1) Trachysomidae,
2) Chordeumidae,
3) Mastigophorophyllidae,
4) Orobainosomidae,
5) Verhoeffiidae,
6) Neoatractosomidae,
7) Anthroleucosomidae,
8) Heterolatzeliidae,
9) Craspedosomidae.

Außerhalb Europas ist von diesen 9 Familien nur eine, und von dieser wieder nur eine Unterfamilie, die Entomobielziinae bekannt geworden, und zwar von Nordamerika. Umgekehrt sind die ostasiatisch-malaiischen und amerikanischen Familien nicht aus Europa bekannt. Die Natürlichkeit der aufgestellten Familien kommt also durch die geographischen Verhältnisse in schärfster Weise zum Ausdruck.

Von den vorgenannten 9 Familien sind in Deutschland 5 bekannt geworden, nämlich Nr. 2, 3, 4, 6 und 9.

7. On intermediate forms among Chiroptera.

By Dr. Augusta Ärnbäck-Christie-Linde.
(Zootomical Institute, University of Stockholm.)

(With 4 figures.)

eingeg. 13. April 1909.

In his work »Zur Entwicklungsgeschichte des Zahnsystems der Säugetiere«[1] Leche says about the dental system: ». . . kaum ein andres (Organsystem) ist weniger konservativ, gibt gefügiger und vollständiger auch den leisesten äußeren Impulsen nach«. Owing to this fact the dentition will of course, to a greater extent than other organic systems, afford instances of individual variability and at the same time of transition from species to species. And the study of the dentition of Chiroptera must be of a special interest from a phylogenetic point of view, as the classification not only of species, but also of genera is of old based on dental characters, especially on the premolars, which present every degree of reduction.

No bat has the complete set of premolars i. e. pm. $\frac{4^2}{4}$, and in no bat the number of the premolars exceeds $\frac{3}{3}$.

In the subfamily Vespertilioninae one of the most important grounds of classification of genera and species is the condition of the premolars. Their varying number and size and the varying situation in the tooth-row of the first and second premolars, especially of the second

[1] W. Leche, Zur Entwicklungsgeschichte des Zahnsystems der Säugetiere. I. Teil: Ontogenie. Stuttgart 1895. p. 2.

[2] In this paper the premolars are signed p^1, p^3, p^4.

one, have been used by systematists as a distinguishing character. A glance at the synopsis of the genera and species in Dobson's Catalogue of the Chiroptera[3] p. 168 and 285 is sufficient to show that.

And by more modern authors too the dentition, especially the premolars, is used as an important character in subdividing the bats into genera. It suffices to mention Winge[4] and Gerrit Miller[5], whose classification of the Chiroptera, contained in his work "The families and genera of bats", is the latest classification of those animals „primarily based on skeletal and dental characters" (l. c. p. 197).

I will give only a few instances. According to Dobson (l. c. p. 169—170) the genus *Scotophilus* is in the first place distinguished from its nearest allies by having the first lower premolar small, crushed in between the canine and second premolar; and the genus *Vespertilio* (*Myotis*) is chiefly distinguished from the genus *Kerivoula* by having the first and second upper premolars much smaller than the third, *Kerivoula* having the first and second upper premolars nearly equal to the third.

According to G. Miller (l. c.) the genus *Pipistrellus* differs from the genus *Myotis* through the absence of pm^3 and pm_3. As regards the genus *Eptesicus* I can not find any essential difference from the genus *Pipistrellus* except the number of the premolars, the former genus having pm $\frac{1}{2}$.

Through the kindness of Professor W. Leche, for which I tender him my grateful thanks, I have got an opportunity of examining some groups of bats belonging to the rich collection of Chiroptera of the Zootomical Institute of the University in Stockholm.

Among the bats belonging to the family Vespertilionidae I have found some cases in which the transition from species to species is manifested in single individuals, the condition of whose premolars clearly shows the connection between forms referred to different genera and which give us an idea of the genesis of those forms.

As regards the nomenclature of the bats I have used the names accepted by Troëssart in his Catalogus mammalium tam viventium quam fossilium. Quinquen. suppl. 1904.

The genera *Myotis* and *Pipistrellus* differ chiefly with regard to the number of the premolars. Winge says (l. c. p. 35):

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[3] G. E. Dobson, Catalogue of the Chiroptera in the British Museum. London 1878.

[4] H. Winge, Jordfundne og nulevende Flagermus (Chiroptera) fra Lagoa Santa, Minas Geraes, Brasilien. E. Museo Lundii. Andet Bind. Kjobenhavn 1893.

[5] Gerrit S. Miller, jr., The families and genera of bats. Washington 1907.

„Det eneste gjennemgaaende Maerke, der skiller *Vesperugo* fra *Vespertilio* og dens Slaegtninge, er vist, at $\overline{p^3}$ mangler" (the only constant character which distinguishes *Vesperugo* from *Vespertilio* and its allies, is no doubt the absence of $\overline{p^3}$). And Gerrit Miller says, speaking of the genus *Pipistrellus* (l. c. p. 205): „Teeth strictly normal and not differing in any essential features from those of *Myotis* and *Lasionycteris*, except in the absence of both pm^3 and pm_3. . . Skull essentially as in *Myotis*, though with a tendency to greater breadth. External characters not essentially different from those of *Myotis* . . ."

But however good a generic character the premolars may have proved to afford in most cases, yet there are facts, which make the fitness of the dental formula as a generic character rather doubtful.

Already the fact that there are bats with pm $\frac{2}{2}$ which in regard to all other external characters agree with bats with pm $\frac{3}{3}$ but differ from bats with pm $\frac{2}{2}$ is apt to show that a subdivision into genera on the sole ground of the dentition, at least so far as concerns the genera *Myotis* and *Pipistrellus*, is an artificial rather than a natural one.

A still more important fact is that the premolars, especially the second one, are in a high degree subject to individual variation and even to reduction in size and number, which may result in the non-function or total absence of this tooth. Thus the essential difference between the two genera is effaced, and chiefly owing to this fact, which the instances given below tend to establish, the dentition is less available as a generic character.

As an instance of artificial classification I mention *Pipistrellus* (*Vesperugo*) *annectens* Dobson, of which species, so far as I know, only one individual has been before described. Blanford[6] writes: „The only specimen obtained is in the Indian Museum Calcutta. A skin, probably belonging to the same species, is amongst Mr. Hodgson's Nepal collections in the British Museum".

In the Zootomical Institute of Stockholm this interesting species is represented by 3 specimens — 2 ♀ and 1 ♂ — in alcohol. The females are adult, but not the male. They are from Sumatra, and this species has not before been recorded from that island. The only specimen known to Dobson has been found in Assam. They differ from Dobson's description (l. c. p. 234) with respect to the measures[7] being

[6] W. T. Blanford, The fauna of British India. Mammalia. London 1888 bis 1891. p. 316.

[7] The following dimensions are taken from one of the females, and the length of the tail is given approximately.

much smaller than the continental example; besides, the extreme tip of tail is not free. Also of these three bats the following words of Dobson hold good (l. c. p. 183) „. . . *Vesperugo annectens* agrees so remarkably in general form with the species of *Vespertilio* that it can only be distinguished by its dental characters". They have pm $\frac{2-2}{2-2}$, and I can not find that they show any other characteristic difference from the genus *Myotis*.

Comparing the skull with those of a *Myotis* and a *Pipistrellus* we find that the crown of the head is slightly raised above the face-line as in *Myotis* and not flat and broad as in *Pipistrellus*, which appears from the fig. 1—3.

The muzzle is pointed as in *Myotis*, not obtuse as in *Pipistrellus*.

The ear and the tragus do not differ from those of the genus *Myotis*; in regard to their shape I refer to the figure 96 in Blanford's Fauna of British India.

They have no postcalcaneal lobe, agreeing in this respect with most species of *Myotis*.

The genus *Pipistrellus* is generally said to be characterized by short legs. To find out if this is true also with regard to *Pipistrellus annectens* and if the genus *Pipistrellus* in general has shorter legs than the genus *Myotis*, I have compared the length of head and body with that of the tibia in specimens belonging to several species of *Myotis* and *Pipistrellus*, using the measures given by Dobson as well as measures taken by myself. I have found the following proportions:

	mm
Skull, total length from the most prominent part of the occiput to the front of the incisors	12
Length, head and body	39
- head	14
- tail	31
- ear, outer margin	12
- - inner margin	10
- - greatest breadth	7,5
- tragus, outer margin	5,5
- forearm	29,5
3rd finger, metacarpus	26
- - 1st phalanx	12
- - 2nd -	13
4th finger, metacarpus	26
- - 1st phalanx	9
- - 2nd phalanx	9
5th - metacarpus	26
- - 1st phalanx	8
- - 2nd -	5
Thumb with claw	6
Lower leg	13
Foot with claws	7

Myotis mystacinus,	length of head and body : length of tibia	=	100 : 41,02.
- *emarginatus*,	- - - - - - - - -		100 : 42,5.
- *montivagus*,	- - - - - - - - -		100 : 39,02.
- *muricola*,	- - - - - - - - -		100 : 41,02.
- *myotis*,	- - - - - - - - -		100 : 36,8.
- *nigricans*,	- - - - - - - - -		100 : 40.
- *albescens*,	- - - - - - - - -		100 : 37,5.
Pipistrellus annectens[8],	- - - - - - - - -		100 : 37,5.
- -	- - - - - - - - -		100 : 33,3.
- *pipistrellus*,	- - - - - - - - -		100 : 29,8.
- *abramus*,	- - - - - - - - -		100 : 29,3.
- *maurus*[8],	- - - - - - - - -		100 : 28,9.
- *stenopterus*,	- - - - - - - - -		100 : 27,3.
- *imbricatus*[8],	- - - - - - - - -		100 : 30,5.
- *brachypterus*[8],	- - - - - - - - -		100 : 27,5.
- *tenuis*[8],	- - - - - - - - -		100 : 30,3.

I have, it is true, examined only a few species, and the measures may vary somewhat in different individuals. However, the above table seems to prove that the genus *Pipistrellus* has shorter legs than the genus *Myotis*. This table also shows the interesting fact that the larger form of *Pipistrellus annectens* agrees in respect to the proportion between the length of head and body and the length of tibia with *Myotis* and not with *Pipistrellus* and that the smaller form has longer tibiae than anyone of the other examined specimens of the genus *Pipistrellus*.

According to Flower[9] there exists another characteristic of the genus *Pipistrellus*, the coracoid being „sometimes forked (as in *Pipistrellus*)".

Weber[10] says about it: » . . Processus coracoideus ist stets lang und gebogen, bei den meisten Vespertilionidae aber gegabelt.«

To find out how the coracoid is in that respect I have examined the following species of the subfamily Vespertilioninae.

Myotis myotis Bechstein	5	specimens.
- *albescens* . . .	2	-
- *daubentonii* . .	2	-
- *nigricans* . . .	3	-
- *muricola* . . .	1	-
Pipistrellus annectens. .	1	-
- *abramus* . .	3	-
- *pipistrellus* .	7	-
Pterygistes noctula. . .	9	-
Eptesicus serotinus . .	5	-
Vespertilio pachypus . .	1	-

[8] According to Dobson's measurements.

[9] W. H. Flower, An introduction to the osteology of the Mammalia. London 1885. p. 253.

[10] M. Weber, Die Säugetiere. Jena 1904. p. 387.

In none of the examined specimens of the genus *Myotis* except *Myotis nigricans* does the coracoid show any mark of bifurcation.

As to the last-mentioned species the three individuals examined do not agree. In one of them, the dental formula of which is that of the genus *Pipistrellus* i. e. pm $\frac{2-2}{2-2}$ (vide infra), the coracoid resembles that of a *Pipistrellus* more than that of a *Myotis*, the distal end forming an angle with the proximal and longer part of the processus and thus showing a tendency to bifurcation; in the two others, the dental for-

Fig. 1.

Fig. 2.

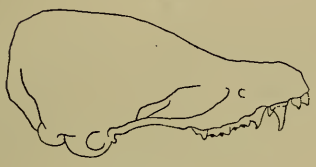

Fig. 3.

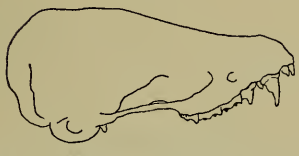

Fig. 4.

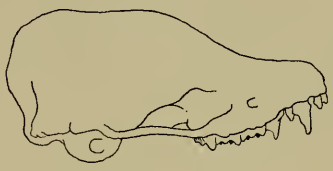

Fig. 1. *Myotis mystacinus.* × 3.
Fig. 2. *Pipistrellus annectens.* × 3.
Fig. 3. *Pipistrellus pipistrellus.* × 3.
Fig. 4. *Myotis nigricans.* × 3.

mula of which is typical, the tip of the coracoid has the same form as in the other species of *Myotis*.

In all the specimens of the genus *Pipistrellus* and the other forms which I have examined (*Vesperugo* and *Vesperus* Dobs.), with the exception of *Pipistrellus annectens*, the coracoid is slightly forked, more or less. In *P. annectens* the coracoid agrees completely with that of *Myotis*, bearing no resemblance at all to that of *Pipistrellus*.

It appears from the above that the species *Pipistrellus annectens* agrees with the genus *Myotis* in respect to the form of the skull, the shabe of the ear, tragus and muzzle, in the absence of a postcalcaneal lope, in the proportion between the length of the tibia and the length of head and body, and in the form of the coracoid.

It differs from *Myotis* in regard to the dental formula, which agrees with that of the genus *Pipistrellus*.

Thus in *P. annectens* we find characters of two genera combined viz. the dental system of *Pipistrellus* and in all other respects the characters of *Myotis*. Consequently a case of transition between forms referred to different genera.

In the Zootomical Institute I have had an opportunity to examine 11 bats, identified as *Myotis nigricans*, from different localities in South America: Surinam, Brazil, Argentine and Bolivia. Among those I found individuals in which the second premolar in the upper jaw (pm^3) gives an instance of individual variation, being more reduced in size and placed more internal to the tooth-row in one specimen than in the other.

Among those from Brazil I found a specimen — a female — which has pm $\frac{3-2}{3-3}$ i. e. the second upper premolar (pm^3) of the left side is lacking.

In the same species and from the same locality I found a specimen — a male — which has pm $\frac{2-2}{2-2}$ (vide fig. 4) i. e. the dental formula of the genus *Pipistrellus*. Between the two premolars there is an interspace.

Apart from the dentition it does not differ externally in any way from the other individuals of the same species; as to its external aspect it is as good a *Myotis* as any one of the others. The skull does not differ from that of a *Myotis*, being elevated above the face-line, and not broader or in any remarkable way shorter. The muzzle, the ear, the tragus bear no resemblance to those of a *Pipistrellus*. The tibiae present the same proportions as those of *Myotis* according to the above table. But — as said above — with respect to the coracoid it agrees better with *Pipistrellus* than with *Myotis*, the coracoid showing a tendency to bifurcation. Thus in this respect and with regard to the dental formula it differs from *Myotis* and agrees with *Pipistrellus*.

The individuals of this species which I have examined, consequently, show a gradual reduction of the second premolar, finally resulting in its total absence. And the last-mentioned individual of *Myotis nigricans* affords one more instance of transition between forms referred to different genera, at the same time indicating one way at least in which those forms originate.

A similar observation has been made by Allen, wo in a paper[11]

[11] G. M. Allen, Bulletin of the Museum of Comparative Zoölogy at Harvard College Vol. 52. No. 3. Cambridge, Mass., U. S. A. 1908. p. 45.

tells us of two specimens of *Myotis nigricans* from South America in which the second premolar is lacking. „In one specimen . . . from Lagoa Santa, Brazil, the second lower premolar of the left side is lacking, and the corresponding upper premolar is somewhat reduced in size. In . . . from Santa Marta, Colombia, the minute second premolar is lacking from the right maxillary row, and the first premolar stands nearly in the centre of the space between the third premolar and the canine." He also observed in individuals in his collection the tendency of the second premolar to be drawn inwards from the tooth-row in both jaws.

It may be added that in some specimens of *Myotis nigricans* a small postcalcaneal lobe is to be seen.

As I have pointed out above, the systematists have used the condition of the anterior premolars as a characteristic of many species of *Myotis* (cfr. Dobson l. c. p. 285). But the condition of the premolars, given by systematists as characteristic of the species, is not always found in individuals which on account of other features might be referred to it. I will here give one more instance of this individual variation.

In *Myotis muricola*, of which species I have examined 8 specimens from Borneo and Java, I found in 6 individuals the second upper premolar (pm^3) situated in the tooth-row or slightly internal to it and, though small in size, visible from the outside. In 2 specimens this tooth is rudimentary and probably non-functional: in one hardly penetrating the gums, being quite internal to the tooth-row in the upper jaw and not visible from the outside, partially drawn inwards in the lower jaw; in the other specimen the same tooth is quite internal to the tooth-row in both jaws and, besides, the reduction has proceeded one more step: the second premolar has not cut through the gums on the left side of the maxillar tooth-row. From this to its total disappearance it is only one step.

Such a condition of the lower second premolar as the last-mentioned one in *Myotis muricola* seems to occur very rarely. Dobson (l. c. p. 292) has found it only in one species, *Myotis hasseltii*, and writes as follows: „Although the second upper premolar is very small in every species of *Vespertilio* and in some quite internal, yet in no other species is the second lower premolar quite internal, placed in the angle between the closely approximated first and third premolars and not sufficiently large to fill that angle".

It may here be pointed out that, according to Dobson, *Myotis muricola* has a small variable postcalcaneal lobe. There are, however, individuals without such a lobe. In other external respects it does not bear any resemblance to the genus *Pipistrellus*, but is a typical *Myotis*.

Comparing *Myotis muricola* with other bats from the same locality I find no nearer ally — apart from the dental formula — than the aforementioned *Pipistrellus annectens*. As said above the latter is from Sumatra, and according to Dobson's note at the bottom of page 316 also *Myotis muricola* has been found in the same locality.

The measures seem to vary in both species. Dobson states that in *Myotis muricola* the length of head and body is 1,75 inches (44 mm) and that of the forearm 1,35 inches (33 mm). In the examples of this Institute the length of head and body varies from 38 to 42 mm, and that of the forearm is 35 or 36 mm.

And Matschie[12] says: »Man kann also annehmen, daß die *muricola* der *Halmahera*-Gruppe, wenn sie ausgewachsen sind, eine Unterarmlänge von 37—38 mm besitzen.«

Pipistrellus annectens seems to be represented by two forms: a large continental one described by Dobson and a small one from the island of Sumatra, of which latter form the collection of the Zootomical Institute has three examples. And there are perhaps transition forms, though, so far as I know, they have not been recorded in the litterature.

In *Myotis myotis* Bechstein, of which species I have examined 7 specimens, I found that in some specimens the second upper premolar is situated in the tooth-row, in others it is placed inside the tooth-row and more or less distinctly visible from without.

Instances of individual variation are to be found in several genera and species of bats.

Leche[13] mentions various bats in which the tendency to lose the above-mentioned and other teeth is stated. He speaks of the reduction of the first upper premolar in most species of the genus *Pipistrellus* (*Vesperugo*) which reduction may in single individuals result in the nonfunction or total absence of this tooth. He mentions an intermediate bat between the genera *Pipistrellus* (*Vesperugo*) and *Eptesicus* (*Vesperus*), viz. a specimen of *Pipistrellus maurus*, in which the first upper premolar is rudimentary, having hardly cut through the gums.

In 3 specimens of *P. maurus* which I have examined the first upper premolar is rather well developed and visible from outside.

As to *Pipistrellus kuhlii* and *Pipistrellus pipistrellus* I have examined 3 skulls and 8 specimens in alcohol of the former and found that in 1 example the first upper premolar is rather well developed and visible

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[12] P. Matschie, Die Säugetiere der von W. Kükenthal auf Halmahera, Batjan und Nord-Celebes gemachten Ausbeute. Abhandlungen d. Senckenberg. Naturforsch. Gesellschaft XXV. 1901. p. 275.

[13] W. Leche, Studier öfver mjölkdentitionen och tändernes homologier hos Chiroptera. Lunds Universitets Årsskrift. Tome XII. 1875. p. 34.

from the outside, standing in an interspace between the second premolar and the canine. In the other 10 examples the first upper premolar is very small, situated inside the tooth-row, the second premolar and the canine being closely approximated.

In *P. pipistrellus* I found individuals in which the first upper premolar is standing in the tooth-row and most likely functional, and others in which it is drawn inside the tooth-row and thus not distinguishable from the outside.

The above-mentioned facts put it beyond a doubt as regards the teeth

1) that there exists among various species of the genus *Myotis* an individual variation in respect to the second premolar,

2) that within each of the afore-said species a gradual reduction of the second upper and lower premolars is going on,

3) that the final result of this reduction may be the rudimentary condition or even the absence of the second premolar in both jaws,

4) that in that way intermediate forms originate, having the dental formula of the genus *Pipistrellus* and the external characters of the genus *Myotis*.

5) that there exist other bats (*Pipistrellus annectens*) in which characters of the genus *Pipistrellus* are in the same way associated with characters of the genus *Myotis*, though of course, I do not venture to give an opinion as to the way in which this form has originated,

6) that in the genus *Pipistrellus* an individual variation of the first upper premolar has been observed,

7) that, according to Leche[14], in the genus *Pipistrellus* the first upper premolar may be quite rudimentary or in some species even lacking and that intermediate forms thus originate between the genus *Pipistrellus* and genera with the dental formula pm $\frac{1—1}{2—2}$.

As regards the coracoid, judging from my own observations and the facts given by the above-mentioned authors, it also seems established

1) that a bifurcation of the coracoid is constant in the genus *Pipistrellus* except in one species,

2) that the coracoid does not show any sign of bifurcation in the genus *Myotis* except in one individual of the species *Myotis nigricans*,

3) that in *Pipistrellus annectens* the coracoid agrees completely with that of *Myotis*, showing no mark of bifurcation, which fact furnishes an additional proof of its close alliance to the genus *Myotis*,

4) that in the individual of the species *Myotis nigricans* which has

[14] l. c. 1875.

the dental formula of *Pipistrellus* the coracoid agrees better with that of *Pipistrellus* than with that of *Myotis*. This specimen thus has one more character common with *Pipistrellus*, to which genus it might be referred with as good or as bad reason as *Pipistrellus annectens*.

As regards the length of the tibia compared with the length of head and body the above table shows

1) that the tibia of the genus *Myotis* is longer than that of the genus *Pipistrellus* except in one species,

2) that the tibia of the larger form of *Pipistrellus annectens* agrees with that of *Myotis* and that the smaller form has a longer tibia than anyone of the other examined specimens of the genus *Pipistrellus*.

Though the above instances are perhaps too few in number to allow of a decisive conclusion, they seem to me to justify the opinion that they point out one way at least in which several species of now living bats are undergoing modification.

Considering the afore-said individual variability of the premolars especially of the second one, it seems probable that the loss of this tooth will be in some way beneficial to bats belonging to the genus *Myotis* under their conditions of life, as the loss of other non-functional organs must be favourable to the individual. And this change of the dental system, if it is of use, may be affected by the natural selection, and new genera and new species might originate.

8. Studien über die in Italien vorkommenden Wieselarten der Untergattung Arctogale.

Von Filippo Cavazza.

(Aus dem Kgl. zool. Institut der Universität Bologna.)

(Mit 8 Figuren.)

eingeg. 16. April 1909.

I. Einleitung.

Es ist bekannt, wie in der systematischen Zoologie noch immer zwei Tendenzen sich gegenseitig bekämpfen: die eine erhöht die Anzahl der Arten, Unterarten und Varietäten der Tiere auf Grund von Merkmalen, die oft ohne irgendwelche Wichtigkeit sind, und bedient sich ohne Maß der dreiteiligen Nomenclatur; die andre, welche von einer gesunden Kritik geleitet wird, sucht die Bedeutung der specifischen Merkmale festzustellen, während sie die individuellen oder durch besondere Umgebungsverhältnisse bedingten aussondert.

Von den europäischen Säugetieren hat sich die erste Tendenz bei der Gattung *Putorius* besonders breit gemacht, und zwar ist dies in be-