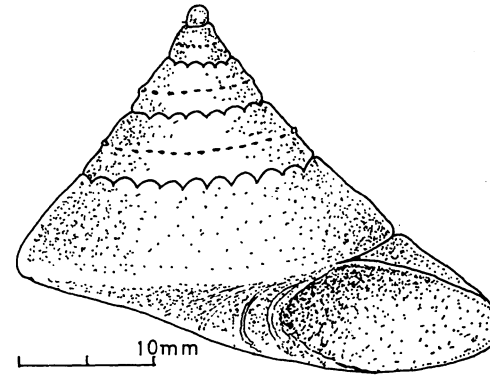
Localities:—81002, 81003, olive-green, fine-grained sandstone, upper part of the Poul Creek formation.

Reg. No. TUE 10026.

Bathybembix jonesi KANNO, n. sp.

Plate 12, figs. 3a-c

Description:—Shell rather small, high-conic, with about six whorls; nucleus defective; more or less nodose spiral ridge situated a little below the middle of each whorl on the adapical three or four whorls; the spiral ridge tapers on the penultimate whorl where the surface becomes smooth excepting for microscopic fine incremental lines of growth; periphery of adapical four whorls denticulate or spinose (Text-fig. 15), but that of body whorl smooth and bluntly rounded; base with about four equally spaced, weak and low spirals; umbilicus imperforate, surrounded by fine closely spaced spirals; altitude of shell, 29.0 mm; maximum diameter, 36.0 mm; minimum diameter, 30.0 mm.



Text-fig. 15. Surface ornamentation of *Bathybembix jonesi* KANNO, n. sp.

Remarks:—Several specimens are at hand, although most are incomplete. These specimens were collected from calcareous concretions and have well preserved shell material. This species is characterized by its highly conical form, a nodulose spiral ridge on the adapical three or four whorls and an almost smooth body whorl, and denticulate or spinose periphery on the adapical three or four whorls.

This new species is somewhat similar to *B. turbonata* (CLARK), 1932, but a spiral nodulose ridge, small-sized shell, and denticulate or spinose periphery of the adapical three or four whorls serve to distinguish it from *B. turbonata*.

This new specific name is dedicated to Mr. R. L. JONES, Standard Oil Company of California, who supported the writer's field work in Alaska.

Locality:—20508-2, calcareous concretion in dark-gray, massive mudstone, lower part of the Poul Creek formation.

Reg. Nos. TUE 10027 (holotype); TUE 10028 (paratype).

Order Monotocardia

Suborder Ptenoglossa

Family Epitoniidae

Genus *Epitonium* RÖDING, 1798

Epitonium BOLTEN. DALL, U. S. Geol. Surv., Prof. Pap., 59, p. 52, 1909; *Epitonium* BOLTEN. OLDROYD, Stanf. Univ. Publ. Univ. Ser., Geol. Sci., vol. 2, pt. 2, p. 50-51, 1927; *Epitonium* BOLTEN. GRANT and GALE, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 852, 1931; *Epitonium* BOLTEN. DURHAM, Jour. Paleont., vol. 11, no. 6, p. 485, 1937; *Epitonium* RÖDING. KEEN, Sea Shells Trop. West Am., p. 270, 1963.

Type-species (by subsequent designation, SUTER, 1913):—*Turbo scalaria* LINNÉ [=*Scalaria pretiosa* LAMARCK=*Epitonium pretiosum* (LAMARCK)], Recent, China Sea.

Remarks:—This genus is characterized by having a turreted and porcellaneous shell with axial varices or lamellae. It is found from low tide to 400 meters in depth but most species live in depths of less than 200 meters, usually on sandy bottoms, although some subgenera live at greater depths in tropical waters.

Geographic distribution:—Cosmopolitan.

Geologic range:—Paleocene to Recent (DURHAM, 1937).

Subgenus *Cirsotrema* MÖRCH, 1852

Cirsotrema MÖRCH, Cat. Conch. Yoldi, p. 49, 1852; *Cirsotrema* MÖRCH. DURHAM, Jour. Paleont., vol. 11, no. 6, p. 491, 1937; *Cirsotrema* MÖRCH. KEEN, Sea Shells Trop. West Am., p. 270, 1963.

Type-species (by monotypy):—*Scalaria varicosa* LAMARCK, Recent, Philippines and Oceanica.

Remarks:—The present subgenus is characterized by the thickened varices and spiral ribs, and well marked basal disk.

Epitonium (*Cirsotrema*) *clallamense* DURHAM, 1937

Plate 12, figs. 17, 18

1937. *Epitonium* (*Cirsotrema*) *clallamense* DURHAM, Jour. Paleont., vol. 11, no. 1, p. 491, pl. 56, figs. 27, 28.
1965. *Epitonium* (*Cirsotrema*) *clallamense* DURHAM. ADDICOTT, U. S. Geol. Surv. Prof. Pap., 525-C, Fig. 3, j.
1970. *Epitonium* (*Cirsotrema*) *clallamense* DURHAM. ADDICOTT, ditto, Prof. Pap., 642, p. 54, pl. 3, figs. 15, 16, 34-37.

Remarks:—This species was originally described from Oligocene strata of the east end of Clallam Bay, Washington (DURHAM, 1937). It is characterized by seven or eight broad axial ribs, slightly developed spiral striations, and very weak radial threads on the varices. The specimen figured in Plate 12, fig. 18 identified to this species, however, it has a larger number of varices, e. g., eleven varices on the body

whorl instead of seven or eight on the type species. It is uncertain that the difference in the number of varices is genetic or is due to individual variation. This problem can not be solved until more specimens are examined.

According to the recent study by ADDICOTT (1970), the geologic age of the type locality of this species is probably early Miocene rather than middle Oligocene in terms of the Pacific coast invertebrate chronology (WEAVER and others, 1944). And he also pointed out that the type locality of the species is in the upper part of the Twin River formation or the Clallam formation. The former is referred to the *Echinophoria apta* zone of the Blakeley Stage by DURHAM (1944). This species occurs in the San Joaquin Valley, California, and the type locality in Washington besides the Yakataga area.

Localities:—80905, 81002, greenish gray, medium-grained sandstone, upper part of the Poul Creek formation.

Reg. No. TUE 10029.

Subgenus *Gyroscala* de BOURY, 1887

Gyroscala de BOURY, Etude sous genres Scalidae, p. 15, 1887; *Gyroscala* de BOURY. COSSMANN, Essais Paleoconch. comp., vol. 9, p. 46, 1912; *Gyroscala* de BOURY. DURHAM, Jour. Paleont., vol. 11, no. 6, p. 485, 1937.

Type-species (by original designation):—*Scalaria ommutata* MONTEROSATO, Recent, tropical western Atlantic Ocean.

Remarks:—The subgenus is distinguished from other subgenera by lacking spiral surface ornamentation, and by having a distinct basal disk.

Geographic distribution:—Caribbean and Oceanica.

Geologic range:—Eocene to Recent.

Epitonium (*Gyroscala*) sp.

Plate 12, fig. 19

Description:—Shell medium in size, with more than four convex whorls (incomplete shell), of which the greatest diameter in near the middle of whorl; suture appressed; surface ornamented by 18 continuous, distinct, hardly reflexed varices; each whorl has a heavy varix; no spiral sculpture is observed; basal part of body whorl almost rounded, excepting weakly developed basal keel; aperture ovate; outer lip decidedly reflexed; inner lip with distinct callus which over-laps the anterior end of varix; umbilicus lacking; maximum diameter, 11.0 mm; height, 27.0 mm (of four whorls); aperture, 9.0×6.5 mm; apical angle, 22°.

Remarks:—One incomplete specimen has been examined. It is characterized by the large number of varices, slightly developed basal keel, and no spiral sculpture. The present specimen is somewhat similar to *E.* (*G.*) *effingeri* DURHAM, (1937, p. 485, pl. 56, fig. 25) from the lower middle Oligocene of Lower Cowlitz Valley, Washington, but it differs from the present one in having a smaller number of radial ribs (about 10 instead of 18).

Locality:—80905, greenish gray, fine- to medium-grained sandstone, upper part

of the Poul Creek formation.

Reg. No. TUE 10030.

Epitonium sp.

Plate 12, fig. 16

Description:—Shell of moderate size, fairly heavy, having about seven or eight whorls (incomplete); whorls strongly inflated in the central part making a blunt angulation; sutures deep; surface ornamented with ten prominent varices on the body whorl, and weakly developed spiral striations; varices strongly reflexed posteriorly, bending slightly backward as they leave the suture; interspaces nearly twice as wide as base of varices; basal keel feebly developed; aperture ovate, oriented oblique to the axial line of shell; outer lip thick and reflexed, inner lip narrowly callous; height, 24.0 mm (about 6 whorls); maximum diameter, 14.0 mm; aperture, 9.0×6.0 mm; apical angle 33°.

Remarks:—A single specimen has been examined, but it is characterized by extremely inflated whorls forming a blunt medial angulation and obliquely oriented aperture. This specimen seems to represent a new species, but more specimens are needed to establish a new name.

Locality:—81401, olive-green, fine- to medium-grained sandstone, upper part of the Poul Creek formation.

Reg. No. TUE 10031.

Suborder Taenioglossa

Family Turritellidae

Genus *Turritella* LAMARCK, 1799

Turritella LAMARCK, Mém. Soc. Hist. Nat. Paris, ser. 1, vol. 1, p. 74, 1799; *Turritella* LAMARCK. H. and A. ADAMS, Gen. Rec. Moll., vol. 1, p. 351, 1854; *Turritella* LAMARCK. WOODRING, Carnegie Inst. Wash., Publ., no. 385, p. 347-349, 1928; *Turritella* LAMARCK. GRANT and GALE, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 769, 1931; *Turritella* LAMARCK. OLDROYD, Stanf. Univ. Publ., Univ. Ser., Geol. Sci., vol. 2, pt. 3, p. 54, 1937; *Turritella* LAMARCK. MERRIAM, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 26, no. 1, p. 26-29, 1941; *Turritella* LAMARCK. KOTAKA, Short. Pap., Inst. Geol. Paleont., Tohoku Univ., no. 1, p. 34, 1950; *Turritella* LAMARCK. IDA, Rep. Geol. Surv. Japan, no. 150, p. 39-40, 1952; *Turritella* LAMARCK. KOTAKA, Sci. Rep. Tohoku Univ. Ser. 2, vol. 31, no. 2, p. 63, 1959; *Turritella* LAMARCK. KANNO, Tertiary Sys. Chichibu Basin, pt. 2, p. 345-346, 1960; *Turritella* LAMARCK. MOORE, U.S. Geol. Surv. Prof. Pap., 419, p. 25, 1963; *Turritella* LAMARCK. ADDICOTT, U.S. Geol. Surv. Prof. Pap., 642, p. 46, 1970.

Type-species (by monotypy):—*Turbo terebra* LINNÉ, Recent, tropical western Pacific.

Remarks:—This genus is characterized by having turriculate shell which has a rounded, entire aperture with a sinus on the outer lip. Species of this genus are classified chiefly upon surface ornamentation, outline of shell, growth line, shape of aperture, and size of the shell. Taxonimic problems were treated by several pre-

vious workers (MERRIAM, 1941; IDA, 1952; MARWICK, 1957; KOTAKA, 1959).

Geographic distribution:—World-wide in rather warm waters.

Geologic range:—Cretaceous to Recent.

Subgenus *Neohaustator* IDA, 1952

Neohaustator IDA, Rep. Geol. Surv. Japan, no. 150, p. 47, 1952; *Neohaustator* IDA. KOTAKA, Sci. Rep. Tohoku Univ. Ser. 2, vol. 31, no. 2, p. 66, 1959.

Type-species (by original designation):—*Turritella nipponica* YOKOYAMA, 1920, Pliocene Koshiba formation of the Miura Peninsula, Kanagawa Prefecture, Japan.

Remarks:—The characteristics of this subgenus are the double-arched and moderately positive inclination of the growth line, the comparatively broad and moderately deep sinus, and the first slender rib which appears on the third volutions somewhat proximal to middle part of the whorl.

Neoahustator differs from *Haustator* MONTFORT, 1810, in the features of the nuclear or juvenile whorls, although the charcter of the growth line is similar to both subgenera. The whorl profile of *T. imbricataria* LAMARCH, type of *Haustator* MONDFORT, is flat in the young stage, and is ornamented by spiral ribs.

Geographic distribution:—Living species occur in Japan Sea, and along the Pacific coast of northern Japan.

Geologic range:—Miocene to Recent.

Turritella (*Neohaustator*) *hamiltonensis* CLARK, 1932

Plate 12, figs. 9–12

1932. *Turritella hamiltonensis* CLARK, Bull. Geol. Soc. Am., vol. 43, p. 827, pl. 21, figs. 13, 14.
1942. *Turritella hamiltonensis* CLARK. MERRIAM, Univ. Calif. Publ. Sci. vol. 27, no. 1, p. 101, pl. 40, figs. 7–9.
1971. *Turritella hamiltonensis* CLARK. ADDICOTT et al., U.S. Geol. Surv. Prof. Pap., 750-C, Fig. 1, i, j, m.

Remarks:—This species was described by CLARK (1932) from the upper reaches of Hamilton Creek. It is characterized by having a rounded whorl profile and a rather large-sized shell which is ornamented by two broad, flat-topped spiral ribs on the abapical part of whorl and two slender spiral ribs on adapical half of the whorl. Generally speaking, the notation of spiral sculpture (MARWICK, 1957) of this species is (C B A r), but some adult specimens have the following notation, (u C t B s A r).

Judging from the development of spiral ribs, this species seems to be conspicific with, or at lest, to have been developed from the same stock as *T.* (*N.*) *chikubetsuensis* KOTAKA (1959) from the Takinoue formation (middle Miocene of central Hokkaido), which has the following spiral ribs (C B A r). *T.* (*N.*) *fortilirata* SOWERBY, living in northern Japan also resembles this species, but it differs by having round-topped spiral ribs and lacking intercalary spirals in adult specimens.

Localities:—80404, 80405, 80406, 80409, 80502, 80503, 80904, 81104, 81403, black shale, lower to middle part of the Yakataga formation.

Reg. No. TUE 10032.

Turritella aff. *T. diversilineata blakeleyensis* WEAVER, 1912

Plate 12, figs. 13, 14

1932. *Turritella* cf. *porterensis* WEAVER. CLARK, Bull. Geol. Soc. Am., vol. 43, p. 828, pl. 21, figs. 10, 15.
1971. *Turritella* aff. *T. diversilineata blakeleyensis* WEAVER. ADDICOTT et al., U.S. Geol. Souv., Prof. Pap., 750-C, Fig. 1, c, k.

Remarks:—This specimens are closely related to *T. diversilineata blakeleyensis* WEAVER (1941) in general features, but the more convex whorl profile, less prominent lowest spiral rib, and lack of a small revolving rib and shallow groove just above the suture serve to distinguish them from WEAVER's subspecies. *T. porterensis* WEAVER (MERRIAM, 1941, p. 102, pl. 20, figs. 10-16) is also somewhat similar to the present specimens, but it differs by having a smaller number of revolving threads, i.e., *T. porterensis* has ordinary five ribs rather than seven in the present specimens. The present specimens seem to represent a new species, but the state of preservation and small number of specimens do not permit establishment of a new name.

Localities:—80906, 81404, gray, fine-grained sandstone, lower part of the Poul Creek formation.

Reg. No. TUE 10033.

Turritella sp.

Plate 18, figs. 3-5

Description:—Shell large for the genus, with about 18 whorls, which have a rather convex profile; suture impressed; the lower portion of the surface of each whorl is decorated but has seven revolving ribs which are separated by narrower interspaces; growth line with more or less shallow lateral sinus, its peak falls adapical to the middle part of the body whorl; aperture rounded; estimated length, about 130 mm; maximum diameter, 26 mm; apical angle, 15°.

Remarks:—Several specimens are at hand, but most are incomplete and somewhat leached. They are characterized by the large-sized shell, with seven spiral ribs which are separated by narrower interspaces, and a rather shallow lateral sinus of the growth line. *T.* aff. *T. diversilineata blakeleyensis* is somewhat similar to the younger specimens of *Turritella* sp., but it is uncertain whether these two are conspecific. This problem will remain unresolved until well-preserved specimens are available.

Localities:—81201, 81401, fine- to medium-grained, gray sandstone, upper part of the Poul Creek formation.

Reg. No. TUE 10034.

Genus *Cristispira* ALLISON, 1965

Cristispira ALLISON, Paleont., vol. 8, pt. 4, p. 676, 1965.

Type-species (by original designation):—*Cristispira pugetensis* ALLISON, Ranging River formation (middle Eocene), northwestern Washington.

Remarks:—This genus is characterized by the primary spirals of a_3 B_1 C_2 d, the growth-line of adult with double sinus, and the deepest part of antispiral sinus situated above whorl midline.

Geographic distribution:—The middle Eocene of Washington and Gulf of Alaska.

Geologic range:—Middle Eocene.

Cristispira pugetensis ALLISON, 1965

Plate 12, fig. 15

1965. *Cristispira pugetensis* ALLISON, Paleont., vol. 8, pt. 4, p. 676-679.
1971. *Cristispira pugetensis* ALLISON. ADDICOTT and PLAFKER, U. S. Geol. Surv. Prof. Pap., 750-B, p. 50, Figs. 3B-3D.

Remarks:—A single poorly preserved specimen was collected by R. L. JONES, Standard Oil Co. of California, who offered it to the writer for identification. Although it is incomplete, the whorl profile and the development of spiral ribs serve to distinguish it from similar species.

This species was originally described by ALLISON (1965) from the Ranging River formation (middle Eocene) of Puget Sound Basin, Washington. Subsequently, ADDICOTT and PLAFKER (1971) reported it from almost the same locality as the present in the Gulf of Alaska. It is noteworthy that this marine Eocene mollusk extended northward from Washington during the Kulthieth age.

Locality:—20537-6, (Standard Oil Co. locality), brownish-gray, medium-grained sandstone, Kulthieth formation.

Reg. No. USGS, Menlo Park.

Family Calyptraeidae

Genus *Calyptraea* LAMARCK, 1799

Calyptraea LAMARCK, Mém. Soc. Hist. Nat. Paris, vol. 1, p. 78, 1799; *Calyptraea* LAMARCK. DALL, U. S. Geol. Surv. Prof. Pap., no. 59, p. 81, 1909; *Calyptraea* LAMARCK. WOODWARD, Man. Moll., p. 276, 1910; *Calyptraea* LAMARCK. OLDROYD, Stanf. Univ. Publ., Univ. Ser. Geol. Sci., vol. 2, pt. 3, p. 114, 1927; *Calyptraea* LAMARCK. GRANT and GALE, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 794, 1931; *Calyptraea* LAMARCK. KANNO, Tert. Sys. Chichibu Basin, p. 352, 1960; *Calyptraea* LAMARCK. KEEN, Sea Shells Trop. West Am., p. 311, 1963; *Calyptraea* LAMARCK. HICKMAN, Mus. Nat. Hist., Univ. Oregon, Bull. no. 16, p. 79, 1969; *Calyptraea* LAMARCK. ADDICOTT, U. S. Geol. Surv. Prof. Pap., 642, p. 60, 1970.

Type-species (by monotypy):—*Patella chinensis* LINNÉ, Recent, western Europe.

Remarks:—This genus is characterized by a conical, limpet-shaped shell with a central or subcentral apex, and aperture with an internal spiral diaphragm. Living species of the genus occur in warm to temperate waters. Two living species are reported from Japan south of lat. 35°N in sandy bottom from 20 to 100 meters in depth. Two species are also reported from the west coast of North America, one from Alaska to southern California, and the other from south of Monterey to the Gulf of California.

Geographic distribution:—Warm to temperate waters of the world.

Geologic range:—?Cretaceous to Recent. Seven fossil species of the genus are reported from Oligocene and younger formations in Japan, but it appears in the Eocene of the west coast of North America.

Calyptraea sp.

Plate 12, figs. 5a-b, 6a-b

Description:—Shell medium in size; apical angle somewhat variable; apex rather blunt, central or nearly so; whorls about three with flat to slightly convex sides; suture indistinct; surface covered with obscure, coarse, radiating ribs which are separated by interspace of about equal width; septum well developed.

Remarks: Several specimens are at hand, but most are incomplete. These specimens are somewhat similar to *C. sookensis* CLARK and ARNOLD, 1923, from the Sooke formation of Vancouver Island, Canada, but they differ by having a rounded shape, and hardly developed radial ribs on the surface. This specimens are also more or less similar to some species of subgenus *Trochita*, but differ by lacking distinct radial sculpture.

Localities:—80602, 81003, calcareous concretions in greenish gray silty sandstone, upper part of the Poul Creek formation.

Reg. No. TUE 10037.

Genus *Crepidula* LAMARCK, 1799

Crepidula LAMARCK, Mém. Soc. Hist. Nat. Paris, Ser. 1, vol. 1, p. 78, 1799; *Crypta* HUMPHREY. H. and A. ADAMS, Gen. Rec. Shells, vol. 1, p. 268, 1854; *Crepidula* LAMARCK. DALL, U.S. Geol. Surv. Prof. Pap., 59, p. 82, 1909; *Crepidula* LAMARCK. WOODWARD, Man. Moll., p. 277, 1910; *Crepidula* LAMARCK. OLDROYD, Stanf. Univ. Publ., Univ. Ser. Geol. Sci., vol. 2, pt. 3, p. 116, 1927; *Crepidula* LAMARCK. GRANT and GALE, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 789, 1931; *Crepidula* LAMARCK. KANNO, Tert. Syst. Chichibu Basin, p. 354, 1960; *Crepidula* LAMARCK. KEEN, Sea Shells Trop. West Am., p. 312, 1963; *Crepidula* LAMARCK. MOORE, U.S. Geol. Surv. Prof. Pap., 419, p. 26, 1963; *Crepidula* LAMARCK. MORRIS, Field Guide Shells, p. 75, 1966; *Crepidula* LAMARCK. ADDICOTT, U.S. Geol. Surv. Prof. Pap., 642, p. 62, 1970.

Type-species (by monotypy):—*Patella fornicata* LINNÉ, Recent, Atlantic and Gulf coasts of North America.

Remarks:—The present genus is characterized by the oval limpet-like shell, large body whorl and aperture, and small closely appressed spire.

Three species have been recorded from the Pacific coast of Japan, all of which live south of lat. 47°N, but more than ten species have been reported from the west coast of North America ranging from south of Alaska to tropical regions. Most of species of the genus inhabit shallow water.

Geographic distribution:—World-wide.

Geologic range:—Cretaceous to Recent.

Crepidula cf. *C. praerupta* CONRAD, 1849

Plate 12, figs. 7, 8

1849. *Crepidula praerupta* CONRAD, U. S. Explor. Exped. Geol., p. 727, pl. 19, figs. 9, 9a, 10a, 10b.
1909. *Crepidula praerupta* CONRAD. DALL, U. S. Geol. Surv., Prof. Pap. 59, p. 83, pl. 7, fig. 8.
1942. *Crepidula praerupta* CONRAD. WEAVER, Univ. Wash. Publ. Geol.. vol. 5, p. 359, pl. 73, figs. 12, 13.

Description:—Shell of moderate size, rather solid, ovate, ventricose; surface smooth except for simple lines of growth; apex curved sharply in the extreme point of the shell and elevated above the plane of the aperture; margin simple, interior obstructed by matrix.

Measurements (in mm):—

Specimens	Longitude	Maximum width	Altitude
No. 1	34.0	19.0	18.0
„ 2	18.0	16.0	12.5
„ 3	18.0	14.0	11.5

Remarks:—The present specimens are closely similar to *C. praerupta* CONRAD reported from the Astoria formation (WEAVER, 1942, p. 359, pl. 73, figs. 1-3). The figured specimen (Pl. 12, fig. 7) is closely akin to CONRAD's holotype, but the other specimens represented by fig. 8 of the same plate are rather distinct from the type; the apex of these specimens is rather blunt, it is elevated above the plane of aperture, and the extreme point of the shell is not curved laterally. The variable shape of these shells may be due to individual variation or to deformation in some degree after burial.

Localities:—81003, 81004, greenish gray, fine- to medium-grained sandstone, and calcareous concretions in fine-grained sandstone, upper part of the Poul Creek formation.

Reg. No. TUE 10037.

Family Naticidae

Genus *Euspira* AGASSIZ in SOWERBY, 1838

Euspira AGASSIZ in SOWERBY, Min. Conch. Gt. Brit., German Ed., p. 14, 320, 1838; *Euspira* AGASSIZ in SOWERBY. GRANT and GALE, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 803, 1931.

Type-species (by subsequent designation, DALL, 1908, 1909):—*Natica glaucinoides* SOWERBY, Eocene of England.

Remarks:—This genus is distinguished from the allied genera by the globose shell, light callus coalescing with less developed funicle, and aperture inclined about 30° from vertical.

Geographic distribution:—World-wide.

Geologic range:—Possibly Eocene to Recent.

Euspira ramonensis (CLARK), 1918

Plate 13, figs. 1a-b

1918. *Natica (Euspira) ramonensis* CLARK, Univ. Calif. Publ. Bull. Dept. Geol., vol. 11, no. 2, p. 166, pl. 19, fig. 16.
1932. *Polinices (Euspira) ramonensis* (CLARK), Bull. Geol. Soc. Am., vol. 43, p. 826, pl. 20, figs. 4, 5, 8, 9.
1971. *Euspira ramonensis* (CLARK). ADDICOTT et al., U.S. Geol. Surv. Prof. Pap. 755-C, Fig. 1, i, j, n, o, t.

Description:—Shell somewhat large for the genus, subglobose, spire moderately high; whorls four or five; aperture wide, semi-lunar, acute posteriorly, broadly rounded anteriorly; outer lip boradly rounded, inner lip nearly straight, with light callus, a portion of which coalesces with a weakly developed funicle which fills part of the umbilicus; umbilicus open; surface marked by lines of growth; height, 45.0 mm; maximum diameter 43.0 mm; aperture, 36.0×18.0 mm.

Remarks:—Many specimens are at hand, but most are deformed and abraded. One well preverved specimen was collected from a calcareous concretion (loc. 81404).

Although the shape of shell is almost the same as the type species, the development of the callus and funicle is somewhat different in certain individuals, e. g., some have a rather developed funicle which fills part of the umbilicus and well marked transverse groove extending across the funicle like that of *Euspira* (Pl. 13, fig. 1b). However, other specimens have light callus, coalescing with less well developed funicle which hardly fills the umbilicus. Those are similar to specimens figured by CLARK (1932, pl. 20, figs. 4, 8).

Localities:—80905, 81201, 81401, 20503, greenish gray, fine-grained sandstone, upper part of the Poul Creek formation; 81404, calcareous concretion in fine-grained sandstone, the lower part of the Poul Creek formation.

Reg. No. TUE 10038.

Genus *Cryptonatica* DALL, 1892

Cryptonatica DALL, Trans. Wagner Free Inst. Sci., vol. 13, p. 362, 1892; *Cryptonatica* DALL, U.S. Geol. Surv. Prof. Pap., 59, p. 85, 1909; ?*Tectonatica* SACCO. GRANT and GALE, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 797, 1931; *Cryptonatica* DALL. MOORE, U.S. Geol. Surv. Prof. Pap., 419, p. 27, 1963.

Type-species (by subsequent designation, DALL, 1909):—*Natica clausa* BRODERIP, Recent, Arctic Ocean to Queen Charlotte Island, British Columbia.

Remarks:—This genus is characterized by its closed umbilicus and smooth operculum. It is characteristic of temperate or boreal waters.

Geographic distribution:—Arctic Ocean, northern Pacific and northern Atlantic regions.

Geologic range:—Possibly Miocene to Recent.

Cryptonatica aff. *C. clausa* (BRODERIP and SOWERBY), 1829

Plate 13, figs. 2a-b

1932. *Natica (Cryptonatica)* n. sp., CLARK, Bull. Geol. Soc. Am., vol. 43, p. 825, pl. 20, figs. 6, 7.
1971. *Cryptonatica* aff. *C. clausa* (BRODERIP and SOWERBY), ADDICOTT et al., U.S. Geol. Surv. Prof. Pap., 750-C, Fig. 2, k, p.

Description:—Shell medium in size, globose in shape; suture abutting; spire slightly elevated; whorls about four, slightly shouldered; aperture semilunar, outer lip broadly rounded, inner lip slightly convex; umbilicus entirely closed by small, flat callus; height about 28.5 mm; maximum width, 28.0 mm; aperture, 25.5×14.0 mm.

Remarks:—Many specimens are at hand, but most are deformed. They are somewhat similar to the *Cryptonatica clausa*, but have a thicker and larger funicle and a more gently abutting suture. However, the state of preservation does not permit naming a new species.

Localities:—80404, 80406, 80801, 81001, dark-gray or black mudstone, Yakataga formation.

Reg. No. TUE 10039.

Suborder Stenoglossa

Family Cassididae

Genus *Liracassis* MOORE, 1963

Liracassis MOORE, U.S. Geol. Surv. Prof. Pap., 419, p. 30-31, 1963.

Type-species (by original designation):—*Dolium petrosum* CONRAD, Astoria formation (middle Miocene), Oregon and Washington.

Remarks:—This genus is closely similar to other cassidids, but the combination of the heavy strap-like spirals and of the wide, deep groove bordering the notched siphonal canal serve to distinguish it from other cassidid genera. This genus has a short, sharply recurved notched canal similar to *Echinophoria* SACCO, 1890, but it differs by having a wide and deep groove bordering the canal and strap-like spiral ribs.

Geographic distribution:—Oregon and Washington, northwest coast of North America, and Hokkaido and northern Honshu, Japan.

Geologic range:—Oligocene to middle Miocene.

Liracassis apta (TEGLAND), 1931

Plate 13, figs. 11-13

1931. *Galeodea apta* TEGLAND, Univ. Calif. Publ., Bull. Dept. Geol. Sci., vol. 19, no. 18, p. 415-417, pl. 63, figs. 1-10; pl. 64, figs. 1-2.
1932. *Gelodea apta* TEGLAND. CLARK, Bull. Geol. Soc. Am., vol. 43, p. 828-829, pl. 21, figs. 1-3.
1942. *Galeodea apta* TEGLAND. WEAVER, Univ. Wash. Publ. Geol., vol. 5, p. 408, pl. 79, figs. 12-13; pl. 80, figs. 1, 3, 5.
1944. *Echinophoria apta* (TEGLAND). DURHAM, Univ. Calif. Publ. Bull. Dept. Geol. Sci., vol. 27, no. 5, p. 166, pl. 18, figs. 13, 15.
1942. *Echinophoria apta* (TEGLAND). DURHAM, Jour. Paleont., vol. 16, no. 2, p. 186, pl. 30, figs. 7-8.
1963. *Liracassis apta* (TEGLAND). MOORE, U.S. Geol. Surv. Prof. Pap., 419, p. 31, pl. 4, figs. 7, 10.
1971. *Liracassis apta* (TEGLAND). ADDICOTT et al., U.S. Geol. Surv. Prof. Pap. 750-C, Fig. 1, g, h.

Remarks:—This species is characterized by having narrow and numerous spiral ribs (about 15 beneath the shoulder on the body whorl) which are separated by somewhat wider interspaces in which one or two fine spiral threads are weakly developed. Moreover, the nodes on shoulder of smaller size and are more numerous than on allied species. Some of the Alaskan specimens have about 15 nodes on the shoulder, but others have no nodes and a rounded shoulder. This species seems to be restricted to the "*Echinophoria apta* zone" of DURHAM (upper part of the Blakeley formation, lower Miocene) in northwestern Washington district.

Localities:—80905, 81001, 81003, 81201, 81203, 81401, 20503, 20508, olive-green, fine- to medium-grained sandstone, upper part of the Poul Creek formation; 81404, olive-green, fine-grained sandstone, lower part of the Poul Creek formation.

Reg. No. TUE 10040.

Liracassis durhami KANNO, n. sp.

Plate 13, figs. 14a-b

1932. *Galeodea apta* TEGLAND. CLARK, Geol. Soc. Am. Bull., vol. 43, p. 828-829, pl. 21, figs. 9, 15 (not figs. 1, 3).
1971. *Liracassis* aff. *L. petrosa* (CONRAD). ADDICOTT et al., U.S. Geol. Surv. Prof. Pap., 750-C, Fig. 1, a, b, e, f; Fig. 2, w, x.

Description:—Shell medium to large, globose, thin, with about five rounded whorls exclusive of the nucleus; earlier two whorls smooth excepting for several weak nodes, third whorl with three or four rather weak spirals, of which one has several rather distinct nodes; fourth whorl with five, somewhat nodulose spiral ribs separated by wider channeled interspaces; body whorl with about 16 spiral cords, of which 10 occur below the shoulder and the rest on the shoulder; spiral cords on the shoulder have about 12 nodes which continue as oblique ridges to the suture; spiral cords below the shoulder of the body whorl are subrounded, strap-like, and separated by interspaces which are smooth and are somewhat wider than the width of spiral cords; body whorl terminates in a slightly reflected and thickened outer lip in the adult; canal short, deeply excavated, twisted and more or less plicate, with a deep sulcus behind it.

Measurements (in mm):—

Specimens	Altitude of		Diameter of		Number* of	
	shell	body whorl	maximum	minimum	spiral ribs	nodes
Holotype**	ca.65.0	ca.50.0	51.0	25.0	10	12
Paratype**	59.0	45.0	41.0	26.0	10	11
„ **	ca.40.0	25.0	33.0	30.0	9	9

* Number counted on the body whorl. ** Somewhat deformed specimens.

Remarks:—This species is closely related to *L. petrosa* (CONRAD), (MOORE, 1963, p. 31, pl. 2, figs. 7, 10-14; pl. 4, figs. 2, 4, 6; pl. 10, figs. 7, 17) from the Astoria Miocene of Oregon and Washington, but the smaller number of nodes on the body whorl and the lack of fine spiral threads in the interspaces serve to distinguish it from the *L. petrosa*.

It is noteworthy that the middle Miocene species *L. petrosa*, although it closely relates to the present new species, has a larger number of nodes on the body whorl than the present new species and a fine spiral thread in the interspace between the spiral cords. Judging from these characteristics, *L. durhami* may be an ancestral form of *L. petrosa* (CONRAD). *L. apta* (TEGLAND) from the Twin River formation of Washington is also somewhat similar to *L. durhami* but it differs by having a larger number of spiral threads and nodes on the body whorl.

This specific name is dedicated to Prof. J. WYATT DURHAM who gave a valuable suggestions to the writer on the classification of fossil cassidids from the northwest coast of North America.

Localities:—80906 (type), calcareous concretion in the fine-grained sandstone, lower part of the Poul Creek formation; 80905, 81001, 81201, fine- to medium-grained sandstone, upper part of the Poul Creek formation.

Reg. No. TUE 10041 (holotype); TUE 10042 (paratype).

Family Muricidae

Genus *Pteropurpura* JOUSSEAUME, 1880

Pteropurpura JOUSSEAUME. DALL, Trans. Wagner Free Inst., vol. 3, p. 242-243, 1892.

Type-species (by subsequent designation, DALL, 1892):—*Murex macropterus* DESHAYES, Recent, East coast of North America.

Remarks:—This genus is characterized by three thin varices which are broad and frill-like.

Geographic distribution:—This genus seems to be restricted to warm subtropical to tropical regions. Most species of this genus occur south of Monterey Bay, California, on the west coast of North America and south of lat. 35°N in Japan. They are found from 20 to 100 meters in depth.

Geologic range:—Possibly Oligocene to Recent.

Pteropurpura n. sp.

Plate 13, figs. 6, 7

Description:—Shell rather large for the genus, with about six whorls; suture distinct, appressed; surface ornamented with spiral ribs which are separated by narrower interspaces; largest varix situated near the outer lip, and is sculptured with about 30 spiral ribs which become broader towards the outer margin; varices on the body whorl extend to the penultimate whorl (Pl. 13, fig. 6); intervarical surface with a single obscure radial rib; aperture inaccessible; anterior canal rather long, bent to the left in incomplete apertural view; apical angle about 38°.

Remark:—Two incomplete specimens are at hand. No previous occurrences of pteropurpurids with such large frill-like varices have been reported from the west coast of North America and other parts of the North Pacific either as fossil or living species. However, there is not enough well preserved material to warrant giving this form a new specific name.

Locality:—81203, calcareous concretions in the dark-gray, massive siltstone, lower part of the Poul Creek formation.

Reg. No. TUE 10043.

Family Buccinidae

Genus *Eosiphonalia* RUTH, 1942

Eosiphonalia RUTH, Univ. Calif. Publ. Bull. Dept. Geol. Sci., vol. 26, no. 3, p. 288, 1942.

Type-species (by original designation):—*Strepsidura washingtonensis* WEAVER, 1916, Lincoln formation (middle Oligocene), Washington.

Remarks:—This genus was originally proposed by RUTH (1942) as a subgenus of *Siphonalia* A. ADAMS. It is characterized by a low spire, a short and less reflected canal than *Siphonalia*, a biangulate and strongly nodose body whorl, and the lack of lirations on the inner side of the outer lip. Although the surface sculpture of some species of *Siphonalia* show an extremely broad range of variation, the lirations on the inner side of the outer lip is one of the most diagnostic characters of the genus. The smooth outer lip and extremely strong biangulated body whorl serve to distinguish *Eosiphonalia* from allied genera.

Geographic distribution:—California, Washington, Oregon, and the Gulf of Alaska.

Geologic range:—Oligocene to early Miocene.

Eosiphonalia sp.

Plate 15, figs. 6a-b

Remarks:—An incomplete specimen represented only by the body whorl is at hand. The surface sculpture on the body whorl, aperture, canal, and outer and inner lips are well preserved. The body whorl is sculptured with two well pronounced revolving ridges making two rows on the shoulder and the periphery, but there are no revolving ridges anterior to these two ridges. There are about fourteen revolving ribs on the body whorl. The surface between the two revolving ridges is slightly concave. The entire surface is covered with spiral threads, but number can not be determined. The aperture is elongate-ovate in outline, and becomes nar-

rower anteriorly where it merges into a slightly reflected canal. A well defined fasciole is present. The inner surface of the outer lip is smooth.

The present specimen is closely similar to *E. washingtonensis* (WEAVER, 1916; 1942, p. 438, pl. 86, figs. 9-11, 13), from the Lincoln formation (Oligocene of Washington), but it seems to differ somewhat from *Eosiphonalia* sp. in having a third revolving ridge anterior to two primary ridges, and a smaller number of distinct nodes on the revolving ridges. However, these differences, may not be very significant, because living species of the allied genus *Siphonalia* exhibit a very broad range of variation in the development of nodes (MAKIYAMA, 1941). However, specific determination must await the collection of more complete specimens.

Locality:—81002, greenish-gray, fine-grained sandstone, upper part of the Poul Creek formation.

Reg. No. TUE 10044.

Family Neptuneidae

Genus *Neptunea* RÖDING, 1798

Neptunea RÖDING in BOLTEN, Mus. Boltenianum, p. 115, 1798; *Neptunea* BOLTON. H. and A. ADAMS, Gen. Rec. Moll., vol. 1, p. 79, 1853; *Neptunea* BOLTEN. STRICZKA, Paleont. Indica, Ser. 4, vols. 1-4, p. 116, 1871; *Neptunea* "BOLTEN" RÖDING. STEWART, Acad. Nat. Soc. Phila., vol. 78, p. 393-394, 1926; *Chrysodomus* SWAINSON. OLDROYD, Stanf. Univ. Publ., Univ. Ser., vol. 2, pt. 1, p. 227, 1927; *Neptunea* BOLTEN. GRANT and GALE, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 652, 1931; *Neptunea* (BOLTEN) RÖDING. THIELE, Handbuch der Sys. Weicht., p. 309, 1931; *Neptunea* RÖDING. ABBOTT, Am. Seashells, p. 229, 1954; *Neptunea* BOLTEN. KANNO, Tert. Sys. Chichibu Basin, p. 369, 1960.

Type-species (by subsequent designation, MONTEROSATO, 1872):—*Fusus antiquus* LINNÉ [=*Murex contrarius* LINNÉ], Recent, Europe.

Remarks:—This genus is characterized by moderately large, elongate-ovate to subfusiform, ventricose shell which is sculptured mostly spiral ribs and have usually simple outer lip, and slightly curved anterior canal of moderate length.

The Recent species of *Neptunea* are mostly living in rather cold waters.

Geographic distribution:—Cold and temperate waters.

Geologic range:—?Late Eocene to Recent.

Subgenus *Neptunea* s. s.

Neptunea s. s., TLIELE, Handb. Syst. Weicht., p. 309, 1931.

Remarks:—*Neptunea* s. s. is characterized by having the moderately high spire which is mostly smooth surface with no sulci or groove below suture. Subgenus *Sulcosipho* DALL, 1916, differs from this subgenus by having fairly slender shell with conspicuously widely sulcated or tabulate whorl below suture.

Neptunea (*Neptunea*) *plafkeri* KANNO, n. sp.

Plate 14, figs. 1, 2, 3

Description:—Shell slender with about six whorls; spire acute, nucleus inaccessible; whorls gently swollen, surface smooth besides the fine incremental lines of growth; body whorl ventricose, with several very weak radial ribs, of which one or two near the outer lip are rather distinct; suture distinct, very narrow and deep; aperture wide, elongate-ovate in outline, outer lip sharp, thin, smooth within; inner lip thin, with narrow callous deposit; canal rather narrow and moderately twisted to the left, no fasciole.

The holotype measures; height of shell, 96.0 mm; height of body whorl, 59.0 mm; maximum diameter, 49.0 mm; minimum diameter, 24.0 mm (holotype is represented by a more or less deformed specimen).

Remarks:—Several specimens are at hand, but most are deformed or incomplete. However, the high spire and acute apical angle, the almost smooth outer surface excepting for fine incremental lines of growth and a few radial ribs near the aperture, and the rather long anterior canal serve to distinguish it from known species.

The new specific name is dedicated to Mr. GEORGE PLAFKER, U. S. Geological Survey, who gave the writer valuable information on the stratigraphy of the Tertiary strata developed along the Gulf of Alaska.

Locality:—81104, dark-gray, massive mudstone, lower part of the Yakataga formation.

Reg. No. TUE 10045 (holotype); TUE 10046 (paratype).

Neptunea (*Neptunea*) sp.

Plate 18, figs. 10a-b

Description:—Shell thick, moderate in size with six or seven whorls; spire very low less than one-fourths of the height of shell (one or two teleoconchs are missing); body whorl and pinultimate one are extremely swollen compared with the whorls of spire; surface ornamented with spiral ribs which are alternating size, of which one situated beneath the suture is strongest among the other spirals and making a shoulder; suture distinct, rather deep; aperture large, elongate ovate in outline; outer lip thick, inner side of it smooth; inner lip with thin and narrow callous deposit; canal rather narrow and moderately long, fairly twisted to left, but no fasciole; height of shell, about 100 mm (protoconch and teleoconch missing), maximum diameter, 57 mm (more or less compressed after burial by rock pressure); height of aperture, 73 mm; width of aperture, 28 mm.

Remarks:—One specimen which is more or less deformed and incomplete one is at hand. The present specimen is characterized by the extremely low spire in the genus, the surface ornamentation of alternating spiral ribs of strong and weak, and fairly long and twisted anterior canal. *N. leffingwelli* (DALL), 1920, *N. pribiloffensis* DALL, 1919, *N. lyrata* (GMELIN), 1791, and *N. ventricosa* (GMELIN) are more or less similar to the present specimen. However, the present specimen differs from *N. leffingwelli* (DALL), (MACNEIL, 1957, p. 111, pl. 13, figs. 1-4, 9) by having low spire and narrow and more twisted anterior canal; from *N. pribiloffensis* DALL (OLDROYD, 1927, p. 231, pl. 21, fig. 4) by having low spire, more distinct alternation of strong

and weak spiral ribs, and narrow and more twisted anterior canal; from *N. lyrata* (GMELIN) (MACNEIL, 1957, p. 113, pl. 17, fig. 11) by having low spire and many spiral ribs on shoulder of the body whorl; from *N. ventricosa* (GMELIN) (MACNEIL, 1957, p. 112, pl. 17, fig. 14) by having low spire and distinct alternation of strong and weak spiral ribs.

This specimen probably represents an ancestral form of those allied species, and seems to be a new species, but the few number of specimen and the state of preservation does not permit to establish a new specific name.

Locality:—80506, gray, fine-grained sandstone, Yakataga formation.

Reg. No. TUE 10047.

Subgenus *Sulcosipho* DALL, 1916

Sulcosipho DALL, Proc. Biol. Soc. Washington, vol. 29, p. 7, 1916; *Sulcosipho* DALL. GRANT and GALE, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 658, 1931.

Type-species (by original designation):—*Chrysodomus tabulata* BAIRD, Recent, south of British Columbia to San Diego in 60 to 400 meters in depth.

Remarks:—The present subgenus is characterized by a slender and elongate shell with conspicuously widely sulcate or tabulate whorls below the suture.

Neptunea (*Sulcosipho*) cf. *N.* (*S.*) *tabulata* (BAIRD), 1863

Plate 13, fig. 10; Plate 15, figs. 1-2

1932. *Neptunea* aff. *N. tabulata* BAIRD. CLARK, Bull. Geol. Soc. Am., vol. 43, p. 830-831, pl. 20, fig. 13.

1971. *Neptunea* (*Sulcosipho*) aff. *N.* (*S.*) *tabulata* (BAIRD). ADDICOTT et al., U. S. Geol. Surv. Prof. Pap., 750-C, Fig. 1, n. p.

Remarks:—Deformed and incomplete two specimens are at hand. These specimens are characterized by a wide, flat channel next to the suture which is bounded by a raised, scaly cord. Moreover, it is sharply angulated and keeled above, forming a rimmed spiral table. The surface is ornamented with about 5 or 6 revolving ridges of alternating size on the penultimate whorl. The canal and columella are inaccessible because the specimens are deformed. This specimens are closely similar to *N.* (*S.*) *tabulata* in general shape, but it is unable to compare completely the present specimens with *N.* (*S.*) *tabulata* owing to the poor preservation of the present specimens.

Localities:—80404, 80408, 80603, 80703, 80802, 81306, 20494, 20541-7, dark-gray or black mudstone, Yakataga formation.

Reg. No. TUE 10048.

Genus *Ancistrolepis* DALL, 1895

Ancistrolepis DALL, Proc. U. S. Nat. Mus., vol. 17, no. 1896, p. 709, 1895; *Ancistrolepis* DALL. OLDROYD, Stanf. Univ. Publ., Univ. Ser. Geol. Sci., vol. 2, pt. 1, p. 203, 1927; *Ancistrolepis* DALL. KURODA, The Venus (Jap. Jour. Malac.), vol. 2, no. 5, p. 288, 1931; *Ancistrolepis* DALL.

GRANT and GALE, Mem. San Diego Soc., Nat. Hist., vol. 1, p. 675, 1931; *Ancistrolepis* DALL. THIELE, Handb. System. Wiecht., p. 308, 1931; *Ancistrolepis* DALL. DURHAM, Univ. Calif. Publ. Geol., vol. 27, no. 5, p. 176, 1944; *Ancistrolepis* DALL. KANNO, Tert. Sys. Chichibu Basin, p. 367, 1960.

Type-species (by original designation):—*Chrysodomus eucosmius* DALL, Recent, Pacific coast. The type specimen was collected from the Bering Sea from the depth of 450 meters by the SS. Albatross.

Remarks:—This genus is characterized by a short, wide anterior canal which is almost obsolete but broadly open, and twisted to the left.

Living species of the genus seem to be restricted to the northern Pacific, i. e., four species are reported from the west coast of North America and nine species and three subspecies from Japan. Japanese species of *Ancistrolepis* are reported from north of off Shikoku (lat. 33°N to 51°N) in deep waters. Judging from the present habitat of this genus, it is a cold water form.

Geographic distribution:—Northern Pacific waters ranging from 70 to 2000 meters (KEEN, 1963, p. 99).

Geologic range:—Oligocene to Recent (in Japan).

Ancistrolepis rearensis (CLARK), 1932

Plate 13, figs. 5, 9; Plate 14, figs. 4–6

1932. *Colus rearensis* CLARK, Bull. Geol. Soc. Am., vol. 43, p. 831.
1933. *Ancistrolepis clarki* var.?, TEGLAND, Univ. Calif. Publ. Bull. Dept. Geol. Sci., vol. 23, p. 132, pl. 12, figs. 15–17.
1944. *Ancistrolepis clarki teglandae* DURHAM, Univ. Calif. Publ. Bull. Dept. Geol. Sci., vol. 27, no. 5, p. 177, pl. 17, fig. 2.
1971. *Ancistrolepis rearensis* (CLARK). ADDICOTT et al., U.S. Geol. Surv. Prof. Pap., 750-C, Fig. 2, b, c, s.

Description:—Shell medium, robust, with six or seven rounded whorls; nuclear whorl inconspicuous, globose; first and second whorls almost smooth, rounded; third whorl with two weak spiral ribs; the fourth ornamented with two heavy, flat-topped revolving ribs, of which the upper one is carinate on the most expanded part of the whorl, and a faint spiral thread appears beneath the suture; the fifth has the same ornamentation as the fourth, although the spiral ribs are stronger than that of the fourth whorl; the body whorl has about eleven spiral ribs, of which three on the most expanded part of the whorl are somewhat stronger than the others and are separated by interspaces broader than the width of spiral ribs, whereas the spirals on the distal part are separated by interspaces narrower than the width of rib; the whole surface excepting the apical part is ornamented with closely set, faint, silky spiral striations and radial growth lines (Pl. 14, fig. 5), but the general appearance of shell is smooth to polished; aperture ovate, almost equal in height to the spire; outer lip rather thin, inner side almost smooth; inner lip with a thin callous deposit; canal short, narrow, and slightly recurved; altitude of shell, 48.0 mm; height of spire, 26.0 mm; maximum diameter, 28.0 mm.

Remarks:—This species was originally described by CLARK (1932) from the Yaka-

taga District, although its exact locality was not plotted on his map. The place name "Rear" does not appear on the topographic map published by U. S. Geological Survey, it may refer to "Bear Glacier" or "Lare Glacier".

The present species is characterized by the deeply incised suture and more rounded whorl profile, prominent spiral ribs, and the presence of moderately well defined spiral rib in a short distance below the suture. However, the last character is somewhat variable as showing plate 13, fig. 9, which has very weak spiral thread beneath the suture.

Localities:—80601, 80905, 81004, 81203, greenish-gray or olive-green, fine- to medium-grained sandstone, the upper part of the Poul Creek formation; 81404, olive-green, fine-grained sandstone, lower part of the Poul Creek formation.

Reg. No. TUE 10050

Ancistrolepis macneili, KANNO, n. sp.

Plate 14, fig. 7

Description:—Shell large, robust, with seven rounded whorls which are somewhat sulcate below the suture; nuclear whorl inaccessible; first whorl smooth, rounded; second whorl swollen, almost smooth, excepting two very weak spiral threads; third whorl ornamented with three distinct spiral striations and a very weak spiral thread beneath the suture; fourth and fifth whorls have the same ornamentation as the third one, but the spiral ribs are stronger; spiral ribs on the penultimate whorl are almost of equal size, flat-topped, and are separated by interspaces wider than the spiral ribs; the body whorl has about eleven spiral ribs, of which five on the most expanded part of the whorl are stronger than the others and are separated by interspaces as broad as on the penultimate whorl; the other spiral ribs on the body whorl are separated by narrower interspace than the main spirals, and a fine spiral thread occurs in each interspace; aperture ovate in outline, shorter than the spire; outer lip rather thin, inner side almost smooth; inner lip with thin, somewhat broad callous deposit; canal short, narrow, and almost straight; altitude of shell, 79.0 mm; height of spire, 47.0 mm; maximum diameter, 45.0 mm; minimum diameter, about 40.0 mm; height of aperture, 39.0 mm; breadth of aperture, 20.0 mm; apical angle, 56°.

Remarks:—One well preserved specimen is at hand. This new species is closely related to the preceding one, but the large number of spiral ribs on each whorl, and the intercalary threads on the distal part of the body whorl serve to distinguish it from allied species.

This specific name is dedicated to Dr. F. STEARNS MACNEIL, formerly of the U. S. Geological Survey, and who gave valuable help to the writer.

Locality:—80906, calcareous concretion in greenish-gray, fine-grained sandstone, lower part of the Poul Creek formation.

Reg. No. TUE 10051 (holotype).

Ancistrolepis sp.

Plate 13, fig. 4

Description:—Shell small with six rather inflated whorls; suture depressed to slightly channeled; surface ornamented with flat-topped rather squarish spiral ribs; nuclear whorl globose; first whorl smooth and swollen; second whorl with a weakly developed spiral thread; the third with two disinct spiral threads of which the anterior one is flat-topped, and which are separated by an interspace nearly equal to the width of rib; fourth and fifth whorls with three spiral ribs, of which the anterior two are flat-topped, squarish, and stronger than the rest; body whorl with about six spiral ribs, of which the third one beneath the suture is strongest; distal part of body whorl almost smooth; canal rather short, twisted to the left; outer lip thin, inner lip callused; length of shell, 30.0 mm; height of aperture, 14.0 mm; maximum diameter, 10.5 mm; and minimum diameter, 10.0 mm (somewhat deformed specimen); apical angle about 37°.

Remarks:—Two specimens are at hand, one of which is more or less well preserved, although it is somewhat deformed, especially, the body whorl. It is difficult then to estimate the original shape of the aperture and canal. The specimens are tentatively included under *Ancistrolepis* DALL, based on general features.

Localities:—80905, 81401, olive-green, fine- to medium-grained sandstone, upper part of the Poul Creek formation.

Reg. No. TUE 10052.

Genus *Beringius* DALL, 1887

Beringius DALL, Proc. U.S. Nat. Mus., vol. 9, no. 571, p. 304, 1887; *Beringius* DALL. OLDROYD, Stanf. Univ. Publ., Univ. Ser., Geol. Sci., vol. 2, pt. 1, p. 192, 1927; *Beringius* DALL. THIELE, Handbuch der System. Weicht., p. 306, 1931.

Type of genus (original designation):—*Chrysodomus crebricostatus* DALL, Recent, Arctic to British Columbia.

Remarks:—This genus is somewhat similar to genus *Neptunea* BOLTEN, 1798, but the former differs from the latter by having wide, short, and hardly recurved canal, large cylindrical or bulbose nuclear whorl, and the spire which is usually longer than the aperture.

Geographic distribution:—Arctic to British Columbia, and Japan.

Geologic range:—Questionably Miocene to Recent.

Beringius cf. *B. crebricostatus* (DALL), 1879

Plate 15, fig. 3

1879. *Chrysodomus crebricostatus* DALL, Proc. Calif. Acad. Sci., vol. 7, p. 6, pl. 2, figs. 1a-c.
1927. *Beringius crebricostatus* (DALL). OLDROYD, Stanf. Univ. Publ., Univ. Ser., Geol. Sci., vol. 2, pt. 1, p. 193, pl. 23, fig. 1.
1954. *Jumala crebricostata* DALL. ABBOTT, Amer. Seashell, p. 227, fig. 51, b.

Remarks:—An incomplete, somewhat compressed specimen has been examined. It is represented by anterior three whorls, of which the body whorl is somewhat well preserved, although the anterior canal is missing. The pinultimate one is complete and the most posterior whorl lacks its posterior half.

This species is characterized by having a deep suture and a wide sulci beneath suture, and the strong, flat-topped, spiral cords separated by channeled interspaces. The pinultimate whorl has four spiral cords, of which three are distinctly strong and the rest situated just above the suture is weaker than the others. The body whorl of the present specimen is ornamented with more than eight spiral cords, of which three one beneath the suture are stronger than the other. These spiral cords are separated by rather wide interspaces which have no intercalary spiral threads.

This specimen is somewhat similar to *N.* (*S.*) *lyrata* of MACNEIL (1957, p. 113, pl. 17, fig. 11) from the moraine of Gyuot Glacier, Gulf of Alaska, Pleistocene or Recent, but the present specimen is distinguished from *N. lyrata* of MACNEIL by having more tabulate beneath suture, and a large number of spiral cords on the pinultimate and body whorls, i. e., the present specimen has four spiral cords on the pinultimate whorl, of which the most anterior one (just above the suture) is weaker than the other, whereas *N. lyrata* of MACNEIL has three spiral cords on the pinultimate whorl. Moreover, the spiral cords on the body whorl of MACNEIL's *N. lyrata* provides almost equal-sized spiral cords separated by the fairly wide interspaces which bear usually fine secondary spiral threads, whereas no intercalary spirals develop on the present specimen.

Locality:—80404, dark-gray siltstone, Yakataga formation.

Reg. No. 10049.

Genus *Colus* RÖDING, 1798

Colus RÖDING in BOLTON, Mus. Boltineanum, p. 117, 1798; *Colus* BOLTEN. OLDROYD, Stanf. Univ. Publ. Univ. Ser. Geol. Sci., vol. 2, pt. 1, p. 211, 1927; *Colus* BOLTEN. GRANT and GALE, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 661, 1931.

Type-species (by subsequent designation, DALL, 1906):—*Murex islandicus* GMELIN, Recent, Iceland to Ireland.

Remarks:—This genus is characterized by the long-fusiform, slender shell, with numerous rounded whorls which are ornamented with spiral sculpture or are smooth. Moreover, the moderate size of the aperture, simple, not reflexed outer lip, smooth pillar, and somewhat tortuous canal serve to distinguish it from allied genera. This genus is closely related to *Neptunea* RÖDING, 1798, but *Colus* is usually smaller, more slender, with less inflated whorls and a shorter aperture than those of *Neptunea*.

Geographic distribution:—Circumboreal, Arctic Ocean to San Diego, California, and north of lat. 33°N in the western Pacific region.

Geologic range:—Possibly Oligocene to Recent.

Colus aff. *C. jordani* DALL, 1913

Plate 13, figs. 3a-b

Description:—Shell of moderate size with about six whorls; suture distinct, whorls moderately rounded; surface ornamented with fine, close-set incremental lines of growth, crossed by numerous fine spirals with very narrow interspaces; aperture elongate-ovate in outline, less than half the length of the shell; outer lip thin, simple,

flexuous, gently inflated; canal short, rather narrow, more or less recurved; height of shell, 34.0 mm; height of aperture, 15 mm; maximum diameter, 15.5 mm; minimum diameter, 15.0 mm; apical angle, 41°.

Remarks:—Several specimens on which periostracum and the nuclear whorl are missing are at hand. They are closely similar to the specimen reported by GRANT and GALE (1939) from the upper Pliocene of Oregon, but which differs slightly by having a wide anterior canal and a more expanded outer lip on the anterior part of the aperture. Recent species are somewhat similar to the present one but they differ by having a more slender shell, a wider anterior canal, and a more expanded outer lip than the fossil species.

These specimens seem to represent a new species, but they are too poorly preserved to establish a new species.

Localities:—80905, 81202, olive-green, fine-grained sandstone, upper part of the Poul Creek formation.

Reg. No. TUE 10053.

Family Fusinidae

Genus *Priscofusus* CONRAD, 1865

Priscofusus CONRAD, Am. Jour. Conchology, vol. 1, p. 150, 1865; *Priscofusus* CONRAD. GRANT and GALE, Mem. San Diego Nat. Hist., vol. 1, p. 490, 1931; *Priscofusus* CONRAD. MOORE, U.S. Geol. Surv. Prof. Pap., 419, p. 39, 1963; *Priscofusus* CONRAD. HICKMANN, Mus. Nat. Hist., Univ. Oregon, Bull. no. 16, p. 96, 1969.

Type-species (by subsequent designation, COSSMANN, 1901):—*Fusus geniculus* CONRAD, Astoria formation, Miocene, Oregon.

Remarks:—*Priscofusus* is characterized by a fusiform shell, moderately high spire, and a moderately short and strongly recurved canal. The spire is angulated, and has rounded or transversely elongated nodes, or an intermittent or constant swelling of one spiral cord. The body whorl is noded like the spire or may be smooth. The surface is sculptured by numerous strong spiral lines between which secondary spirals are sometimes intercalated, and growth lines bending backward below the suture in a broad, shallow, rounded embayment with its maximum depth close to the periphery. The suture is appressed and generally even and collared.

The present genus is closely similar to *Siphonalia* A. ADAMS, 1863, which differs by having a distinct posterior canal, large fasciole, and crenulations inside of the outer lip.

This genus seems to have flourished in the middle Miocene age on the west coast of North America.

Geographic distribution:—West coast of North America, south of Kodiak Island, Gulf of Alaska, to California.

Geologic range:—?Eocene, Oligocene to early Pliocene of the Pacific coast of North America.

Priscofusus clarki KANNO, n. sp.

Plate 13, fig. 8; Plate 14, figs. 8, 9, 15

1932. *Fusinus* cf. *F. hannibali* CLARK and ARNOLD. CLARK, Bull. Geol. Soc. Am., vol. 43, p. 833, pl. 20, figs. 1-3.
1971. *Priscofusus* aff. *P. hannibali* (CLARK and ARNOLD). ADDICOTT et al., U.S. Geol. Surv. Prof. Pap., 750-C, Fig. 2, a, d, e, f.

Description:—Shell medium for the genus, fusiform, with about six whorls; spire rather high, with a blunt apex; whorls of the spire obtusely angulated a little anterior to the middle, nearly flat above and slightly convex below; ornamentation consisting of fine spiral threads separated by wider interspaces carrying fine intercalary lines and thirteen to fifteen nodes which run obliquely from the shoulder to behind the suture; on the penultimate whorl with about thirteen major spiral threads; suture distinct; body whorl inflated, ornamented with a row of nodes in a little above the middle producing, a slight angular appearance, convex above and below; spiral sculpture similar to that of the whorls of the spire, excepting the rhythmic alternation with secondary spirals; aperture elongate-ovate in outline, with a broad and shallow posterior canal; anterior canal narrow and moderately long, and twisted to left.

Measurements (in mm):

Specimens	Altitude of		Maximum diameter	Apical angle
	shell	aperture		
Holotype	41.5	21.0	20.0	48°
Paratype*	28.0	15.0	14.0	50°

* Apex and anterior part of canal defective.

Remarks:—Many specimens are at hand, but most are represented by inner moulds or rubber casts made from external moulds. Although the specimens are incomplete, the rubber casts represent detailed sculpture. The surface sculpture of intercalary spiral threads seems to be variable; e. g., some specimens show rhythmic alternation of the main and secondary spiral threads, but on others this alternation is restricted to only a part of the surface of the whorl.

The new species was originally described by CLARK (1932) as *Fusinus* cf. *hannibali* CLARK and ARNOLD, based on incomplete specimens. The type species of *F. hannibali* is from the Sooke formation (Oligocene) of Vancouver Island, however, it differs by having a more slender spire, smaller number of longitudinal nodes (about nine to eleven), a distinct sutural collar, and coarse internal striations on the outer lip. *Priscofusus lincolnensis* (ANDERSON and MARTIN), (WEAVER, 1942, p. 487, pl. 93, figs. 8-9), is somewhat similar to this species but it can be distinguished by the large number of main spiral threads on the penultimate whorl (about twenty-four).

Localities:—80902, 80905, 81002, 81201, 81401, greenish gray, fine-grained sandstone, upper part of the Poul Creek formation; 81404, olive-green, fine-grained sandstone, lower part of the Poul Creek formation.

Reg. Nos. TUE 10054 (holotype); TUE 10055 (paratype).

Priscofusus sp.

Plate 14, figs. 11, 12, 13

Remarks:—Several deformed and incomplete specimens are at hand. These specimens are closely akin to the preceding species, but the less number of radial nodes (about ten) and spiral threads (about nine to ten) on the penultimate whorl serve to distinguish it from the preceding species. However, it is difficult to decide that these differences may be due to individual variation rather than of specific rank. The present writer hesitates to give a conclusion because the specimens are incomplete and there are very few complete specimens of *P. clarki* at hand.

Localities:—80905, greenish gray, fine- to medium-grained sandstone, upper part of the Poul Creek formation; 81404, olive-green, fine-grained sandstone, lower part of the Poul Creek formation.

Reg. No. TUE 10056.

Family Volutidae

Genus *Musashia* HAYASHI, 1960

Musashia HAYASHI, Jap. Jour. Malac., vol. 21, no. 1, p. 2, 1960; *Musashia* HAYASHI. SHIKAMA, Sci. Rep. Yokohama Nat. Univ. sec. 2, no. 13, p. 32, 1967.

Type-species (by original designation):—*Voluta hirasei* SOWERBY, Recent, Suruga Bay to off Kochi, Shikoku, Japan.

Remarks:—This genus was originally described by HAYASHI (1960), as a subgeneric taxon, as follows; "protoconch similar to the group 'b' (*Psephaea*); shell without a colour pattern (except the weak spiral lines); ground colour of shell deep fleshy; columellar plaits generally 1 (sometimes with a weak additional one above". Subsequently, SHIKAMA (1967) raised it to generic rank, and gave this diagnosis: "no operculum; initial columella plaits 1-2 and last columellar plaits 1-4; the value of the y/x ratio* rather small, species with above 0.60 being less than 30 percent of the total; subsutural band almost present; shell often becomes very large".

Geographic distritution:—Northern Pacific, Japan and the west coast of North America.

Geologic range:—Possibly Oligocene to Recent.

Subgenus *Neopsephaea* TAKEDA, 1953

Neopsephaea TAKEDA, Stud. Coal Geol., no. 3, p. 59, 1953; *Neopsephaea* TAKEDA. SHIKAMA, Sci. Rep. Yokohama Nat. Univ., Sec. 2, no. 12, p. 33, 1967.

Type-species (by original designation):—*Psephaea antiquior* TAKEDA, Poronai formation (Oligocene), Hokkaido, Japan.

Remarks:—The original description of the subgenus *Neopsephaea* TAKEDA (1953) is as follows: "columella thick, with one oblique plait; *Aurinia* A. ADAMS and *Guivillea* WATOSON are distinguished from this subgenus by lacking the fold on pillar".

* y ··· width of ultimate protoconch volution; x ··· width of the first teleoconch volution.

SHIKAMA (1967) gave this diagnosis: "initial and last columella plaits one; teleoconch with 4-5 volutions; suture not deep, without subsutural band; spire very low and slender, fusiform in general outline; small size".

Musashia (Neopsephaea) corrugata (CLARK), 1932

Plate 15, figs. 5a-b; Plate 18, fig. 11

1932. *Psephaea corrugata* CLARK, Bull. Geol. Soc. Am., vol. 43, p. 831-832, pl. 21, figs. 4, 5, 11.
1971. *Musashia (Miopleiona) corrugata* (CLARK). ADDICOTT et al., U.S. Geol. Surv. Prof. Pap., 751-C, Fig. 2, y, aa, bb.

Description:—Shell rather thin, slender, with five or six whorls; the height of aperture greater than that of the spire; surface sculptured by fine threads and longitudinal ribs which taper on the anterior part of the body whorl; longitudinal ribs, about 13 on penultimate whorl, slightly deflected near the sture; ribs prominent, heavy, rounded separated by interspaces slightly wider than the ribs, a few fine longitudinal threads cover the ribs; whole surface sculptured by fine, closely spaced subequal spiral threads, which are not swollen where they cross the ribs and do not produce denticles on the edge of the outer lip; suture appressed; subsutural band more or less distinct; number of volutions of protoconch about 2, ratio of the width of ultimate protoconch (y) and that of first teleoconch volution (x) is about 6.3; pillar straight, with one strong plait, which tapers toward the posterior whorl, and is hardly visible on the few whorls beneath the protoconch (Plate 18, fig. 11); outer lip arcuate, receding toward the suture, not denticulate; shell consists of three layers i.e., the fine spiral threads are distinct on the outer surface of fresh specimens, but many microscopic longitudinal striations appear when the outer surface is weathered; moreover, there is a different inner layer under the meso-layer; inner layer shows many microscopic transverse striations; length, 89.0 mm; maximum diameter, 27.5 mm (somewhat compressed specimen); length of spire above the aperture, 43.0 mm; height of aperture, 46.0 mm.

Remarks:—This species was originally described by CLARK (1932) from the upper reaches of Hamilton Creek. Its characteristics are the surface sculpture of about 13 to 15 radial ribs and fine spiral lines, and the single plait on the columella of the anterior whorls of mature specimens. Ontogenetically, the columella plait seems to be only in the later stages of growth. Judging from SHIKAMA's study (1967), this species seems to be suggestive of a rather primitive development of the plait, because the columella plait of this species hardly develops in the young stage. However, this species is tentatively assigned to *Musashia* HAYASHI, which has one columella plait on the initial volution, whereas there is hardly developed plait on the younger growth stage of the present species.

Psephaea (Miopleiona) indurata (CONRAD), (DALL, 1909, pl. 18, fig. 5; MOORE, 1963, p. 43, pl. 7, figs. 1-3, 6-9, 11; pl. 8, figs. 1-5), seems to be related to the present species but it differs from CONRAD's species in having fewer longitudinal ribs (about 13 to 14 instead of 18 to 21), and one distinct columellar plait instead of two. *Musashia (Neopsephaea) antiquior* (TAKEDA) from the Oligocene Poronai formation (TAKEDA,

1953, pl. 4, figs. 1-4; pl. 5, fig. 7) is closely related to this species in general shape, but detailed comparison of the two species is difficult because of the defective columellar fold on TAKEDA's specimen.

Localities:—80601, 80905, 81401, 20493, 20503, fine- to medium-grained sandstone, upper part of the Poul Creek formation; 81404, olive-green, fine-grained sandstone, lower part of the Poul Creek formation.

Reg. No. TUE 10057.

Musashia (*Neopsephaea*?) sp.

Plate 15, fig. 4

Description:—Shell rather thick for the genus, somewhat swollen, with six or seven whorls, although the present specimen is somewhat compressed and its apical part is missing; aperture much higher than the height of spire; surface sculptured by longitudinal ribs and barely visible fine spiral threads; longitudinal ribs seem to be slightly deflected near the suture, and separated by the interspaces as wide as or slightly narrower than the ribs, number of ribs indeterminate; surface of longitudinal ribs ornamented by a few fine radial threads; pillar straight, with two distinct, almost equal sized plaits; outer lip arcuate, receding toward the suture, not denticulate; shell consists of, at least, two layers viewed under the microscopic, i. e., an outer longitudinal layer and an inner transverse layer; length of shell (incomplete specimen), about 100.0 mm; height of aperture, 55.5 mm; height of spire above the aperture, 48.0 mm.

Remarks:—A rather compressed specimen and its external mould are at hand. Though it is represented by compressed specimen, this species is more or less similar to *M.* (*N.*) *corrugata* but the larger number of columella plaits and the lesser height of spire serve to distinguish it.

Locality:—80702, fine-grained silty sandstone, upper part of the Poul Creek formation.

Reg. No. TUE 10058.

"*Fulgoraria*" sp.

Plate 14, figs. 14a-b

Description:—Shell thin, rather small for the genus, slender, with more than five whorls (apical portion missing); surface sculptured by fine spiral threads and longitudinal ribs; fine spiral threads are well developed over the entire surface, i. e., about 20 main spiral threads occur on the penultimate whorl, and separated by wider interspaces where secondary fine spirals are intercalated between the main and intercalary spirals; longitudinal ribs are distinct on the teleoconch, but it tapers towards the body whorl where the longitudinal ribs become indistinct and are represented by a few irregular radial undulations; number of volutions of protoconch inaccessible; pillar somewhat curved to the left, although this form might be dure to deformation; columella plait barely visible; shell structure same as in *M.* (*N.*) *corrugata* (CLARK); apertue elongate ovate, higher than spire; length of shell (in-

complete specimen), 59.0 mm; height of spire, 33.0 mm; maximum diameter about 18.0 mm.

Remarks:—The rather small incomplete specimen at hand is characterized by poorly developed longitudinal ribs which are distinct only beneath the suture, and well developed fine spiral threads. The general features of this species bears some reseblance to *Miopleona weaveri* TEGLAND, (WEAVER, 1942, p. 492, pl. 94, figs. 6, 10, 11), but it differs from the present species by its well developed longitudinal ribs which are distinct on the whole surface, and its large apical angle. Although the present specimen is somewhat similar to *Musashia*, the surface sculpture, obsolete columellar plait, and state of preservation make it difficult to determine its generic position.

Locality:—81201, olive-green, fine- to medium-grained sandstone, upper part of the Poul Creek formation.

Reg. No. TUE 10059.

Suborder Toxoglossa

Family Cancellariidae

Genus *Cancellaria* LAMARCK, 1799

Cancellaria LAMARCK, Soc. Hist. Nat. Paris, Ser. 1, p. 71, 1799; *Merica* H. and A. ADAMS, Gen. Rec. Shells, vol. 1, p. 277, 1854; *Euclia* H. and A. ADAMS, ditto, p. 277, 1854; *Cancellaria* LAMARCK. OLDROYD, Stanf. Univ. Publ. Univ. Ser. Geol. Sci., vol. 2, pt. 1, p. 151, 1927; *Cancellaria* LAMARCK. GRANT and GALE, Mem. San Diego Nat. Hist., vol. 1, p. 612, 1931; *Cancellaria* LAMARCK. THIELE, Handb. Sys. Weicht., p. 352, 1931; *Cancellaria* LAMARCK. MOORE, U. S. Geol. Surv. Prof. Pap., 419, p. 44, 1963; *Cancellaria* LAMARCK. ADDICOTT, U. S. Geol. Surv. Prof. Pap., 642, p. 105-106, 1970.

Type-species (by monotypy):—*Voluta reticulata* LINNÉ, Recent, North Carolina to both sides of Florida, and the West Indies.

Remarks:—This genus is characterized by cancellate surface sculpture, a short anterior canal, and a columella with several strong oblique folds. *Cancellaria* occurs south of lat. 39°N to tropical regions in the western Pacific, but most species occur south of lat. 35°N. This genus is representative of warm water conditions.

Fossil species in Japan range from the Oligocene to the Pleistocene. According to ADDICOTT (1970, p. 105), genus reached to a sudden flood of species and many subgeneric units appeared in the middle Miocene, "Temblor stage" of the Pacific coast megafaunal chronology of WEAVER and others (1944).

Geographic distribution:—Florida, West Indies, Mediterranean, West Africa, India, China, Japan, West Coast of North America.

Geologic range:—Upper Cretaceous to Recent (WOODWARD, 1910).

Subgenus *Crawfordina* DALL, 1919

Crawfordina DALL, U. S. Nat. Mus., vol. 56, p. 306, 1919; *Crawfordina* DALL. GRANT and GALE, Mem. San. Diego Nat. Hist., vol. 1, p. 614, 1931; *Crawfordina* DALL. ADDICOTT, U. S. Geol. Surv. Prof. Pap., 642, p. 117, 1970.

Type-species (by monotypy):—*Cancellaria crawfordina* DALL, Pliocene to Recent, northeastern Pacific Ocean, from Alaska to San Diego, California.

Remarks:—*Crawfordina* is characterized by an elongate-ovate shell with axial and spiral sculpture, and a long columella with two oblique folds. The subgenus is distinguished from *Cancellaria* (*Cancellaria*) by its more elongate shape, smaller, more oblique plaits, and shorter columella.

Cancellaria (*Crawfordina*) *alaskensis* CLARK, 1932

Plate 14, figs. 17, 18; Plate 18, fig. 9

1932. *Cancellaria* (*Progabbi*) *alaskensis* CLARK, Bull. Geol. Soc. Am., vol. 43, p. 832, pl. 20, figs. 10, 12, 16, 17.

1971. *Cancellaria* (*Crawfordina*) *alaskensis* CLARK. ADDICOTT et al., U.S. Geol. Surv. Prof. Pap., 750-C, Fig. 2, l, m, q, r.

Remarks:—This species was originally described by CLARK (1932) from U.C. locality 3864, which was not plotted on his locality map. However, according to the present study this species seems to be restricted to the upper part of the Poul Creek formation where it occurs abundantly.

This species is characterized by: 1) about five whorls with a rather strongly depressed suture; 2) 18 to 19 narrow, rounded, obliquely longitudinal ribs on the body whorl; 3) about seven major spiral ribs on the penultimate whorl and 17 to 18 spiral ribs on the body whorl; 4) a short, straight anterior canal; and 5) two distinct columellar folds. However, it is rather difficult to observe the columellar folds unless an axial section through the columella is made, because the most specimens are somewhat deformed and poorly preserved. This species is somewhat similar to *C. weaveri* ETHERINGTON, (WEAVER, 1942, p. 505, pl. 96, fig. 4), from the Astoria formation (Miocene), which has a larger number of longitudinal ribs (about 26 compared with 17-18 in the present species).

Localities:—81201, 81401, 20503, olive-green, fine- to medium-grained sandstone, upper part of the Poul Creek formation.

Reg. No. TUE 10060.

Family Turridae

Genus *Antiplanes* DALL, 1902

Antiplanes DALL, Proc. U.S. Nat. Mus., vol. 24, p. 513, 1902; *Antiplanes* DALL. OLDROYD, Stanf. Univ. Publ. Univ. Ser., Geol. Sci., vol. 2, pt. 1, p. 81-82, 1927; *Antiplanes* DALL. THIELE, Handb. Syst. Weicht., p. 360, 1931; *Antiplanes* DALL. GRANT and GALE, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 552-553, 1931; *Antiplanes* DALL. KEEN, Mar. Moll. Gen. West. North Am., p. 40-41, 1963.

Type-species (by original designation):—*Pleurotoma* (*Surcula*) *perversa* GABB, Pleistocene?, San Pedro, California; the species is living from Alaska to off the coast of Lower California, in muddy bottoms from 80 to 120 meters in depth.

Remarks:—According to DALL, this genus is characterized by having an almost smooth shell surface, a shallow and more or less rounded posterior sinus which

usually is situated some distance from the suture, a rather wide and long canal which is often somewhat recurved, and is represented by both dextral and sinistral species. However, KEEN (1963) subdivided this genus into two subgenera, *Antiplanes* s. s. and *Rectiplanes* BARTSCH, of which the former is coiled sinistrally and the latter is characterized by dextral coiling.

Geographic distribution:—North Pacific, mostly in deep water.

Geologic range:—Eocene to Recent (GRANT and GALE, 1931).

Subgenus *Antiplanes* s. s.

Remarks:—This subgenus is characterized by elongate, and sinistral shell, with aperture about one-half the length of the spire.

The present subgenus is reported from the Pacific coast of Japan north of lat. 35°N at depths of 30 to 250 meters.

Antiplanes (*Antiplanes*) sp.

Plate 15, figs. 9a-b

Description:—Shell small, sinistral, with six or seven whorls (apical part missing); spire more or less high, nuclear whorls inaccessible; suture deep; body whorl large, ventricose, higher than the half of the length of the entire shell; surface smooth excepting for incremental lines of growth which bend backwards; aperture rounded-ovate, broadest in the middle, narrowing regularly anteriorly; inner lip moderately incrusted; outer lip simple; sinus rather broad, deep, rounded, and adjoining the suture; canal very short and rather borad; height of shell, (apical portion missing), 15.0 mm; height of aperture, 8.0 mm; maximum diameter (somewhat compressed specimen), ca. 9.0 mm; apical angle, about 40°.

Remarks:—A rather well preserved, but somewhat compressed specimen is at hand. It is characterized by an extremely short and small shell, compared to known species. The present specimen seems to represent a new species, but more specimens are needed to establish a new name.

Locality:—80604, dark-gray, massive siltstone, lower part of the Yakataga formation.

Reg. No. TUE 10061.

Genus *Turricula* SCHUMACHER, 1817

Turricula SCHUMACHER, Ess. d'um Nouv. Syst., p. 217, 1817; *Turricula* SCHUMACHER. THIELE, Handb. Syst. Weicht., p. 360, 1931; *Turricula* SCHUMACHER. GRANT and GALE, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 486, 1931; *Turricula* SCHUMACHER. ADDICOTT, U. S. Geol. Surv. Prof. Pap., 642, p. 129, 1970.

Type-species (by monotypy):—*Turricula flammea* SCHUMACHER, Recent, East Indies.

Remarks:—This genus is characterized by having high spire, shouldered whorls with spiral sculptures, large aperture about half as long as the whole length, and long and narrow anterior canal curved backwards.

This genus is related to *Clavatula* LAMARCK, 1801, but *Turricula* differs by hav-

ing longer and narrower anterior canal, more inconspicuous sutural band, and simpler surface sculpture than those of *Clavatula*.

Geographic distribution:—Warm waters of tropical to subtropical regions.

Geologic range:—Cretaceous to Recent.

Turricula cf. *T. washingtoniana* (WEAVER), 1912

Plate 14, figs. 10

1912. *Pleurotoma washingtoniana* WEAVER, Wash. Geol. Surv., Bull. no. 15, p. 78, pl. 3, fig. 31.
1916. *Turris washingtonianus* (WEAVER), WEAVER, Univ. Wash. Publ. Geol., vol. 1, pl. 4, fig. 45.
1942. *Turricula washingtonensis* (WEAVER), WEAVER, Univ. Wash. Publ. Geol., vol. 5, p. 533, pl. 98, figs. 16, 17, 22.

Remarks:—A single rather poorly preserved external mould and its rubber-cast are at hand. This species is characterized by a high fusiform spire with heavy, noded cord-like, spiral angles and a smooth concave surface above, and a spirally striated surface below. According to WEAVER (1942), the apical angle and strength of nodes of this species show a rather wide range of variation. The present specimen has a distinct, strong cord-like spiral angle, but heavy nodes are poorly developed on the cord. It seems to represent a varietal form.

Locality:—81404, olive-green, fine-grained sandstone, lower part of the Poul Creek formatton.

Reg. No. TUE 10062.

Turricula sp.

Plate 14, fig. 16

Remarks:—An external mould and its rubber cast are at hand. This specimen is similar to the preceding one, but its large apical angle and more acute keel-like cord are different from *Turricula* cf. *T. washingtonensis*. Both specimens have the same surface sculpture of fine, silk-like spiral threads beneath the spiral cord on the body whorl.

Locality:—80905, olive-green, fine- to medium-grained sandstone, upper part of the Poul Creek formation.

Reg. No. TUE 10063.

Order Tectibranchiata

Family Scaphandridae

Genus *Scaphander* MONTFORT, 1810

Scaphander MONTFORT, Conch. Syst., vol. 2, p. 335, 1810; *Scaphander* MONTFORT. OLDROYD, Stanf. Univ. Publ., Univ. Ser. Geol. Sci., vol. 2, pt. 1, p. 35, 1927; *Scaphander* MONTFORT. GRANT and GALE, Mem. San Diego Soc. Nat. Hist., vol. 1, p. 451, 1935; *Scaphander* MONTFORT. KEEN, Mar. Moll. Gen. West. North Am., p. 18, 1963; *Scaphander* MONTFORT. ADDICOTT, U.S. Geol. Surv. Prof. Pap. 642, p. 139, 1970;

Type-species (by original designation):—*Bulla lignaria* LINNÉ, Recent, eastern North Atlantic and Mediterranean Sea.

Remarks:—*Scaphander* is characterized by having a large elongate-ovate shell, an involute spire, a shallow apical perforation, a large and wide aperture broadly expanded anteriorly, and a surface sculptured by narrow spiral grooves.

Geographic distribution:—World-wide, on sandy bottom about 100 meters in depth.

Geologic range:—Eocene to Recent.

Scaphander alaskensis CLARK, 1932

Plate 15, figs. 7-8; Plate 18, figs. 6, 7

1932. *Scaphander alaskensis* CLARK, Bull. Geol. Soc. Am., vol. 43, p. 834, pl. 21, figs. 6, 7.
1932. *Haminoea* n. sp.? CLARK, Bull. Geol. Soc. Am., vol. 43, p. 834, pl. 21, fig. 12.
1971. *Scaphander alaskensis* CLARK. ADDICOTT et al., U.S. Geol. Surv. Prof. Paper 750-C, Fig. 1, g, h.
1971. *Haminoea* n. sp.? CLARK. ADDICOTT et al., U.S. Geol. Surv. Prof. Paper, 750-C, Fig. 2, u, v.

Remarks:—Several specimens are at hand. This species was originally described by CLARK (1932) from the Poul Creek formation (U.C. loc. 3854) exposed on the right side of Beare Glacier. Although the writer was unable to collect it from the type locality, several specimens were collected from the Poul Creek formation at Lear Glacier and Johnstone Creek, about 8 kilometers and 12.5 kilometers respectively west of the type locality.

The present species is characterized by a large shell, numerous fine spiral grooves which alternate in strength. It is noteworthy that the shape of the present shell is extremely variable, i.e., some specimens are rather elongate form (Plate 15, figures 8a-b), but others are more globose (Plate 15, figures 7a-b). Specimens figured in Plate 18, figures 6, 7 are the most globose, but their general features are the same as the preceding ones.

Localities:—81201, 81401, olive-green, fine- to medium-grained sandstone, upper part of the Poul Creek formation.

Reg. No. TUE 10064.

CEPHALOPODA

Subclass Nautiloidea

Order Nautilida

Family Aturiidae

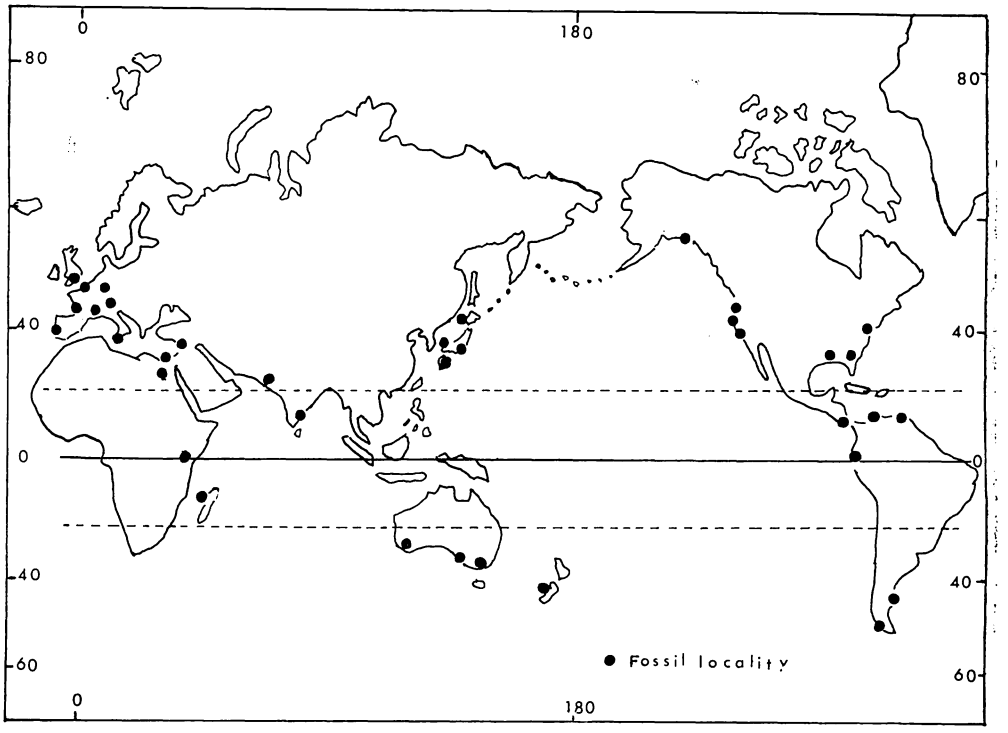
Genus *Aturia* BRONN, 1838

Aturia BRONN, Lethaea geognostica, vol. 2, p. 1122-1123, pl. 42, figs. 17a-c, 1838; *Aturia* BRONN. SCHENCK, Univ. Calif. Publ. Bull. Dept. Geol. Sci., vol. 19, no. 19, p. 448-450, 1931; *Aturia* BRONN. MILLER. Geol. Soc. Am., Mem. 23, p. 78-81, 1948; *Aturia* BRONN. MOORE, U.S. Geol. Surv. Prof. Paper 419, p. 85, 1963; *Aturia* BRONN. MOORE et al., Treat. Invert. Paleont., pt. K, Moll. 3, p. 457, 1964.

Type-species (by tautonomy):—*Nautilus aturi* BASTEROT, lower Miocene (lower Burdigalian) in St. Poul de Dax (Landes), France.

Remarks:—The genus is characterized by having a quite narrow umbilicus, a rounded venter, a siphuncle situated very near the dorsum, almost tubular and pointed simple funnels similar to the siphuncle, and very simple sutures.

About 40 species are reported from the Tertiary strata throughout the world, and they are restricted in age from the Eocene to the Miocene, excepting one species from the Chico formation (upper Cretaceous) of the west coast of North America (SCHENCK, 1931) and one from the questionable Pliocene of Australia (SCHENCK, 1931) (Text-fig. 16). However, there are no reported occurrences of *Aturia* from upper



Text-fig. 16. Geographic distribution of *Aturia*.

Miocene or younger strata in the northern Pacific region both from the west coast of North America and the western Pacific. There are seven species from Eocene to middle Miocene strata of the west coast of North America and four species from Japan. These species are usually associated with rather warm water inhabitants. However, it is noteworthy that no species of *Aturia* have been reported from the Philippine and Taiwan.

Geographic distribution:—World-wide, essentially in the tropical to subtropical regions.

Geologic range:—Paleocene to Miocene (rarely in the upper Cretaceous and questionably in Pliocene).

Aturia alaskensis SCHENCK, 1931

Plate 16, figs. 1-4; Plate 18, fig. 8

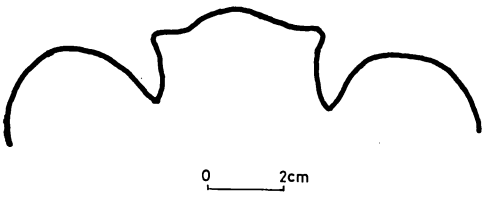
1931. *Aturia angustata* (CONRAD) *alaskensis* SCHENCK, Univ. Calif. Publ. Bull. Dept. Geol. Sci., vol. 19, no. 19, p. 463-464, pl. 71, fig. 2.
1932. *Aturia angustata* (CONRAD) *alaskensis* SCHENCK. CLARK, Bull. Geol. Sci. Am., vol. 43, p. 835, pl. 16, fig. 5, 6.
1954. *Aturia minoensis* KOBAYASHI, Jap. Jour. Geol. Geogr., vol. 25, nos. 1-2, p. 36-39, pl. 5, figs. a-d.
1955. *Aturia minoensis* KOBAYASHI. KOBAYASHI and MASATANI, Trans. Proc. Paleont. Soc. Japan, N.S., no. 17, p. 1-3, pl. 1, figs. a-d.
1956. *Aturia* cf. *A. minoensis* KOBAYASHI. KOBAYASHI and HORIKOSHI, Jap. Jour. Geol. Geogr., vol. 29, nos. 1-3, p. 52-53, pl. 5, figs. 1, 2.
1957. *Aturia minoensis* KOBAYASHI var., KOBAYASHI, Proc. Paleont. Soc. Japan, N.S., no. 28, p. 111-114, pl. 19, figs. 1-3.
1971. *Aturia alaskensis* SCHENCK. ADDICOTT et al., U.S. Geol. Surv. Prof. Paper 750-C, Fig. m, o.

Remarks:—The present species was originally described by H. G. SCHENCK based on a specimen collected from the Poul Creek formation exposed along Johnson Creek, near Yakataga Reef. According to his discription, the present species is characterized by having narrow and pointed lateral lobes which seem to be telscoped into the preceding one. Subsequently, CLARK (1932) described *A. angustata* (CONRAD) *alaskensis* based on the holotype of this species, and stated that "when more and better materal representing these two subspecies is found they will prove to be sufficiently different from the typical species *angustata* to be described as distinct species".

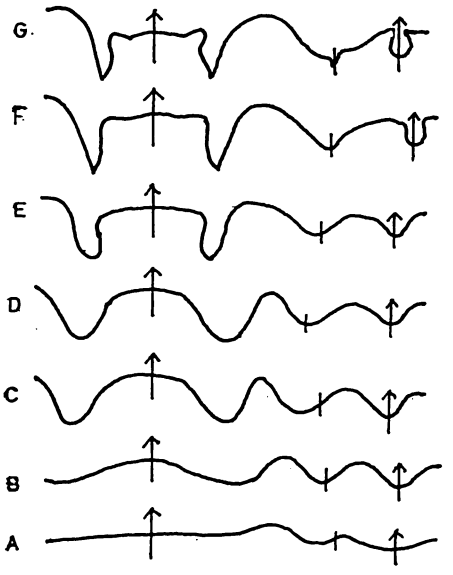
The single specimen upon which this species was described is somewhat deformed. Fortunately, the writer collected more than ten specimens from the type area, of which a few specimens are rather well preserved. The supplemental description based on these specimens is as follows:

Shell fairly large, thin more or less compressed; most expanded at about one-third or half of its height; ventral side regularly rounded but lateral sides are slightly convex; umbilicus closed; siphuncle in the ultimate whorl located at about one-third the distance from the venter of the penultimate whorl to that of the ultimate one; septa closely set; ventral saddle subquadrate and almost same as or somewhat narrower than the lateral saddle; suture nearly transversal on the ventral side except a pair of a small shoulders which protrude antero-laterally and are slightly sinuated backward before their protrusion; lateral saddle large, very high and more convex on the inner side than on the outer side of the whorl; following the lateral saddle umbilical seam distinct (Text-figs. 17, 18).

The ratio (Text-fig. 19) of the height of ventral saddle (x), lateral saddle (z), and the diameter of lateral saddle (y) seems to be variable in various stages of growth in each species, but there are some distinctions between different species. The writer believes that the ratio of the height of the ventral and lateral saddles in correlation with the breadth of lateral saddle has specific significance. Text-fig. 20 is based upon species from the Pacific coast of America and Japan. It is clear that

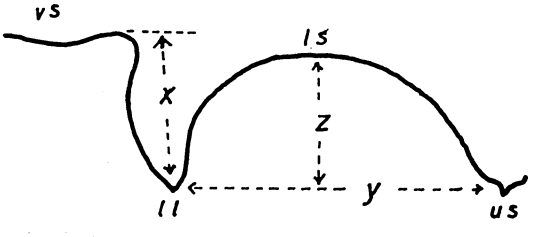


Text-fig. 17. Suture of *Aturia alaskensis* SCHENCK.



Text-fig. 18. Developmental series nautiloid sutures (after MILLER and FURNISH, 1938).

A. *Cimomia* (Paleocene). B. *Hercoglossa* (Lower Eocene), primitive from. C. *Hercoglossa* (Lower Eocene), advanced form. D. *Aturia* (Lower Eocene). F. *Aturia* (Upper Eocene), typical form. G. *Aturia* (Miocene), advanced form.



Text-fig. 19. Ratio* between height of ventral and lateral saddles in suture of *Aturia*.

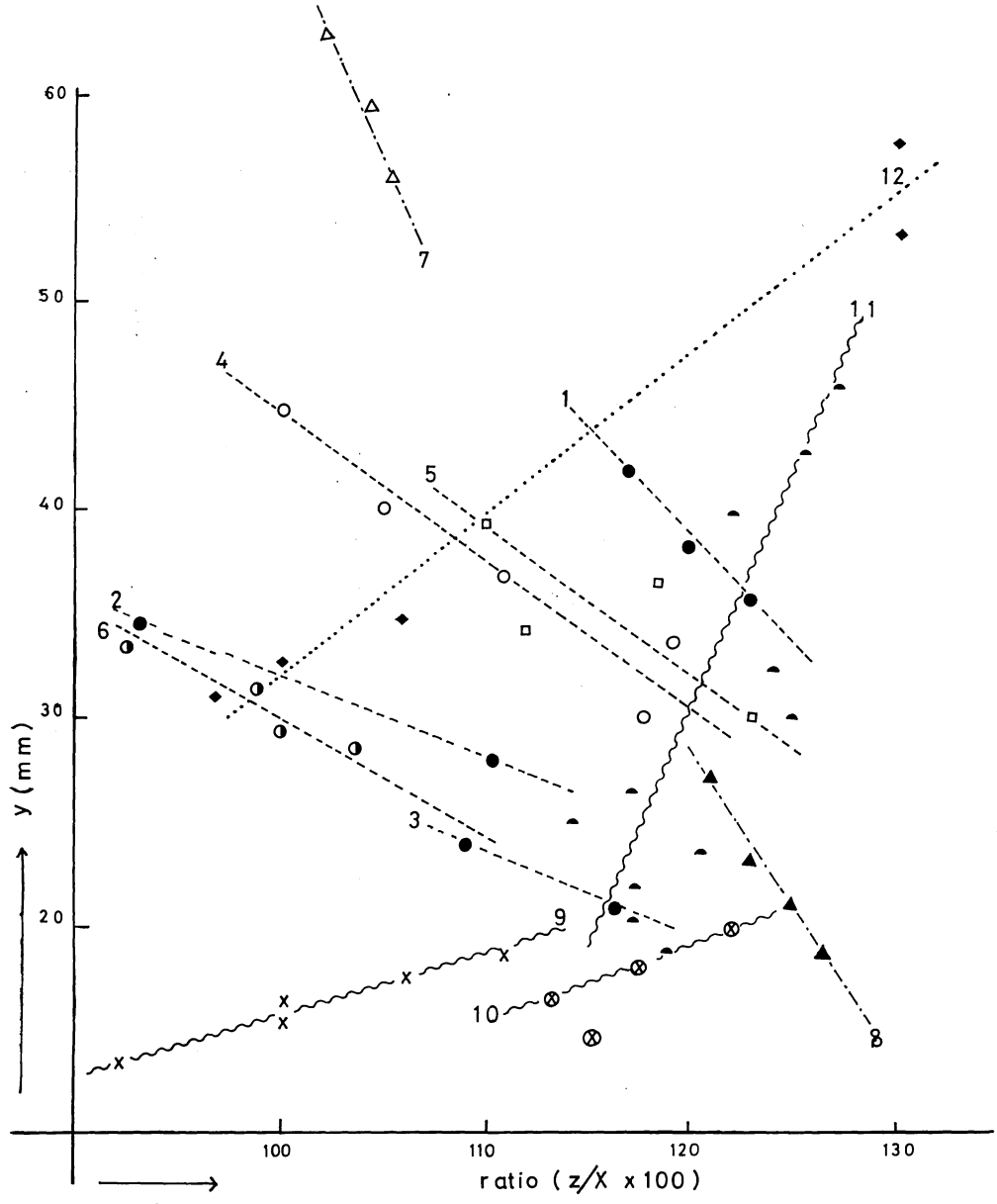
*...Z/X×100, vs...ventral saddle; ls...lateral saddle; ll...lateral lobe; us...umbilical seam.

with the exception of the Alaskan species, the American species are inclined to the right side whereas Japanese ones are inclined to the left side (Text-fig. 20).

The inclination of *A. alaskensis* is almost the same as that of the Japanese species *A. minoensis* KOBAYASHI which has been reported from several lower to middle Miocene localities in Japan. According to the original description (KOBAYASHI, 1954, p. 36-39), *A. minoensis* KOBAYASHI is characterized by having narrow, pointed lateral lobe which form an angle of about 30-35 degrees and which are in contact with the shoulder of the preceding ventral saddle. Moreover, he stated "lateral saddle large, occupying three-fourths of the radius of the whorl, very high and more convex on the inner side than on the outer where it becomes nearly straight or even a little concave near the ventro-lateral lobe". The writer measured the relative growth ratio of *A. minoensis* and other known species of Japan, and these results are shown in Text-fig. 20.

It seems clear that *A. alaskensis* SCHENCK differs from *A. angustata* (CONRAD) which was originally described from the Miocene of Astoria, Oregon. Moreover, the present species is conspecific with *A. minoensis* KOBAYASHI, 1954. Accordingly, KOBAYASHI's *minoensis* is preoccupied by SCHENCK's *alaskensis*.

The present species occurs abundantly in the Yakataga area and is represented by individuals of every growth stage. It is noteworthy that the Asian species of *A. alaskensis* flourished on the Pacific coast of Alaska during deposition of the Poul Creek formation.



Text-fig. 20. Relative dimensions in the sutures of Pacific coast species of *Aturia*. 1-3. Poul Creek specimens; 4-6. "*A. minoensis* KOBAYASHI, 1954" (Miocene species in Japan); 4. Tsukiyoshi specimen; 5. Kurosedani specimen; 6. Oita specimen; 7-8. *A. yokoyamai* NAGAO (Oligocene species in Japan); 7. Ashiya specimen; 8. Poronai specimen; 9-11. *A. angustata* (CONRAD); 9. Washington specimen (Miocene); 10. Licoln Oligocene specimen; 11. Temblor Miocene specimen; 12. *A. myrlae* M. A. HANNA, middle Eocene of Calif.

This species occurs from lower to middle Miocene strata in Japan.

Localities:—80905, 81401, olive-green, fine- to medium-grained sandstone, upper part of the Poul Creek formation; 80906, 81404, dark-gray, calcareous concretions, in dark-gray silty sandstone, lower part of the Poul Creek formation.

Reg. No. TUE 10065.

VIII. REFERENCES

ABBOTT, R. T. (1954): American Seashells. *New York, D. Van Nostrand Co.*, p. 1-541, with 32 pls.

ADDICOTT, W. O. (1967): Zoogeographic Evidence for late Tertiary lateral slip on the San Andreas fault, California. *U. S. Geol. Surv. Prof. Paper 593-D*, p. 1-12.

——— (1969): Tertiary climatic change in the marginal north eastern Pacific Ocean. *Science, Vol. 165, No. 3893*, p. 583-586.

——— (1970): Miocene gastropods and biostratigraphy of the Kern River area, California. U. S. Geol. Surv. Prof. Paper, 642, p. 1-174, with 21 pls.

——— (1970): Latitudinal gradients in Tertiary molluscan faunas of the Pacific coast. *Palaeogeogr., Palaeoclimatol., Palaeoecol., Vol. 8*, p. 287-312.

———, KANNO, S., SAKAMOTO, K. & MILLER, D. G. (1970): CLARK's Tertiary molluscan types from the Yakataga District, Gulf of Alaska, Alaska. *U. S. Geol. Surv. Open-file Report*, p. 1-21, with 6 pls.

———, ———, ——— & ——— (1971): *Ditto, U. S. Geol. Surv. Prof. Paper 750-C*, p. C18-C21.

——— & PLAFKER, G. (1971): Paleogene mollusks from the Gulf of Alaska Tertiary Province; a significant new occurrence on the North Pacific Rim. *U. S. Geol. Surv. Prof. Paper 750-B*, B48-B52.

ALLISON, R. C. (1965): Apical development in turritellid classification with a description on *Cristispira pugetensis*, gen. et sp. nov. *Palaeontology, Vol. 8, Pt. 4*, p. 666-680, with 1 pl.

AOKI, S. (1954): Mollusca from the Miocene Kabeya formation, Jo-ban coal-field, Fukushima Prefecture, Japan. *Sci. Rep. Tokyo Univ. Education, Sec. C, Vol. 3, No. 17*, p. 23-41, with 2 pls.

ARNOLD, R. (1906): Tertiary and Quaternary pectens of California. *U. S. Geol. Surv. Prof. Paper 47*, p. 1-246, with 53 pls.

BANDY, O. J., BUTLER, E. A. & WRIGHT, R. C. (1969): Alaskan upper Miocene marine glacial deposits and the *Turborotalia pachyderma* plane. *Science, Vol. 166*, p. 607-609.

BRABB, E. E. & MILLER, D. J. (1962): Reconnaissance traverse across the eastern Chugach Mountains, Alaska. *U. S. Geol. Surv., Misc. Geol. Inv. Map.*, 1-341, Scale 1: 96.000.

BROWN, R. D., Jr. & GOWER, H. D. (1956): Lyre formation (redefinition) northern Olympic Peninsula, Washington. *Am. Assoc. Petrol. Geol., Bull., Vol. 40*, p. 94-107.

CLARK, B. L. (1925): Pelecypoda from the marine Oligocene of western North America. *Univ. Calif. Publ., Bull. Dept. Geol., Vol. 15, No. 4*, p. 69-136, with 17 pls.

——— (1932): Fauna of the Poul and Yakataga formations (upper Oligocene) of southern Alaska. *Bull. Geol. Soc. Am., Vol. 43*, p. 798-846, with 8 pls.

CLOUD, P. E., Jr. (1955): Physical limits of glauconite formation. *Am. Assoc. Petrol. Geol. Bull., Vol. 39*, p. 484-492.

CONRAD, T. A. (1849): Fossils from the Northwestern America: Mollusca. *U. S. Expl. Exped., Undercommand of* CHARLES WILKES, *Vol. 10, (Geol.), App. 1*, p. 723-729.

——— (1865): Catalogue of the older Eocene shells of Oregon. *Am. Jour. Conchology, Vol. 1*, p. 150-154.

——— (1867): Description of a new genus of Astartidae. *Am. Jour. Conch., Vol. 3*, p. 191.

COSSMANN, M. (1912): Essais de Paleonconchologie comparee, *Vol. 9*,

DALL, W. H. (1891): On some new or interesting west American shells obtained from the dredgings of the U. S. Fish Commission steamer "Albatros" in 1888. *Proc. U. S. Nat. Mus., Vol. 14*, p. 173-191, with 2 pls.

——— (1895): Report on Mollusca and Brachiopoda dredged in deep water, chiefly near the Hawaiian Islands, with illustrations of hitherto unfigured species from northwest America. *U. S. Nat. Mus., Vol. 17, No. 1032*, p. 675-733, with 10 pls.

——— (1902): Illustrations and descriptions of new unfigured or inperfectly known shells,

chiefly American, in the United States National Museum. *Proc. U.S. Nat. Mus., Vol. 24, No. 1264*, p. 499-566, with 15 pls.

——— (1895-1903): Contributions to the Tertiary fauna from Florida, with special reference to the Miocene Silex beds of Tampa and the Pliocene beds of Caloosahatchie River. *Trans. Wagner Free Inst. Sci., Vol. 3, Pt. 4*, p. 1219-1620.

——— (1908): A revision of the Solenomyacidae. *Nautilus, Vol. 22, No. 1*, p. 1-2.

——— (1909): Contribution to the Tertiary Paleontology of the Pacific coast. I. The Miocene of Astoria and Coos Bay, Oregon. *U.S. Geol. Surv. Prof. Paper 59*, p. 1-278, with 23 pls.

DENTON, G.H. & ARMSTRONG, R.L. (1969): Miocene-Pliocene glaciations in southern Alaska. *Am. Jour. Sci., Vol. 267*, p. 1121-1142.

DURHAM, J.W. (1937): Gastropods of the family Epitoniidae from Mesozoic and Cenozoic rocks of the west coast of North America, including one new species by F.E. TURNER and one by P.A. BRAMKAMP. *Jour. Paleont., Vol. 11, No. 6*, p. 479-512, with 2 pls.

——— (1942): Notes on Pacific coast Galeodeas. *Ditto, Vol. 16, No. 2*, p. 183-191, with 2 pls.

——— (1944): Megafaunal zones of the Oligocene of northwestern Washington. *Univ. Calif. Publ., Bull. Dept. Geol. Sci., Vol. 27, No. 5*, p. 101-212, with 6 pls.

——— (1950): Cenozoic marine climates of the Pacific coast. *Bull. Geol. Soc. Am., Vol. 61*, p. 1243-1264.

——— (1960): Paleoclimate. *Physics and Chemistry of the Earth. Vol. 3*, p. 1-16.

——— & SASA, Y. (1961): A comparison of the fauna of the Poronai formation of Japan with the west American middle Tertiary faunas. *Nineth Pacific Sci. Cong. Proc., Vol. 12*, p. 276.

EAMES, F.E. (1967): Notes on some *Anadara*. *Proc. Malacol. Soc. London, Vol. 37, Pt. 4*, p. 303-308.

EHLMANN, A.J., HULINGS, N.C. & GLOVER, E.D. (1963): Stages in glauconite formation in modern foraminiferal sediments. *Sed. Petr., 33*, p. 87-89.

EMERSON, W.K. (1962): A classification of the Scaphopod mollusks. *Jour. Paleont., Vol. 36, No. 3*, p. 461-482, with 5 pls.

FUJIE, T. (1957): On the myarian pelecypods of Japan. Pt. 1. Summary of the study of the genus *Mya* from Hokkaido. *Jour. Fac. Sci., Hokkaido Univ. Ser. 4, Vol. 9, No. 4*, p. 381-413, with 8 pls.

ГЛАДЕНКОВ, Ю.Б. (1966): Биостратиграфия верхнеогеновых отложений восточной Камчатки. *Бюлл. М. О-ВА Исп. Природы. Отд. Геол.*, Т. XLI (1), 83-95.

——— & ЦИКУНОВ, А.Г. (1966): Стратиграфия неогеновых отложений восточной Камчатки (валагинский хребет). *Изв. Акад. Наук. СССР., Сер. Геол.*, 5, 105-117.

GRANT, U.S. & GALE, H.R. (1931): Catalogue of the marine Pliocene and Pleistocene mollusca of California and adjacent regions. *Mem. San Diego Soc. Nat. Hist., Vol. 1*, p. 1-1036, with 32 pls.

GRAY, J.E. (1847): A list of genera of Recent Mollusca, their synonyms and types. *Proc. Zool. Soc. London, Vol. 15*, p. 129-219.

GRAY, G. (1959): Pectinidae of the eastern Pscific. *Allan Hancock Pacific expeditions, Univ. South Calif. Press., Los. Angeles, Calif., Vol. 23*, p. 1-308, with 57 pls.

HABE, T. (1950): Solemyidae in Japan. *Illustrated Catalogue of Japanese Shells, No. 10*, p. 61-63, 8 text-figures.

——— (1951-1953): Genera of Japanese shells. *Pts. 1-4*, p. 1-326, with 770 text-figures.

——— & ITO, K. (1965): Shells of the world in colour, *Vol. 1*, (The northern Pacific). *Hoikusha, Tokyo, Japan*, with 56 pls.

HALL, C.A., Jr. (1964): Shallow-water marine climates and molluscan provinces. *Ecology, Vol. 45, No. 2*, p. 226-234.

HAYASHI, S. (1950): On a new subgenus and a new species of *Fulgoraria* from Japan. *Jap. Jour. Malac., Vol. 21, No. 1*, p. 1-4, with 1 pl.

HICKMAN, J.C. (1969): The Oligocene marine molluscan fauna from the Eugene formation in Oregon. *Bull. Mus. Nat. Hist., Univ. Oregon, No. 16*, p. 1-112, with 14 pls.

HIRAYAMA, K. (1954): On some Miocene species of *Lucinoma* from Japan, with description

of two new species. *Jap. Jour. Geol. Geogr., Vol. 25, Nos. 1-2*, p. 101-115, with 2 pls.

——— (1955): The Asagai formation and its molluscan fossils in the northern region, Joban coal-field, Fukushima Prefecture, Japan. *Sci. Rep. Tokyo Univ. Education, Sec. C, Vol. 4, No. 29*, p. 49-130, with 5 pls.

HOPKINS, W.S. (1968): Subsurface Miocene rocks, British Columbia-Washington, a palynological investigation. *Geol. Soc. Am., Bull., Vol. 79*, p. 763-768.

HOWE, H.V. (1922): Faunal and stratigraphic relationship of the Empire formation, Coos Bay, Oregon. *Univ. Calif. Publ., Bull. Dept. Geol. Sci., Vol. 14, No. 3*, p. 85-114, with 6 pls.

IDA, K. (1952): A study of fossil *Turritella* in Japan. *Rep. Geol. Surv. Japan, No. 50*, p. 1-62, with 7 pls.

ИЛЬИНА, А.П. (1962): Некоторые новые виды Моллюсков иэ Миоцена Камчаки. *Труды ВНИГРИ Вып. 196, Палонт., Сбор. 3*, Стр. 361-374, 4 Табл.

——— (1963): Моллюски неогена Камчаки. *Труды Внигри Вып. 202*, Стр. 1-241, 54 Табл.

KAMADA, Y. (1962): Tertiary marine mollusca from the Joban coal-field, Japan. *Paleont. Soc. Japan, Spec. Paper No. 8*, p. 1-187, with 21 pls.

KANEHARA, K. (1937): Miocene shells from the Joban coal-field. *Bull. Imp. Geol. Surv. Japan, Vol. 27, No. 1*, pl. 1-21, with 5 pls.

KANNO, S. (1960): Tertiary system of the Chichibu Basin, Saitama Prefecture, Central Japan. Part II. Paleontology. *Japan Soc. Prom. Sci., Ueno, Tokyo*, p. 123-396, with 31 pls.

——— (1962): Molluscan fauna from the so-called Setana formation, southwestern Hokkaido, Japan. *Sci. Rep. Tokyo Univ. Education Sec. C, Vol. 8, No. 73*, p. 49-62, with 5 pls.

——— (1967): Molluscan fauna from the Miocene formations in the Itsukaichi Basin, Tokyo Prefecture. *Prof.* H. SHIBATA, *Memorial Volume*, p. 396-406, with 2 pls.

——— & MATSUNO, K. (1960): Molluscan fauna from "the Chikubetsu formation", Hokkaido, Japan. *Jour. Geol. Soc. Japan, Vol. 66, No. 772*, p. 35-45, with 2 pls.

——— & OGAWA, H. (1964): Molluscan fauna from the Momijiyama and Takinoue districts, Hokkaido, Japan. *Sci. Rep. Tokyo Univ. Education, Sec. C, Vol. 8, No. 81*, p. 269-294, with 4 pls.

———, OHARA, S. & KAITEYA, H. (1968): The "Asahi Fauna" from the Miocene formation developed near the Asahi Coal-Mine, Iwamizawa City, Hokkaido. *Sci. Rep. Tokyo Univ. Educat., Sec. C, Vol. 10, No. 94*, p 1-14, with 2 pls.

KEEN, A.M. (1936): A new pelecypod genus of the Family Cardiidae. *Trans. San Diego Soc. Nat. Hist., Vol. 8, No. 17*, p. 119-120.

——— (1958): Sea shells of tropical west America. *Stand. Univ. Press., Standard, Calif.*, p. 1-624.

——— (1963): Marine molluscan genera of western North America. *Stanford Univ. Press*, p. 1-126.

KOBAYASHI, T. (1954): A contribution toward paleo-flumentology, science of the oceanic current in the past, with a description of a new Miocene *Aturia* from central Japan. *Japan. Jour. Geol. Geogr., Vol. 25, Nos. 1-2*, p. 35-56, with 1 pl.

KOTAKA, T. (1952): Paleogene *Turritella* of Japan. *Short Paper, IGPS., No. 1*, p. 32-41, with 1 pl.

——— (1959): The Cenozoic Turritellidae of Japan. *Sci. Rep. Tohoku Univ. Ser. 2, Vol. 31, No. 2*, p. 1-135, with 15 pls.

КРИЩТОФОВИЧ, Л.В. (1960): Обоснование выделения ярусов в Третичных отложениях Сахалина. *Труды Всео. Нефт. Научно-Исслед. Геол. Инст. (Внигри)*, Вып. 154, Стр. 84-141.

——— (1964): Моллюски третичных отложений Сахалина. *ВНИГРИ. Вып. 232*, Стр. 1-228, Табл. 1-54.

——— & ИЛЬИНА, А.П. (1960): Биостяатиграфия третичны отложний западнои Камчаки. *Вюллетень М. О-ВА Исп. Природы, Отд. Геол.*, Т 35(1), Стр. 98-109.

KURODA, T. (1931): Tertiary molluscan fossils from the central Shinano, in Homma's Geology of Central Shinano. *Pt. 4*, p. 1-90, with 13 pls.

LAMARCK, J.G. de (1799): Prodrome d'une norvelle classification des coquelles, comprenant une rédaction appropriée des caracteres géneriques, et télablissement d'un grand nombre de genres nouveaux. *Soc. Hist. Nat. Paris, Mem. Vol. 1*, p. 63-91.

——— (1818-19): Historie naturelle des animaux sans vertebres. *Vol. 5*, p. 1-612; *Vol. 6, No. 1*, p. 1-343.

LINK, H.F. (1806-08): Bescheibung der Naturalien-Sammlung der Universität zu Rostock. p. 1-160 (1806), pl. 1-30, 1-38 (1807), pl. 1-38 (1808) (Rostock).

LOEL, W. & CORRY, W.H. (1932): The Vaqueros formations, lower Miocene of California. I. Paleontology. *Univ. Calif. Publ. Bull. Dept. Geol. Sci., Vol. 22, No. 3*, p. 31-410, with 62 pls.

MACNEIL, F.S. (1957): Cenozoic megafossils of northern Alaska. *U.S. Geol. Surv. Prof. Paper 249-C*, p. 99-126, with 7 pls.

——— (1961): *Lituyapecten* (new subgenus of *Patinopecten*) from Alaska and California. *U.S. Geol. Surv. Prof. Paper 354-J*, p. 225-239, with 12 pls.

——— (1965): Evolution and distribution of the genus *Mya*, and Tertiary migrations of molluska. *Ditto, 483-G*, p. 1-51, with 11 pls.

——— (1967): Cenozoic pectinids of Alaska, Iceland, and other northern region. *Ditto, 553*, p. 1-57, with 24 pls.

———, MERTIE, J.D., Jr. & PILSBRY, H.B. (1943): Marine invertebrate faunas of the buried beaches near Nome, Alaska. *Jour. Paleont., Vol. 17, No. 1*, p. 69-96, with 6 pls.

———, WOLFE, J.A., MILLER, D.J. & HOPKINS, D.M. (1961): Correlation of Tertiary formations of Alaska. *Bull. Amer. Assoc. Petrol. Geol., Vol. 45, No. 11*, p. 1801-1809.

MAKIYAMA, J. (1926): Tertiary fossils from north Kankyodo, Korea. *Mem. Coll. Sci., Kyoto Imp. Univ., Ser. B, Vol. 2, No. 3*, p. 143-160, with 2 pls.

——— (1941): Evolution of the Gastropod genus *Siphonalia* with account on the Pliocene species of Totomi and other examples. *Mem. Coll. Sci., Kyoto Imp. Univ. Ser. B, Vol. 16, No. 2, Art. 4*, p. 75-93, with 4 pls.

MASUDA, K. (1962): Tertiary pectinidae of Japan. *Sci. Rep. Tohoku Univ., Ser. 2, Vol. 33, No. 2*, p. 117-238, with 10 pls.

——— (1963): The so-called *Patinopecten* of Japan. *Trans. Proc. Paleont. Soc. Japan, N.S., No. 52*, p. 145-153, with 2 pls.

MEEK, F.B. (1876): A report on the invertebrate Cretaceous and Tertiary fossils of the upper Missouri Country. *U.S. Geol. Surv. of the Territories, Rept., Vol. 9*, p. 1-629, with 45 pls.

MERRIAM, C.W. (1941): Fossil *Turritella* from the Pacific coast region of north America. *Univ. Calif. Publ. Bull. Dept. Geol. Sci., Vol. 26, No. 1*, p. 1-214, with 41 pls.

MILLER, A.K. (1947): Tertiary nautiloids of the Americas. *Geol. Soc. America, Mem. 23*, p. 1-234, with 100 pls.

MILLER, D.J. (1951): Geology and oil possiblities of the Katalla district, Alaska. *U.S. Geol. Surv. Report, Open-file*, p. 1-66, with 5 figures and 3 maps.

——— (1953): Late Cenozoic marine glacial sediments and marine terraces of Middleton Island, Alaska. *Jour. Geol., Vol. 61, No. 1*, p. 17-40.

——— (1957): Geology of the southeastern part of the Robinson Mountains, Yakataga District, Alaska. *U.S. Geol. Surv., Oil and Gas Invest. Map*, OM 187.

——— (1961a): Geology of the Lituya District, Gulf of Alaska Tertiary province, Alaska. *U.S. Geol. Surv., Open File Rep.*

——— (1961b): Stratigraphic occurrence of *Lituyapecten* in Alaska. *U.S. Geol. Surv. Prof. Paper 354-K*, p. 241-248.

——— (1971): Geologic map of the Yakataga District, Gulf of Alaska Tertiary province, Alaska. *U.S. Geol. Surv., Miscellaneous Geologic Investigation Map*, 1-610.

———, PAYNE, T.G. & GRYC, G. (1959): Geology of possible petroleum provinces in Alaska. *U.S. Geol. Surv. Bull., 1094*, p. 131.

MINATO, M., MATSUI, M., & UOZUMI, S. (1950): On the genus *Mya* from Hokkaido. *Shinsei dai-no-kenkyu, No. 8*, p. 10-12, with 1 pl.

MÖLLER, H.P.C. (1842): Index molluscorum Groenlandiae. *Naturhist. Tidsskr., Vol. 4, No. 1*, p. 1-97.

MOORE, E.J. (1963): Miocene marine mollusks from the Astoria formation in Oregon. *U.S. Geol. Surv. Prof. Paper 419*, p. 1-109, with 32 pls.

MOORE, R. C. (1960): Treatise on Invertebrate Paleontology. Pt. I, Mollusca I, p. 1-351. *Geol. Soc. Amer., and Univ. Kansas Press.*

——— (1969): Treatise on Invertebrate Paleontology. Pt. N, *Vols. 1-2*, Mollusca 6 (Bivalvia), p. 1-952. *Geol. Soc. Am., and Univ. Kansas Press.*

MÖRCH, O. A. L. (1857): Prodrome Mollusca Grönlandica: in RINK, H. L., Grønland Geographisk og stratisk Beskrevet, Band 2, pt. 4, Kjøpenhagen.

MORRIS, P. A. (1966): A field guide to shells of Pacific coast and Hawaii. p. 1-297, with 72 pls.

NAGAO, T. & INOUE, T. (1941): Myarian fossils from the Cenozoic deposits of Hokkaido and Karahuto. *Jour. Fac. Sci., Hokkaido Imp. Univ., Ser. 4, Vol. 6, No. 2*, p. 143-158, with 3 pls.

NAKAJIMA, M. (1958): Notes on gross anatomy of *Conchocele disjuncta*. *Jap. Jour. Malac., Vol. 20, No. 20*, p. 186-203, with 1 pl.

NODA, H. (1966): The Cenozoic Arcidae of Japan. *Sci. Rep. Tohoku Univ., 2nd Ser., Vol. 38, No. 1*, p. 1-161, with 16 pls.

NOMURA, S. & HATAI, K. (1937): A list of the Miocene Mollusca and Brachiopoda collected from the region lying north of the Nanakita River in the vicinity of Sendai, Rikuzen province, Japan. *Saito Ho-on Kai Mus. Res. Bull., No. 13*, p. 121-145, with 5 pls.

OKUTANI, T. (1966): Identity of *Calyptogena* and *Akebiconcha* (Bivalvia, Cyprinidae). *Jap. Jour. Malacol., Vol. 24, No. 4*, p. 297-303, with 2 pls.

OLDROYD, K. S. (1924): Marine shells of the west coast of North America. *Stanf. Univ. Publ., Univ. Ser., Geol. Sci., Vol. 1, No. 1*, p. 1-247, with 57 pls.

——— (1927): Marine shells of the west coast of North America. *Stanf. Univ. Publ., Univ. Ser., Geol. Sci., Vol. 2, Pts. 1-3*, (pt. I, p. 1-297, with 29 pls.; pt. II, p. 1-304, with 43 pls.; pt. III, p. 1-339, with 36 pls.).

OLSSON, A. A. (1961): Mollusks of the tropical eastern Pacific (Panamic-Pacific Pelecypoda). *Paleont. Research Inst., Ithaca, N. Y.*, p. 1-574, with 86 pls.

OMORI, M. & UTASHIRO, T. (1954): "*Pecten peckhami* GABB" from Japan. *Shin-sei-dai-no-Kenkyu (The Study of Cenozoic), No. 19*, p. 1-10, with 3 pls.

OTUKA, Y. (1940): Miocene Mollusca from the Tesio province, Hokkaido. *Jap. Jour. Geol. and Geogr., Vol. 17, Nos. 1-2*, p. 91-99, with 1 pl.

OYAMA, K. & MIZUNO, A. (1958): On the new species of Paleogene mollusks from Japan. *Bull. Geol. Surv. Japan, Vol. 9, No. 9*, p. 589-606, with 4 pls.

———, ——— & SAKAMOTO, T. (1960): Illustrated handbook of Japanese Paleogene mollusks. *Geol. Surv. Japan*, p. 1-244, with 71 pls.

PACKARD, E. L. (1916): Mesozoic and Cenozoic Mactrinae of the Pacific coast of North America. *Univ. Calif. Publ., Bull. Dept. Geol., Vol. 9, No. 15*, p. 261-360, with 24 pls.

PLAFKER, G. (1967): Geologic map of the Gulf of Alaska Tertiary province, Alaska. *U. S. Geol. Surv., Miscellaneous Geol. Invest. Map*, I-484.

——— (1970): Possible future petroleum resouces in the Pacific margin Tertiary basin, Alaska (MS).

——— & MILLER, D. J. (1957): Reconnaissance geology of the Malaspina District, Alaska. *U. S. Geol. Surv., Oil and Gas Invist. Map*, OM-189, Scal 1:25.000.

PALMER, R. H. (1927): The Hok formation of Washington. *Jour. Geol., Vol. 35, No. 3*, p. 276-278.

PARKER, P. (1949): Fossil and Recent species of the pelecypod genera *Chione* and *Securella* from the Pacific coast. *Jour. Paleont., Vol. 23, No. 6*, p. 577-593, with 7 pls.

PARKER, R. H. (1964): Preliminary results of Scrips Institution of Oceanography Investigations in the Indian Ocean during expeditions Monsoon and Lusida, 1960-1963. *Univ. Calif., San Diego.*

——— (1963): Zoogeography and ecology of some macro-invertebrates, particulary mollusks, in the Gulf of California and continental slope off Mexico. *D. N. F. V. M., Vol. 126*, p. 1-178, with 15 pls.

PRATT, W. L. (1963): Glauconite from the sea floor off soutern California. *Essays in marine geology in honor* K. O. EMERY, p. 97-119. *Univ. South Calif. Press, Los. Angeles.*

QUAYLE, D. B. (1960): The intertidal bivalves of British Columbia. *British Columbia Prov. Museum, Dept. Education, Handbook No. 17*, p. 1-104.

RAU, W. W. (1948): Foraminifera from the Miocene Astoria formation in southern Washington. *Jour. Paleont., Vol. 22, No. 6*, p. 774-782, with 1 pl.

——— (1951): Tertiary Foraminifera from the Willapa River Valley of southwest Washington. *Jour. Paleont., Vol. 25, No. 4*, p. 417-453, with 5 pls.

——— (1963): Foraminifera from the upper part of the Poul Creek formation of southeastern Alaska. *Contributions from the Cush. Found. Foram. Res., Vol. 14, Pt. 4*, p. 135-145, with 2 pls.

——— (1964): Foraminifera from the northern Olympic Peninsula, Washington. *U. S. Geol. Surv., Prof. Paper 374-G*, p. 1-33, with 7 pls.

REAGAN, A. B. (1909): Some notes on the Olympic Peninsula, Washington. *Trans. Kans. Acad. Sci., Vol. 22*, p. 131-238, with 6 pls.

REINHART, P. W. (1935): Classification of the pelecypod family Arcidae. *Bull. Mus. Roy. d'Hist. Nat. Belgique, T. 11, No. 13*, p. 1-68.

——— (1943): Mesozoic and Cenozoic Arcidae from the Pacific slope of North America. *Geol. Soc. Am., Spec. Pap., No. 47*, p. 1-117, with 15 pls.

RÖDING, P. E. (1798): Museum Boltenianum seve Catalogus cimelioum e tribus regnis naturae quae olim collegerat Joa. Fried. Bolten, M. D. p. d., Paris Secunda. p. 1-199.

RÖMER, E. (1857): Kritische Untersuchung der Arten des Mollusken geschlichts *Venus* bei LINNE und GMELIN, mit Buruchschtigung der Spater beschriebenen Arten. p. 1-135.

RUTH, J. W. (1942): The molluscan genus *Siphonalia* of the Pacific coast Tertiary. *Univ. Calif. Publ., Bull. Dept. Geol. Sci., Vol. 26, No. 3*, p. 287-306, with 2 pls.

SAITO, T. (1963): Miocene planktonic Foraminifera from Honshu, Japan. *Sci. Rep. Tohoku Univ., Ser. 2, Vol. 35, No. 2*, p. 123-209, with 4 pls.

SCHENCK, H. G. (1926): Cassididae of western America. *Univ. Calif. Publ., Bull. Dept. Geol. Sci., Vol, 16, No. 4*, p. 69-98, with 4 pls.

——— (1936): Nuculid bivalves of the genus *Acila*. *Geol. Soc. Am., Spec. Paper, No. 4*, p. 1-149, with 18 pls.

——— & REINHART, P. W. (1938): Oligocene arcid pelecypods of the genus *Anadara*. *Mus. Roy. d'Hist. Nat. Belgique, Mém., 2nd Sér., Fasc. 14*, p. 1-74.

SHIKAMA, T. (1967): System and evolotion of Japanese fulgorarid Gastropoda. *Sci. Rep. Yokohama National Univ., Sec. 2, No. 13*, p. 1-132, with 17 pls.

СЛОДКЕВИЧ, В. С. (1938): Третичные палециподы дальнего Бостока. Палеонтология СССР. Изд-во АН СССР, Т 10, Ч. 3, Вып. 18, И 19, Стр 1-508, Табл. 1-CVI.

STEWART, P. B. (1926): GABB's California type Cretaceous and Tertiary Gastropids. *Acad. Nat. Sci., Phila., Vol. 78*, p. 287-447, with 13 pls.

——— (1930): GABB's California Cretaceous and Tertiary type Lamellibranchia. *Acad. Nat. Sci. Phila., Spec. Publ., No. 3*, p. 1-314, with 7 pls.

STOLICZKA, F. (1871): Cretaceous fauna of southern India, Pelecypoda. *Paleont. Indica*, p. 1-537.

STONELEY, R. (1967): The structural development of the Gulf of Alaska sedimentary province in southern Alaska. *Geol. Soc. London, Quart. Jour., Vol. 123*, p. 25-57.

STRAUCH, F. (1968): Determination of Cenozoic sea-temperature using *Hiatella arctica* (LINNÉ). *Palaeogeography, Palaeoclimatology, Palaeoecology, Vol. 5*, p. 213-233.

SWAINSON, W. (1840): A treatise on malacology or shells and shell-fish. *The Cabinet Cyclopedia, Nat. Hist.*, p. 1-420, with 130 text-figs., Longman (London).

TAKEDA, H. (1953): The Poronai formation (Oligocene), Tertiary of Hokkaido and south Sakhalin and its fossil fauna. *Studies on Coal Geol., No. 3*, p. 1-103, with 13 pls.

TAKI, I. & OTUKA, Y. (1942): Conchologia Asiatica, Part I. Kajiya Shoin, Tokyo.

TALIAFERRO, N. L. (1932): Geology of the Yakataga, Katalla, and Nichawak Districts, Alaska. *Geol. Soc. Am., Bull., Vol. 43, No. 3*, p. 749-782, figs. 1-14.

TEGLAND, N. M. (1929): Correlation and affinities of certain species of *Pitaria*. *Univ. Calif. Publ., Bull. Dept. Geol. Sci., Vol. 18, No. 10*, p. 275-290, with 3 pl.

——— (1931): The gastropod genus *Geleodea* in the Oligocene of Washington. *Univ. Calif.*

Publ. Bull. Dept. Geol. Sci., Vol. 19, No. 18, p. 397-434, with 7 pls.

——— (1933): The fauna of the type Blakeley upper Oligocene of Washington. *Univ. Calif. Publ. Bull. Dept. Geol., Vol. 23, No. 3*, p. 81-174, with 14 pls.

THIELE, J. (1931): Handbuch der Systematischen Weichtierkunde. *Vol. 1*, p. 1-778; *Vol. 2*, p. 779-1154.

TRYON, G.W. (1889): Manual of conchology, *Vols. 1-17. Acad. Nat. Sci., Philadelphia.*

TURNER, F.E. (1938): Stratigraphy and Mollusca of the Eocene of western Oregon. *Geol. Soc. Am., Spec. Paper, No. 10*, p. 1-130.

UOZUMI, S. (1957): Studies on the molluscan fossils from Hokkaido. Pt. II. Genera *Yoldia* and *Portlandia*. *Jour. Fac. Sci., Hokkaido Univ., Ser. 4, Vol. 9, No. 4*, p. 539-596, with 7 pls.

UTASHIRO, T. (1957): On some *Palliolum peckhami* in Japan, part 3. *Bull. Niigata Univ., Takada, No. 1*, p. 161-174, with 3 pls.

——— (1958): On the variation of *Palliolum peckhami*. *Jub. Publ. Commemorat., Prof.* H. FUJIMOTO *sixteen birthday*. p. 320-326, with 2 pls.

VERASTEGUI, P. (1953): The pelecypod genus *Venericardia* in the Paleocene and Eocene of western North America. *Paleontgr. Am., Vol. 3, No. 25*, p. 1-112, with 22 pls.

VOKES, H.E. (1955): Notes on Tertiary and Recent Solemyacidae. *Jour. Paleont., Vol. 29, No. 3*, p. 534-545.

———, SNAVELY, P.D., Jr. & MYERS, D.A. (1951): Geology of the southern and southwestern areas, Willamette Valley, Oregon. *U.S. Geol. Surv. Oil and Gas Inv. Map*, OM-L10, Geol. Map and Text.

WEAVER, C.E. (1912): A preliminary report on the Tertiary Paleontology of western Washington. *Wash. Geol. Surv. Bull., No. 15*, p. 1-80, with 15 pls.

——— (1916): Tertiary faunal horizons of western Washington. *Univ. Wash. Publ. Geol. Vol. 1*, p. 1-67.

——— (1937): Tertiary stratigraphy of western Washington and northwestern Oregon. *Univ. Wash. Publ., Geol., No. 4*, p. 1-266, with 15 pls.

——— (1942): Paleontology of the marine Tertiary formations of Oregon and Washington. *Univ. Wash. Publ. Geol., Vol. 5, Nos. 1-3*, p. 1-789, with 104 pls.

——— & Western Cenozoic Subcommittee, (1944): Correlation of marine Cenozoic formations of western North America, with correlation chart. *Geol. Soc. Am., Bull., Vol. 55*, p. 569-598.

WOLFE, J.A. (1969): Paleogene floras from the Gulf of Alaska region. *U.S. Geol. Surv., Open-file Report*, p. 1-110.

WOODRING, W.P. (1925): Contribution to the geology and Paleontology of the west Indies, Miocene mollusks from Bowden, Jamaica. Pt. 1, Pelecypoda and Scaphopoda. *Carnegie Inst., Washington Publ., No. 366*, p. 1-222, with 58 pls.

——— (1928): Contribution to the geology and paleontology of the west Indies, Miocene mollusks from Bowden, Jamaica. Pt. 2, Gastropoda and discussion of results. *Carnegie Inst., Wash. Publ., No. 385*, p. 3-564, with 40 pls.

WOODWARD, S.P. (1910): Manual of Mollusca. *Croby Lockwood and Son*, p. 1-541, with 23 pls.

YOKOYAMA, M. (1924): Molluscan remains from the lowest part of the Jo-ban coal-field. *Jour. Coll. Sci., Imp. Univ. Tokyo, Vol. 45, Art. 3*, p. 1-22, with 5 pls.

——— (1925): Molluscan remains from the uppermost part of the Jo-ban coal-field. *Jour. Coll. Sci., Imp. Univ. Tokyo, Vol. 45, Art. 5*, p. 1-34, with 6 pls.

——— (1926): Fossil shells from Sado. *Jour. Fac. Sci., Imp. Univ. Tokyo, Sec. 2, Vol. 1, Pt. 8*, p. 249-312, with 6 pls.

——— (1932): Tertiary mollusca from the coal-field of Uryu, Ishikari. *Jour. Fac. Sci., Imp. Univ. Tokyo, Sec. 2, Vol. 3, Pt. 6*, p. 221-247, with 4 pls.

YOUNGQUIST, W. (1961): Annotated lexicon of names applied to Tertiary stratigraphic units in Oregon and Washington, west of the Cascade Mountains, with the bibliography. p. 1-92.

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geological age **27**
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(*C.*) *yakatagensis* .....
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Yunagaya group 81

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Plate 1

Explanation of Plate 1

(All figures are in natural size unless otherwise stated.)

Fig. 1. *Solemya (Acharax) dalli* CLARK ..... page 42
Right valve (intact valves). Loc. 80906 (Tp*) Reg. No. TUE 8409.

Fig. 2. *Acila (Acila)* cf. *A. (A.) submirabilis* MAKIYAMA..... page 34
Rubber cast of a right valve. Loc. 81202 (Tp) Reg. No. TUE 8342.

Fig. 3. *Acila (Acila)* sp. ..... page 34
Left valve. Loc. 81404 (Tp) Reg. No. TUE 8343.

Figs. 4, 7. *Acila (Acila) gettysburgensis* (REAGAN) ..... page 32
Loc. 81201 (Tp) Reg. No. TUE 8341.

Figs. 5, 6. *Acila (Truncacila) taliaferroi* CLARK ×1.5 ..... page 35
Loc. 80604 (Ty**) Reg. No. TUE 8345.

Fig. 8. *Acila (Truncacila)* cf. *A. (T.) kamtschatica* ILYINA ..... page 35
Loc. 20525-1 (Ty) Reg. No. TUE 8344.

Fig. 9. *Yoldia* sp. ..... page 41
Float specimen, possibly from the upper part of the Poul Creek formation.
Loc. 81102 (?Tp) Reg. No. TUE 8408.

Figs. 10, 11. *Yoldia (Cnesterium) ensifera* DALL ..... page 39
10. Rubber cast, showing the incised oblique ornamentation, ×2.
11. Left valve.
Loc. 80802 (Ty) Reg. No. TUE 8349.

Figs. 12, 18. *Yoldia (Cnesterium) yakatagensis* KANNO, n. sp..... page 40
12. Holotype. Loc. 80802 (Ty) Reg. No. TUE 8350.
18. Paratype. Loc. 80802 (Ty) Reg. No. TUE 8407.

Figs. 13-15. *Yoldia (Yoldia) takaradaiensis* KRISHTOFOVICH..... page 38
13, 15. Loc. 81401 (Tp).
14. Loc. 81201 (Tp) Reg. No. TUE 8347.

Figs. 16, 17. *Yoldia (Yoldia) biremis* UOZUMI..... page 38
16. Loc. 81404 (Tp).
17. Loc. 81201 (Tp) Reg. No. TUE 8348.

Figs. 19-22. *Nuculana (Borissia) alferovi sakhalinensis* KRISHTOFOVICH ..... page 36
19, 21, 22. Left valve, ×2. Loc. 80604 (Ty).
19b. Apical view of fig. 19a.
20. Right valve. ×1.5. Loc. 80802 (Ty) Reg. No. TUE 8346.

Figs. 23, 24. *Anadara (Anadara)* sp. ..... page 44
23b. Apical view of fig. 23a.
24. Left valve, showing the somewhat deformed specimen.
Loc. 20503-19 (Tp) Reg. No. TUE 8410.

Figs. 25, 26. *Swiftopecten donmilleri* (MACNEIL) ..... page 49
25. Loc. 81105 (Ty).
26. Loc. 81403 (Ty) Reg. No. TUE 8414.

Fig. 27. *Crenella porterensis* WEAVER ×2..... page 47
Loc. 81201 (Tp) Reg. No. TUE 8412.

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* Tp....Poul Creek formation.
** Ty....Yakataga formation.

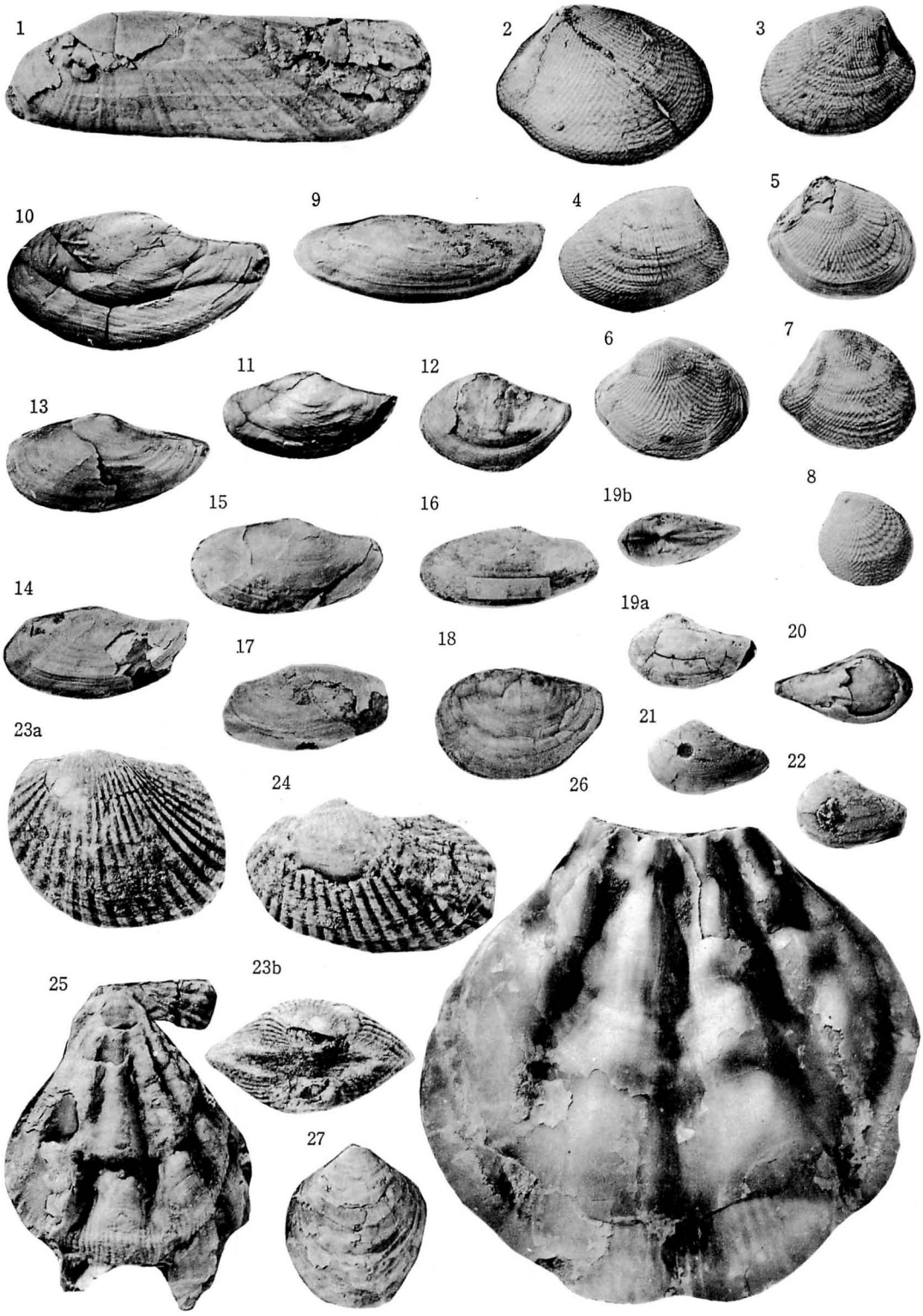
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Plate 2

Explanation of Plate 2

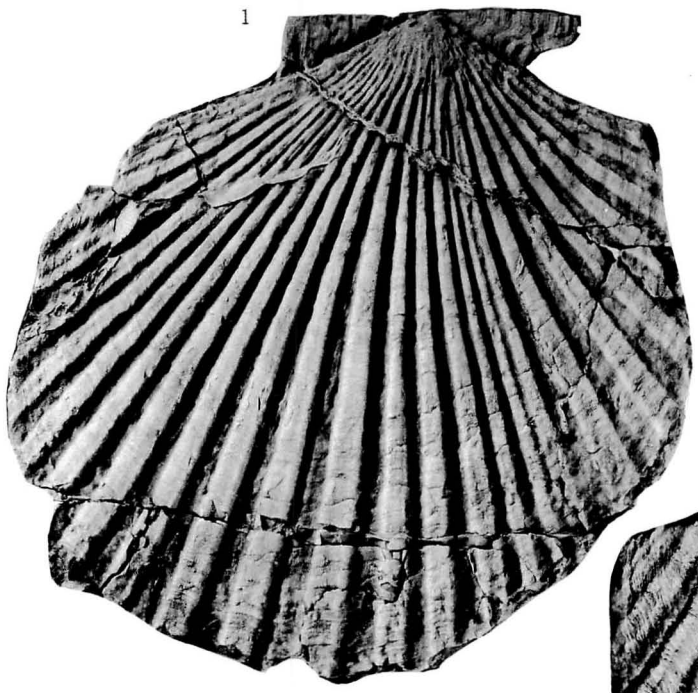
(All figures are in natural size unless otherwise stated.)

Fig. 1. *Patinopection* (*Lituyapecten*) *lituyaensis* MacNeil ×0.7 ..... page 52
Loc. 80404 (Ty) Reg. No. TUE 8417.

Figs. 2, 3. *Patinopecten* (*Lituyapecten*) *poulcreekensis* MacNeil ..... page 54
2. Fragment of right valve, rubber cast, showing frilled interstitial ribs. Loc. 7011-68. Reg. No. TUE 8419.
3. Holotype, figured for comparison, ×0.75 USNM 563572.

Fig. 4. *Vertipecten* sp. ..... page 50
Left valve, rubber cast, showing four distinct strong radial ribs among the radial. Loc. 81401 (Tp) Reg. No. TUE 8416.

Figs. 5, 6. *Macoma arctata* (Conrad) ..... page 78
Internal mould of right and left valves. Loc. 80605 (Tp) Reg. No. TUE 8448.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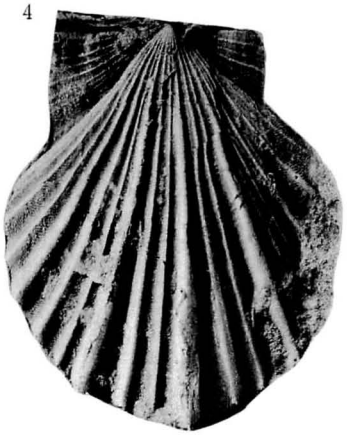
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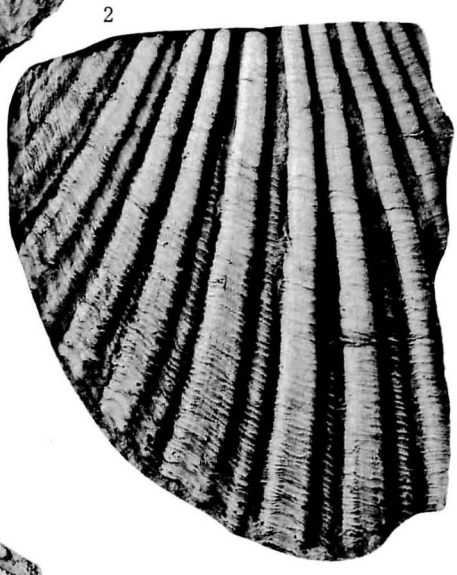
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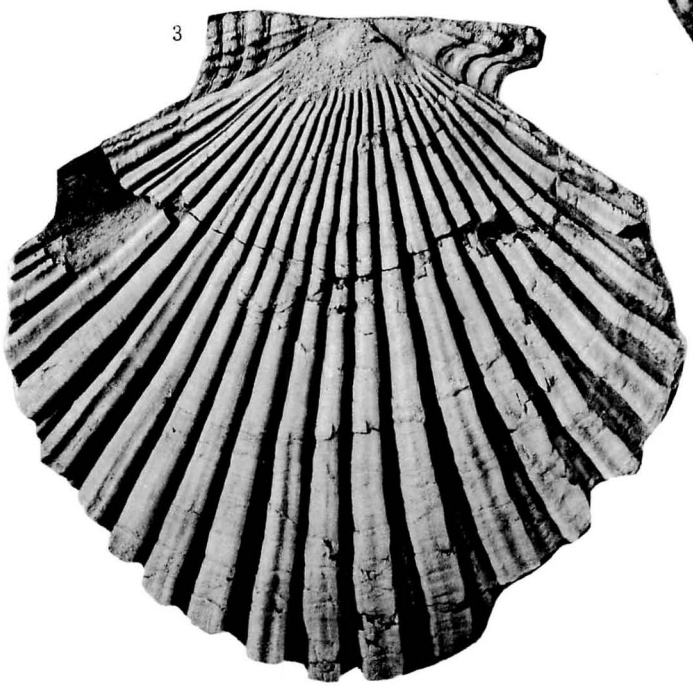
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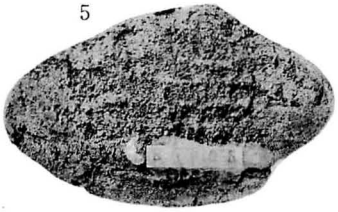
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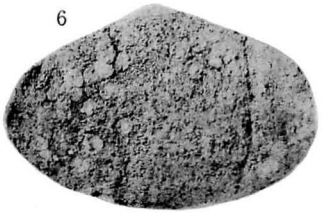
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Plate 3

Explanation of Plate 3

(All figures are in natural size unless otherwise stated.)

Figs. 1, 2. *Patinopecten (Lituyapecten) yakatagensis* MACNEIL ..... page 53
1. Fragment of left valve, rubber cast, showing frilled ribs with various top surface of the ribs. ×0.9 Float, Loc. 81001 (possibly Ty).
2. Left valve, rubber cast. ×0.7 Loc. 7011-68 (Ty) Reg. No. TUE 8418.

Fig. 3. *Patinopecten (Lituyapecten) lituyaensis* MACNEIL. ×0.9 ..... page 52
Incomplete left valve. Loc. 80506 (Ty) Reg. No. TUE 8417.

Fig. 4. *Papyridea hamiltonensis* (CLARK) ..... page 69
Loc. 81401 (Tp) Reg. No. TUE 8436.

Fig. 5. *Periploma (Aelga) besshoense* (YOKOYAMA) ..... page 96
Incomplete and decorticated right valve. Loc. 80905 (Tp) Reg. No. TUE 10022.

Fig. 6. *Cyclocardia hamiltonensis* (CLARK) ..... page 63
Left valve, showing the hinge structure. Loc. 81401 (Tp) Reg. No. TUE 8428.

Figs. 7a-b. *Cyclocardia yakatagensis* (CLARK) ..... page 63
7a. Dorsal view of left valve.
7b. Apical view of fig. 7a. Loc. 81401 (Tp) Reg. No. TUE 8427.

Figs. 8, 9. *Cyclocardia* sp..... page 64
8a. Decorticated left valve. 8b. Apical view of fig. 8a.
Loc. 81401 (Tp) Reg. No. TUE 8429.

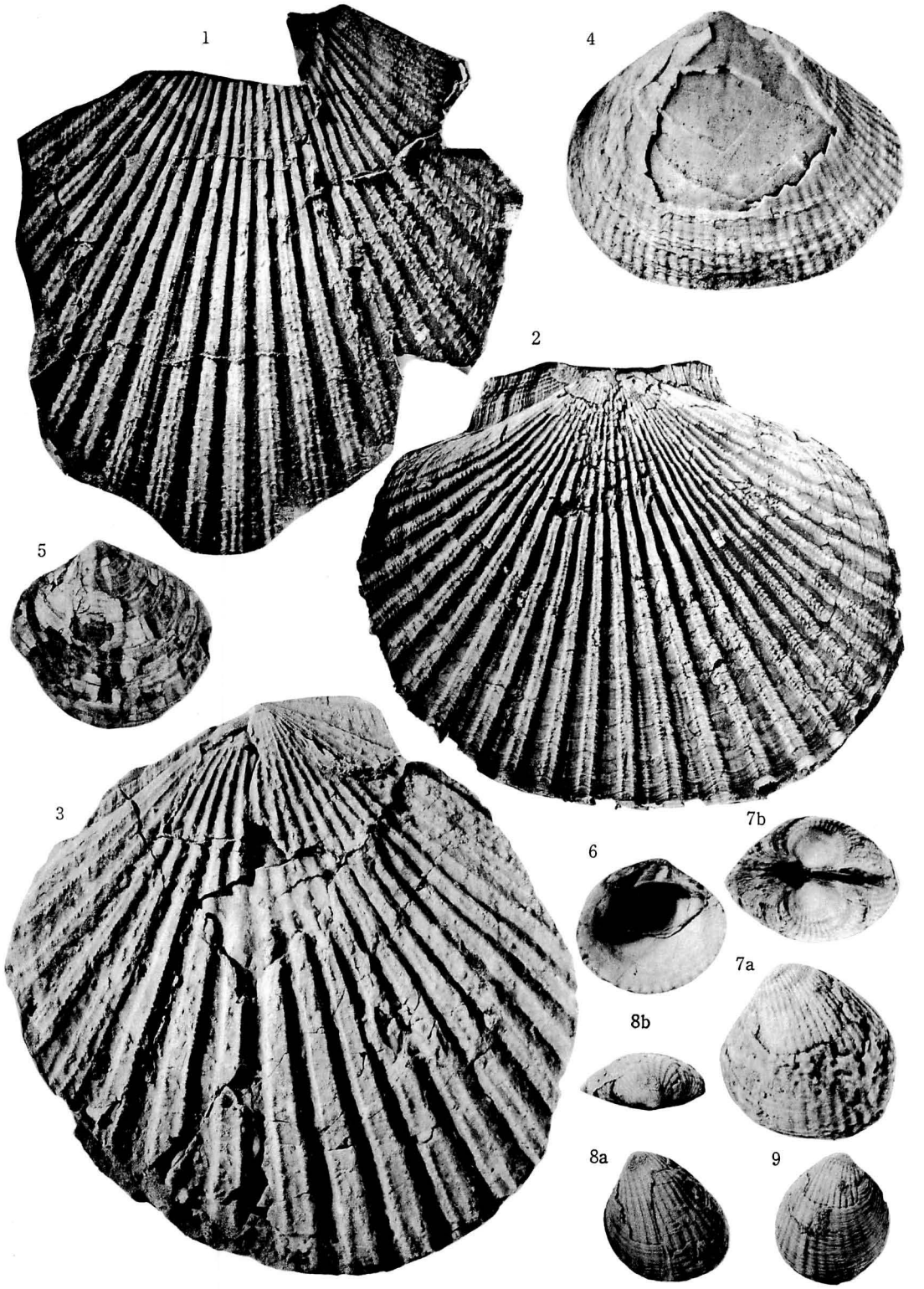
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Plate 4

Explanation of Plate 4

(All figures are in natural size unless otherwise stated.)

Figs. 1–4. *Patinopecten jonesi* KANNO, n. sp. ..... page 56
1. Holotype, right valve, about ×0.6; length 147 mm; height more then 130 mm; length of hinge line, more than 78 mm; thickness, about 28 mm. Loc. 81402(Ty) Reg. No. TUE 8420.
2. Paratype, inner surface of left valve, about ×0.6; length about 145 mm. Loc. 81402(Ty) Reg. No. TUE 8421.
3. Paratype, rubber cast, showing the outer surface of a left valve. Loc. 81402(Ty) Reg. No. TUE 8421.
4. Paratype, inner mould of a right valve. Loc. 81402(Ty) Reg. No. TUE 8421.

Figs. 5, 7. *Crassatella* cf. *C. washingtoniana* (WEAVER) ..... page 65
5. Inner surface of right valve, rubber cast. ×2.
7. Outor surface of decorticated left valve. Loc. 80905(Tp) Reg. No. TUE 8430.

Figs. 6a–b. *Crassatina carmanahensis* (CLARK) ..... page 65
6b. Hinge structure of left valve. Loc. 80905(Tp) Reg. No. TUE 8431.

Fig. 8. *Lucinoma* cf. *L. tomitensis* KANNO ..... page 60
Loc. 81001(Tp) Reg. No. TUE 8425.

Figs. 9a–b. *Cyclocardia yakatagensis* (CLARK) ..... page 63
9a. Decorticated right valve.
9b. Hinge area of fig. 9a. Loc. 81401(Tp) Reg. No. TUE 8427.

Figs. 10, 11. *Cyclocardia hamiltonensis* (CLARK)..... page 63
10. Decorticated left valve. Loc. 81002(Tp).
11. Ditto, Loc. 81401(Tp) Reg. No. TUE 8428.

Figs. 12a–b. *Nemocardium* aff. *N. yokoyamai* TAKEDA..... page 71
12b. Apical view of fig. 12a. Loc. 81401(Tp) Reg. No. TUE 8438.

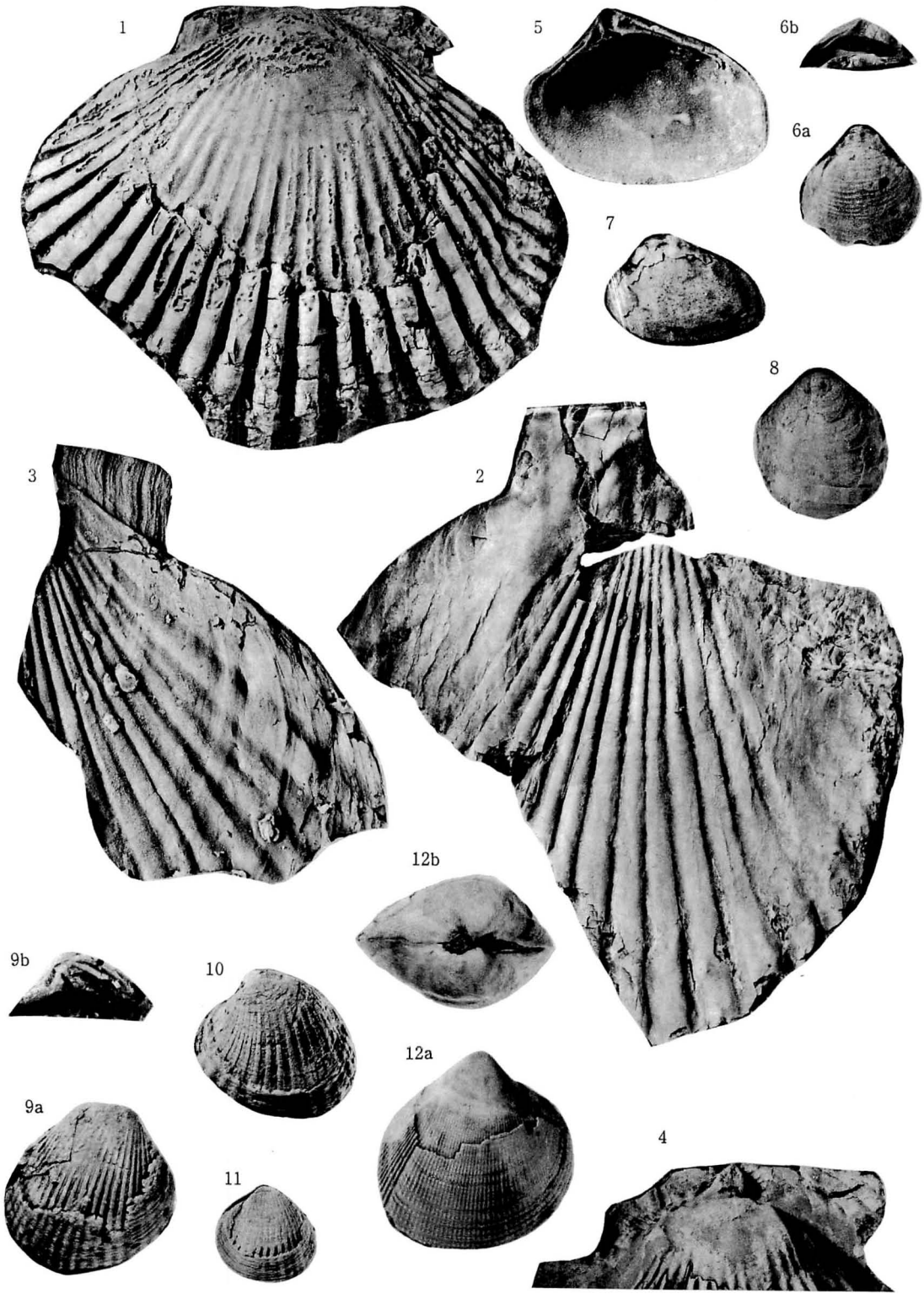
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Plate 5

Explanation of Plate 5

(All figures are in natural size unless otherwise stated.)

Fig. 1. *Patinopection (Lituyapecten) lituyaensis* MacNeil ..... page 53
Right valve, anterior ear incomplete. Loc. 80404(Ty) Reg. No. TUE 8418.

Figs. 2, 3. *Miyagipecten* sp. ..... page 50
Decorticated right valves. Loc. 80904(Ty) Reg. No. TUE 8415.

Figs. 4, 5, 8. *Papyridea hamiltonensis* (Clark) ..... page 69
4, 5. Loc. 81201(Tp).
8a. Incomplete right valve.
8b. Cardinal area of fig. 8a. Loc. 81401(Tp) Reg. No. TUE 8436.

Figs. 6, 7. *Clinocardium hopkinsi* Kanno, n. sp. ..... page 68
6. Paratype, loc. 81401(Tp) Reg. No. TUE 8435.
6b. Cardinal area of fig. 6a.
7a–b. Holotype; 7b. apical view of fig. 7a, loc. 81401(Tp). Reg. No. TUE 8434.

Fig. 9. *Clinocardium brooksi* (Clark) ..... page 67
Articulating both valves. Loc. 81306(Ty) Reg. No. TUE 8433.

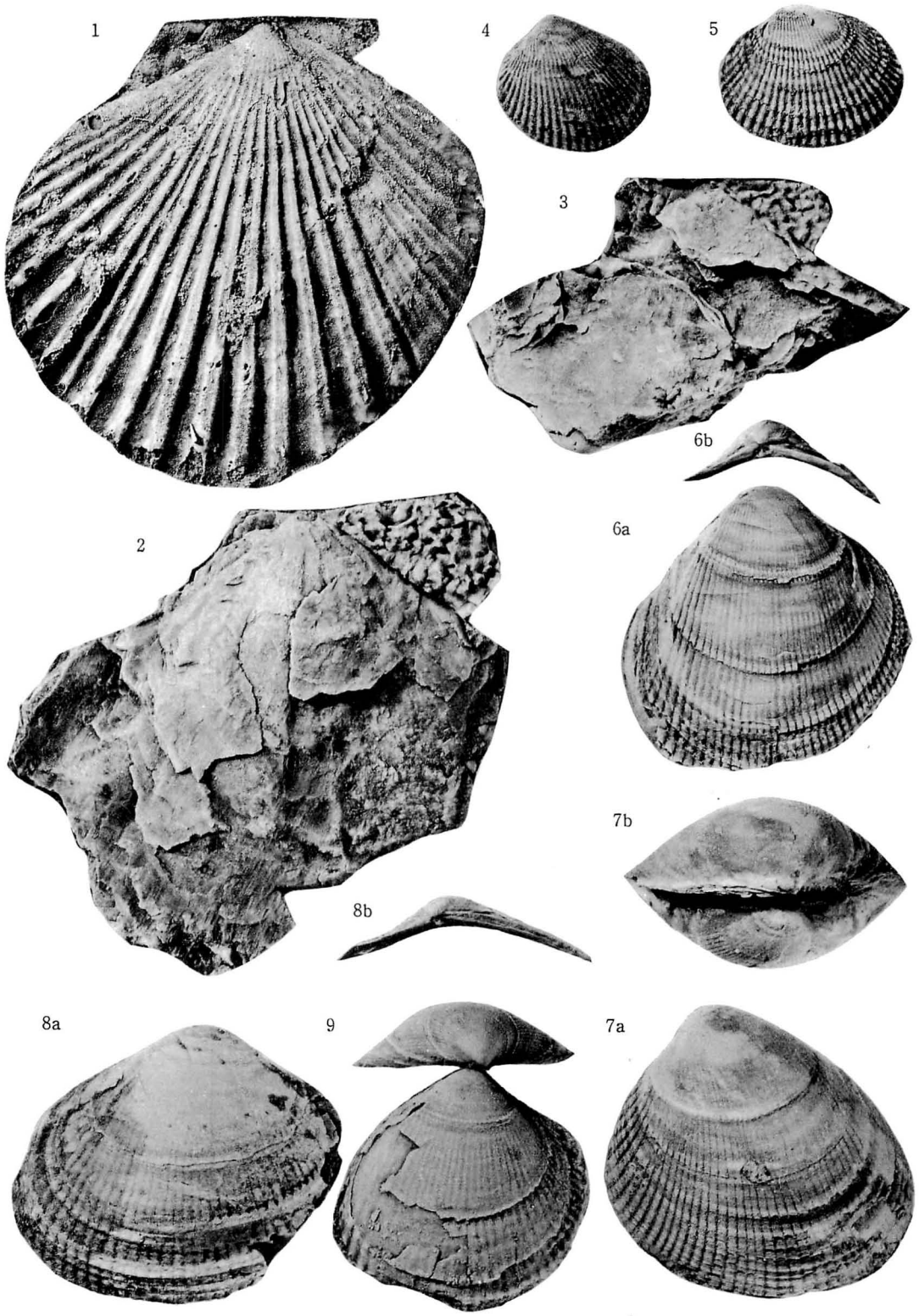
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Plate 6

Explanation of Plate 6

(All figures are in natural size unless otherwise stated.)

Figs. 1, 2. *Patinopecten jonesi* KANNO, n. sp. ..... page 56
1. Paratype, incomplete right valve about ×0.6, rubber cast, height 142 mm (incomplete). Loc. 81402(Ty) Reg. No. TUE 8421.
2. Paratype. incomplete left valve about ×0.8, height 110 mm (incomplete). Loc. 81402(Ty) Reg. No. TUE 8421.

Fig. 3. *Patinopecten* (*Lituyapecten*) *yakatagensis* (CLARK) ..... page 53
Radial ribs of right valve. Loc. 80503(Ty) Reg. No. TUE 8418.

Fig. 4. *Clinocardium brooksi* (CLARK) ..... page 67
Somewhat decorticated left valve. Loc. 81403(Ty) Reg. No. TUE 8433.

Fig. 5. *Tellina* cf. *T. cowlitzensis* WEAVER ..... page 76
Loc. 81401(Tp) Reg. No. TUE 8444.

Fig. 6. *Macoma incongrua* v. MARTENS ..... page 77
Incomplete right valve. Loc. 81401(Tp) Reg. No. TUE 8446.

Fig. 7. *Spisula equilateralis* (CLARK) ..... page 72
Immature left valve. Loc. 81201(Tp) Reg. No. TUE 8439.

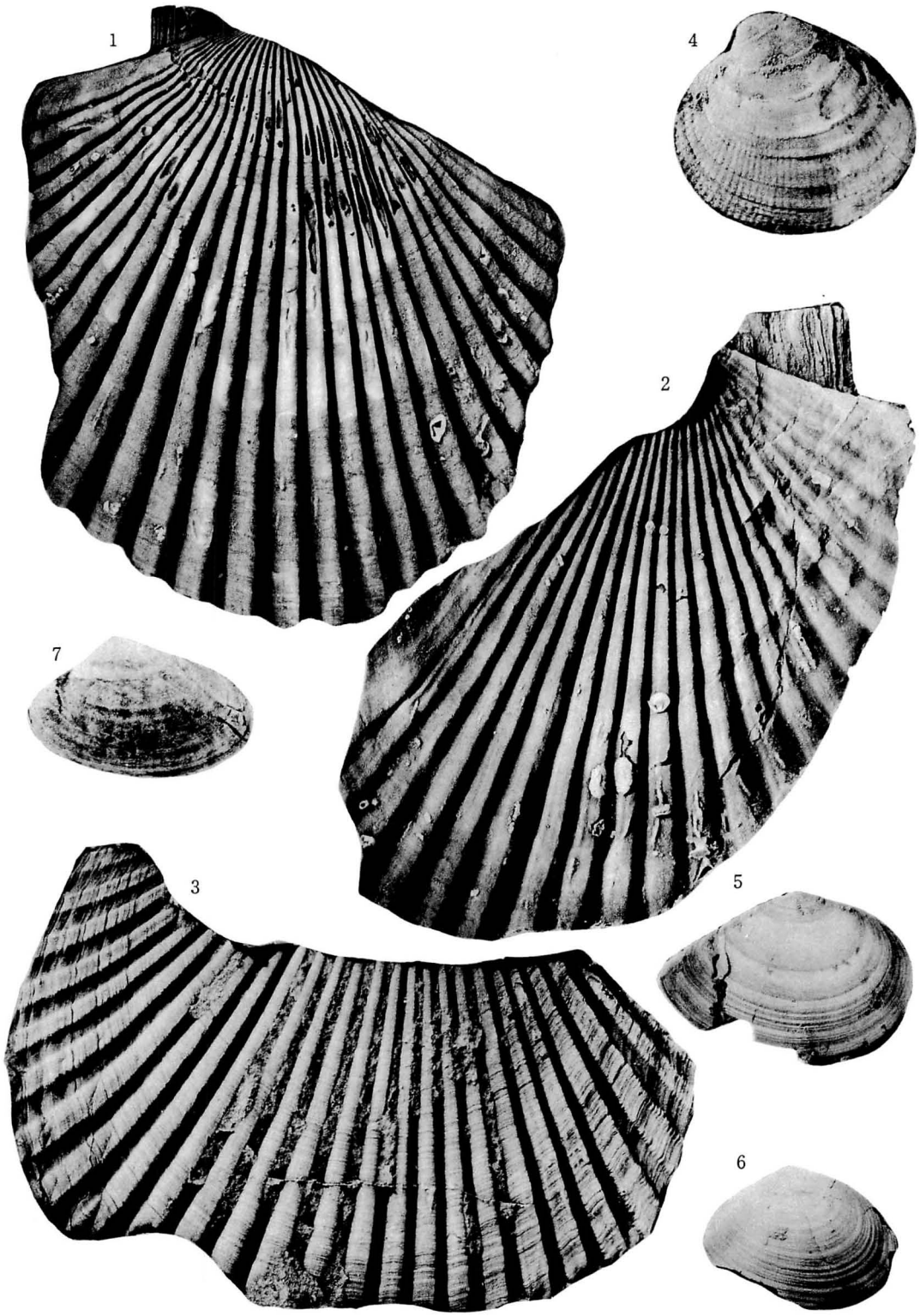
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Plate 7

Explanation of Plate 7

(All figures are in natural size unless otherwise stated.)

Figs. 1, 2. *Acesta* cf. *A. yagenensis* (OTUKA) ..... page 58
1. Incomple right valve, about ×0.8, apical part missing, obliquity (longest length measured from beak to ventral margin) ca. 127 mm, width 95 mm. Loc. 81002(Tp) Reg. No. TUE 8423.
2. Anterior ear, rubber cast. Loc. 81002(Tp) Reg. No. TUE 8423.

Fig. 3. *Conchocele disjuncta* GABB..... page 61
Decorticated left valve. Float, Loc. 80606(?Tp) Reg. No. TUE 8426.

Figs. 4a-b. *Pitar (Katherinella)* sp. ..... page 85
4b. Hinge teeth of fig. 4a. Loc. 81001(Tp) Reg. No. TUE 10010.

Figs. 5, 6a-b. *Calyptogena chitanii* (KANEHARA) ..... page 80
Loc. M 1769 (locality number of USGS, Menlo Park)(Ty)
5. Inner mould of immature specimen of right valve.
6a. Rubber cast of fig. 6b, showing the hinge teeth. Reg. No. TUE 8450.

Figs. 7a-b. *Clinocardium brooksi* (CLARK) ..... page 67
7a. A left valve, showing the surface sculpture;
7b. Lateral view of the same specimen of fig. 7a. Loc. 81403 Reg. No. TUE 8433.

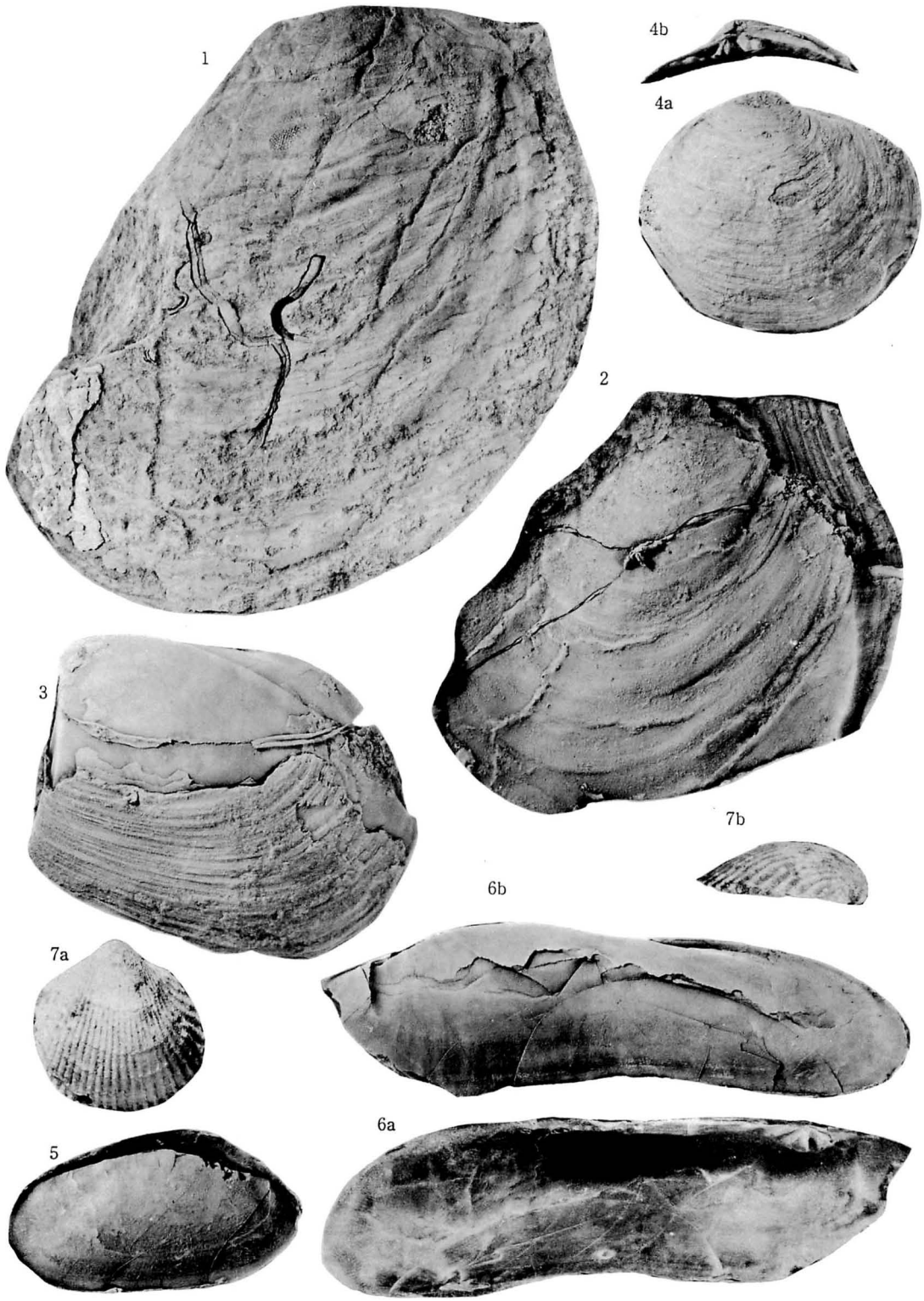
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Plate 8

Explanation of Plate 8

(All figures are in natural size unless otherwise stated.)

Figs. 1-3. *Clinocardium yakatagense* (CLARK) ..... page 66
1a. Decorticated left valve.
1b. Apical view of fig. 1a.
2, 3. Incomplete right valves. 2b. Cardinal teeth of fig. 2a.
Loc. 81402(Ty) Reg. No. TUE 8432.

Figs. 4, 5. *Pitar (Katherinella) arnoldi etheringtoni* (TEGLAND)..... page 85
4b. Apical view of fig. 4a. Loc. 81401(Tp).
5. Deformed left valve. Loc. 81401(Tp) Reg. No. TUE 10009.

Figs. 6, 7. *Pitar (Katherinella) arnoldi* (WEAVER) ..... page 85
6b. Apical view of fig. 6a. Loc. 80602(Tp).
7. Cardinal teeth and inner surface of left valve. Loc. 81102(Tp)
Reg. No. TUE 10008.

Figs. 8a-c. *Securella alaskensis* (CLARK) ..... page 86
8b. Cardinal teeth of fig. 8a.
8c. Apical view of fig. 8a.
Loc. 81402(Ty) Reg. No. TUE 10011.

Fig. 9. *Spisula equilateralis* (CLARK) ..... page 72
Incomplete specimen of right valve. Loc. 81401(Tp) Reg. No. TUE 8439.

Fig. 10. *Spisula addicotti* KANNO, n. sp. ..... page 72
Paratype, immature left valve. Loc. 81401(Tp) Reg. No. TUE 8441.

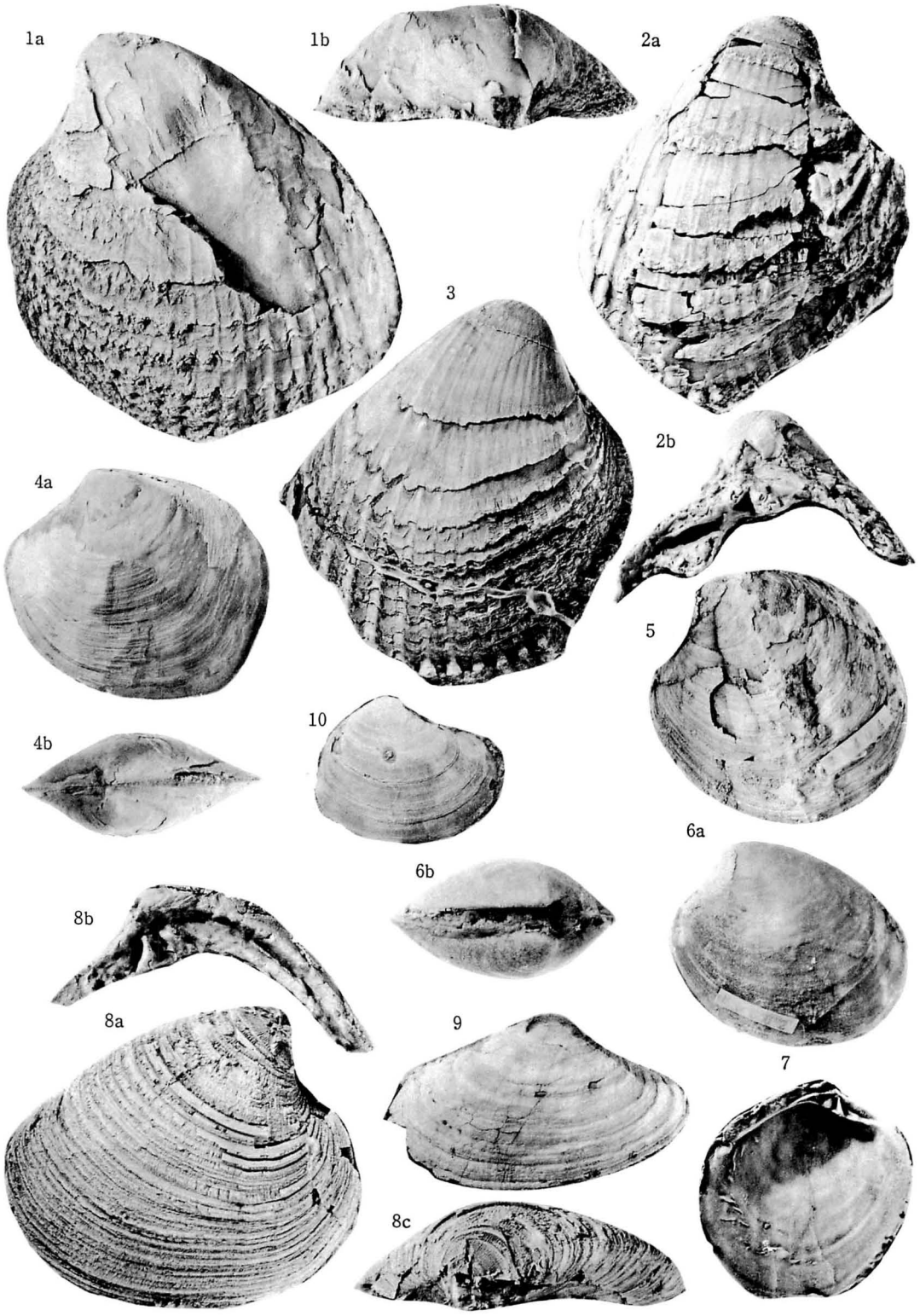
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Plate 9

Explanation of Plate 9

(All figures are in natural size unless otherwise stated.)

Figs. 1, 4, 5, 7, 8. *Spisula equilateralis* (CLARK) ..... page 72
1b. Apical view of fig. 1a.
4. Dorsal view of right valve.
Loc. 81401(Tp) Reg. No. TUE 8439.
5, 8. More or less deformed right valves.
8b. Apical view of fig. 8a. Loc. 81201(Tp)
7. Somewhat deformed right valve. 7b. Cardinal teeth of fig. 7a.
Loc. 81401(Tp) Reg. No. TUE 8439.

Figs. 2, 3, 6. *Spisula addicotti* KANNO, n. sp. ..... page 72
2a. Holotype, right valve. 2b. Apical view of fig. 2a.
Loc. 81401(Tp) Reg. No. TUE 8440.
3a. Paratype, left valve. 3b. Cardinal teeth of fig. 3a.
6. Paratype, somewhat deformed specimen.
Loc. 81401(Tp) Reg. No. TUE 8439.

Figs. 9, 10, 12. *Macoma incongrua* v. MARTENS ..... page 77
All specimens are intact valves.
9, 12. Loc. 81401(Tp) Reg. No. TUE 8446.
10. Loc. 81201(Tp) Reg. No. TUE 8446.

Fig. 11. *Macoma* cf. *M. incongrua* v. MARTENS ..... page 78
Deformed specimen of right valve (intact valves). Loc. 80802(Tp)
Reg. No. TUE 8447.

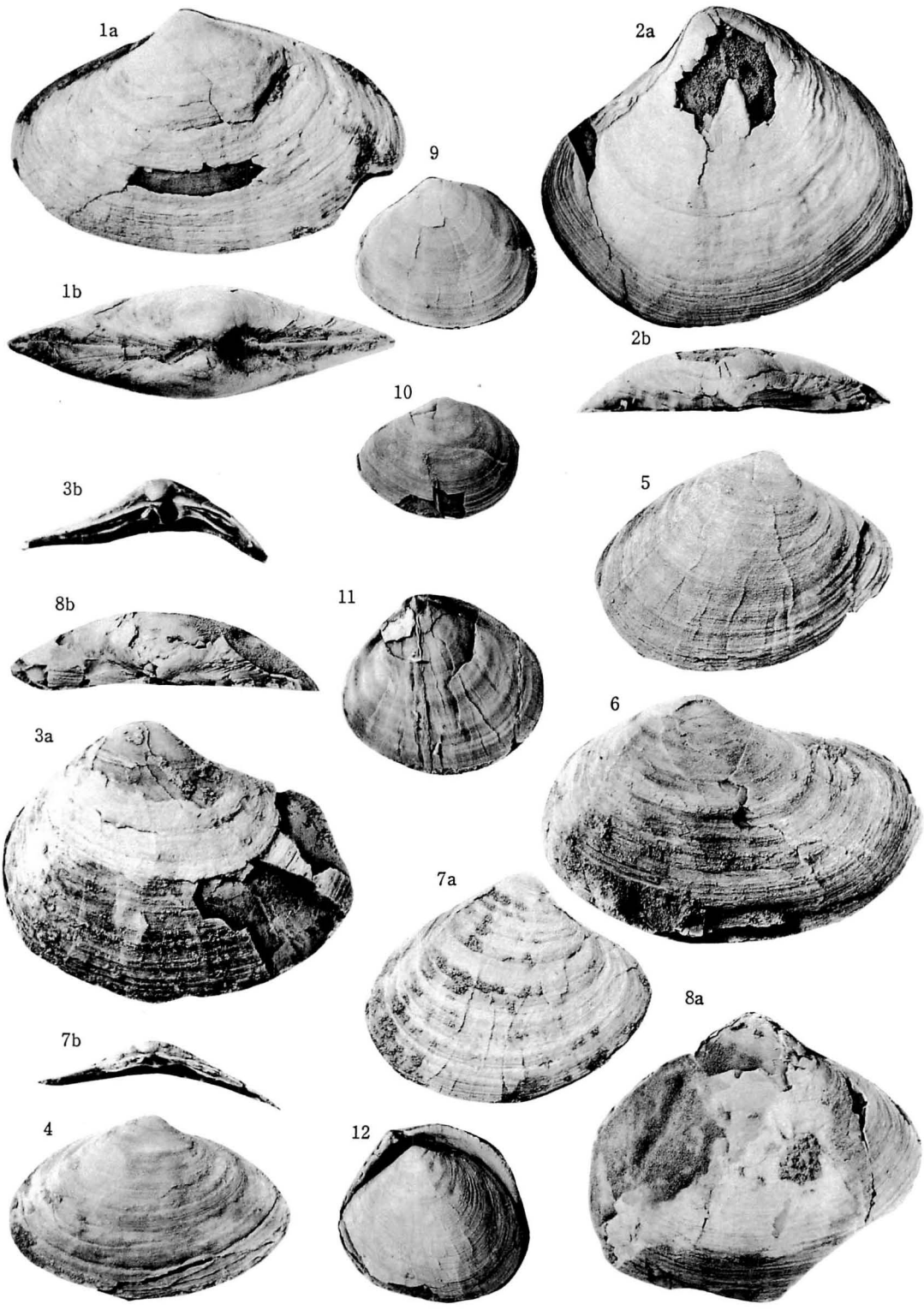
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Plate 10

Explanation of Plate 10

(All figures are in natural size unless otherwise stated.)

Figs. 1, 2. *Macoma* aff. *M. lorenzoensis arnoldi* TEGLAND..... page 76
1. Right valve. 2. Incomplete inner mould of intact valve, showing the pallial sinus. Loc. 80506(Ty) Reg. No. TUE 8445.

Fig. 3. *Macoma* sp. ..... page 79
Strongly deformed specimens, each valve of right and left shows different shape by the difference of deformation. Float, Loc. 81106(?Tp) Reg. No. TUE 8449.

Figs. 4, 5. *Tellina* (*Oudardia*) sp. ..... page 75
4. Decorticated right valve.
5. Decorticated left valve, showing the thick internal rib radiating from beak to antero-ventral corner. Loc. 81401(Tp) Reg. No. TUE 8443.

Figs. 6, 7. *Mya* (*Mya*) *truncata* LINNÉ ..... page 89
6a. Decorticated left valve. 6b. Apical view of fig. 6a. Loc. 80406(Ty) Reg. No. TUE 10013.
7. Showing the surface sculpture of left valve. Loc. 80404(Ty) Reg. No. TUE 10013.

Figs. 8–10. *Panomya arctica* (LAMARCK) ..... page 94
8b. Apical view of fig. 8a. Loc. 80406(Ty) Reg. No. TUE 10019.
10. Somewhat decorticated left valve. Loc. 80406(Ty) Reg. No. TUE 10019.
9. Rubber cast, showing the cardinal teeth and inner surface of right valve. Loc. 81105(Ty) Reg. No. TUE 10019.

Figs. 11a–b. *Hiatella arctica* (LINNÉ) ..... page 91
11a. Somewhat decorticated intact valve.
11b. Rubber cast of fig. 11a. Loc. 80802(Ty) Reg. No. TUE 10016.

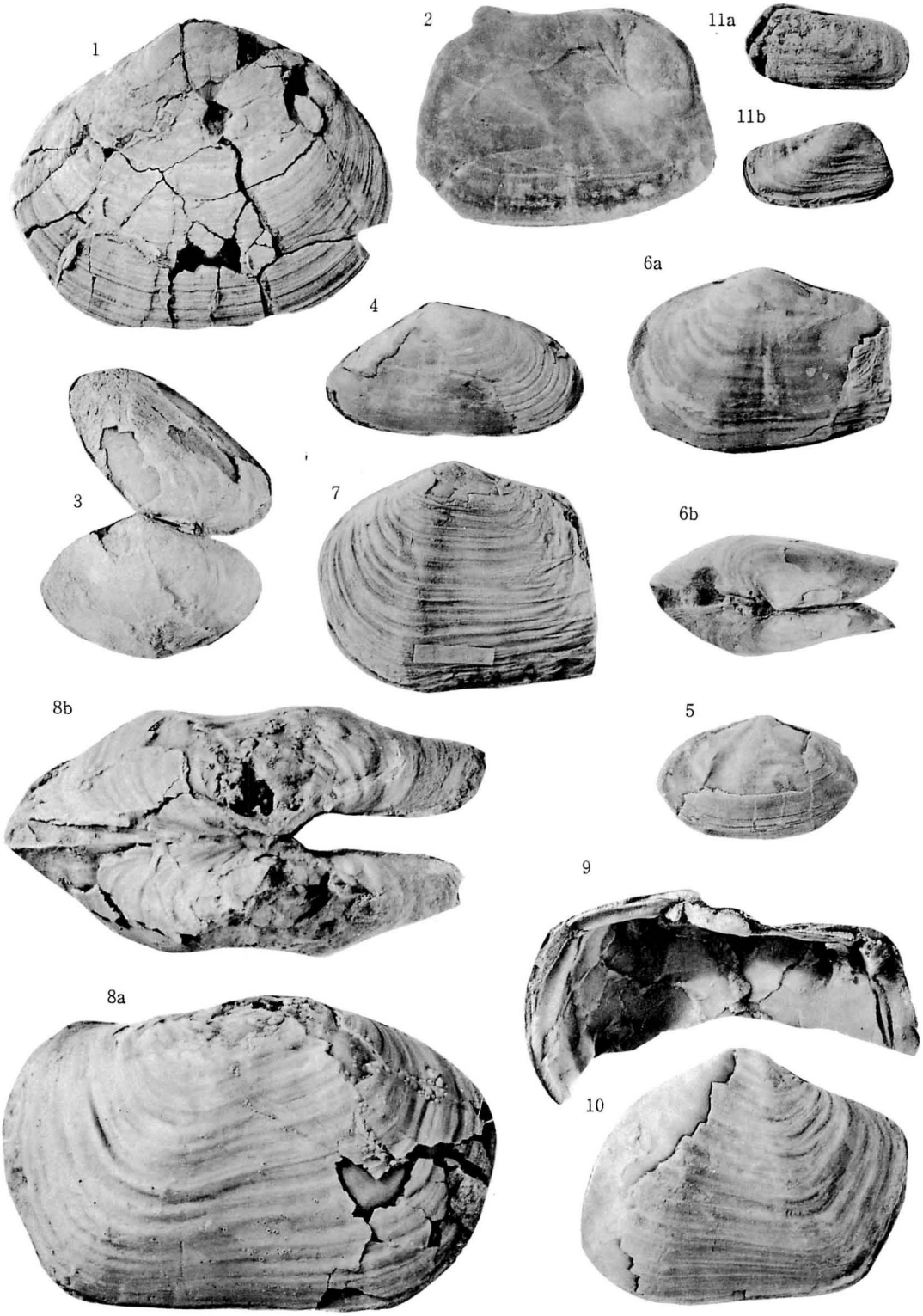
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Plate 11

Explanation of Plate 11

(All figures are in natural size unless otherwise stated.)

Fig. 1. *Macoma* sp. ×2 ..... page 79
Rubber cast, showing the hinge structure. Float, Loc. 81106(?Tp) Reg. No. TUE 8449.

Figs. 2a-b. *Panope snohomishensis* CLARK ..... page 93
2b. Apical view of fig. 2a. Loc. 81401(Tp) Reg. No. TUE 10017.

Figs. 3a-b. *Panope* n. sp.?..... page 93
3b. Apical view of fig. 3a. Loc. 81401(Tp) Reg. No. TUE 10018.

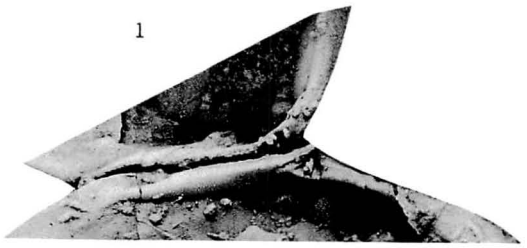
Figs. 4a-b. *Mya* (*Mya*) *truncata* LINNÉ ..... page 89
4a. Decorticated left valve, showing the large pallial sinus.
4b. Apical view of fig. 4a, showing the condrophore. Loc. 81402(Ty) Reg. No. TUE 10013.

Fig. 5. *Mya* (*Mya*) *salmonensis* CLARK ..... page 90
Decorticated intact spacimen. Flart, Loc. 80906(Tp) Reg. No. TUE 10014.

Figs. 6, 7. *Panomya elongata* KANNO ..... page 95
6. Somewhat deformed right valve. Loc. 81401(Tp) Reg. No. TUE 10020.

Figs. 8, 9. *Thracia schencki* CLARK ..... page 97
8. Decorticated and incomplete right valve.
9. Decorticated left valve.
Loc. 81401(Tp) Reg. No. TUE 10023.

Fig. 10. *Periploma* (*Aelga*) *besshoense* (YOKOYAMA) ..... page 96
More or less deformed specimen. Loc. 80404(Ty) Reg. No. TUE 10022.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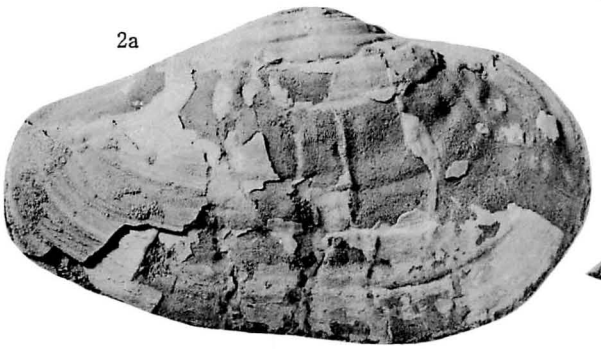
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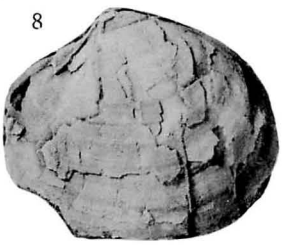
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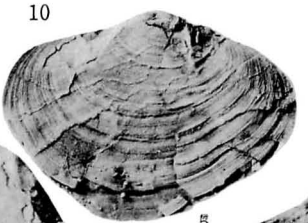
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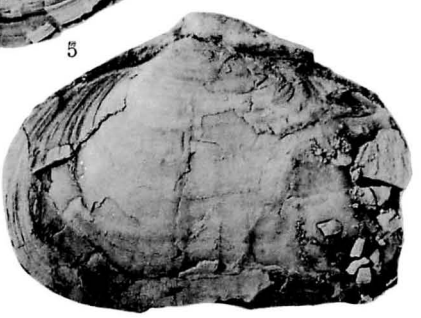
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Plate 12

Explanation of Plate 12

(All figures are in natural size unless otherwise stated.)

Figs. 1, 2. *Dentalium (Coccodentalium)* cf. *D. (C.) nunomae* TAKEDA ..... page 99
1. Deformed specimen, showing the microscopic cancellate surface sculpture, ×2. Loc. 80905(Tp) Reg. No. TUE 10025.
2. Decorticated specimen. Loc. 81401(Tp) Reg. No. TUE 10025.

Figs. 3a-c. *Bathybembix jonesi* KANNO, n. sp. ..... page 101
3a-b. Side view of holotype. 3c. Basal view of the same. Loc. 20508-2 Reg. No. TUE 10027.

Figs. 4a-b. *Bathybembix turbonata* (CLARK) ..... page 100
4a. Apertural view. 4b. Side view of fig. 4a, showing a spiral cord on the body whorl. Loc. 81103(Tp) Reg. No. TUE 10026.

Figs. 5, 6. *Calyptraea* sp. ..... page 108
5. Loc. 80602(Tp) Reg. No. TUE 10036.
6. Loc. 81003(Tp) Reg. No. TUE 10036.

Figs. 7, 8. *Crepidula* cf. *praerupta* CONRAD ..... page 109
Loc. 81004(Tp) Reg. No. TUE 10037.

Figs. 9-12. *Turritella (Neohaustator) hamiltonensis* CLARK ..... page 105
9, 10. Loc. 81104(Ty) Reg. No. TUE 10032.
11, 12. Loc. 81403(Ty) Reg. No. TUE 10032.

Figs. 13, 14. *Turritella* aff. *T. diversilineata blakeleyensis* WEAVER ..... page 106
13. Loc. 81404(Tp) Reg. No. TUE 10033.
14. Loc. 80906(Tp) Reg. No. TUE 10033.

Fig. 15. *Cristispira pugetensis* ALLISON ×2 ..... page 107
Loc. 20537-6(Tk*)

Fig. 16. *Epitonium* sp. ..... page 104
Loc. 81401(Tp) Reg. No. TUE 10031.

Figs. 17, 18. *Epitonium (Cirsotrema) clallamense* DURHAM ..... page 102
17. Outer lip brocken. Loc. 81002(Tp) Reg. No. TUE 10029.
18. Varietal form, providing rather large number of axial varices. Loc. 80905(Tp) Reg. No. TUE 10029.

Fig. 19. *Epitonium (Grysoscala)* sp. ..... page 103
Loc. 80905(Tp) Reg. No. TUE 10030.

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* Tk....Kultieth formation.

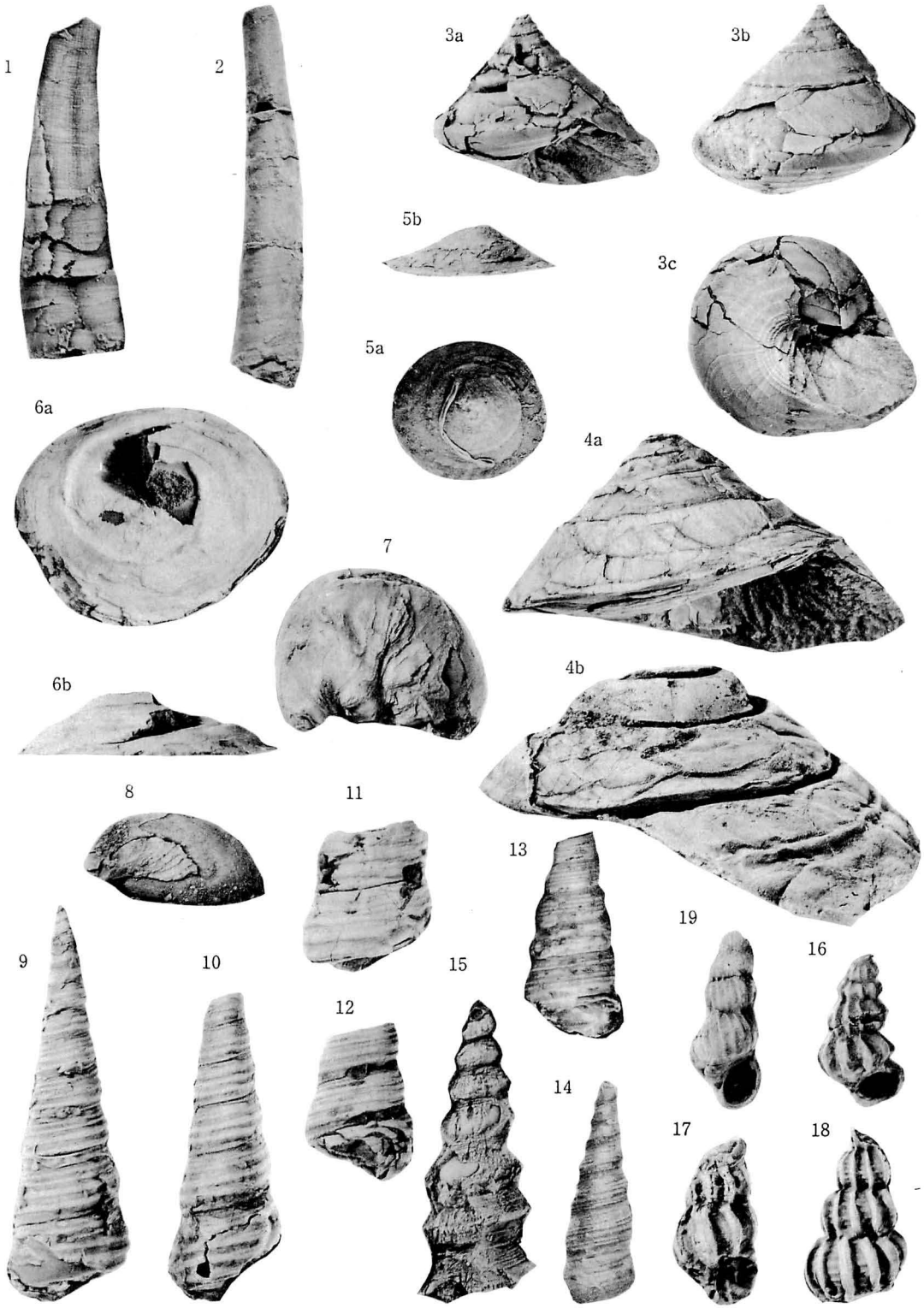
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Plate 13

Explanation of Plate 13

(All figures are in natural size unless otherwise stated.)

Figs. 1a-b. *Euspira ramonensis* (CLARK) ..... page 110
1b. Apertural view of fig. 1a, showing the well developed funicle. Loc. 81404(Tp) Reg. No. TUE 10038.

Figs. 2a-b. *Cryptonatica* aff. *C. clausa* (BRODERIP and STEWART) ..... page 111
2b. Apertural view of fig. 2a, showing the umbilicus which entirely closed by small and flat callus. Loc. 80406(Ty) Reg. No. TUE 10039.

Figs. 3a-b. *Colus* aff. *C. jordani* DALL ..... page 121
3a. Apertural view of fig. 3b. Loc. 81202(Tp) Reg. No. TUE 10053.

Fig. 4. *Ancistrolepis* sp. ..... page 119
Loc. 81401(Tp) Reg. No. TUE 10052.

Figs. 5, 9. *Ancistrolepis rearensis* (CLARK) ..... page 118
5a. Apertural view of fig. 5b. Loc. 80905(Tp)
9. Incomplete specimen. Loc. 81203(Tp) Reg. No. TUE 10050.

Figs. 6, 7. *Pteropurpura* n. sp. ..... page 113
6. Rubber cast, body whorl missing. Loc. D161, USGS Menlo Park.
7. Rubber cast, showing the large frill on the body whorl. Loc. 81203(Tp) Reg. No. TUE 10043.

Fig. 8. *Priscofusus clarki* KANNO, n. sp. ..... page 122
Apertural view, rubber cast based on the holotype. Loc. 81002(Tp) Reg. No. TUE 10054.

Fig. 10. *Neptunea* (*Sulcosipho*) cf. *N.* (*S.*) *tabulata* (BAIRD) ..... page 117
Immature specimen. Float, Loc. 80802(Ty) Reg. No. TUE 10048.

Figs. 11, 12, 13. *Liracassis apta* (TEGLAND) ..... page 111
11. Back view, showing two distinct nodulose rows and more faint nodulose rows beneath the distinct one. Loc. 81404(Tp) Reg. No. TUE 10040.
12b. Apical view of fig. 12a, showing no node on the shoulder. Loc. 81401(Tp) Reg. No. TUE 10040.
13. Apertural view, showing slightly developed nodes on the shoulder. Loc. 81401(Tp) Reg. No. TUE 10040.

Figs. 14a-b. *Liracassis durhami* KANNO, n. sp. ..... page 112
14a. Holotype, showing the back view and surface ornamentation.
14b. Apical view of fig. 14a. Loc. 80906(Tp) Reg. No. TUE 10041.

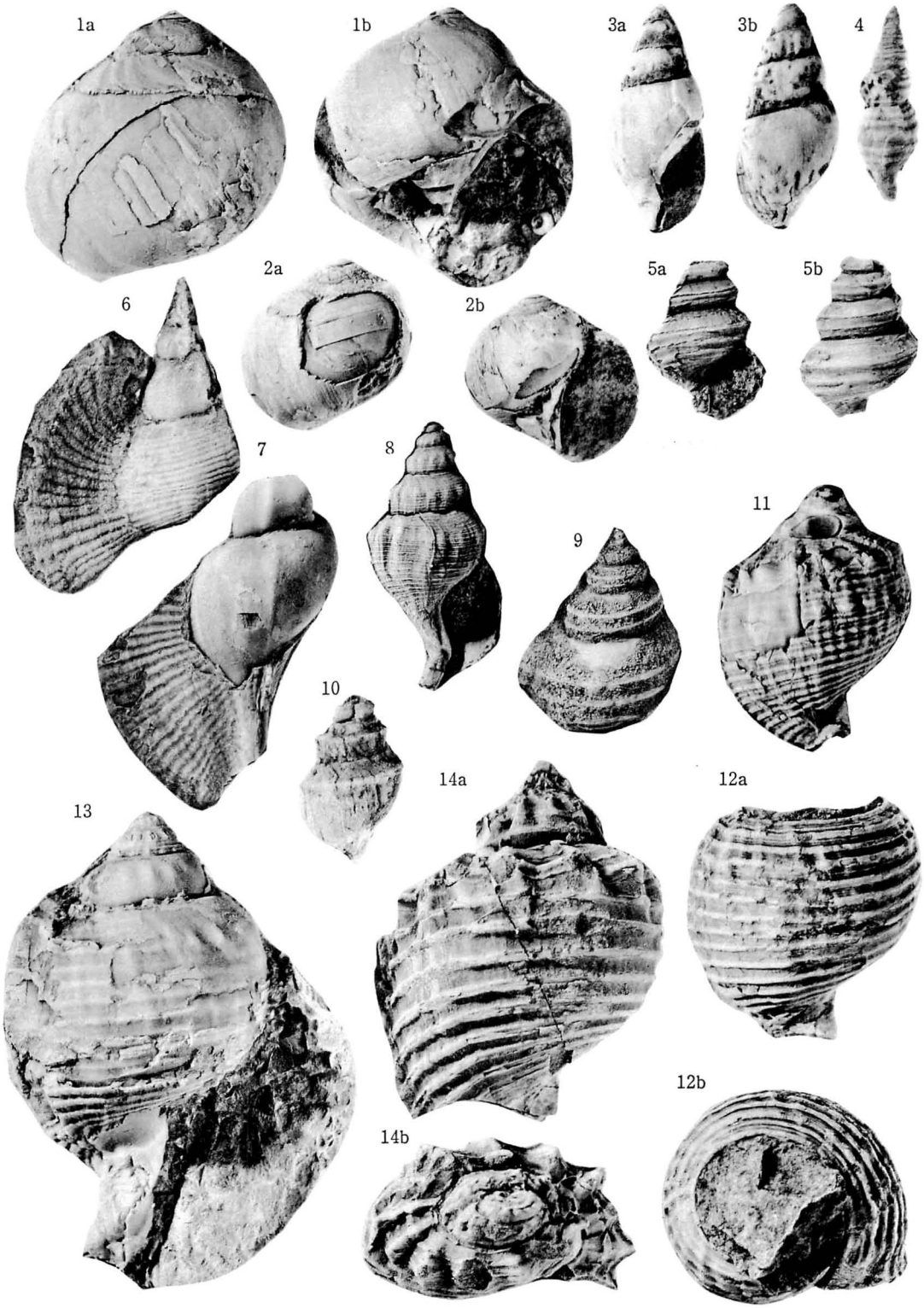
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Plate 14

Explanation of Plate 14

(All figures are in natural size unless otherwise stated.)

Figs. 1-3. *Neptunea (Neptunea) plafkeri* KANNO, n. sp. ..... page 115
All specimens are somewhat deformed or crashed.
1. Holotype. Loc. 81104(Ty) Reg. No. TUE 10045.
2, 3. Paratype (incomplete). Loc. 81104(Ty) Reg. No. TUE 10046.

Figs. 4-6. *Ancistrolepis rearensis* (CLARK) ..... page 118
4. Apertural view.
5. Incomplete specimen, showing the surface sculpture, ×2.
6. Incomplete specimen, showing the spire.
Loc. 81404(Tp) Reg. No. TUE 10050.

Fig. 7. *Ancistrolepis macneili* KANNO, n. sp. ..... page 119
Holotype, Loc. 80906(Tp) Reg. No. TUE 10051.

Figs. 8, 9, 15. *Priscofusus clarki* KANNO, n. sp. ..... page 122
Paratype, all incomplete specimens. Loc. 80905(Tp) Reg. No. TUE 10055.

Fig. 10. *Turricula* cf. *T. washingtoniana* (WEAVER) ..... page 130
Incomplete specimen, missing its spire and aperture. Loc. 81404(Tp)
Reg. No. TUE 10062.

Figs. 11-13. *Priscofusus* sp. ..... page 124
11, 12. Incomplete specimens. Loc. 81404(Tp) Reg. No. TUE 10056.
13. Rubber cast. Loc. 80905(Tp) Reg. No. TUE 10056.

Figs. 14a-b. *"Fulgoraria"* sp. ..... page 126
14a. Apertural view of fig. 14b. Loc. 81201(Tp) Reg. No. TUE 10059.

Fig. 16. *Turricula* sp. ..... page 130
Loc. 80905(Tp) Reg. No. TUE 10063.

Figs. 17, 18. *Cancellaria (Crawfordina) alaskensis* CLARK ..... page 128
17. Apertural view. Loc. 81201(Tp) Reg. No. TUE 10060.
18. Back view, rubber cast. Loc. 81401(Tp) Reg. No. TUE 10060.

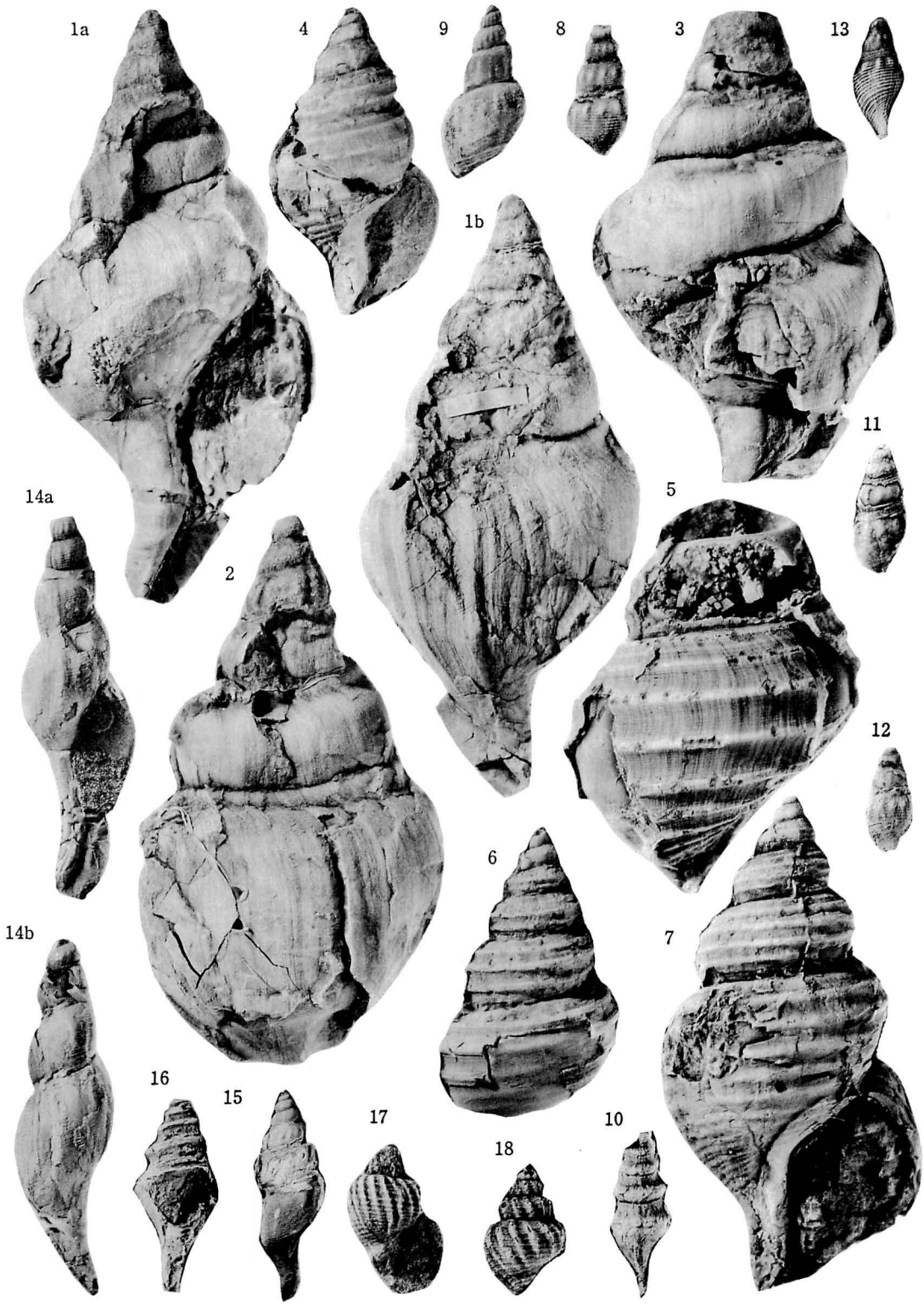
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Plate 15

Explanation of Plate 15

(All figures are in natural size unless otherwise stated.)

Figs. 1, 2. *Neptunea* (*Sulcosipho*) cf. *N.* (*S.*) *tabulata* (BAIRD) ..... page 117
1. Apertural view, somewhat deformed specimen. Loc. 20541-7(Ty) Reg. No. TUE 10048.
2. Decorticated and incomplete specimen. Loc. 81306(Ty) Reg. No. TUE 10048.

Fig. 3. *Beringius* cf. *B. crebricostatus* (DALL) ..... page 120
Incomplete specimen. Loc. 80404(Ty) Reg. No. TUE 10049.

Fig. 4. *Musashia* (*Neopsephaea?*) sp. ..... page 126
Rubber cast, showing two columella folds and surface ornamentation. Loc. 80702(Tp) Reg. No. TUE 10058.

Figs. 5a–b. *Musashia* (*Neopsephaea*) *corrugata* (CLARK) ..... page 125
5a. Apertural view of fig. 5b. Loc. 81401(Tp) Reg. No. TUE 10057.

Figs. 6a–b. *Eosiphonaria* sp. ..... page 114
Incomplete specimen, showing some part of body whorl. Loc. 81002(Tp) Reg. No. TUE 10044.

Figs. 7, 8. *Scaphander alaskensis* CLARK ..... page 131
7. Showing somewhat lower shell than fig. 8. Loc. 81401(Tp) Reg. No. TUE 10064.

Figs. 9a–b. *Antiplanes* (*Antiplanes*) sp. ..... page 129
9a. Apertural view of fig. 9b. Loc. 80604(Ty) Reg. No. TUE 10061.

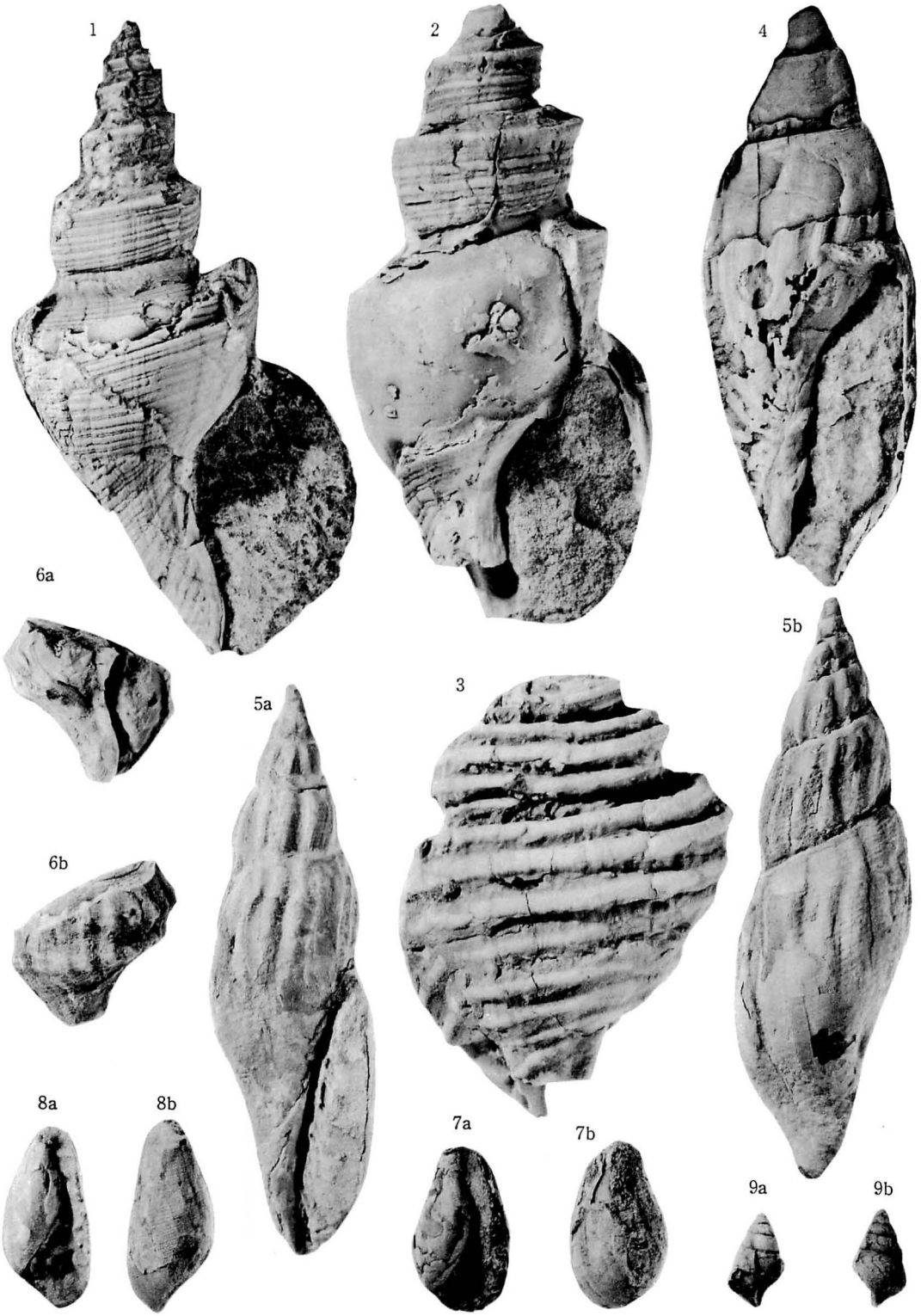
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Plate 16

Explanation of Plate 16

(All figures are in natural size unless otherwise stated.)

Figs. 1–4. *Aturia alaskensis* SCHENCK ..... page 133

1. Deformed specimen, showing almost complete aperture. Loc. 81401 Reg. No. TUE 10065.
2. Almost complete immature specimen. Loc. 81401 Reg. No. TUE 10065.
3a. Incomplete specimen. Loc. 81401 Reg. No. TUE 10065.
3b. Showing the surture of fig. 3a.
4. *Aturia "minoensis* KOBAYASHI, 1954", refigured from the KOBAYASHI's original paper for comparison.


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Plate 17

Explanation of Plate 17

(All figures are in natural size unless otherwise stated.)

Fig. 1. *Pododesmus* (*Monia*) *macroschisma* (DESHAYES) ..... page 57
Incomplete right valve, showing large byssal foramen. Loc. 20541-1(Ty) Reg. No. TUE 8422.

Fig. 2. *Nemocardium alaskense* (CLARK) ×2 ..... page 70
Showing the silk-like fine radial threads. Loc. 80906(Tp) Reg. No. TUE 8437.

Figs. 3, 4. *Modiolus* sp. ..... page 46
Decorticated left valves. Loc. 80906(Tp) Reg. No. TUE 8411.

Fig. 5. *Delectopecten peckhami* (GABB) ×2 ..... page 48
Loc. 20495-24(Ty) Reg. No. TUE 8413.

Fig. 6. *Siliqua* sp. ..... page 74
Incomplete specimen, showing the internal rib running vertically from beak to the ventral margin. Loc. 80605(Ty) Reg. No. TUE 8442.

Figs. 7-11. *Macrocallista weaveri* CLARK ..... page 87
Showing the varietal forms; 7, 8. Rather higher form, but fig. 11 shows rather lower form.
9. Rubber cast, showing cardinal teeth, ×2.
11. Internal mould, showing the pallial sinus. Loc. 9002-2(Tp) Reg. No. TUE 10012.

Fig. 12. *Calyptogena chitanii* (KANEHARA) ..... page 80
Rubber cast, showing cardinal teeth. USGS, Menlo Park, Loc. M 1767. Reg. No. TUE 8450.

Figs. 13-15. *Corbicula* (*Corbicula*) sp. ..... page 83
13. Right valve, missing its beak.
14. Mode of occurrence of *Corbicula* (*C.*) sp. in Kultieth formation.
15a. Rubber cast of fig. 15b, showing cardinal teeth. ×2.
Loc. 81501(Tk) Reg. No. TUE 10007.

Figs. 16, 17. *Thracia* cf. *T. condoni* CONRAD ..... page 98
16. Slightly decorticated left valve. Loc. 81401(Tp) Reg. No. TUE 10024.
17. Decorticated right valve. Loc. 81201(Tp) Reg. No. TUE 10024.

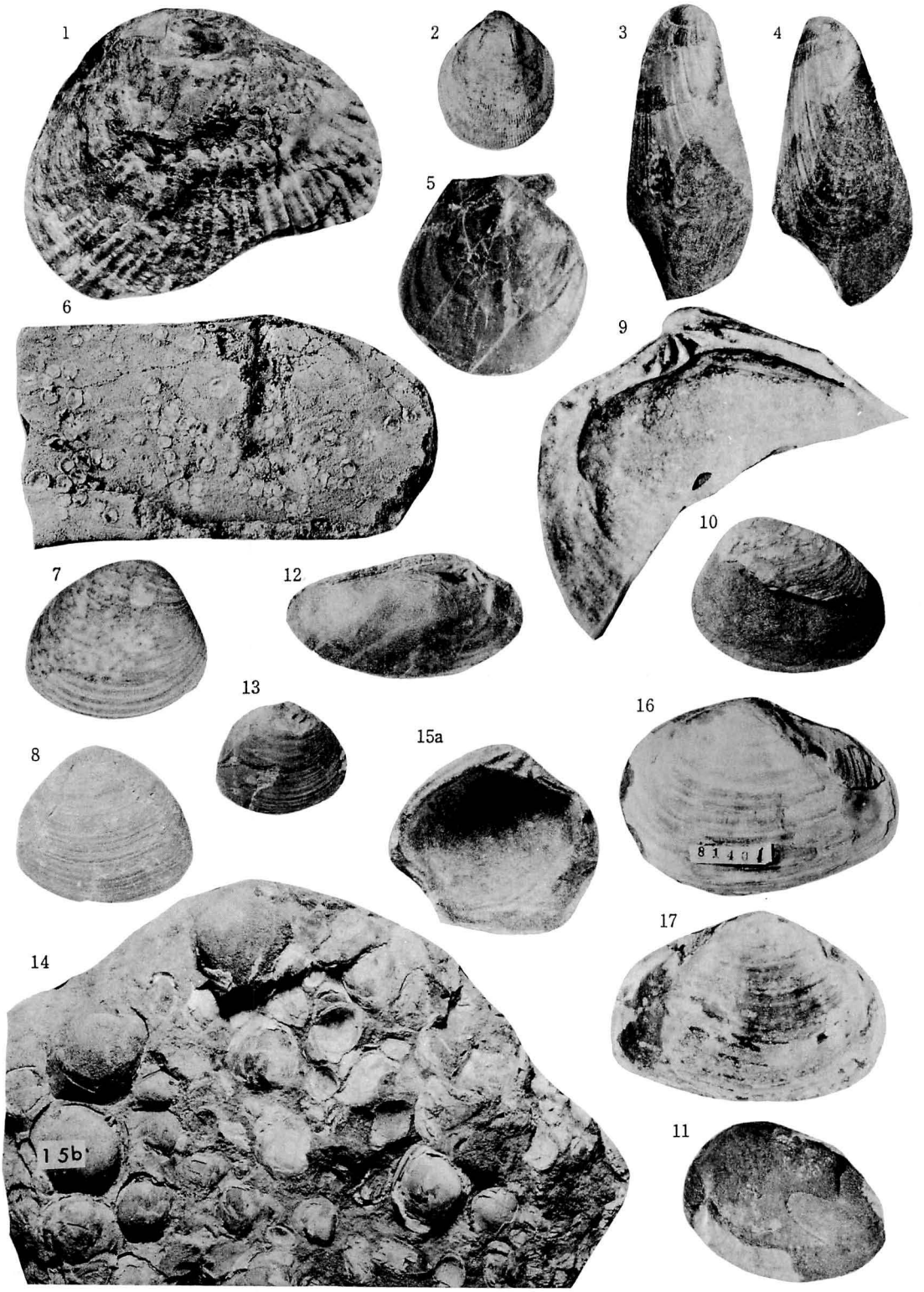
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Plate 18

Explanation of Plate 18

(All figures are in natural size unless otherwise stated.)

Figs. 1–2. *Ostrea* sp. ..... page 59
1. Decorticated right valve.
2. Inner surface of left valve (almost flat). Loc. 81502(Tk) Reg. No. TUE 8424.

Figs. 3–5. *Turritella* sp. ..... page 106
3, 4. Somewhat decorticated specimens.
5. Showing the growth line. TUE loc. 81401(Tp) Reg. No. 10034.

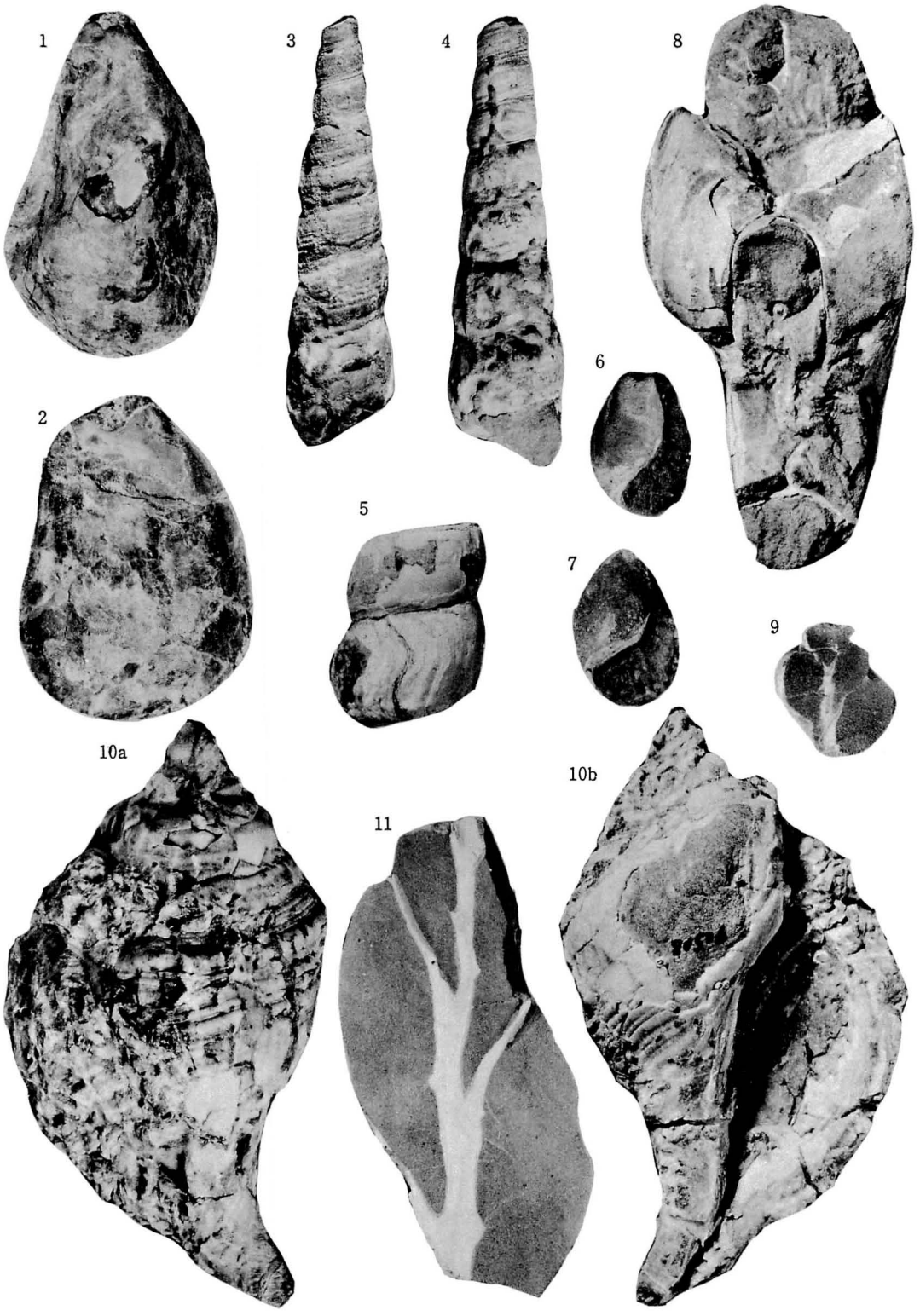
Figs. 6, 7. *Scaphander alaskensis* CLARK ..... page 131
Showing lower form of the present species. Loc. 81201(Tp)
Reg. No. TUE 10064.

Fig. 8. *Aturia alaskensis* SCHENCK ..... page 133
Showing apertural view of plate 16, fig. 3. Loc. 81401(Tp) Reg. No. TUE 10065.

Fig. 9. *Cancellaria* (*Crawfordina*) *alaskensis* CLARK ..... page 128
Axial section, showing the columella folding. Loc. 81201(Tp)
Reg. No. TUE 10060.

Figs. 10a–b. *Neptunea* (*Neptunea*) sp. ..... page 116
10a. Surface mostly covered by barnacle.
10b. Showing the aperture. Loc. 80506(Ty) Reg. No. TUE 10047.

Fig. 11. *Musashia* (*Neopsephaea*) *corrugata* (CLARK) ..... page 125
Axial section, showing the columella folding. Loc. 80905(Tp)
Reg. No. TUE 10057.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