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A New Subgenus and New Species of Squirrel from Borneo

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Oldfield Thomas had only one specimen of the diminutive sculptor squirrel, *Glyphotes simus*, when he described the new genus and species in 1898. The specimen was from Mt. Kinabalu in Borneo. The following year another specimen was taken in Borneo on Marapok Mountain (latitude 5° 04' N., longitude 115° 06' E.) and was deposited in the Sarawak Museum at Kuching, according to Chasen and Kloss (1927, p. 349), and the same authors report (p. 350) a third specimen in the Raffles Museum at Singapore which had been taken on July 10, 1925, at Tenompok on Mt. Kinabalu, Borneo.

Moulton (1911, p. 30) had listed two specimens of this squirrel in the Sarawak Museum, and although Chasen and Kloss (1927, p. 350) were later advised that that information was erroneous, a still later but enigmatic report by Banks (1931, p. 49) of a second *Glyphotes* specimen existing in the Sarawak Museum collections, from Mt. Kinabalu, implies that Moulton's original listing may have been correct. Only these (evidently) four specimens have been published upon.¹ On July 4, 1951, David H. Johnson of the United States National Museum took a sixth specimen in Tenompok Pass at 4500 feet on Mt. Kinabalu, Borneo. Between August 29 and September 1, 1953, Robert Traub of the

¹ Hill's (1959) report, which appeared while the present paper was in press, shows that Banks (but not Moulton) was correct, adds details concerning the known specimens, records a fifth specimen now in the British Museum collected at Tenompok on Mt. Kinabalu, June 16, 1952, and provides photographs of the skull, mandible, and baculum.

United States Public Health Service obtained seven more specimens at Tenompok Pass on Mt. Kinabalu. Consequently all but one of the specimens of *Glyphotes simus* known to the present writer are from Mt. Kinabalu in Borneo. Ten, and quite possibly all, of the topotypes are from Tenompok Pass. Only two of these 13 specimens are female, the immature one in the Raffles Museum and the adult from Kinabalu in the Sarawak Museum.

When Dr. Karl F. Koopman had begun putting the important but neglected mammal collections of the Academy of Natural Sciences of Philadelphia into working order, the present writer studied the material available there on Oriental Sciuridae in April, 1958, and found three specimens labeled "*Callosciurus notatus*" which were peculiarly small for that species. A glance at the incisor teeth revealed that they were *Glyphotes*, but further examination of the skulls disclosed that they lacked some of the characters ascribed to *Glyphotes simus*. The size of the animals and color of the pelage on the skins were wrong for *Glyphotes simus* also. These specimens were collected at Mt. Dulit in Borneo by Charles Hose in August, 1895, October, 1895, and June, 1896. Elevation is given on only one specimen, 2000 feet. These were part of a Charles Hose collection originally presented by Dr. W. H. Furness, 3rd, to the Wistar Institute in Philadelphia in 1897, according to information on the labels. The skins of this collection were obtained by the Academy of Natural Sciences of Philadelphia after some years, but Wistar Institute did not relinquish the skulls to the Academy until just recently.

There are collector Charles Hose's printed labels on the skins inscribed with collecting date, locality, sex, identification, but not catalogue number. The skulls each have a single number penciled on them: 2, 3, and 4, respectively. Each skull has a Wistar Institute catalogue number (12135, 12148, and 12176) inked on the cranium and the mandible, and a small metal tag associated with it bears the same number. With each skull also is a printed Wistar Institute specimen tag, such as is usually put on skins, with the respective catalogue number and with data evidently copied from the collector's tag on the respective skin. Each of these Wistar Institute tags is labeled "Skull," and below that in the same ink script is the comment "Skin catalogued as No. 3283" (and 3301 and 3426, respectively). Each skin has an Academy of Natural Sciences of Philadelphia printed tag tied to it with the Academy's catalogue number (14142, 14143, 14144, respectively), together with the data copied in ink from the collector's tag, and the Wistar Institute catalogue number. The Wistar Institute's tags

for the skins had been removed but kept. These bore numbers W.I. 3283, 3301, and 3426, all the data copied from the collector's tags, and, handwritten in ink, "Skin," with below it the comment "Skull catalogued as no. 12176" (and 12148 and 12135, respectively). The three skulls are clearly related to one another and very distinct from any others. The three skins are quite alike and rather distinct from other Bornean ones. Although the skulls have been separated from the skins for many years, the documentation of the identity seems good.

The skulls of these Mt. Dulit specimens key out to subtribe Callosciurina in a recently constructed key to the tribes and subtribes of the Sciurinae (Moore, in press), and also possess the six characters that are offered to define the subtribe Callosciurina. In the key to the genera of Callosciurina (Moore, in press), they key out to the genus *Glyphotes*. These three Mt. Dulit specimens differ in several important characters of the skull from *Glyphotes simus*, being more like *Callosciurus* in these characters. Nevertheless, the Mt. Dulit material is here regarded as a new species congeneric with *Glyphotes simus*. Because *Glyphotes* has until the present time been regarded as monotypic, the distinctive skull characters in which the new species agrees with *G. simus* now constitute the diagnostic characters of the genus.

GENUS *GLYPHOTES*

DIAGNOSIS: (1) While the anterior surfaces of the upper incisors are strongly convex, those of the lower incisors are flat or slightly concave.¹ (2) A distinctive hollow is gouged into the posterior surface of the dentine of each upper incisor. (3) From anterior view the nasal aperture appears flattened dorsoventrally.

OTHER DESCRIPTIVE CHARACTERISTICS: Compared to the very generalized skulls of *Tamiops maclellandi* and *Callosciurus nigrovittatus*, to which those of *Glyphotes simus* and the new species are, respectively, similar in size of braincase and orbit, other notable divergences of *Glyphotes* from the ordinary callosciurine skull are these: The whole rostrum is short. The top of the cranium in lateral view is domed. The auditory bullae are proportionally quite small.

SUBGENUS *GLYPHOTES*

DIAGNOSIS: (4) The total breadth of the posterior extremities of the nasals exceeds the breadth of the posterior extremity of either pre-

¹ The concavity (denied by Hill, 1959, p. 260) is on the transverse axis only; on the longitudinal axis of the tooth, its anterior surface is, of course, convex.

maxillary (i.e., on the dorsal surface of the skull the total breadth of the two premaxillaries is less than two-thirds of the distance between the maxillaries). (5) The nasals are no more than a quarter of the greatest length of the skull. (6) The greatest width across both nasals is about 0.75 or more of the greatest length of either nasal. (7) Each upper incisor is wider than the greatest linguolabial breadth of any of the animal's upper molars. (8) Each incisor tooth is wider than it is deep. (9) The incisors spread slightly (the left and right incisor teeth of other Callosciurini converge from the points where they leave the skull, and at the point where they meet they are kept worn off. In the subgenus *Glyphotes* the left and right incisor teeth leave the skull, converge, and begin to diverge again before they reach the point at which their cutting edges are maintained. This is true of the lower as well as the upper incisors).

Other characteristics that distinguish the subgenus *Glyphotes* from the new material and from other more typical Callosciurina are: (10) The occiput and foramen magnum are oriented unusually ventrad, the latter being only about 45 degrees from the occlusal plane. (11) The incisive foramina are wide. (12) The zygoma is rotated (on an antero-posterior axis) top outward, until its side is only about 30 degrees from the horizontal. (13) The condylar process of the mandible is exceptionally long and exceptionally slender. (14) In lateral aspect the zygomatic plate and anterior part of the zygoma rise at about 65 to 70 degrees from the occlusal plane.

In his original description of *Glyphotes simus* (from a single specimen) as a new genus and species Thomas (1898, p. 250) made some note of the characters numbered above 1, 3, 8, 9, 13, and 14. Ellerman (1940, p. 393) repeated some of Thomas' observations on the single specimen and made some note of number 6. Characters are mentioned by both of these authors that do not characterize the six skulls of *simus* which are before the present writer: The nasals do not have parallel sides. The postorbital processes are not small nor set "far back" for squirrels of this size. The part of the zygomatic plate behind the infraorbital foramen is not notably reduced.

The three specimens from Mt. Dulit appear to represent a notably larger species than *simus*. *Glyphotes simus* is smaller than *Sundasciurus lowi*, *S. tenuis*, *S. fraterculus*, *S. brookei*, or *S. jentinki*, and smaller than *Prosciurillus murinus* or *P. abstrusus*, but compares well with *Tamiops mccllellandi* and *T. rodolphei*. The new species is larger than any of the above, but is smaller than average individuals of any common species of subgenus *Callosciurus*. *Callosciurus nigrovittatus nigrovit-*

tatus of Java and *C. pygerythrus pygerythrus* of Burma have some individuals as small as this, and *Tamiops swinhoëi* from Wenchuan, Szechwan, China, has some individuals as large. The above comments are made from direct comparisons of skulls. The new species appears to belong alone in a new subgenus of *Glyphotes*.

HESSONOGLYPHOTES, NEW SUBGENUS

DIAGNOSIS: The characters of the skull that distinguish subgenus *Hessonoglyphotes* from the subgenus *Glyphotes* are: (1) The total breadth of the posterior ends of both nasal bones only approximates the greatest breadth of either premaxillary on the dorsal surface of the skull. (2) The greatest length of the nasals exceeds one-quarter of the occipitonasal length. (3) The greatest breadth across both nasals is less than three-quarters of the greatest length of the nasals. (4) The width of the incisors is less than their depth and less than the linguo-labial width of the largest upper molars. (5) The incisors do not diverge distally.

The name *Hessonoglyphotes* is from the Greek words "hesson" meaning "less" and "glyphotes" meaning "I chisel." The combined meaning "I chisel less" is suggested by the chisel-shaped but proportionally less-differentiated lower incisors of this subgenus.

Glyphotes (*Hessonoglyphotes*) *canalvus*, new species

The type is Academy of Natural Sciences of Philadelphia No. 14142 for both skin and skull (which, respectively, bear Wistar Institute numbers 3283 and 12176) collected by Charles Hose on Mt. Dulit (latitude 3° 03' N., longitude 114° 11' E.), Borneo, in October, 1895. The name *canalvus* is from the Latin words "*canus*" for "ashy gray" or "hoary" and "*alvus*" for "abdomen" or "belly." The species *canalvus* is the type species of *Hessonoglyphotes*.

COLOR DESCRIPTION: The two paratypes are especially important in pelage characters of *Glyphotes canalvus*, for, although the skull of the type is the least damaged, its pelage is dorsally quite worn, and the color notes are taken from the two paratypes primarily. Capitalized color terms are those of Ridgway (1912), and the Roman numerals that follow in parentheses are the numbers of the Ridgway plates. The dorsal pelage is Buffy Brown (XL), and an agouti produced by banded pelage. Most of the dorsal guard hairs have black tips, middles, and bases and two light bands in the intervening spaces. Some have only one light band, and a few are entirely black. The head and ears are just like the back, and the eye ring is very slight. The shoulder areas

TABLE 1

SKULL MEASUREMENTS (IN MILLIMETERS) OF *Glyphotes (Hessonoglyphotes) canalvus*

	A.N.S.P. No. 14142 ^a	A.N.S.P. No. 14143	A.N.S.P. No. 14144
1. Occipitonasal length ^b	39.2	40.0	39.0
2. Zygomatic breadth	24.9	—	—
3. Length of nasal	10.8	10.6	11.1
4. Anterior breadth of nasals	6.1	6.0	6.5
5. Posterior breadth of nasals	3.2	2.9	4.0
6. Least interorbital breadth	16.2	15.7	15.7
7. Least postorbital breadth	16.0	15.8	14.5
8. Cranial breadth	19.7	19.9	18.7
9. Palatal length	18.7	—	17.9
10. Least diastema length ^c	9.7	—	10.0
11. Maxillary tooth row	6.9	6.5	6.4
12. Breadth of upper incisor	1.4	1.4	1.35
13. Breadth of lower incisor	1.5	1.5	1.3
14. Length of mandible (bone)	24.5	24.0	24.8
15. Coronoid process to angular process	11.8	12.7	12.2
16. Length of condylar process posterior to coronoid	7.7	6.9	7.0
17. Mastoid breadth	—	17.5	—

^aThe type.^bIn the absence of other specification, "greatest" is implied.^cFrom the fourth upper premolar.

are slightly redder in the type. At the lower edge of each side is a strongly marked, light band about 5 mm. wide and 50–60 mm. long. This is about Pinkish Buff (XXIX) and is constituted by hairs with long, nearly white tips and pale gray bases. Adjacent to the light stripe of the side is the black stripe of the lateral margin of the ventral pelage. This about equals the length and width of the light line but is definitely wider in one specimen. The hairs of this generally appear to be blackish for their full length but may have lighter bases and occasionally white tips. The remainder of the ventral pelage is about Light Olive-Gray (LI) and appears to be composed of hairs that are almost white for their terminal half and blackish basally. The ventral pelage turns faintly yellowish on the throat of one paratype but not the others. The hairs of the tail have thin black tips but about 3-mm. subapical white bands which to the unaided eye appear to be white tips; then there are two black bands and two yellowish orange bands,

TABLE 2

MEASUREMENTS (IN MILLIMETERS) OF THE SKULL OF *Glyphodes simus*
 (The numbers in the first column indicate the measurements as given in table 1.)

Type ^a	Type ^b	U.S.N.M. No. 292611	U.S.N.M. No. 301013	U.S.N.M. No. 301014	U.S.N.M. No. 301015	U.S.N.M. No. 301016	U.S.N.M. No. 301018	Marabok Mt. ^c
1	—	28.6	28.7	28.1	29.1	28.4	28.3	—
2	18.2	19.7	18.5	—	19.6	—	18.6	—
3	6.9	6.9	7.0	6.5	6.8	7.0	7.0	6.5
4	5.1	5.3	5.1	5.3	5.8	5.3	5.2	5.8
5	4.3	—	3.7	4.1	4.4	3.9	3.8	—
6	11.8	12.6	12.7	12.4	12.5	11.9	12.2	12.8
7	14.5	—	14.0	14.4	13.8	14.3	14.3	—
8	16.5	16.6	16.0	16.3	16.1	16.0	16.2	16.7
9	11.2	12.2	12.9	12.6	12.9	12.5	12.4	11.2
10	6.4	6.3	6.6	6.6	7.1	6.1	6.7	6.7
11	4.1	4.5	4.5	4.3	4.3	4.5	4.2	4.4
12	1.6	1.6	1.6	1.6	1.6	1.6	1.5	1.6
13	1.5	1.4	1.5	1.5	—	1.4	1.3	—
14	19.6	19.5	19.0	19.2	19.4	18.7	19.3	20.0
15	7.5	8.2	7.6	7.7	7.7	7.3	7.6	—
16	6.6	6.3	5.9	6.2	6.5	5.8	6.7	—
17	—	—	—	14.1	14.2	14.0	13.9	—

^aMeasurements from Thomas (1898, p. 251).

^bMeasurements made by G. H. H. Tate in the British Museum (Natural History).

^cMeasurements from Chasen and Kloss (1927).

TABLE 3
LENGTH MEASUREMENTS (IN MILLIMETERS) OF *Glyphotes simus*

	Head and Body	Tail	Hind Foot	Ear
B.M. No. 93.113.6, type, male	129	106	28	11
Marabok Mountain, immature, female	103	112	21	14
U.S.N.M. No. 292611, male	120	95	33	14
U.S.N.M. No. 301013, male	94	95	27	13
U.S.N.M. No. 301014, male	100	101	29	14
U.S.N.M. No. 301015, male	109	95	29	14
U.S.N.M. No. 301016, male	144	104	28	13
U.S.N.M. No. 301017, male	106	95	29	14
U.S.N.M. No. 301018, male	131	96	31	14

all about 2–3 mm. long, and generally a shorter blackish base. At the very tip of the tail the hairs are elongated to about 40–45 mm. and blackened in the paratypes. All three have quite noticeable postauricular patches, as pale as the light lateral line.

DIAGNOSTIC COLOR CHARACTERS: The dorsal pelage color is quite distinct from the Light Grayish Olive (XLVI) of *Glyphotes simus*. Both lateral lines are proportionally much narrower than in *simus*, and the light line is much less white than in *simus*. The general ventral pelage is gray instead of the Tawny-Olive (XXIX) of *simus*. The tail hairs have one more light-colored band and one more black band than do those of *simus*. *Glyphotes simus* has no postauricular color patch. (Thomas, 1898, p. 250, wrote "indistinct whitish postauricular patches present," but the present writer finds them so extremely faint as to be but uncertainly detectable in any of the seven dry specimens of *simus*.)

The possession of a quite distinct postauricular patch by the Mt. Dulit material led the writer to consider whether this material represented the Bornean squirrel *Callosciurus adamsi* Kloss, 1921. *Callosciurus adamsi* is described as a small squirrel apparently just about the size of the Mt. Dulit specimens, and Mt. Dulit is in northern Sarawak apparently about 50 or 60 miles from the type locality of *adamsi*. However, Kloss (1921, p. 151) reported the ventral pelage of his two specimens "Orange-Cinnamon to Cinnamon Rufous (Ridgway)," which is a quite different color from the Light Olive-Gray of the Mt. Dulit material reported here. Kloss (1921) compared [*Callosciurus*] *adamsi* to *Glyphotes simus* and [*Callosciurus notatus*] *dulitensis* in various de-

tails of pelage color, but regarding characters of the hard parts succinctly stated, "Skull and teeth as in . . . *dulitensis* but smaller." This statement by Kloss certainly suggests that *adamsi* is not congeneric with *canalvus*. Although Chasen (1940) also had an opportunity to compare the teeth of the type of *adamsi* with those of a specimen of *Glyphotes* and apparently saw no similarity, the present writer inquired of Mr. John Edward Hill of the British Museum whether the type of *adamsi* had notably flat anterior surfaces of the lower incisors. He replied that it did not, and there seems, thus, no possibility that *adamsi* is congeneric with *simus* and *canalvus*.

The character of the baculum of *Glyphotes* has been unknown. Simpson (1945, p. 79) presumably placed the genus in the Oriental tribe Callosciurini in his classification of mammals only on the basis of geographical association, but the present writer (in press) has found morphological support for this allocation. *Glyphotes* possesses the single transbullar septum in each auditory bulla that has proved characteristic of the subtribe Callosciurina. No report has been published on the characters of the male genital tract of this rare squirrel, of course, nor for any member of the large Oriental squirrel tribe Callosciurini, but with Dr. David H. Johnson's approval the writer made the alcoholic male specimen of *Glyphotes* available to Drs. Harland W. Mossman and M. R. N. Prasad who extracted the genital tract for study.¹

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SUMMARY

With the description here of the squirrel *Glyphotes* (*Hessonoglyphotes*) *canalvus*, two evidently rare species with subgeneric differences are now known within this Bornean genus.

¹ Hill (1959) has now described and figured a baculum of *Glyphotes simus* and shows it to possess the separate blade attached to the dorsal surface of the shaft, which is diagnostic for the Oriental squirrel tribe Callosciurini.

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