Researches on the Holocene Epoch in the Far East : Review of the Researchs during the Inter-Congress Time, 1988～1991, of the Intenational Union for Quaternary Research (INQUA)

Researches on the Holocene Epoch in the Far East:

Review of the Researches during the Inter-Congress Time, 1988-1991, of the International Union for Quaternary Research (INQUA)*

Norio FUJI**

the president

of

Subcommission of the Far East for the Study of the Holocene,

the International Union for Quaternary Research

Preface

In the 12nd.-International Congress of the International Union for Quaternary Research (INQUA) held in Canada on August of 1987, the International Union for Quaternary Research adopted that the Commission for the Study of the Holocene organized the Subcommittee of the Far East for the Study of the Holocene, and then Prof. Dr. Norio FUJI being a palynological and geological scientist in Japan, was elected for the president of the subcommission.

During the inter-congress time : 1988-1991, many scientists of every country belonging to the Subcommission of the Far East have investigated on some problems concerning the Holocene as summarized in a following section.

In this report, outlines of the main researches among them have been described on the basis of main publications by the academic societies in every country.

I Human Impacts on the Natural Environments

Secondary Community around the Middle Neolithic Mawaki Site, Noto, Japan

Introduction. The Mawaki Archaeological Site is located at a narrow lowland facing on Toyama Bay of Japan Sea, Central Japan. This site was a small village during the middle Neolithic age from the early Jomosian period (ca. 6,000-4,500 years ago) to the latest Jomonian period (ca. 3,500-2,200 years ago), and covers an area of 40,000m^2. The site was excavated for about five years since 1982 from the viewpoints of archaeology and the natural environment based on geology, palaeontology, and chemistry. Fossil bones of dolphins and fish, and manufactured woods in the form of an oar, a sculptured pillar as a totem pole, knittings, a wooden tray and non-manufactured woods were found in sediments of the early Jomonian to middle Jomonian periods. Also, a late Jomonian earthen mask, and the latest Jomonian large wooden pillars were excavated. The index earthenwares of the Jomonian periods in the Hokuriku region, Japan, were included stratigraphically in thick sediment as follows : namely, the older eartherwares have been found in the lower part of the sediments, and the younger ones

Received on September 5th., 1990

* : Contribution from the Department of Earth Sciences, Faculty of Education, Kanazawa University ; New Series No. 141.

** : Department of Natural Sciences for Environment, Division of Physical Science, Graduate School of Natural Science and Technology, Kanazawa University ; 1-go, 1-ban, Marunouchi, Kanazawa 920, Japan.

have been excavated from the upper part of the sediments which are about 5m thick.

In the present paper, the author reports on palaeovegetation based upon pollen analyses, manufactured and non-manufactured woods at the site.

The author wishes to express his acknowledgement to Emeritus Prof. Teiichi Kobayashi, M. J. A., Drs. Mitsuo Suzuki, and Misaburo Shimakura for their help during his investigation of the Mawaki Site.

Tab. 1 Name of the non-manufactured wood-stumps identified from the Mawaki Site

Botanic name	Specimen	number(%)
Pinus densiflora	121	35.2
Thujopsis dolabrata	39	11.3
Torreya nucifera	22	6.4
Cephalotaxus harringtonia	17	4.9
Cryptomeria japonica	11	3.2
Abies	2	0.6
conifer trees	212	61.6
Castanea crenata	18	5.1
Acer	11	3.2
Quercus (*Prinus*)	10	2.9
Juglans ailanthifolia	7	2.0
Fagus	7	2.0
Maackia amurensis	7	2.0
Zelkova serrata	5	1.5
Ostrya japonica	3	0.9
Cercidiphyllum japonicum	3	0.9
Fraxinus	3	0.9
Carpinus (*Eucarpinus*)	2	0.6
Morus bombycis	2	0.6
Prunus	2	0.6
Aesculus turbinata	2	0.6
Aralia elata	2	0.6
Callicarpa	2	0.6
Cornus	1	0.3
Rhus javanica	1	0.3
Acanthopanax sciadophylloides	1	0.3
deciduous groad-leaved trees	89	25.9
Camellia japonica	10	2.9
Castanopsis	9	2.6
Eurya japonica	8	2.3
Quercus (*Cyclobalanopsis*)	6	1.7
Daphniphyllum	5	1.5
Cleyera japonica	2	0.6
evergreen broad-leaved trees	40	11.6
Elaeagnus	2	0.6
woody vine	1	0.3
Total	344	100.0

Archaeological Review. The Mawaki Site is a complex site. Many bones of dolphins identified as *Delphinus delphis* and *Lagenorhynchus obliquidens* are found in the sediments from the early Jomonian period to the middle Jomonian period. It is estimated that peoples of the Jomonian period had used dolphins for a fuel and/or food. The manufactured plant remains such as a rope, knittings, a wooden tray, an oar, and large pillars were excavated from the sediments from the early Jomonian period to the latest Jomonian period. Especially, the large pillars, 50-100cm in diameter were found from the late stage of the latest Jomonian period (ca. 3,000-2,500 years ago), and these pillars are identified as *Castanea crenata*.

Judging from the chronology of the archaeological eartherwares and radiocarbon dating data, age of the site is ranged in the middle Neolithic age from the early Jomonian to the latest Jomonian periods[2].

Review of the Plant Remains. The plant remains from the site are divided into wood stumps as manufactured and non-manufactured woods, leaves, seeds and pollen grains.

(1) Non-manufactured woods : The 344 specimens were identified into 33 taxa as shown in Tab. 1. These taxa are grouped into three types as conifer trees, decidutus broad-leaved trees, and evergreen broad-leaved trees. According to a botanical study of these remains[3], the conifer trees are most dominant with about 65% of the total specimens, and the deciduous broad-leaved trees occupy a quater of the total, while the evergreen broad-leaved trees are less abundant with only about 12%.

(2) Manufactured woods : The 83 specimens of the manufactured woods except for three unknown specimens have been identified into 16 taxa. Among these taxa, *Castanea crenata* is most common (44%), and *Chamaecyparis obtusa, Torreya nucifera* and *Cryptomeria japonica* are common.

(3) Leaves, seeds and cones : These macroplants found from the site are rare in a comparison with other archaeological sites. *Aesculus turbinata, Pinus densiflora,* and *Juglans mandshurica* are predominant.

(4) Pollen analyses : According to the pollen analyses of the 27 samples from the site, the pollen-flora at each horizon can be summarized as shown in Fig. 1. On the other hand, judging from 250 samples from the boring-well near the site, the change of pollen-flora during the Holocene epoch around the site is concluded as shown in Fig. 1.

Discussion. On the basis of the consideration of the macroplant and pollen fossils, the predominant taxa were *Pinus densiflora* and deciduous *Quercus* after the middle stage of the Early Jomonian period. However, according to the palynological researches of the Holocene deposits, it is reported that the evergreen laurel and tall forests were predominantly spread in the land areas around the site. Accordingly, in the Hokuriku region, judging from the palaeobotanical researches of the Postglacial deposits[1], the natural vegetation for the early and middle Neolithic ages around the site was fundamentally *Polysticho-Machiletum thunbergii* association with *Cyrtomium falcatum* subassociation in the lowland, *Polysticho-Machiletum thunbergii* association with *Zelkova serrata* subassociation in the small valleys, and *Quercus*

Tab. 2　Scientific name of the manufactured woods and their ages

Horizon	Archaeological Age	Scientific Name	Number	Total
I	After Yayoian Period	*Frarinus mandshurica japonica*	2	5
		Camellia japonica	1	
		Castanea crenata	1	
		Zelkova serrata	1	
II	Late Jomon.-Latest Jomon.	*Chamaeccyparis ootusa*	3	34
		Castanea crenata	30	
		Zelkova serrata	1	
III	early Late Jomonian P.	*Cryptomeria japonica*	1	1
IV		*Pinus densiflora*	1	4
		Abies firma	1	
		Pterocarya rhoifolia	1	
		undeterminable	1	
V－X	Late Jomon.-Mid. Jomon.	*Cryptomeria japonica*	1	1
XI	early Middle Jomonian ⟩ late Early Jomonian P.	*Pinus densiflora*	1	34
		Chamaecyparis obtusa	7	
		Cryptomeria japonica	2	
		Acer spp.	2	
		Aesculus turbinata	1	
		Aesculus turbinata	1	
		Frarinus mandshurica japonica	2	
		Quercus serrata	3	
		Castanea crenata	6	
		Torreya nucifera	4	
		Juglans mandshurica var.	1	
		Carpineu sp.	1	
		Cercidiphyllum japonicum	1	
		Camellia japonica	1	
		Quercus (*Cyclobalanosis*) sp.	1	
		undeterminable	1	
XII	late Early Jomonian P.	*Frarinus mandshurica japonica*	1	4
		Aesculus turbinata	1	
		Castanea crenata	1	
		Quercus (*Cyclobalanopsis*)	1	
unknown age & horizon		*Cryptomeria japonica*	1	3
		Torreya nucifera	1	
		undeterminable	1	
TOTAL			86	86

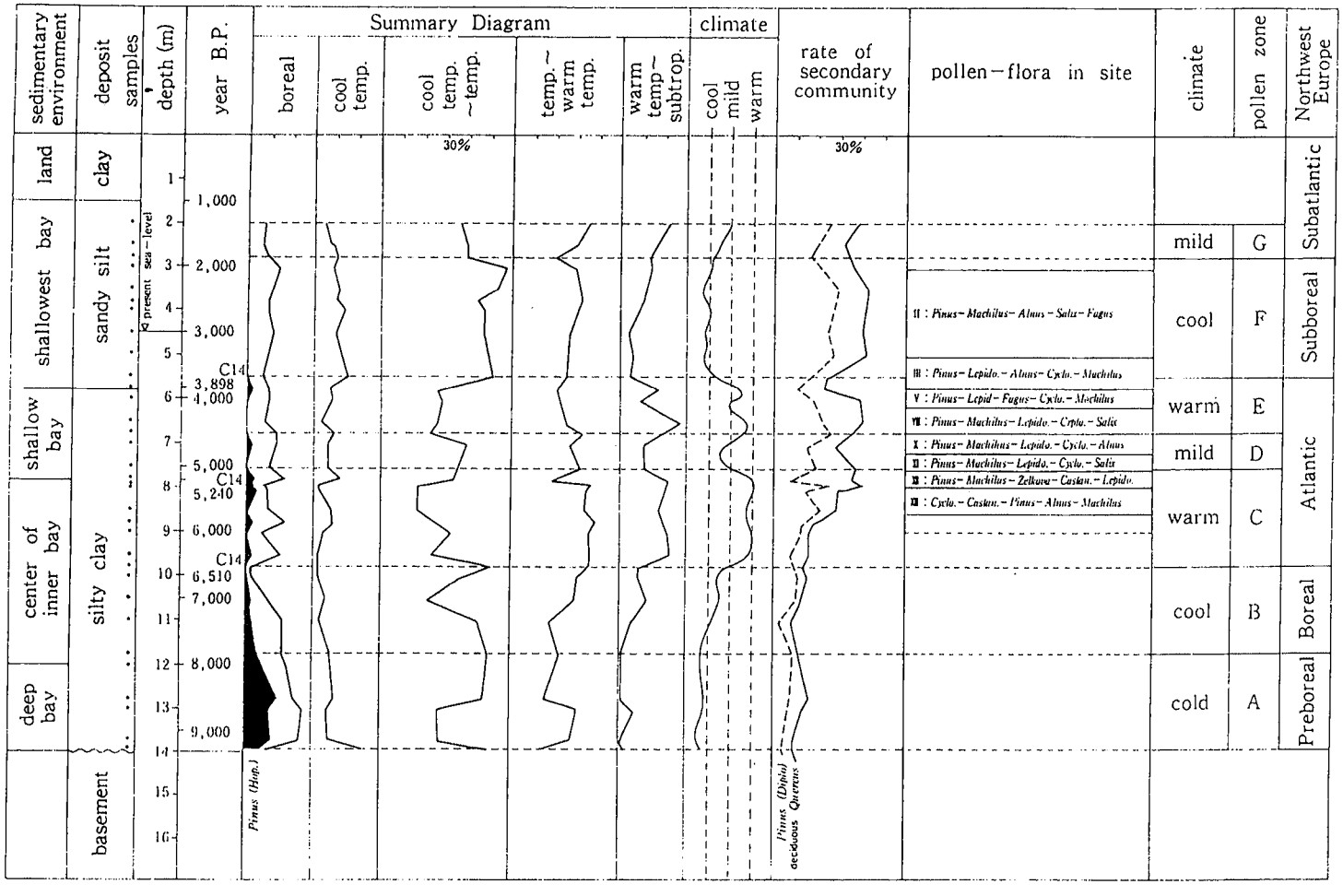

Fig. 1 Diagram showing the summary of pollen analyses, rate of the secondary community, palaeoclimate change, and comparison with the pollen zoning of Northwestern Europe.

Tab. 3 Name of the macroplant remains except for woods and their ages

Horizon	Archaeological Age	Scientific Name	Number
II	Late Jomon.-Latest Jomon.	*Crytomeria japonica*	many leaves
		Alnus japonica	8 seeds
		Lepidobalanus spp.	8 seeds
		Cyclobalanosis spp.	7 seeds
		Salir spp.	leaves
		Zelkova serrata	leaves
		Aesculus turbinata	seeds
		Pinus thunbergii	leaves
III	early Late Jomonian Per.	*Aesculus turbinata*	11 seeds
		Lepidobalanus spp.	leaves
		Juglans mandshurica	seeds
IV		*Lepidobalanus* spp.	6 seeds
		Machilus thunbergii	5 leaves
		Aesculus turbinata	seeds
		Cyclobalanopsis spp.	leaves
VII	mid. Middle Jomonian P.	*Pinus densiflora*	22 leaves
		Fagus cf. *crenata*	seeds
		Lepidobalanus spp.	leaves
		Pinus thrnbergii	cones
VIII	mid. Middle Jomonian P.	*Aesculus turbinata*	19 seeds
		Lepidobalanus spp.	18 leaves
		Salir spp.	12 leaves
		Machilus thunbergii	11 leaves
		Pinus densiflora	cones
X	early Middle Jomonian P.	*Juglans mandshurica*	17 seeds
		Pinus densiflora	cones
		Aesculus turbinata	seeds
XII	late Early Jomonian P.	*Pinus densiflora*	22 leaves
		Machilus thrnbergii	13 leaves
		Fagus cf. *japonica*	leaves
		Lepidobalanus spp.	leaves

salicina forest with *Castanopsis cuspidata, Zelkova serrata* and *Abies firma* in the hills. However, slightly different from the general consideration, it may be said that the pine and oak forests had been spread widely around the site since the middle stage of the Early Jomonian period. Dominant occurrence of the pine and oak is commonly observed in the forests of the secondary community of the vegetation at the present. Therefore, it is inferred that the

natural vegetation had been changed into the secondary community composed mainly of *Pinus densiflora* and deciduous *Quercus* by the human's heavy impact around the site since the middle stage of the Early Jomonian period. Additionally, it is summarized that the forests have been constructed by the mixture of plants of the Cool Temperate and Warm Temperate forests since the Early Jomonian period.

Reference

1) Fuji, N. (1984) : Chronostratigraphic subdivision of the Postglacial deposits in the Japanese Islands. *Striae*, 16.

2) Fuji, N. (1988) : Secondary Community of palaeovegetation around the middle Neolithic Mawaki Site, Noto Peninsula, Japan. Proc. Japan Academy, 64, 9, B., 265-268.

3) Noto-machi Educational Committee (1986) : "Mawaki Site". 482pp.

4) Yoda, Y. & Suzuki, M. (1986) : Natural woods from the Mawaki Site, Noto Peninsula, Central Japan. *Bull. Japan Sea Res. Institute, Kanazawa Univ.*, 18.

II Review of Recent Japanese Researches Concerning Holocene Sea Level Changes

This section is a review of the recent researches on relative sea level changes and coastal evolution during the Holocene in Japan. The Japanese Working Group of IGCP Project 200 concerning "the late Quaternary sea level changes", compiled the two-volume : *Atlas of Sea Level Records in the late Quaternary in Japan*" in 1987, which included data related to this problem. This group compliled the "*Middle Holocene Shoreline Map of Japan*", which demonstrated the location of the middle Holocene shoreline with numerous data on height and radiocarbon age representing the sea level of that stage, and with 15 insets, considered to be typical examples of various types of research. Numbers of papers by year in terms of research field and study area have been summarized by Ohta, Y. et al. (1990 ; see Bibliography of this paper).

Relative sea level curves published since 1980 have been reported in their papers (Ohta et al., 1990). The curve pattems show noticeable local or regional differences, reflecting tectonic factors with a different amount and character in each area. Some areas characterized by a rather late culmination age of the postglacial transgression contrast with most of the Japanese, ciast, which have a culmination age of ca. 6,000 to 6,500 years B. P. Two minor fluctuations of Holocene sea level which were pointed out by Ohta et al. (1982), have been recognized in several areas ; an eustatic origin for such fluctuation is most likely, judging from the nearly coincident occurrence of climate fluctuation revealed by pollen analyses, diatom analyses, molluscan assemblage analyses and submarine core data. On the basis of recent Japanese researches, some topics have been discussed in particular detail as follows : (1) Progress of excavation on the Holocene lowland and coral reefs, in order to obtain systematic samples for identification of marine limits and samples for analyses of various kinds of fossil and dating ; (2) Holocene marine terrace study with special references to coseismic uplift and volcanic activity ; (3) Identification of the former sea level on the rocky coast. Barnacles and tube worms as sea level indicators have been discussed, including some problems with accuracy of

radiocarbon dating ; (4) Problems concerning the recognition and accuracy of former shorelines in the large alluvial plains ; (5) the significance of small drowned valleys for the reconstruction of sea level change ; (6) climatic fluctuations during the Holocene, with relation to sea level fluctuation a in this epoch ; and also (7) increasing overseas researches concerning the Holocene sea level changes by the Japanese researchers, especially since 1980 (Ohta et al., 1990)

III Reconstraction of Palaeoenvironment in the Archaeological Sites

An archaeological investigation is generally one of interdisciplinary researches such as geography, limnology, and environmentology. The archaeologists of the European countries, therefore, had gone on with their studies by the co-operation of natural scientists, especially geomorphologists, geologists, and palaeontologists etc. In Japan, following the establishment of Pleistocene stratigraphy, topography, and palaeontology as respectable fields of scientific endeavor in regard to anthropology about 100-50 years ago, a latter stage of development was more specifically orientaed toward prehistoric man from the Pleistocene deposits in some limestone caves. Certainly much of the research concerning the prehistoric man in the foreign countries such as French, Germany, and Switzerland since about 1850 A. D. affected on the research of anthropology in the Japanese Islands, and had interdisciplinary overtones. The archaeologists and anthropologists of prehistoric studies have long been aware that the natural sciences provide a number of useful techniques. A new pattern, however, was probably first set by the geological and palaeontological investigations of the Kuzuu Caves near Tokyo and Akashi coast area near Osaka. Another important individual research should be mentioned as a pioneer an use of stratigraphic method for archaeological investigation by Sugao Yamanouchi.

Following the Second World War, in the foreign countries, biological investigation such as pollen and diatom analyses, and chemical investigation as radiometric dating and chemical analysis of materials from archaeological sites have been used frequently, while the number of contributions and new techniques developed by individual natural scientific division has grown tremendously. However, the Japanese archaeologists had not complied easily and readily the new techniques of natural sciences. In regard to this cause, the author is thinking as following two reasons ; firstly, archaeologists do not fully understand on natural sciences, and on the other hand, natural scientists do not fully co-operate together with archaeologists. However, a development of archaeology at the present-day, it is not too much to write, needs some techniques of natural sciences, especially dating by radiocarbon-14, reconstruction of palaeovegetation and estimation of palaeoclimate based on palynology and diatom analysis, inference of ancient coastal line and changes of sea-level during the prehistoric ages by shells, and other marine and/or brachish organisms etc.

A more comprehensive study of past environments needs an approach from geology, especially stratigraphy, and geomorphology concerned with the natural environment, and focuss on the same themes of "man and nature" that are the concern of historical and

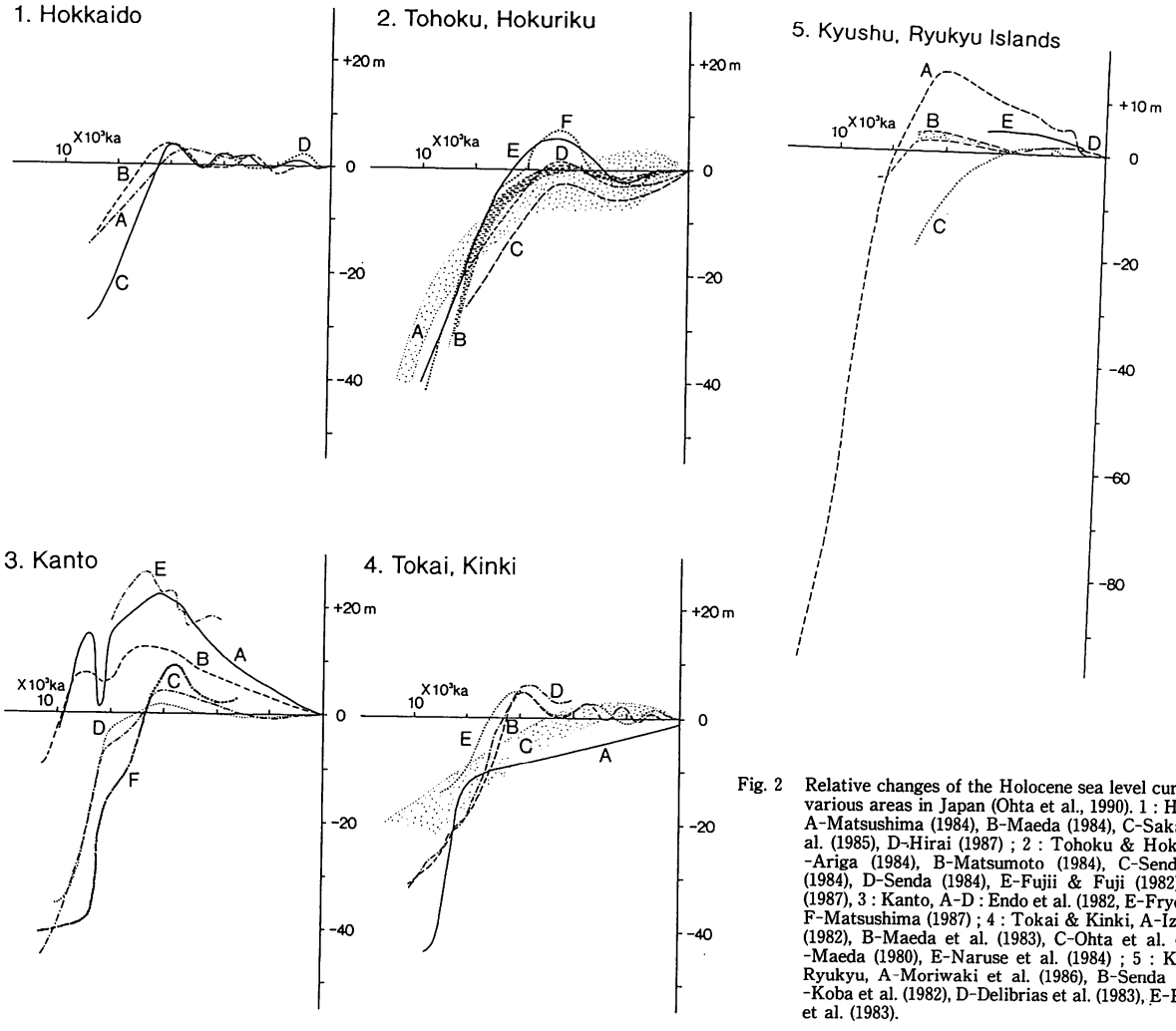

Fig. 2 Relative changes of the Holocene sea level curves from various areas in Japan (Ohta et al., 1990). 1 : Hokkaido, A-Matsushima (1984), B-Maeda (1984), C-Sakaguchi et al. (1985), D-Hirai (1987) ; 2 : Tohoku & Hokuriku, A-Ariga (1984), B-Matsumoto (1984), C-Senda et al. (1984), D-Senda (1984), E-Fujii & Fuji (1982), F-Fuji (1987), 3 : Kanto, A-D : Endo et al. (1982, E-Frydl. (1982), F-Matsushima (1987) ; 4 : Tokai & Kinki, A-Izeki et al. (1982), B-Maeda et al. (1983), C-Ohta et al. (1986), D-Maeda (1980), E-Naruse et al. (1984) ; 5 : Kyushu & Ryukyu, A-Moriwaki et al. (1986), B-Senda (1987), C-Koba et al. (1982), D-Delibrias et al. (1983), E-Pirazzola et al. (1983).

contemporary geographies. This is a field to which both the natural scientist and the archaeologist should contribute more directly and with greater enthusiasm.

In the recent Japan, a few hundreds of archaeological sites have been excavated within one year, and those excavations have been gone on under the joint research of natural scientists and archaeologists.

IV Main Scientific Bibliographies Published during the Inter-Congress Period

Ando, M. (1988) : Marine clay deposits on the US (Holocene Upper Sand Bed) in Arakawa lowland, Saitama Prefecture, Japan. *Jour. Jap. Ass. Quat. Res.*, 28, 2 ; 79-94.

Endo, K. et al. (1989) : Holocene environmental history in and around the Paleo-Nagareyama Bay, Central Kanto Plain. *Jour. Jap. Ass. Quat. Res.* ; 28, 2 ; 61-78.

Fuji, N. (1987a) : Archaeological palynology. pp. 251 ; Selected Archaeological Book Ser. no. 27 ; pp. 251 ; Yuzankaku Publish., Tokyo.

————(1987b) : Palaeoenvironment around the Jomonian Teraji Jade Site, Ohmi, Niigata Prefecture, Central Japan. *Bull. Japan Sea Res. Institute, Kanazawa University* ; 20 ; 1-32.

————(1988a) : 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. Educat. Kanazawa Univ.* ; 37 ; 59-76.

————(1988b) : For International correlation of Pleistocene/Holocene boundary palynological investigation of the late Pleistocene-Holocene deposits in the Mihama and Kaminaka areas, Fukui Prefecture, Japan. *Bull. Fac. Educat. Kanazawa University* ; 37 ; 77-96.

————and Horowitz, A. (1988c) : Brunhes epoch palaeoclimates of Japan and Israel. *Palaeogeogr. Palaeoclim. Palaeoecol.* ; 72 ; 79-88.

————(1988d) : Secondary community of palaeovegetation around the middle Neolithic Mawaki Site, Noto Peninsula, *Japan. Proced. Japan Acad.* ; *B*, 9 ; 265-268.

————and Shimakura, M. (1988e) : Manufactured woods from Mawaki archaeological Site, Noto Peninsula, Central Japan. *Bull. Japan Sea Res. Institute, Kanazawa Univ.* ; 20 ; 1-32.

————(1989a) : Palaeovegetation during the Jomonian period around the Mawaki archaeological Site, Noto Peninsula, Japan. *Bull. Fac. Educat. Kanazawa Univ.* ; 38 ; 41-57.

————(1989b) : Palaeovegetation and palaeoclimate changes around Lake Biwa, Japan during the last ca. 3 million years. *Quat. Sci. Rev.* ; 7 ; 21-28.

————(1990) : Climatic changes based on palynological evidences from Lake Biwa, Central Japan since the middle Pleistocene. *Bull. Fac. Educat. Kanazawa Univ.* ; 39 ; 17-30.

Hosono, M. et al. (1989) : Basement of Komatsu Kofun (Old mound) under flood plain of the River Tone——an elucidation using pedological method——. *Jour. Jap. Ass. Quat. Res.* ; 28, 2 ; 79-94.

Kanauchi, A. (1987) : Pollen analysis of deposits in Kinu Bog. *Jour. Jap. Ass. Quat. Res.* ; 26, 2

; 147-154.

————et al. (1989) : Stratigraphy and pollen analysis of the boring core at Lake Ippekiko (Numa-ike), Ito City, Shizuoka Prefecture, Japan. *Jour. Jap Ass. Quat. Res.* ; 28, 1 ; 27-34.

Kashima, K. et al. (1990) : Holocene sea-level change in Takagami lowland, Choshi Peninsula, Japan. *Jour. Jap. Ass. Quat. Res.* ; 29, 2 ; 139-150.

Kawachi, S. et al. (1988) : Electroconductivity measurements and pollen analysis of a late deposit in Ohachidaira caldera, Daisetsu Volcana, Hokkaido, Japan. *Jour. Jap. Ass. Quat. Res.* ; 27, 3 ; 153-164.

Koizumi, I. (1987) : Pulses of Tsushima Current during the Holocene. *Jour. Jap. Ass. Quat. Res.* ; 26, 1 ; 27-46.

Kosugi, M. (1988) : Classification of the living diatom assemblages as the indicator of environments, and its application to reconstruction of paleoenvironments. *Jour. Jap. Ass. Quat. Res.* ; 27, 1 ; 1-20.

————(1989) : Salinity from the former Tokyo Bay in Holocene based on diatom assemblages. *Jour. Jap. Ass. Quat. Res.* ; 28, 1 ; 19-26.

Kyokon, H. et al. (1987) : Holocene marine terrace at Onogi, Nanao, West Coast of Toyama Bay, Japan and its ^{14}C age. *Jour. Jap. Ass. Quat. Res.* ; 26, 2 ; 159-162.

Matsushita, M. et al. (1988) : Holocene vegetation history around Lake Hamana on the Pacific Coast of Central Japan. *Jour. Jap. Ass. Quat. Res.* ; 26, 4 ; 393-400.

Miyoshi, N. (1989) : Vegetational history of the Hosoike moor in the Chugoku Mountains, Western Japan during the Late Pleistocene and Holocene. *Jap. Jour. Palynol.* ; 35, 2 ; 27-42.

Mori, Y. et al. (1990) : Volcanic ash layer near the boundary between late and final Jomonian period from Choda and Matsukawado, Aichi Prefecture, Central Japan. *Jour. Jap. Ass. Quat. Res.* ; 29, 1 ; 17-24.

Ogura, T. (1988) : Land form development during the last glacial and the Postglacial ages in the Matsumoto basin and its surrounding mountains, Central Japan. *Jour. Jap. Ass. Quat. Res.* ; 27, 2 ; 101-124.

Ohmori, H. et al. (1988) : Thermal conditions both of the upper and lower limits of the *Fagus crenata* forest zone, and changes in summer temperature from the Latest Pleistocene to the Middle Holocene in Japan. *Jour. Jap. Ass. Quat. Res.* ; 27, 2 ; 81-100.

Ohta, Y. et al. (1990) : Resent Japanese research on relative sea level changes in the Holocene and related problems——Review of studies between 1980 and 1988. *Jour. Jap. Ass. Quat. Res.* ; 29, 1 ; 31-48.

Sadakata, N. et al. (1988) : Sea level of the two stages in the late Holocene deduced from the deposits of the coastal lowland in the subsided region of the southern Shikoku Island. *Jour. Jap. Ass. Quat. Res.* ; 27, 2 ; 125-129.

Sase, T. et al. (1988) : Opal phytolith analysis of present and buried volcanic ash soils at Te Ngae Road Tephra section, Rotorua Basin, North Island, New Zealand——Soil vegeta-

tion relationship for Last 20,000 yrs. *Jour. Jap. Ass. Quat. Res.* ; 27, 3 ; 153-164.

Shimizu, C. (1989) : Vertical change of slope stability from Last Glacial to early Holocene in the southern part of the Yubari Mountains and the western part of the Hidaka Range, Hokkaido, *Japan. Jour. Jap. Ass. Quat. Res.* ; 28, 3 ; 159-170.

Uchiyama, T. (1987) : Palynological studies of some Alluvial sediments in a Temperate ecotone in Japan. (I) Southeastern area of Tohoku district. *Jap. Jour. Palynol.* ; 33, 2 ; 111-118.

Uesugi, Y. et al. (1987) : Recent tephrae of the younger Fuji Volcano ——classification and age ——. *Jour. Jap. Ass. Quat. Res.* ; 26, 1 ; 59-68.

Yamamoto, K. (1989) : Chronology of Holocene periglacial slope deposits in the Northern Hidaka Mountains, Hokkaido, Japan. *Jour. Jap. Ass. Quat. Res.* ; 28, 3 ; 139-158.

Yoshii, R. (1988) : Palynological study of the bog deposits from the Murodo-daira, Mt. Tateyama, Central Japan. *Jap. Jour. Palynol.* ; 34, 1 ; 43-58.