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**Neogene Argonautinae from Kahoku-gun,
Ishikawa Prefecture, Japan.***

By

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(With 3 Textfigures and 1 Plate)

INTRODUCTORY

The occurrence of fossil Argonautinae seems rather rare not only in Japan but also all over the world, and, as far as the writer's knowledge is concerned, there are seven species hitherto described. Among them, two species from Japan, namely: *Argonauta tokunagai* YOKOYAMA and *Izumonauta lata* KOBAYASHI, both from the Miocene Fujina Formation in Izumo. Recently, T. KOBAYASHI summarized the informations on the fossil Argonautinae, and noticed their rare but gregarious occurrence in Japan.

Lately, several specimens of Neogene Argonautinae were collected from two localities in Kahoku-gun, Ishikawa Prefecture, by Mr. S. TANAKA and Mrs. A. KOSAKA and their pupils, who favored the writer with entrusting all the specimens for examination. Deeply interested in the new occurrence of fossil Argonautinae, the writer also had opportunities to visit the localities, and made observations on the occurrences, and obtained some specimens. On examining these specimens, the writer has been led to establish two new species as will be described in the present note, with some remarks on the other species.

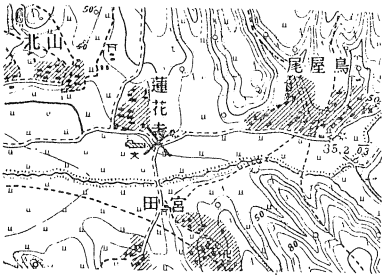
The writer wishes to express his sincere thanks to Mr. S. TANAKA, Mrs. A. KOSAKA and their pupils for their kind donation of the valuable specimens, and to Mr. H. MATSUO of our Institute and Professor T. KOBAYASHI of the Tokyo University for their valuable advices and suggestions given to the writer in this study. The writer's special thanks are also due to Professor I. HAYASAKA of the Hokkaido University for his criticism and his kindly reading the manuscripts.

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LOCALITY AND OCCURRENCE

(1) Specimens from Tsubata-machi, Kahoku-gun, Ishikawa Prefecture.

Locality: Road-side cutting (3 meters or less high) near the Kasatani Secondary School at Rengeji, Tsubata-machi, Kahoku-gun, Ishikawa Prefecture.* Lat. $36^{\circ} 41' 11''.4$ N.; Long. $136^{\circ} 47' 7''.7$ E. (Textfigure 1)



Textfigure 1. Map showing the locality in Tsubata-machi. (Topographical Map, Scale 1/25,000 : Isurugi sheet)

Occurrence: In the massive, homogeneous mudstone, which considerably suffered from weathering action and turned yellowish brown in colour. The occurrence is rather common and the specimens are found rather crowded in a horizon, but almost all specimens are imperfect and more or less deformed. Beside Argonautinae, the mudstone yields some fossils as: *Dentalium yokoyamai* MAKIYAMA, *Limopsis tokaiensis* YOKOYAMA, and *Acila* sp., as well as fragments of echinoid and plant leaves.

Formation: Upper part of the Yoshikura mudstone member of the Yoshitaki Formation.

Collector: Mr. S. TANAKA and his pupils of the Kasatani Secondary School (1952-53), Mrs. A. KOSAKA and her pupils of the same school (Oct.-Nov., 1954), and the writer (Aug. 12, 1953 ; Nov. 11, 1954).

(2) Specimens from Morimoto-machi, Kahoku-gun, Ishikawa Prefecture.

Locality: Road-side cutting and valley side exposure at about 400 meters SEE from Wakihara village, Morimoto-machi, Kahoku-gun, Ishikawa Prefecture.** Lat. $36^{\circ} 34' 42''$ N.; Long. $136^{\circ} 46' 55''.4$ E. (Textfigure 2).



Textfigure 2. Map showing the locality in Morimoto-machi. (Topographical Map, Scale 1/25,000 : Fukumitsu sheet)

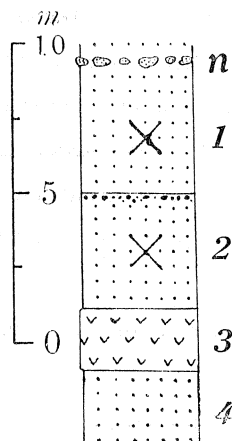
Occurrence: The specimens were procured from the massive bluish grey tuffaceous sandstone, which is partly weathered into yellowish brown colour. This tuffaceous sandstone contains hard calcareous nodules in its upper part, and is underlain by white tuff layer, 2 meters or more thick. These hard nodules contain some molluscan fossils, such as *Dentalium yokoyamai* MAKIYAMA, *Calliostoma* sp., *Turritella* sp., *Crenella* sp., *Felaniella usta* (GOULD), and *Cardium* sp. (Textfigure 3)

Formation: Lower part of the Takakubo mudstone member of the Otokawa Formation.

Collector: Mr. KOSUGI in Wakihara village (May, 1954).

* 石川県河北郡津幡町(旧笠谷村)蓮花寺、笠谷中学校の東約20mの路傍の切割

** 石川県河北郡森本町(旧三谷村)脇原の東南東約400mの、道路の切割および谷



Textfigure 3. Columnar section in the locality of Morimoto-machi.

- 1 : tufaceous massive bluish grey sandstone.
- 2 : tufaceous medium-grained sandstone, partly muddy, with granules and small pebbles in its uppermost part.
- 3 : fine-grained homogeneous white grey tuff.
- 4 : bluish grey massive tufaceous muddy sandstone.
- n : hard calcareous nodules containing molluscs.
- × : the position where *Argonauta* occurred.

DESCRIPTION OF SPECIES

Phylum Mollusca, Class Cephalopoda
 Order Dibranchiata, Suborder Octapoda
 Family Argonautidae CARTRAINE
 Subfamily Argonautinae BERRY
 Genus *Argonauta* LINNÉ

Argonauta kagana sp. nov. (Pl. 1, Figs. 1 a, b, c.)

Materials : One adult shell of fairly good preservation from Wakihara, Morimoto-machi, Kahoku-gun, Ishikawa Prefecture. No shell material remains in the specimen, but the surface sculptures are fairly well impressed, and scarcely deformed.

Description : Whorls rapidly growing ; lateral sides ornamented with numerous (25 or more in number), rounded, transverse ribs separated by shallow grooves of about equal breadth. Transverse ribs slightly convex orad, tuberculate ; tuberculation distinct and prominent toward umbilicus and orad, that is, ribs become discontinuous toward both directions. External side flat orad, slightly grooved backward, being bounded on both sides by low, blunt keels. Transverse ribs curve back on the external side, non-tuberculate. The aperture is elongate-elliptical in shape, being about 1.5 times as high as its greatest breadth. Dimensions :

- The greatest diameter of the specimen 67 mm.
- The diameter perpendicular to the above 42 mm.
- The height of the aperture 45 mm.
- The greatest breadth of the aperture 30 mm.

Comparisons : The present species as a whole resembles the fossil species *Argonauta tokunagai* YOKOYAMA. In the present form, however, the radial transverse ribs are more prominent, tuberculation more irregular, and the median groove on the external side is less distinct, than in *tokunagai*. The present species also resembles *Izumonauta lata* KOBAYASHI, but differs from the latter in the following features : median groove on the external side is less prominent, and radial ribs more continuous and prominent, and the aperture is more compressed.

Geological Horizon : Later Miocene or Early Pliocene (Upper G of the Letter Nomination by N. IKEBE).

Depository : Geological Institute, Faculty of Science, Kanazawa University.

Type Specimen : Holotype, Reg. No. GKZ05507.

Argonauta cfr. *tokunagai* YOKOYAMA (Pl. 1, Fig. 2)

Materials : Two fragmental specimens from Rengeji, Tsubata-machi, Kahoku-gun, Ishikawa prefecture. One is the flank showing the surface ornamentations, and the other reveals the outer side of the shell.

Description : Radial ribs rather slender and regularly arranged, tuberculation more or less elongated to the direction of the ribs, forming longitudinal rows parallel to the periphery. External side furnished with a shallow but distinct median groove, which is lined on both sides by a row of small tubercles ; transverse ribs curve back on the external side.

Remarks : These forms perhaps belong to *Argonauta tokunagai* YOKOYAMA, on the basis of some characteristic features cited above.

Geological Horizon : Later Miocene or Early Pliocene (Upper G of the Letter Nomination by N. IKEBE).

Depository : Geological Institute, Faculty of Science, Kanazawa University.

Specimens : Reg. No. GKZ05502a, b and GKZ05506.

Argonauta sp. (Pl. 1, Figs. 3 a, b.)

Materials : One adult shell from Wakihara, Morimoto-machi, Kahoku-gun, Ishikawa Prefecture. Shell large, the surface sculptures are fairly well preserved, but more or less crushed and devoid of the initial portion of the shell.

Description : Shell large, ornamented with numerous, prominent, rounded transverse ribs which curve back on the external side. Radial ribs provided with numerous, rounded tubercles, which more or less regularly arranged.

Remarks : This form is different from any other species in its features, and may belong to another species. The writer, however, without more materials, can not dare to establish a new species on the present specimen.

Geological Horizon : Later Miocene or Early Pliocene (Upper G of the Letter Nomination by N. IKEBE.)

Depository : Geological Institute, Faculty of Science, Kanazawa University.

Specimen : Reg. No. GKZ05508.

Argonauta kasataniensis sp. nov. (Pl. 1, Figs. 4a, b; 5; 6a, b.)

Materials : Several specimens from Rengeji, Tsubata-machi, Kahoku-gun, Ishikawa Prefecture. No shell material is preserved, but tinted dark or reddish brown on the surface. One of them (holotype) is a fairly well preserved young shell, and others are all fragmentary and strongly deformed or crushed.

Description : This is closely allied to *Izumonauta lata* KOBAYASHI as a whole, and also resembles *Argonauta tokunagai* YOKOYAMA. In the present species, however, the radial transverse ribs and tubercles are less prominent, and the median groove on the external side is less distinct, than in the preceding species. Shell seems to be rather thin and fragile, and easy to break or deform. Dimensions of the holotype:

The greatest diameter of the specimen	35 mm.
The diameter perpendicular to the above	23 mm.
The height of the aperture	24 mm.
The greatest breadth of the aperture	14 mm.

Geological Horizon : Later Miocene or Early Pliocene (Upper G of the Letter Nomination by N. IKEBE).

Depository : Geological Institute, Faculty of Science, Kanazawa University.

Type Specimens : Holotype, GKZ05501. Paratypes, GKZ05503, -04, -05, -09, -10, -11, -12, -13.

REMARKS

Some two decades ago, T. ONOYAMA (1935) put on record the occurrence of *Argonauta* cf. *tokunagai* YOKOYAMA, from near Amada-goe, Kahoku-gun, not far from the present localities. The geological horizon which ONOYAMA obtained his specimens is apparently equivalent to that of the present localities, and also corresponds to the Later Miocene or Early Pliocene in age. As to the type specimens of *Argonauta*

tokunagai YOKOYAMA and *Izumonauta lata* KOBAYASHI, the details are not known of the occurrence and the correct stratigraphical horizon, but it is quite likely that it came from the horizon approximately corresponding to the present ones.

Argonauta tokunagai YOKOYAMA and the two new species described herein, are all closely related to *Argonauta tuberculosa* LAMARCK living in the Moluccas, Tasmania, Brazil, etc. Then, the occurrence of these forms may indicate that the shore of this part of the country was washed by the warm temperate currents during the latest period of Miocene or the earliest period of the Pliocene. Moreover, *Argonauta* may be useful as a horizon-marker of the Neogene formation in the Japanese region. However, in order to prove this conjecture, farther materials have to be sought for in the region under consideration.

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Neogene Argonautinae from Kahoku-gun, Ishikawa Prefecture, Japan.

PLATE 1

Explanation of Plate 1

(All Figures about 5/6)

1. *Argonauta kagana* KASENO, sp. nov. Holotype.
Locality : Wakihara, Morimoto-machi, Kahoku-gun, Ishikawa Pref.
Depository : Geol. Inst., Fac. Sci., Kanazawa Univ. GKZ05507.
2. *Argonauta* cfr. *tokunagai* YOKOYAMA.
Locality : Rengeji, Tsubata-machi, Kahoku-gun, Ishikawa Pref.
Depository : Geol. Inst., Fac. Sci., Kanazawa Univ. GKZ05502.
3. *Argonauta* sp.
Locality : Wakihara, Morimoto-machi, Kahoku-gun, Ishikawa Pref.
Depository : Geol. Inst., Fac. Sci., Kanazawa Univ. GKZ05508.
4. *Argonauta kasataniensis* KASENO, sp. nov. Holotype.
Locality : Rengeji, Tsubata-machi, Kahoku-gun, Ishikawa Pref.
Depository : Geol. Inst., Fac. Sci., Kanazawa Univ. GKZ05501.
5. *Argonauta kasataniensis* KASENO, sp. nov. Paratype.
Locality : Rengeji, Tsubata-machi, Kahoku-gun, Ishikawa Pref.
Depository : Geol. Inst., Fac. Sci., Kanazawa Univ. GKZ05509.
6. *Argonauta kasataniensis* KASENO, sp. nov. Paratype.
Locality : Rengeji, Tsubata-machi, Kahoku-gun, Ishikawa Pref.
Depository : Geol. Inst., Fac. Sci., Kanazawa Univ. GKZ05510.

