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ABSTRACT.—Based on similarities of the dentition, especially the diagnostic triangular shape and development of the slight cingular shelf on the P4 and the notched protoconic crest of the M1, *Canimartes*? *idahoensis* (Gazin, 1937) and *Canimartes*? *cookii* (Gazin, 1937) are assigned to the genus *Trigonictis*. Statistical analyses of various parameters in certain Recent mustelids show that although sexual dimorphism can account for great differences in size, comparison with the results obtained for the fossil forms seems to indicate that *Trigonictis idahoensis* (Gazin) and *T. cookii* (Gazin) are valid species.

Remains of mustelids from the Upper Pliocene, especially remains of upper dentitions, which are needed to establish correct systematic relationships, are extremely rare. Inferences, based chiefly on lower dentitions, are hazardous because of the generalized nature of the dentition and the varying degrees of sexual dimorphism known to occur among members of the Mustelidae. Because of these factors, the proper relationships of some fossil forms have been clouded.

Among these are the two species, *Lutravus*? *idahoensis* and *Lutravus*? *cookii* (larger and smaller, respectively), that Gazin (1934) described on the basis of lower dentitions from the Glenns Ferry formation (Malde and Powers, 1962), south of Hagerman, Twin Falls Co., Idaho. Subsequently, upon finding, at the same locality, unassociated upper teeth which he attributed to *idahoensis*, Gazin (1937) questionably placed the two species in the genus *Canimartes* Cope (1893).

Intensive collecting by field parties from the University of Michigan, Museum of Paleontology, under the direction of Claude W. Hibbard, has resulted in the recovery of additional remains of these two mustelids. Among these is a partial skeleton of *cookii* with both lower jaws and fourth upper premolars present. Only the dentitions will be discussed here. The skeleton will be reported on later by Philip R. Bjork.

SYSTEMATICS

The lower jaws compare favorably with the description and measurements as given by Gazin (1934) for *Lutravus*? *idahoensis* and *L.*? *cookii* and Hibbard (1941) for *Trigonictis* (Table 1). The P4 of *Trigonictis* is characterized by the cingulum forming a slight shelf, which runs from the protocone to the posterior part of the tooth and gives to it a triangular appearance. The P4 of both *idahoensis* and *cookii* differs from *T. kansasensis* Hibbard by a subequal development of the hypocone and by the absence of a protoconule, which is strongly developed in the latter species. *Trigonictis* differs from *Canimartes* by the development of the shelf and the hypocone. *Canimartes* lacks the shelf and the hypocone, and its protocone is sharply constricted and

TABLE 1.—*Measurements (mm) of fossil mustelids.*

	T. cookii		*T. idahoensis*				*T. kansasensis*
	USNM 12606[1]	UMMP 49819	USNM 12027	UMMP 48862	USNM 12030[1]	UMMP 49654	KU 4604[1]
Toothrow length	27.5[2]	27.7	32.0[2]	32.8	—	36.4	37.4
Thickness below m1	5.3	5.3	6.3	6.8	7.5	6.9	8.0
Depth below m1	—	10.4	14.3	13.0[2]	15.2	15.1	13.3
p3, length	5.3	4.7	—	6.4	—	—	6.8
p3, width	3.2	3.1	—	3.7	—	—	4.2
p4, length	5.8	5.9	7.3	7.4	7.7	7.8	8.0
p4, width	3.1	3.3	3.8	3.9	4.4	3.8	4.3
m1, length	10.7	11.5	13.3	13.5	14.2	14.8	14.8
m1, width	4.6	5.2	5.7	6.3	6.3	6.7	6.4
Trigonid length[3]	7.2	7.5	9.2	9.1	9.9	10.0	10.0
Talonid width	4.5	4.7	5.3[2]	5.3	6.0	5.9	6.0
p4, length	—	9.4	—	11.6[4]	—	—	11.9
p4, width of tooth across hypocone	—	4.2	—	5.4[4]	—	—	6.6

[1]—denotes type specimen; [2]—estimate; [3]—length of trigonid from anterior part of tooth to notch between protocone and hypocone; [4]—UMMP 49728.

set off from the main body of the tooth as in the modern fisher, *Martes pennanti* (Erxleben). *Canimartes* also possesses M2 (*fide* Cope, 1893). Hibbard (1941) considered each of the forms distinct on the basis of the P4. The M1 of *idahoensis* differs additionally from that of *T. kansasensis* in having a slightly developed cuspule on the expanded cingular shelf.

The similarities of lower dentitions and especially the similarities of the P4 and the M1 warrant the placing of the Idaho mustelids into the genus *Trigonictis*. The differences in the hypocone and protocone development of the P4 make desirable the retention of the geographically separated forms as distinct species.

McGrew (1944) thought that *Trigonictis* might be an aberrant otter. *Trigonictis* differs from the otter in that the cingular shelf of the P4 is greatly expanded in the latter form, while the M1 of *Trigonictis* is characterized by the presence of a metaconule and a notch in the protoconic crest.

Trigonictis bears a close relationship to the tropical American genus *Galictis* Bell. Both genera possess the slight shelf and hypocone on the P4; they differ in that the protoconic area of *Galictis* is represented by a shallow basin rather than by a cusp. *T. cookii* is about the same size as *Galictis*.

The triangular appearance of the P4 with its slight shelf and hypocone is diagnostic in *Trigonictis*. These features are also found in the European fossil genus *Pannonictis* Kormos and the Recent *Galictis*. Pilgrim (1932), in discussing the phylogeny of the Mustelidae, considered *Pannonictis* and *Galictis* to have developed from a common stock. Reig (1957) discussed the possibility of *T. cookii* being a species of *Galictis* and *T. idahoensis* belonging to the genus *Trigonictis*; and he placed all these forms, as well as *Pannonictis*,

into a new subfamily, Galictinae. While Reig anticipated the relationship of *T. idahoensis* to *Trigonictis*, the lack of upper teeth prevented his proper assignment of the smaller form. These genera, without a doubt, have a close phylogenetic relationship, but more material will be necessary to clarify the relationship.

Statistical Analyses

Sexual dimorphism is an important phenomenon among the Mustelidae; in some species males may be almost twice as large as females. Because of the striking dental similiarities between *Trigonictis idahoensis* and *T. cookii*, it was thought that the size difference might be due to secondary sexual, rather than to specific, variation. Various Recent mustelids in the collection of the Museum of Zoology, University of Michigan, were measured to find the limiting size ranges due to sexual dimorphism. Animals chosen for study were *Mustela erminea* Linnaeus, *M. vison* Schreber, *Martes americana* (Turton), and *M. pennanti* (Erxleben). All of the specimens were collected by H. F. Quick in the late 1940's near Fort Nelson, British Columbia. Although this method of sampling somewhat reduced the number of specimens available for study, it was hoped that any size variations which might occur owing to clinal differences would be eliminated.

Measurements in Table 1 were made on all specimens. Two were chosen for further consideration, the distance from the posterior margin of the canine alveolus to the posterior margin of the alveolus for the m2 (listed as toothrow in Table 1), and the anteroposterior length of the m1. These measurements were used because they best express size differences between species and sex. The mean ($\bar{x}$), variance (V), and the standard deviation (SD) were calculated for each sex in all groups. The size difference between the two sexes was compared by dividing the mean of the males by the mean of the females for each species. The number obtained can be considered as a "sex size ratio" (SSR). The data above are listed in Table 2.

After the variation in the Recent forms had been established, the fossil sample was treated in the same manner. Measurements of 14 specimens were available, four identified as *Trigonictis cookii*, 10 as *T. idahoensis*. The assumption was made that the fossils represented only one species, all *T. cookii* specimens being females, all *T. idahoensis* being males (species A, Table 2). Comparison of the sex size ratio with the Recent forms shows that the toothrow ratio is slightly larger, while the m1 ratio is equal to that found between the opposite sexes of the ermine. These ratios could denote the presence of only one species in the population. This, however, does not seem to be the case. The variation (V) found in *T. idahoensis*, when considered as representing all males, exceeds the next most variable group of mustelids, the male *Martes pennanti*, by some 450% in the toothrow measurement, and some 42% in the m1 measurement. This great variation would seem to indicate the

TABLE 2.—*Number, mean, variance, standard deviation, and sex size ratio of some Recent and fossil species of Mustelidae.*

Species			TOOTHROW				FIRST LOWER MOLAR			
			$\bar{x}$	V	SD	SSR	$\bar{x}$	V	SD	SSR
M. erminea		♀ (6)	9.3	0.03	0.17	1.22	4.1	0.01	0.10	1.20
		♂ (10)	11.3	0.37	0.61		4.9	0.09	0.30	
M. vison		♀ (10)	18.6	0.16	0.40	1.10	7.2	0.05	0.22	1.10
		♂ (10)	20.6	0.21	0.46		8.0	0.09	0.30	
M. americana		♀ (15)	26.4	0.27	0.52	1.12	8.1	0.05	0.22	1.12
		♂ (15)	29.7	0.65	0.83		9.1	0.07	0.26	
M. pennanti		♀ (10)	36.8	0.82	0.90	1.15	11.9	0.16	0.40	1.15
		♂ (5)	42.4	0.95	0.97		13.7	0.18	0.42	
	A	♀ (4)	27.2	0.45	0.67	1.24	11.2	0.22	0.47	1.20
		♂ (10)	33.7	4.29	2.04		13.5	0.77	0.88	
	B	♀ (7)	32.5	0.47	0.68	1.12	13.0	0.23	0.48	1.11
		♂ (3)	36.4	1.67	1.29		14.5	0.18	0.42	
	C	♀ (4)	27.2	0.45	0.67	1.20	11.2	0.22	0.47	1.16
		♂ (7)	32.5	0.47	0.68		13.0	0.23	0.48	

presence of more than one sex within the *T. idahoensis* specimens, at least by Recent standards.

The *Trigonictis idahoensis* sample was split into two groups: three specimens with a toothrow 35 mm or longer and an m1 length 14 mm or more; seven specimens below these measurements. The first group can be considered large, the second intermediate with respect to the small *T. cookii* specimens.

Calculations were made for the *Trigonictis idahoensis* sample with the large forms representing three males and the intermediate group representing seven females (species B, Table 2). The results obtained were comparable with those obtained for Recent forms. It appears that this sample could represent a valid species. One other possibility was suggested: that the small specimens of *T. cookii* were females in a species in which the intermediate group were males (species C, Table 2). Comparisons of ratios show that this grouping also falls within the range of Recent forms and the possibility of this grouping being a species should not be dismissed.

Two species occur in the fossil population. The large specimens represent male *Trigonictis idahoensis* and those of intermediate size are assigned as females to that species. Better material may prove that all or part of these intermediate specimens may be males of the smaller species, *T. cookii*. The

specimens of *T. cookii* are considered as belonging to one sex. The other sex is either unknown or sexual dimorphism is not readily apparent because of the small sample.

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