

NOTES ON THE VAMPIRE BAT (*DIPHYLLA ECAUDATA*),
WITH SPECIAL REFERENCE TO ITS RELATIONSHIPS
WITH *DESMODUS RUFUS*.

By HARRISON ALLEN, M. D.

I HAVE had the privilege of studying two specimens of *Diphylla ecaudata*¹ belonging to the National Museum (No. $\frac{9140}{9970}$, from Sta. Efigenia, Tehuantepec, Mexico, and No. 6990, from Orizaba, Mexico), both collected by F. Sumichrast. The dried skins contained fragments of skulls in which the teeth were preserved. Upon a casual examination I was struck with the fact that the coloration was different from that given by Dobson in his catalogue of the Chiroptera of the British Museum, and that four incisors instead of two were present in the upper jaw. Since Dobson states that the muzzle and ears in *Diphylla* are as in *Desmodus*, and that the skull is very similar to that of *D. rufus*, I was not prepared to find marked contrasts when I came to compare *Diphylla* with that genus. I also noted that the original description of Spix gave an account in some respects more in harmony with the Mexican individuals than was Dobson's, and I received the impression that either the single specimen on which Dobson's account was based was not a specimen of *Diphylla*, or that the condition of the specimen did not permit of a critical comparison being made.

The text of Spix is herewith given, since the work in which it appeared² is rare and can not be readily consulted by the student.

DIPHYLLA, Spix.

Naso bifoliato; cauda et membrana interfemorali nullis. Descriptio: Corpus mediocre; caput breve, apice subobtusum; auriculae oblongo-rotundatae, perbreves, quasi truncatae, basin versus omnino deficientes; tragus lanceolatus, integer, haud reconditus; vexilla duo supra nasum juxta seposita, quasi truncata, ad latera non prolongata perbrevia, praecipue posterius; dentes canini supra infraque duo, vix

¹SPIX, Simiar. et Vespert. Brasil., p. 68, pl. XXXVI, fig. 7, 1823.—WAGNER, Schreb. Säugethier, Suppl. V, p. 615, 1855.—DOBSON, Cat. Chir. Brit. Mus., 1878, p. 550.—ALSTON, Biol. Centrali-Americana, 1879-1882, p. 1853, pl. III, fig. 6.

²Simiarum et Vespertilionum Brasiliensium Species Novae, 1823-1863, p. 68, pl. XXXVI, fig. 7.

exserti; incisivi supra infraque quatuor, superiores medi lateralibus postpositi, maiores, apice sexdentati, semicirculariter collocati, largi, caninis contigui; molares supra infraque octo, breves apice crenulati, inferiores a caninis distantes, lingua subverrucosa, apice nonnihil lata et obtusa; labia non verrucosa, fere uti in Molosso pilosa; membrana alaris angustata, lumbis aduata, versus apicem digitorum valde elongata, tenuis, recurva, versus tibiæ basin excavato-decurrens: pollex manus solummodo unguiculatus, cum radio et digito indice membrana vix ulla conjunctus; pedes posteriores radium brachii fere æquantes, membrana interfemoralis deficiente omnino liberi; planta pedis longior; digiti pedis posterioris omnes unguiculati; calcaneus extus vix conspicuus; cauda nulla.

DIPHYLLA ECAUDATA.

Corpore villosopiloso; dorso fusco-brunneo; capite et abdomine subtus brunneo-canescens; alis nigricantibus, nudiusculis; facie versus aures villosopilosa, nudiuscula; cauda et membrana interfemorali nullis; calcaneo extus vix conspicuo.

Longitudo trunci a nasi apice usque ad caudæ innitum 3'', capitis $\frac{3}{4}$ '', humeri $\frac{5}{8}$ '', radii $1\frac{3}{4}$ '', pollicis 5'', digiti indicis $1''\frac{4}{8}$ '', medii $2\frac{3}{8}$ '', minimi $2''\frac{1}{8}$ '', femoris $\frac{3}{4}$ '', tibiæ 7'', plantæ 8'', auricularum 3'', tragi $\frac{3}{4}$ ''; latitudo occipitis ultra $\frac{1}{2}$ '', auricularum $4\frac{1}{4}$ '', interseapulas $1\frac{1}{2}$ '', alarum extensarum $10\frac{1}{4}$ ''.

There is a slight lack of harmony between the figure and the description. The calcaneum is said to be present (vix conspicuus), while it is not visible at all in the figure.¹

The molars are erroneously given, since four are counted on each side of both upper and lower jaws. One fails to understand how the exceedingly minute lateral incisor was detected when the larger teeth making up the premolar and molar series were miscounted.

The coloration given by Dobson—"above, reddish brown; below, yellowish white"—is unlike that of the National Museum specimens. The language of Spix, however, agrees so far as I translate the phrases "dorsus fuscus-brunneo, subtus brunneo-canescens" (back, clear brown to obscure brown; below, obscure brown gray and white)—as we would say, "hoary brown".

It is difficult to account, except on the ground that this specimen was immature, for the description of Wagner. According to this writer, *Diphylla* possesses six incisors in the upper jaw, only two molars (premolars and molars?) in the upper and three in the lower jaw. The interfemoral membrane is absent. Above, the hair is red brown and unicolored; below, of a dirty yellowish white, the hairs being brown at their bases. The account would be quite unrecognizable were the characteristic pectination of the lower incisors not given, a peculiarity, indeed, which creates for the species the name of "Der Kammzahn."

E. R. Alston states that *Diphylla* is distinguished from *Desmodus*

¹Spix's name *Diphylla* is defined in the first words of his description "naso bifoliata." The nose may be said to be bifoliate in *Diphylla*, *Desmodus*, *Brachyphylla*, *Mormops*, *Chilonycteris* and *Natalus*. The posterior "leaf" appears to be a glandular mass, the sides of which are constant in all the Phyllostomidae. In the usual forms (naso monofoliata) the lance-shaped appendage to the muzzle appears to take the place of the posterior "leaf."

by possessing a shorter calcaneum;¹ by the breadth of the lower incisors; by the fur being reddish-brown above and yellowish white beneath. The figure he presents is a copy of the specimen in the Berlin Museum, and is based on an original drawing made under the supervision of Peters. The specimen would appear to have been a dried skin. The tragus is not erect, but deflected in a manner not described by any writer. The chinplate is very large. The muzzle is concave both at the sides and at the upper margin. The transverse ridge across the face vertex is as thick in the center as at the sides, thus differing from Dobson's description. The auricle is hairy on the interior.

The standard for comparison accepted by Dobson is a correct one. There is no form with which *Diphylla* can be compared so profitably as *Desmodus*. On page 775 I have grouped a number of cranial characters which the genera have in common. To these many others in the skeleton and the superficial parts may be added, a partial list of which is here given:

Plan of elbow joint the same, viz., a simple middle convexity playing on two external flanges; epitrochlea transverse, massive. A calcaneum (without calcar) constituting the projection at ankle for the attachment of the interfemoral membrane; a lower lip more or less cleft in the middle line;² absence of the tail; the small size of the second interdigital space; the greatly shortened face axis, and teeth specialized for cutting and piercing.

I have thought it desirable to revise the description of *Diphylla* by the aid of the two dried specimens already noted. The following is an account of the fur: The tips of the hair covering the back and sides of the neck, of a dark fawn, the shafts nearly white. The effect on the eye is of the mingling of the white and dark fawn colors. It is distinct from that of the hair over the back, where the tips are dark brown, and, while the shafts are white, they are not seen, owing to the adpressed arrangement of the hair. Toward the rump the hair is more woolly. The arm and forearm are closely furred almost to the wrist. A fine growth of hair covers the thumb. The thigh, leg and foot are also hairy, but the fur is here woolly and sparse. The skin to the outer side of the leg, the hem and margin of the endopatagium (wing membrane from body and posterior extremity to the fifth digit) is hairy.

The prevalent color of the under surface of the body is gray. The white color on the hair is confined to the base. The wing membranes are covered, by a broad triangular field of gray hair, whose base is at the side of the body and whose apex reaches to within an inch of the

¹ In three specimens of *Desmodus* studied, the calcaneum was found shorter than in *Diphylla*. Indeed, in *Desmodus* the calcaneum is a mere tubercle, scarcely measurable, while in *Diphylla* it constitutes a rod 4 millimeters long.

² This assertion is made advisedly, notwithstanding the statement of Dobson that the lower lip is "not grooved," and the figure of Peters (vide Alston) in which a very large individual truncate labial plate is seen. Unfortunately the plate is not represented as divided in figure 1.

wrist. The anterior surfaces of the inferior extremities are covered with woolly gray hair as far as the ankles.

The face is nearly naked, but a conspicuous pencil of hair occupies the space between the eye and the nose leaf.

The description of the fur by Dobson is as follows: "Fur above, reddish brown; beneath, yellowish white, darker at the base of the hairs." The inadequateness of this description when compared with the above account is evident. In the National Museum specimens, the base of the hair is everywhere white, and the hair of the crown and back of the neck is for the greater part of its length pure white. The shades of brown are nowhere to be interpreted as reddish brown.

The general scheme of fur distribution is of interest. As a whole, the genus is more hirsute than *Desmodus*. The hairiness of the thumb and back of the foot, and the extension of hair on the endopatagium, are unusual characters. The appropriation of hair by the wing membrane to the outer side of the leg is also unusual. In *Artibeus* I have

noted how the skin in the region of the fibular side of the leg is differentiated from the rest of the wing membrane. In *Diphylla* this tendency is carried to a yet higher degree—the region named being covered with hair. The separation of the fur of head and neck from that of the trunk is as conspicuous in *Diphylla* as elsewhere in

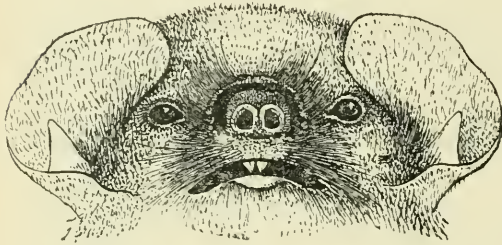


Fig. 1.

DIPHYLLA ECAUDATA.

Front view of face and head. Twice natural size.

the order. The great length and richness of the fur on the side of the neck (extending as far as the shoulder) is remarkable.

The muzzle is flat and square, without excavations or incisions on the upper border, and is not separated inferiorly from the lip. Continuous with the lower outer angle is a ridge leading to the great crescentic gland-mass, constituting a coarsely setose ridge. The space directly back of the muzzle is occupied in one specimen (No. 6990, U. S. N. M.) by slight extension from the right side of the gland-mass. The left side is without such occupation. In the other specimen (No. 9440, U. S. N. M.) the space is filled with a minute elevated mass of glands, which extends across and unites the two great crescentic gland-masses. Dobson states that "a raised (?) glandular ridge forms a semicircle between and behind the eyes, somewhat broader on the sides, but not thickened in the center." This "center" answers to the transverse ridge back of the muzzle in specimen No. 9440, U. S. N. M., and which is seen to be imperfect in No. 6990, U. S. N. M. Alston figures the head with this transverse crest well developed.

The lower lip, as already mentioned, does not present a square-sided naked surface but is indistinctly cleft. See figure in Alston's account.¹

Auricle subrounded, entire, with obscurely developed, internal basal and external basal lobes. Tragus erect, broad, naked, abruptly acuminate, thickened on surface near apex. The outer border not spinose or crenulate; external basal lobe small, external basal notch shallow.

The membranes do not present any noteworthy features. The radius exhibits a humeral trochlea which is much deeper than in *Desmodus*. The ulna ends at the distal end of the middle third of the radius by anchylosis with that bone, but no flange extends its line toward the wrist as is the case with *Desmodus*. The radius is articulate with the humerus by a surface which is concave in the middle and convex on the borders. The distal end of the humerus exhibits anteriorly a rounded convexity in the middle and concave borders; the epicondyle is of great size (equal to two-thirds of the articular surface), and projects horizontally.

The interfemoral membrane is rudimental and is confined to a mere hem on the inside of the thigh and leg. In *Desmodus* the membrane extends across the interfemoral space as an apron, 12 mm. wide. These contrasts lead me to conclude that the two genera exhibit peculiarities in wing movements which correlate with wing characters, but the material at hand is insufficient to establish them. The following contrasts with *Desmodus* are tabulated:

COMPARISON OF THE CHARACTERS OF DIPHYLLA AND DESMODOUS.

<i>Diphylla.</i>	<i>Desmodus.</i>
Humeral trochlea deep.	Humeral trochlea shallow.
Radius without ridge distal to ulna.	Radius with ridge distal to ulna.
Prebrachium membrane extends to wrist.	Prebrachium membrane extends to middle of radius.
Interfemoral membrane confined to inferior extremities as a hem.	Interfemoral membrane crosses space between inferior extremities.
Gland-masses at sides of muzzle scarcely meet across face-vertex or not at all.	Gland-masses at sides of muzzle meet across face-vertex in a high subconical skin fold.
Tragus naked.	Tragus hairy.
One-third length of thumb occupied by the metacarpal bone, whose base does not retain a conical callosity.	One-half the length of thumb occupied by the metacarpal bone, whose base retains a conical callosity.

$$\text{Dental formula.}—i \frac{4}{4} c \frac{1}{1} p \frac{2}{3} m \frac{1}{1} \times 2 = 34.$$

Upper teeth.—The enormous central incisors larger than the canines. They are trenchant, opposed for the one-third their length, the lanceolate points being distinct. The posterior concave surfaces are almost contiguous to the canines. The very minute nodular lateral incisors lie to the inside of the canines. The premolars compressed with knife-like edges, obscurely pointed—the first with a simple, the second with

¹ Biol. Centrali-Americana, 1879-1882, p. 53, pl. III, fig. 6.

a wavy contour suggesting the presence of a trilobed cutting edge. The single molar is a minute conoid nodule.

Lower teeth.—The incisors large, pectinate, the central twice the size of the lateral. The centrals are apparently with scarcely any alveolæ, being seen in their entire length in the pit back of the mentum,



Fig. 2.

SKULLS OF DIPHYLLA AND DESMODUS.

Anterior portion of skull of (a) *Diphylla caudata* and (b) *Desmodus rufus*; viewed from above. More than twice natural size.

while but little of the socket-wall is visible from in front. The canines exhibit small heels, which give at first sight the impression that an interval exists between the canines and the first premolars, but close inspection shows that the teeth are contiguous. The premolars compressed laterally with sharp knife-like edges; first premolar twice the

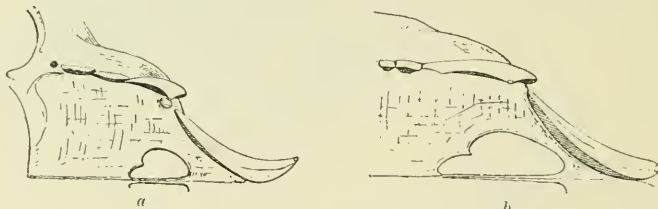


Fig. 3.

PALATES OF DIPHYLLA AND DESMODUS.

Hard palate and teeth of upper jaw of (a) *Diphylla caudata* and (b) *Desmodus rufus*; viewed from below. Five times natural size.

size of the second, and the third more than twice the size of the first. Thus the four teeth are alternated in size, the first being larger than the second, the third larger than the fourth. The third premolar is obscurely trilobed; the others are simple.

Palatal rugæ six.



Fig. 4.

LOWER JAWS OF DIPHYLLA AND DESMODUS.

Horizontal ramus of lower jaw and teeth of (a) *Diphylla caudata* and (b) *Desmodus rufus*; viewed from above. Six times natural size.

Skull.—Neither of the skulls of the specimens examined were complete; one, indeed, was in fragments. The following notes have been made in comparison with the skull of *Desmodus*. It will be seen that the statement of Dobson that the skull of *Diphylla* resembles *Desmodus* is not sustained.

COMPARISON OF THE CHARACTERS OF THE SKULLS OF *DIPHYLLA* AND *DESMODUS*.*Diphylla*.

Anterior nasal aperture as high as wide.

Distance between anterior ends of the pretemporal crests equal to length of the convex face-vertex.

Nasal bones marked at the side by a vessel groove.

The pretemporal crests do not unite to form sagitta.

The incisive foramina one-fourth the length of the flat hard palate, which is scarcely narrowed posteriorly.

The skull subrounded.

The margin of the palate bone beyond hard palate with spine.

The fronto-maxillary inflation conspicuous, the entire orbital margin swollen.

The infraorbital canal simple and opening on the face immediately at orbital rim.

The zygoma narrow, scarcely high in middle; arch well sprung from the side of the head.

Coronoid process greatly inclined backward, much higher than condyloid process.

Length of sigmoid notch scarcely exceeding distance from condyloid process to the angle.

Masseteric impression on lower jaw extends to the free margin of the mandible.

The symphyseal suture of the lower jaw closed.

Within cranium, ethmoid region and body of sphenoid flat.

Inner wall of orbit uniformly concave.

Desmodus.

Anterior nasal aperture higher than wide.

Distance between anterior ends of the pretemporal crests greater than that of the length of the concave face-vertex.

Nasal bones without groove, but with four foramina at naso-frontal suture.

The pretemporal crests unite to form a small sagitta.

The incisive foramina over one-third the length of the acutely vaulted hard palate, which is narrowed posteriorly.

The skull subpyramidal.

The margin of the palate bone beyond hard palate without spine.

The fronto-maxillary inflation inconspicuous.

The infraorbital canal double and opening a distance beyond the orbital rim in a depression caused by a thickening of the alveolar border.

The zygoma wide, conspicuously high at the middle; arch scarcely at all sprung from the head.

Coronoid process almost vertical, almost on level with condyloid process.

Length of sigmoid notch twice the distance between the condyloid process and the angle.

Masseteric impression does not reach the lower margin of the mandible.

Symphyseal suture of lower jaw open.

Within cranium, ethmoid region and body of sphenoid greatly elevated.

Inner wall of orbit convex over region of ethmoid bone.

The face axis in the two forms being of the same length, and the ethmoid being wider and deeper in *Desmodus*, while the nasals and naso-maxillary inflations are larger in *Diphylla*, gives the impression that the uses of the nasal chambers must differ in the two forms.

Measurements of skulls of Diphylla and Desmodus.

Measurements.	<i>Diphylla</i>	<i>Desmodus</i>
	No. 6990. U. S. N. M.	No. 13202. U. S. N. M.
	mm.	mm.
Greatest length.....	23	12
Greatest width.....	11	6
Least width.....	8	4
Length of face from orbit.....	3	3
Length of nasal bones.....	4	3
Length of palate.....	6	9
Width of mesopterygoid fossa posteriorly.....	4	3
Length of lower jaw.....	14	15
Distance from tip of coronoid to the basal line of ramus.....	4	7
Intergonial distance.....	10	9

After this rather striking contrast, it is of interest to note the following points which the two genera possess in common, showing a close alliance between them.

Interval between the maxillary canines occupied by the enormous central incisors. Length of central incisors equal to height of anterior nasal aperture. Pterygoid process produced posteriorly in a sharp



Fig. 5.

LOWER JAW OF DIPHYLLO AND DESMODUS.

Ascending ramus of lower jaw of (a) *Diphylla ecaudata* and (b) *Desmodus rufus*; viewed from side. Four times natural size.

spine. Tympanic bones inflated, large, nearly of same size, firmly ankylosed to the temporal bone; the opening for membrane small. Mesopterygoid fossa narrowed anteriorly and progressively widened posteriorly. Ascending ramus of the lower jaw high, with shallow sigmoid notch and rudimental angular process. The lower jaw back of

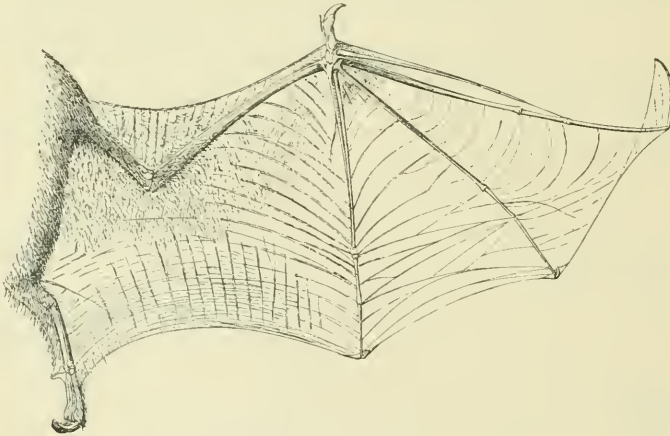


Fig. 6.

WING MEMBRANE OF DIPHYLLO ECAUDATA.

Anterior view. One-half natural size.

mentum provided with deep pit in which during articulation the maxillary central incisors are received. All teeth sectorial; lower incisors and canines pass well in front of upper incisors in closure of jaws.

Diphylla is more generalized than *Desmodus*. The face axis is longer, the nasal chambers more ample, the maxillary incisors and canines weaker, while the teeth are less reduced in number.

Diphylla is, on the whole, a less specially adapted form than *Desmodus*. The proportion of first metacarpal bone and phalanges are as is the

order, while in *Desmodus* the metacarpal is nearly as long as the phalanges and furnished with a tactile pad at base; a similar but smaller pad is seen on the foot. The teeth in *Diphylla* are more numerous than in *Desmodus*, but are less powerful. The projection of the lower jaw beyond the upper is less marked in *Diphylla*. The claws, on the other hand, are more curved and prehensile than in that genus. It is correct to assume that in *Diphylla* the thumb and foot are employed in a manner like the rest of the order, but that in *Desmodus* the use to which the parts are put is distinctive; and further, that *Diphylla*, while known to take blood from animals, can make but a weak attack as compared to *Desmodus*. This is due not only to the smaller teeth, but to the lower jaw being less protruding and the animal not being able to breathe therefore so freely when feeding as is the case with *Desmodus*.

In the phylum of the Chiroptera, *Diphylla* and *Desmodus* are on a branch of the Stenodermata, *Diphylla* being near the base of the branch, while *Desmodus* arises from near the free end.

While these pages were going through the press, I wrote to Dr. Paul Matschie of the Königliche Museum für Naturkunde, Berlin, requesting that he examine the specimen of *Diphylla* in that institution, especially as to the number of the upper incisors. He courteously responded, and I am glad to reaffirm the accuracy of the description and enumeration as given by Dobson. Under all the circumstances *Diphylla* is correctly described by Spix (with the exception of the number of the molars), and therefore the Berlin form is either anomalous as to the number of the upper incisors or is a type of a separate genus. It is most likely the former. I have in my possession a specimen of *Chilonycteris macleayi* which has but two incisors in the upper jaw. If, however, comparisons should not sustain this reference, the name *Hematonycteris* may be assigned the form described by Dobson.

Dimensions of two specimens of Diphylla caudata.

Measurements.	Cat. No.	Cat. No.
	U. S. N. M. 6990.	U. S. N. M. 9440.
Length of head.....	18	18
Head and body (from crown of head to base of tail).....	75	75
Length of forearm.....	55	50
First digit:		
Length of first metacarpal bone.....	4	4
Length of phalanges.....	9	9
Second digit:		
Length of second metacarpal bone.....	45	45
Length of first phalanx.....	7	6
Third digit:		
Length of third metacarpal bone.....	51	50
Length of first phalanx.....	11	12
Length of second phalanx.....	29	25
Length of third phalanx.....	15	18
Fourth digit:		
Length of fourth metacarpal bone.....	51	50
Length of first phalanx.....	10	10
Length of second phalanx.....	22	20
Fifth digit:		
Length of fifth metacarpal bone.....	51	50
Length of first phalanx.....	12	13
Length of second phalanx.....	17	15
Length of third phalanx.....	13	
Height of ear.....	5	
Height of tragus.....	15	15
Length of thigh.....	20	20
Length of tibia.....	14	15
Length of foot.....		