

On a New *Anourosorex* from the Ryûgasi Formation (Fissure Deposits) in Japan

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In the spring of 1953, a field party of the Geological Institute of the Faculty of Liberal Arts and Science of the University of Shizuoka, found several outcrops of bone breccia at a new quarry in Ryûgasi, Inasa-gun, Sizuoka Prefecture. In the following summer, the junior author visited the locality and found rich vertebrate fossils of Middle Pleistocene in fissure deposits. The ossuaries of about 100 m above sea level, lie to the north-west of Mikata-hara Hill, and seem to indicate a marginal facies of fan deposits composing Mikata-hara Hill.

Since then the authors worked several times at the locality and collected a good amount of vertebrate fossils of 36 species, rich in small mammals. Among these fossils, there are many specimens of a new insectivora. Recently the junior author has pointed out the occurrence of *Anourosorex* in Japan. The living forms of Genus *Anourosorex* are found from south-western China, Tibet, Assam and Formosa (Taiwan), and a fossil species (*A. squamipes* M.-E.) is reported from the middle pleistocene of Szechwan in China.

The discovery of the Genus *Anourosorex* in Japan is very interesting and important to the mammal fauna of the country from the zoogeographical point of view. No allied species has been found in Japan since pleistocene.

The authors extend their sincer thanks to Proffesor F. TAKAI of Geologi-



Distribution map of *Anourosorex japonicus* n. sp. in Japanese Island.

1. Kuzuû-mati district, Totigi Prefecture.
2. Iinoya-mura district, Sizuoka Prefecture.
3. Isa-mati district, Yamaguti Prefecture.

cal Institute, Tokyo University, for his kind advice. Also they thank Dr. M. TOKUDA of the Zoological Institute, Kyoto University., Dr. K. KISHIDA of the Institute of Mammalogy and Ornithology, Agricultural Experiment Station, and Dr. Y. IMAIZUMI of Section of Zoology, National Science Museum for their valuable help and suggestions during the preparation of this work.

CLASS Mammalia

ORDER Insectivora

FAMILY Soricidae

Anourosorex japonicus n. sp.

(Pl. XIV, figs. 1-5; text figs. 1-2)

Compared with *Anourosorex squamipes* M.-EDWARDS.
and *A. assamensis* ANDR.

- 1868-74 *A. squamipes* M.-EDWARDS, Recherches pour servir a l'histoire naturelle des mammifères, p. 264, pl. 38, fig. 1.
 1923 *A. s. squamipes* G. M. ALLEN., Amer. Mus. Novit., no. 100, p. 10.
 1923 *A. s. capnias* G. M. ALLEN., ibid.
 1935 *A. squamipes* M.-EDWARDS., Contr. Biol. Lab. Sci. Soc. China, zool. ser., vol. XI, no. 5, pp. 129-32.
 1935 *A. squamipes yamashinai* N. KURODA.; Jour. Mamm., vol. 16, no. 4, pp. 277-91.
 1935 *A. squamipes* M.-EDWARDS., C. C. Young; Bull. Geol. Soc. China., vol. XIV, pp. 247-8.
 1938 *A. squamipes* M.-EDWARDS., G. M. ALLEN; Natural History of Central Asia vol. XI, part 1, pp. 137-42.
 1878 *A. assamensis* ANDR., J. ANDERSON; Anatomical and Zoological Reserches, Zoological Results of the Yunnan Expeditions to Western Yunnan in 1868-1875, etc., pl. no. V, fig. 1-16, pp. 150-59.
 1923 *A. a. capito* G. M. ALLEN., Amer. Mus. Novit., no. 100, p. 11.

Specimens: Holotype; No. An. S. 5, an incomplete anterior part of skull bearing I¹-M², but left I² missing, stored in Geological Institute, Yokohama National University. Paratypes; No. An. S. 64, anterior part of skull, about half brain case missing, but with left I¹-M¹ and right I¹, P³-M¹; No. An. S. 19, jointed specimen of skull and jaw; No. An. R. 37, a complete right ramus bearing I-M³; No. An. L. 1, an incomplete ramus with I-M³.

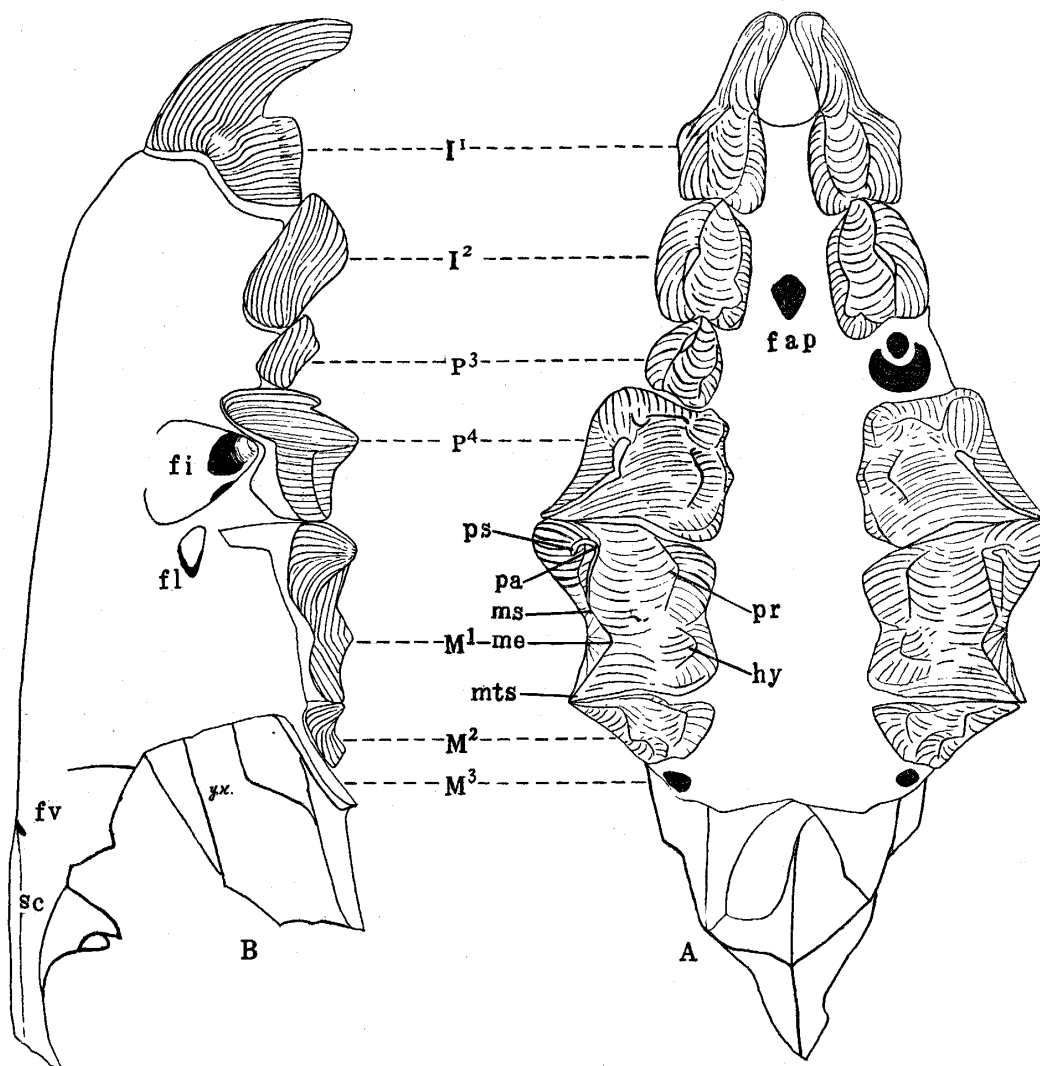
Type locality: Siraiwa No. 5 fissure, Siraiwa quarry of Iwaki Cement Co., Inoya-mura, Inasa-gun, Sizuoka Prefecture.

Horizon: Siraiwa fauna, brecciated clay or bone breccia of Lower Ryû-gasi formation, Middle Pleistocene.

Distributions: At present this new form is known from the following districts in Japan: Neighbourhood of Kuzûi, Totigi Prefecture; adjacent to Inoya-mura, Sizuoka Prefecture; environs of Isa-mati, Yamaguti Prefecture.

Diagnosis: Large shrew with dental formula of $I \frac{2}{1}$, $C \frac{0}{0}$, $P \frac{2}{2}$, $M \frac{3}{3}$ = 26, has a small swell on outer side. Two upper succeeding teeth unicuspid. The second is smaller than the first. M^1 and M_1 best developed of all teeth; M^3 and M_3 very small. Premaxilla swollen in the region of P^4 and M^1 . Only one anterior palatine foramen.

The species *japonicus* is distinguished from *squamipes* M.-E. and *assamensis* ANDR. by more acute coronoid process, existence of a spicule of coronoid process, the development of posterior border of P^4 and anterior border of M^1 and



Text fig. 1. *Anourosorex japonicus* n. sp., Holotype no. An. S. 5. A: Ventral view of holotype, B: Right lateral view of holotype., Abbreviations: fap., anterior palatine foramen; fi., infraorbital foramen; fl., lacrimal foramen; fv., vascular foramen; sc., sagittal crest; hy., hypocone; me., metacone; ms., mesostyle; mts., metastyle; pa., paracone; pr., protocone; ps., parastyle. about $\times 7$, Hasegawa del.

by the reduction of M^2 , M^3 and M_3 .

Description of Holotype: The brain case is broken. The anterior part of the skull is elongate and strong, facial portion is solid, more massive, and with a low but prominent saggittal ridge. The parietal surface of the brain case is rugose with fairly well developed plica for muscle attachment. Cranium becomes broad from the area of small vascular foramen. A short striated ridge runs vertically from above sphenopalatine foramen to near the middle of the facial. The infraorbital foramen is large, subtriangular, opened between roots of the fourth premolar, and extends to nearly half the rostrum. The lacrimal foramen is shallow, triangular, and is situated at the tip of the anterior root of first molar. The palate is trenched domelike, deepest at premolar, and 11.5 mm in length. The anterior palatine foramen is oval and is situated medially between first upper unicuspid. The posterior palatine foramen is indistinct.

Dentition: The dental formula is $I \frac{2}{1} C \frac{0}{0} P \frac{2}{2} M \frac{3}{3} = 26$. Teeth are entirely white. Two conical teeth are lying between the first large and stout insisor and the multicuspidate premolar on each side of the upper jaw.

I^1 , the first incisor is strong, large and with distinct longitudinal depression. Crown is divided into two; anterior cusp is tolerably long, strong and laterally compressed, and projects antero-downward; posterior cusp is shorter and broader than the anterior one. A rounded small swell is present outside, near the base between the anterior and posterior cusps.

I^2 , the first unicuspid is plumped, rectangular, and larger than the posterior cusp of the I^1 . The tip of cusp lies forwardly.

P^3 , the second unicuspid is approximately one-half the size of the I^2 , and is shaped like it; left teeth are missing but two alveoli, anterior one of which is small and rounded, and posterior one is large and crescent in shape.

P^4 is molariform, possesses a well developed postero-buccal angle. It has two external cusps: the anterior one is very small, while the other is largest of all cusps. Interior three cusps are low and poorly developed, posterior side of which is very broad.

M^1 , the greatest horizontal extension of the permanent teeth, is best in the development of anterior external angle, paracone and parastyle; mesostyle, metacone and metastyle are with very sharp edge. Protocone and hypocone are shaped like the crescent; the protocone is larger than hypocone and buccal side is sharply cut. The premaxilla is swollen in the region of P^4 and M^1 .

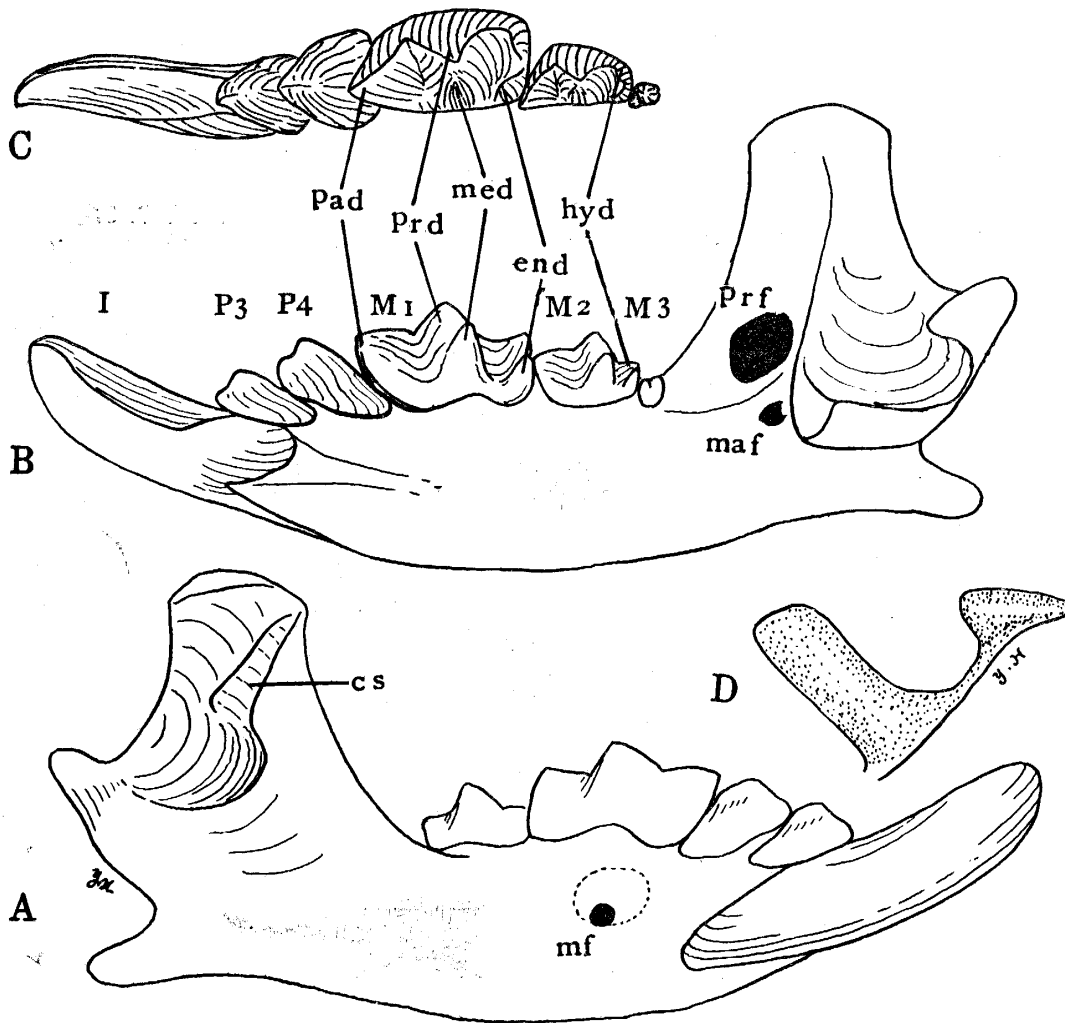
M^2 , only one-third the size of M^1 , triangular in outline, has three cusps; the exterior cusp is W-shaped but not well developed, interior cusp is only one owing to reduction of members.

M^3 is lost but small alveolus is present.

The posterior border of each tooth is in close contact with the anterior

border of the next tooth.

Description of Paratypes: Specimen, No. An. S. 64; posterior cranial portion is broken, anterior and facial portions are filled with brecciated clay. Glenoid process is large, strong and connected to the buccal side of the posterior extremity of the pterygoid process, which closes to each other posteriorly. Both M^2 , M^3 , and left I^2 are unpreserved. The tip of the left I^1 is broken. The tympanic bullae are not seen. No. An. S. 19, is broken in cranial portion. Upper and lower jaws are closely jointed in preservation. Upper first incisor is very worn. Dimentions of the skull and the teeth of upper jaw are as follows in mm:



Text fig. 2. Paratype of *Anourosorex japonicus* n. sp., no. An. R. 37. A: Buccal view, B: Lingual view, C: Occlusal view, D: Posterior view of condyle. Abbreviations: maf., mandibular foramen; prf., posteriointernal ramal fossa; mf., mental foramen; cs., coronoid spicule; end., entoconid.; hyd., hypoconid; med., metaconid; pad., paraconid; prd., protoconid. about, $\times 10$, Hasegawa del.

	Holotype	No. 64	No. 19
Length of the palate	11.5	11.5	—
Width between both infrorbital foramens	4	4	4.5—
Maximum width between both I ¹	3.1	4.2	4.4—
Ditto, both M ¹	8.7	9.0	9.3—
United length of I ¹ -M ¹	11.7	11.5+	—
Ditto, I ¹ -M ²	12.7	—	—
Ditto, I ² -M ²	9.7	—	—
Ditto, P ³ -M ²	7.6(right)	—	—

The lower jaw, No. An. R. 37 of best preservation retains all teeth, and No. An. L. 1 is broken in angular process but with all teeth preserved. The angular process is not strongly developed, thin and curved lingually. The condyle is well developed, divided into two; the lower one of elongate quadrangular shape and upper one of triangular shape are separated by a wide notch; the lower one is larger than the upper. Dimentions of condyle and notch are as follows in mm:

	No. An. L. 1	No. An. R. 37
Maximum length of condyle	5	5.2
Width of notch	2	2.2

The coronoid process is higher than that of *squamipes* M.-E. & *assamensis* ANDR. The coronoid spicule is varied in every specimen. The mental foramen is situated beneath the protoconid of M¹. The area surrounding the foramen is shallow oval and 11.5 mm in diameter. The mandibular foramen is situated at the anterior of the inferior articular facet of the condyle, and is connected to the postero-internal ramal fossa, which is considerably large, subtriangle and is situated above the mandibular foramen.

Cingula of teeth are not seen. Inisor is developed, large, very long, and projects antero-upward. Its upper interior surface is concave from the tip to the point beneath the third premolar.

Third and fourth premolar are pyramidal unicuspid; postero-external borders of the crowns are longer than the interior.

M₁ is the largest of the molars. The two valleyes open lingualward; anterior valley is shallow and wide, while posterior one is deeper and smaller than the former. Paraconid is the largest and entoconid is the smallest of all cusps.

M₂ is half the size of M₁ and not so much different from it in outline. The hypoconid and the entoconid do not so much separate from each other as they do in M₁ but continue gradually to each other.

M₃ is the smallest of all lower teeth, almost unicuspid, is situated more interiorly than the other teeth; cusp is divided into two tips. Dimentions of the ramus and the teeth are as follows in mm:

	No. An. L. 1	No. An. R. 37
Maximum length of jaw	18.4	17.3
United length of I-M ₃	11.2	11.5
Ditto, P ₃ -M ₃	8	8.2
Ditto, M ₁ -M ₃	5.7	5.9
Maximum length along the outside of I	7	7.2

Remarks: *A. japonicus* is regarded to belong to the same genus as *squamipes* M.-E. & *assamensis* ANDR. because of the total number of teeth amount to 26, and of its only anterior palatal foramen, but is considered as a species distinct from them by the following characters:

Comparative characters of the three species

	<i>Anourosorex japonicus</i> n. sp.	<i>A. assamensis</i> ANDR. & <i>A. squamipes</i> M.-E.
nasal	not tapering forward	tapering forward
I ¹	projected to out side of nasal	not projected
external width between both M ¹	broad	not broad
M ²	small, triangular	large, quadrangular
M ³	very small, pointed	small, triangular
M ₃	very small	small
coronoid process	high	low
coronoid spicule	developed, irregular	undeveloped, concave

It is well known that the Japanese flora and fauna are composed of various components of the north and south elements, and in the latter case some elements show relationships with forms of southwestern China. (Imaizumi, Y. 1940; Miki S. 1950; Tokuda M. 1955; etc) The authors here note the existence of a new congeneric shrew supporting the close relationship between Japan and southwestern China.

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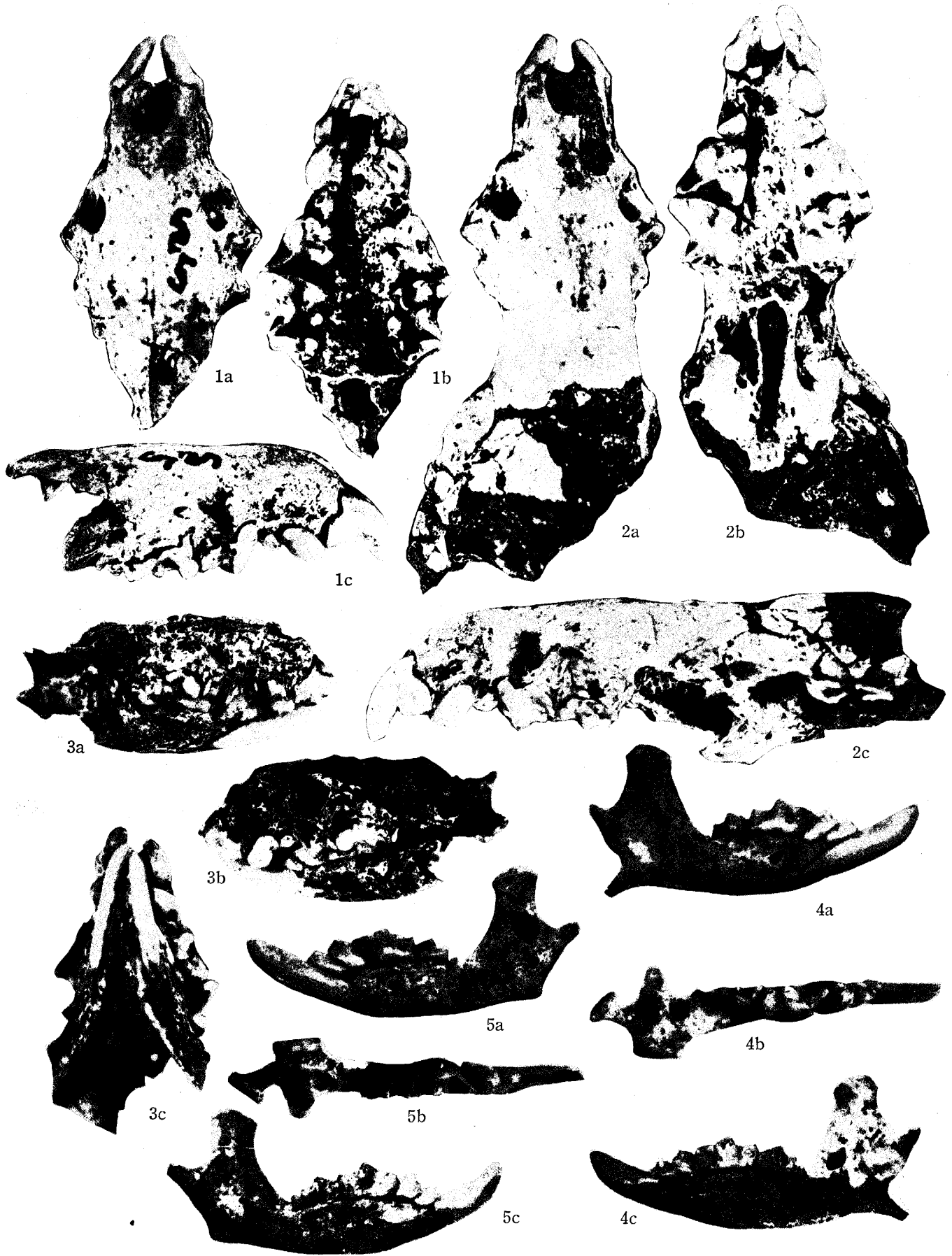
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Explanation of Plate

Anourosorex japonicus n. sp.

- Fig. 1a. Ventral view of Holotype, no. An. S. 5; $\times 3.6$
- 1b. Ditto; occlusal view.
- 1c. Ditto; right lateral view.
- Fig. 2a. Ventral view of Paratype, no. An. S. 64; $\times 3.6$.
- 2b. Ditto; occlusal view.
- 2c. Ditto; left lateral view.
- Fig. 3a. Right lateral side of jointed skull and jaw of Paratype An. S. 19; $\times 3.6$.
- 3b. Ditto; left side view.
- 3c. Ditto; ventral view.
- Fig. 4a. Buccal view of right jaw of Paratype, no. An. R. 37; $\times 3.2$.
- 4b. Ditto; occlusal view.
- 4c. Ditto; lingual view.
- Fig. 5a. Buccal view of left jaw of Paratype, no. An. L. 1; $\times 3.2$.
- 5b. Ditto; occlusal view.
- 5c. Ditto; lingual view.



Hasegawa photo.