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Three Fish Fossils from the Neogene Strata at Himi City, Toyama Prefecture, Central Japan

By

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Abstract Three Neogene fish fossils were found in central Japan. Species level identification was not possible due to the poor condition of the material, but they could be keyed to *Pseudorhombus* sp. cf. *P. cinnamoneus*, *Sebastes* sp., and Teleostei.

Introduction

Three incomplete fish fossils were found in the Neogene strata at Himi City, northwestern Toyama Prefecture, Japan.

The fossil identified as *Sebastes* sp. was found during construction of the Nomen tunnel on the road from Jyunicho to Kamisho-dani. The other two fossils were noticed among a collection including various molluscan fossils kept at Nadaura Junior High School, Himi City. These fossils are probably yielded from the Yabuta siltstone judging from the mud attached to the fossils. Perhaps they were found at the time of widening the road construction in the Yabuta siltstone along the Nadaura rocky coast.

Geology

The geological condition of the fossil occurring sites is shown in Fig. 1. The Inazumi mudstone member is the upper part of the Sugata Formation. It consists of blue grey massive mudstone in fresh surface, with yellow powder at the weathering surface. Generally, there are not many fossils excepting occasional rich occurrence of sponge of the genus *Makiyama* in the mudstone. It is about 100 m thick. The age of the Sugata Formation is about 3.5–6.5 Ma on the basis of microfossil analysis (MOROZUMI *et al.*, 1979, 1981; KOIZUMI, 1979a, b; TSUCHI *et al.*, 1981).

The locality which yielded *Sebastes* sp. is near the north entrance of the Nomen tunnel (Fig. 1, A), and specimens of the bivalve, *Solemya tibai* are commonly found in the closed condition with the fossil.

The Yabuta siltstone consists of green blue calcareous siltstone with a few concreation layers about 100 cm thick. There are a lot of foraminiferas and sponge spicules, and some closed *Chonchocele nipponica*, *Lucinoma actulineata*, *Nucula* sp.,

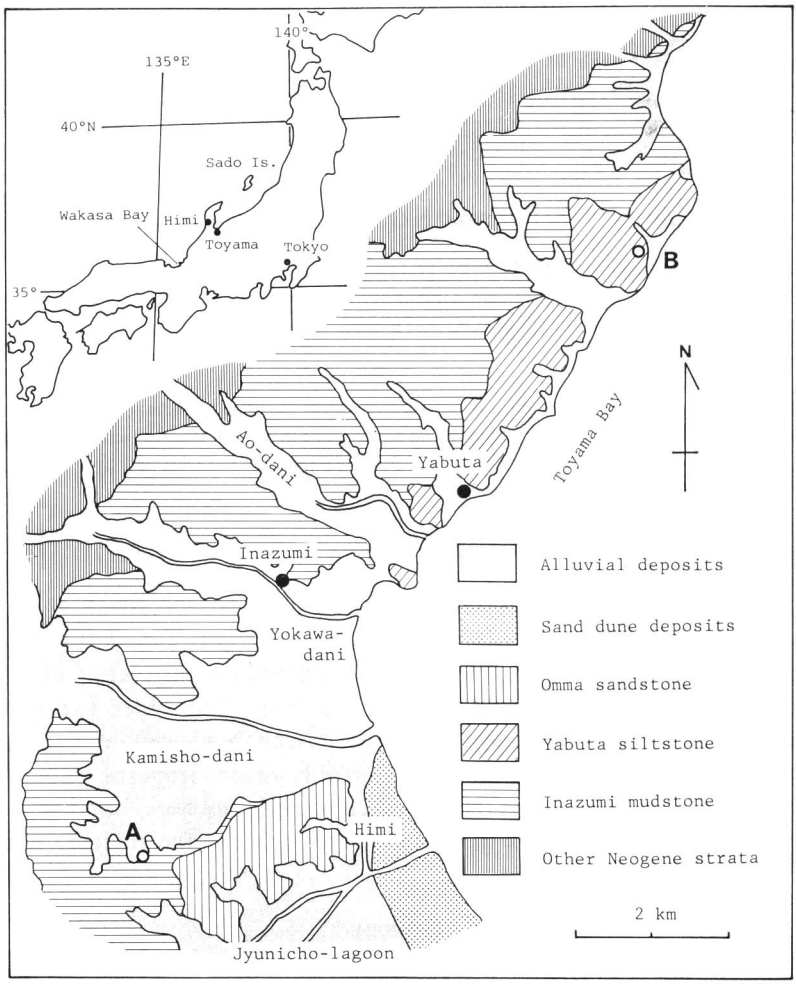


Fig. 1. Geological map of Nadaura District of Himi City, Toyama Prefecture, central Japan. A, Nomen tunnel; B, Nadaura Junior High School. After KASENO *et al.* (1957), IMAI *et al.* (1966) and HASEGAWA (1979a, b).

Yoldia sp. and *Tellina* sp. are found in the siltstone. It is distributed along the Nadaura sea coast with cliff. The Yabuta siltstone overlies the Inazumi mudstone with conformity. The age of the Yabuta siltstone is 1.5–3.5 Ma by the analysis of microfossils (MOROZUMI *et al.*, 1979, 1981; KOIZUMI, 1979a, b; TSUCHI *et al.*, 1981). The siltstone attached to the fossils, *Pseudorhombus* sp. cf. *P. cinnamoneus* and Teleostei order indet., is similar to the Yabuta sitlstone in its color and particle size.

Systematic Paleontology

Class Osteichthyes

Order Pleuronectiformes

Suborder Pleuronectoidei

Family Paralichthyidae

Pseudorhombus sp. cf. ***P. cinnamoneus*** (TEMMINCK and SCHLEGEL, 1846)

(Figs. 2 and 3)

Material: Nadaura Junior High School Collection.

Standard length (SL) is estimated as approximately 22 cm.

Description: The specimen is incomplete and lacks anterior and posterior portion of body.

The dorsal fin rays and their pterygiophores are incomplete, and their fragments

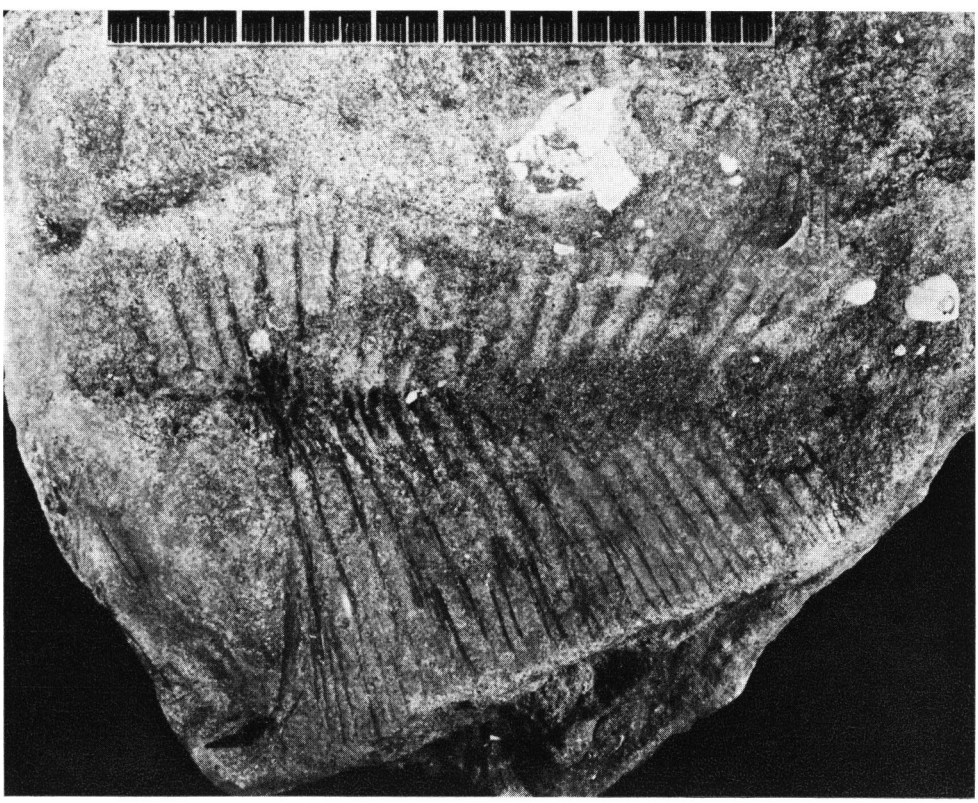


Fig. 2. A Neogene lefteye flounder, *Pseudorhombus* sp. cf. *P. cinnamoneus*, from Neogene Yabuta siltstone, Himi City, Toyama Prefecture, central Japan.

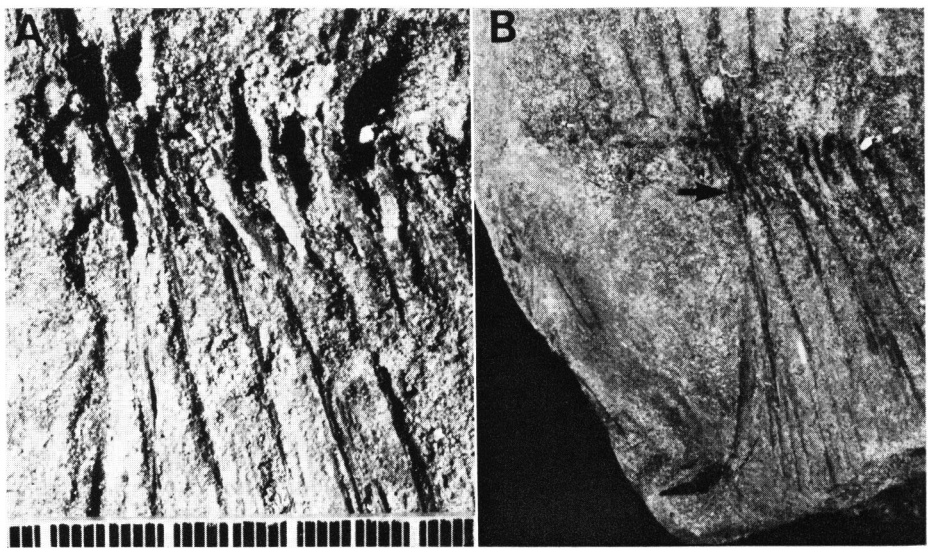


Fig. 3. Photographs showing the anterior caudal vertebra (A) and the posterodorsal tip (arrow) of the first proximal pterygiophore of the anal fin in *Pseudorhombus* sp. cf. *P. cinnamoneus* (B).

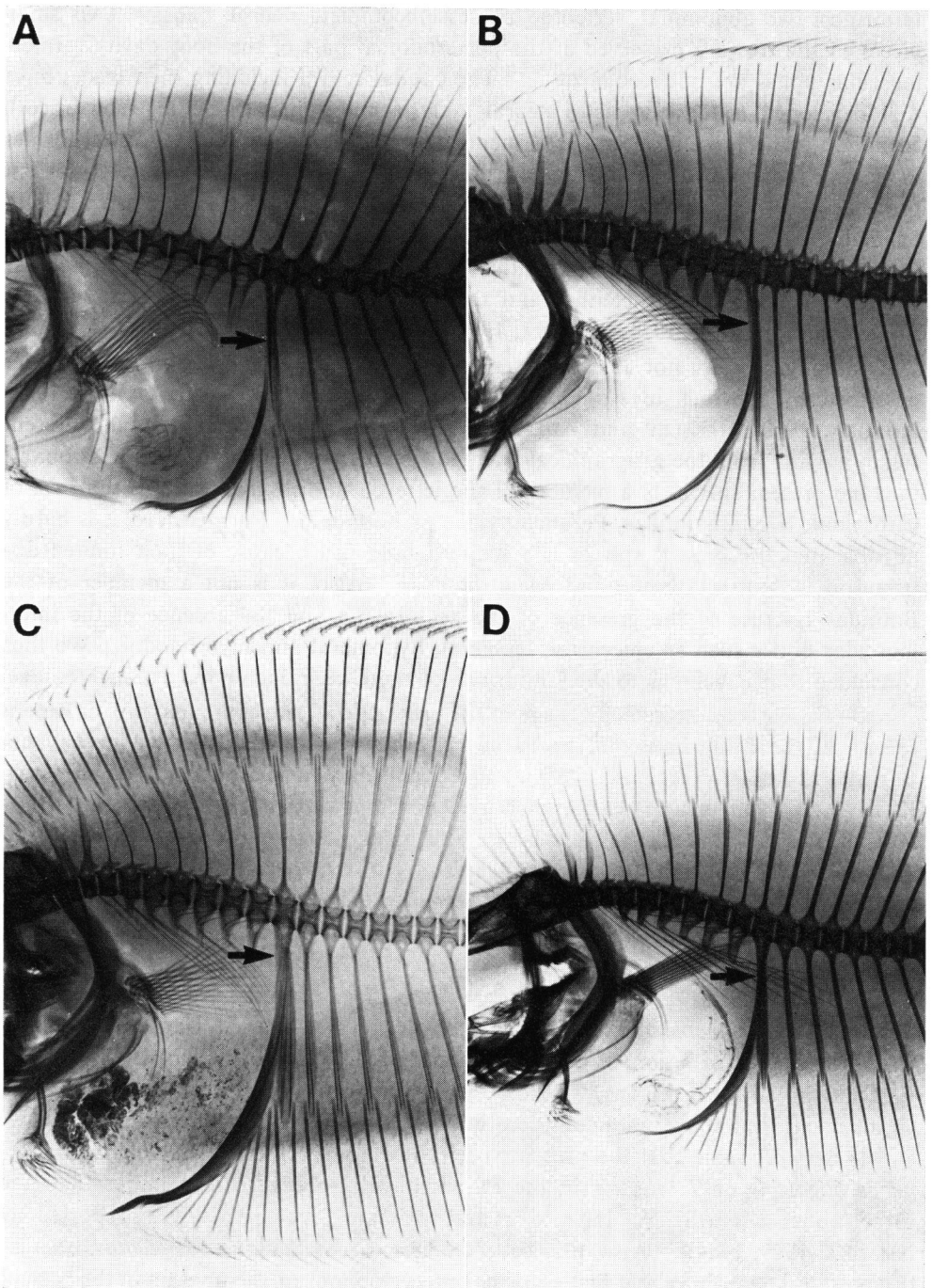
are preserved in the posterodorsal part. Thirteen fin rays and 6 proximal pterygiophores are countable.

All anal fin rays are missing. Their proximal pterygiophores are incomplete, but 36 are counted (the total is not estimated). Two proximal pterygiophores are usually inserted between two adjacent haemal spines, excepting several anterior ones. The anteriormost pterygiophore which is the largest and stoutest, is represented by the trace of the main portion and the small preserved anteroventral- and posterodorsal portion. It is attached to the anterior margin of the first haemal spine and its posterodorsal tip extends to about a fifth portion from the base of the haemal spine (Fig. 3). Its anteroventral end curves forward.

Of the pectoral fin rays, only three fragments are observable. A pair of long and slender postcleithra are directed posteroventrally. Several scattered pieces of the pectoral girdle elements are recognizable at the anteriormost portion of the fossil.

Several incomplete centra are preserved at the middle and posteriormost portion of the fossil. The centra including their traces can be counted as 6 in the posterior abdominal region and as 22 in the caudal region (the total is not estimated). Pos-

Fig. 4. X-rayed photographs showing the posterodorsal tip of the first proximal pterygiophore of the anal fin in four lefteyed flatfishes. A, *Citharoides macrolepidotus*, ZUMT (Department of Zoology, University Museum, University of Tokyo) 22259, 171 mm SL, Tsushima Strait, Japan; B, *Paralichthys olivaceus*, NSMT-P (National Science Museum, Tokyo) 1266, 176 mm SL, Kochi, Japan; C, *Pseudorhombus cinnamoneus*, ZUMT 4453, 170 mm SL, Obama, Japan; D, *Pseudorhombus oligodon*, ZUMT 22611, 151 mm SL, Taiwan.


A
B
C
D

teriormost two abdominal vertebrae possess incomplete neural spines. Two small pieces of the ribs are preserved at the posterodorsal part of the body cavity. Intermuscular bones are not recognizable. The caudal centra including their traces have well developed (but incomplete) neural and haemal spines (including their traces).

Remarks: The present species is a member of the flatfish order Pleuronectiformes in having the following characters: a great body depth and the almost consistent presence of two proximal pterygiophores of the anal fin rays between two adjacent haemal spines. The fossil is a member of the suborder Pleuronectoidei (containing Citharidae, Scophthalmidae, Paralichthyidae, Bothidae and Pleuronectidae), because it has well developed postcleithra and the enlarged first proximal pterygiophore of the anal fin (NORMAN, 1934; AMAOKA, 1969; HENSLEY and AHLSTROM, 1984).

Although we are not able to observe most of family characters in the suborder described by previous investigators (NORMAN, 1934; HUBBS, 1945; OCHIAI, 1966; AMAOKA, 1969; HENSLEY and AHLSTROM, 1984; SAKAMOTO, 1984b) in the present fossil, judging from the geographical and geological setting of the fossil, it is probable that the present species is a member of the lefteyed flatfish groups (ie. Citharinae of Citharidae, Scophthalmidae, Paralichthyidae or Bothidae). Furthermore, it is hardly possible that the present species is a scophthalmid fish because of their limited distribution in North Atlantic and Meditteranean. Also, it is not a member of the Bothidae because of the presence of the pectoral fin and the absence of the intermuscular bones such as epicentral, epimeral, hypomeral and myorhabdoi. We thus concluded that it belongs to the Citharinae of the Citharidae or the Paralichthyidae.

On the basis of the geological age of the present fossil, we compared it with Recent species of the Citharinae and the Paralichthyidae which are distributed in Toyama Bay and its adjacent regions (Fig. 1). In Toyama Bay near the locality of the fossil, KATAYAMA (1940) listed two paralichthyid fishes: *Paralichthys olivaceus* and *Pseudorhombus cinnamoneus*. In Sado Island and its adjacent waters located at north of Toyama Bay, HONMA and KITAMI (1978) and HONMA *et al.* (1984) reported 5 paralichthyids: *Paralichthys olivaceus*, *Pseudorhombus pentophthalmus*, *P. cinnamoneus*, *Tarphops oligolepis* and *T. elegans*. In Wakasa Bay located at south of Toyama Bay, a citharid and 6 paralichthyids were recognized by MINAMI and NAKAMURA (1978): *Citharoides macrolepidotus*, *Paralichthys olivaceus*, *Pseudorhombus pentophthalmus*, *P. oligodon*, *P. cinnamoneus*, *Tarphops oligolepis* and *T. elegans*. Under this circumstance on the distribution of Recent citharine and paralichthyid fishes in Toyama Bay and its adjacent regions, we took 7 lefteyed flatfishes (a citharid and 6 paralichthyids mentioned above) into consideration for identifying the present fossil.

It is improbable that the present species is *Pseudorhombus pentophthalmus*, *Tarphops oligolepis* or *T. elegans* in the Paralichthyidae, because it is larger than the three (about 22 cm SL vs. 15, 6, 6 cm in maximum SL respectively as reported by AMAOKA (1969, 1984)). Also, it is not a citharid, *Citharoides macrolepidotus*, because the posterodorsal tip of the first proximal pterygiophore of the anal fin in the present species reaches near the base of the first haemal spine, whereas in *Citharoides mac-*

rolepidotus its tip is located near the middle of the haemal spine (Figs. 3 and 4). Regarding this character, the present fossil resembles the remaining three paralichthyids (Figs. 3 and 4). Judging from the general appearance, the body depth, the shape of the posterior body cavity, the shape of the first proximal pterygiophore of the anal fin and the widths of the bases of the haemal spines of the anterior caudal vertebrae in proportion with the lengths of their corresponding centra (Figs. 3 and 4), it seems that the present fossil is closest to *Pseudorhombus cinnamoneus* than to the other two species. Consequently, we identify it as *Pseudorhombus* sp. cf. *P. cinnamoneus* of the family Paralichthyidae.

Class Osteichthyes

Order Scorpaeniformes

Family Scorpaenidae

Sebastes sp.

(Figs. 5–7)

Material: National Science Museum catalogue number NSM PV-18940.
Description: The head and anteriormost portions are missing. The countable abdominal vertebrae are 7, and the caudal vertebrae are 17. The anterior portion of

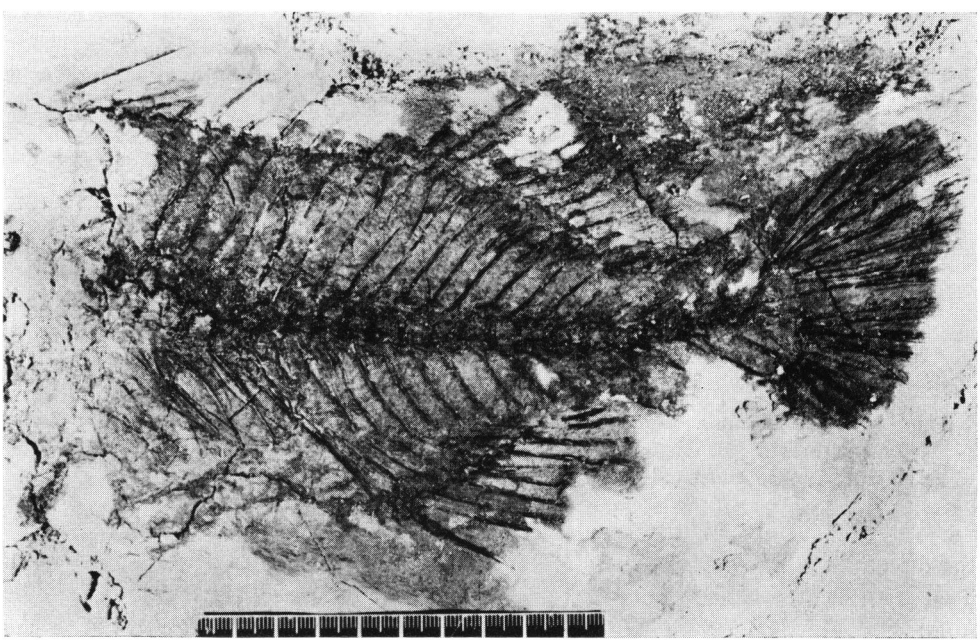


Fig. 5. A Neogene rockfish, *Sebastes* sp., from the Neogene Inazumi mudstone, Himi City, Toyama Prefecture, central Japan.

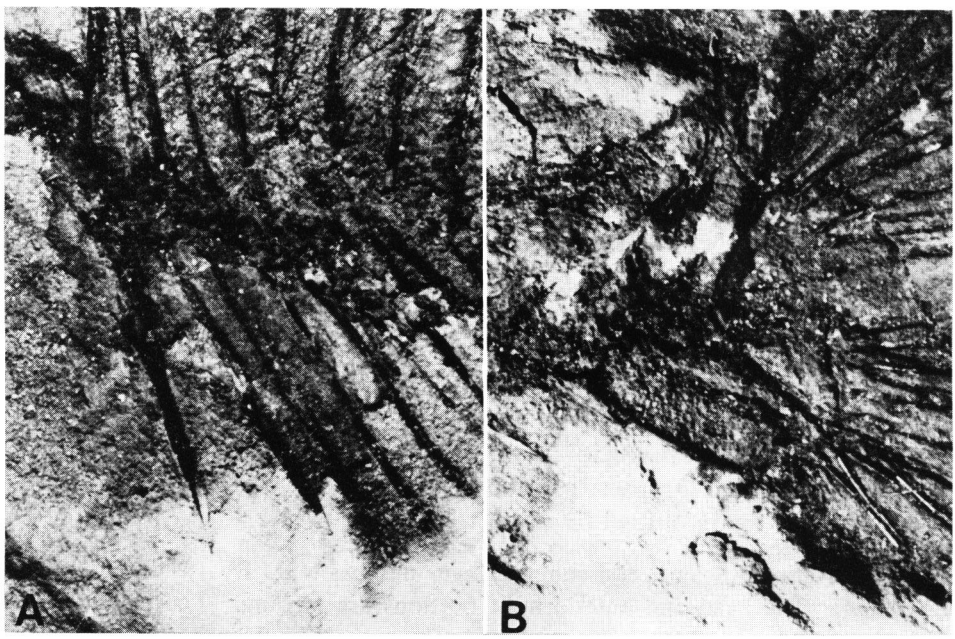


Fig. 6. Photographs showing the anterior anal fin (A) and caudal skeletons (B) of *Sebastes* sp.

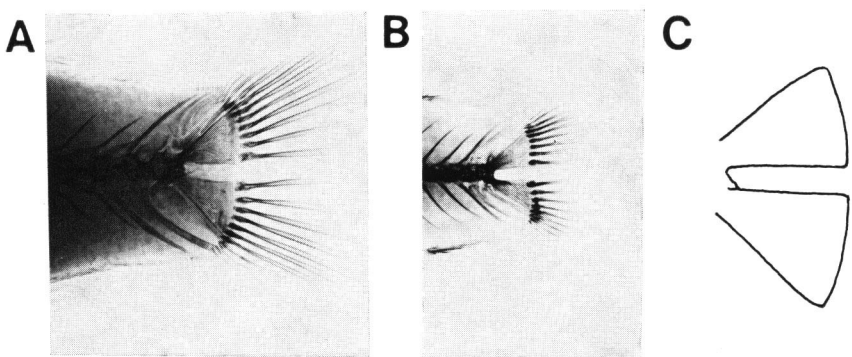


Fig. 7. Caudal skeletons. A, *Sebastes steindachneri*, NSMT uncatalogued, 214 mm SL, Otaru, Japan (X-rayed); B, *Choerodon azurio*, NSMT-P 534, 112 mm SL, Miyako Is., Japan (X-rayed); C, *Sebastes* sp. (×1.2).

the dorsal fin is missing, but there are at least 9 spines and 13 rays in the dorsal fin. Two of three anal spines are visible, and the number of the soft anal rays is 7. The number of branched caudal rays are 6 in the upper lobe and 6 in the lower lobe. The estimated standard length is about 280 mm. The body depth is 110 mm. The caudal peduncle length is 70 mm. The anal fin base is 48 mm. The length of the caudal

vertebrae including the hypural plate is 137 mm. The length of the second anal spine is 34 mm. The length of the first anal pterygiophore is 49 mm and very strong (Fig. 6a). The body is deep, and the hypural plate supporting the caudal fin has a wide and deep characteristic notch with parallel median edges between the upper and lower plates. This character is not usual among teleostean fishes, and only common among fishes of the genus *Sebastes* in the family Scorpaenidae and some species of the Labridae (see FUJITA, 1990).

Remarks: The general shape of the body (Fig. 5), the number of the caudal vertebrae (17), the number of the anal rays (7), and the form of the hypural plate (Figs. 6b and 7) indicate that the fossil belongs to the genus *Sebastes*, but impossible to identify to the species level.

Class Osteichthyes

Subclass Actinopterygii

Infraclass Teleostei

Order indet.

(Fig. 8)

Material: Nadaura Junior High School Collection.

Description: The specimen is quite incomplete and consists of only a portion of the dorsal or anal fin rays and their corresponding pterygiophores, and neural or haemal spines.

About 24 incomplete fin ray elements and about 19 incomplete proximal pter-

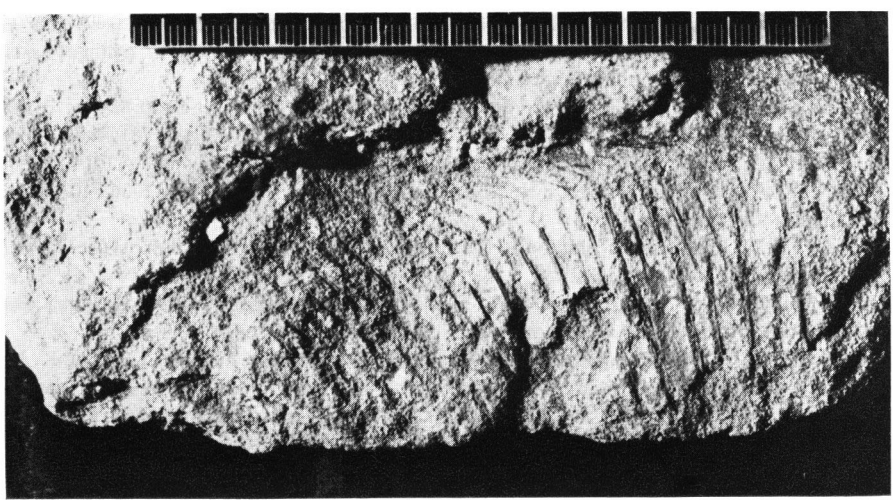


Fig. 8. A teleostean fossil from the Neogene Yabuta siltstone, Himi City, Toyama Prefecture, central Japan.

ygiophores including their traces are observable. Proximal portions of 7 neural or haemal spines are recognizable.

Remarks: The present fossil is not identifiable beyond the infraclass level because of its poor condition.

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