

Anna ROMANKOWOWA¹⁾**The Sesamoid Bones of the Autopodia of Bats****Trzeczki odcinka wolnego (autopodium) kończyn nietoperzy**

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I. INTRODUCTION

There is a marked lack in literature of comparative research on the sesamoid bones in bats. Macalister (1872) merely mentions the sesamoid bones in his research on the muscular system of the bat, without, however, giving a fuller description of their shape or their precise names. Comparative investigations have been made of the „accessorium” — the cartilage in the plagiopatagium, situated parallel to the final phalange of the 5th digit (Törne, 1913). The problem of the sesamoid bones is also connected with

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that of the occurrence in bats of the *os pisiforme*. Leboucq (1899), Schmidt-Ehrenberg (1942), Greene (1951) consider that the *os pisiforme* occurs in this group of animals — that it has only altered its position from the boundary between carpus and metacarpus to the volar side of the hand. Holmgren (1952) considers that this bone corresponds to the sesamoid bone of the ulnar carpal ball.

The aim of the investigations described in this work was to make a comparative review of sesamoid bones in the bat, and to attempt to identify them.

II. MATERIAL AND METHODS

I obtained the bats for these investigations from Dr. Kazimierz Kowalski, Natalia Skinder, M. Sc., Professor Dr. Kazimierz Szarski and Bronisław Wołoszyn, to all of whom I must here express my sincere thanks for making this material available.

The following were examined: 10 *Rhinolophus hipposideros* (Bechstein 1800) — *Rhinolophidae*; 5 specimens of *Plecotus auritus* (Linnaeus 1758), 1 *Barbastella barbastellus* (Schreber 1774), 12 *Myotis myotis* (Borkhausen 1779), 1 *Myotis dasycneme* (Boie 1825) and 1 *Myotis daubentoni* (Kuhl 1819) — *Vespertilionidae*. Preparations of the autopodia of fore and hind limbs were made from a total of 30 individuals.

The chief method used in the work was preparation under a dissecting microscope. For dissection or demonstration of skeletal elements specimens were cleared by Mall's method and stained in alizarin.

A list of the categories of sesamoid bones found in the material examined is given below:

os falciforme
ossa sesamoidea carpometacarpalia volaria
ossa sesamoidea metacarpophalangealia volaria
cartilago accessorium plagiopatagii
os sesamoideum musculi flexoris carpi ulnaris
os sesamoideum musculi extensoris carpi radialis brevis
os sesamoideum musculi extensoris carpi radialis longi
os sesamoideum musculi extensoris indicis
os sesamoideum musculi extensoris pollicis
calcaneus
calcar calcanei
os sesamoideum tarsi praeaxiale
os sesamoideum tarsometatarseum plantare
ossa sesamoidea metatarsophalangealia plantaria
os sesamoideum tarsi dorsale

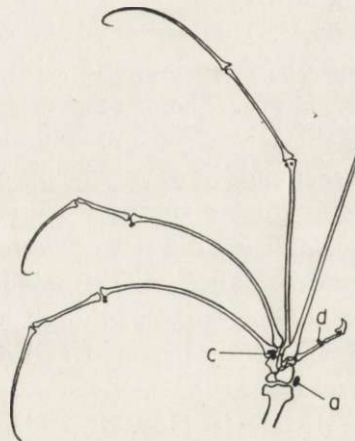
III. DESCRIPTION OF THE MATERIAL EXAMINED

In describing the various species, I have omitted the calcaneus, which occurs in the whole of the material examined. The letters after the names of the sesamoid bones refer to the corresponding bone elements shown in the illustrations.

1. *Rhinolophus hipposideros* (Bechstein 1800) — Fig. 1.

H a n d: *Os falciforme* (a) on the radial surface of the radiale is relatively large, oval. This sesamoid bone is connected by wide ligaments with: the base of metacarpale II, with the *os sesamoideum carpometacarpalis volaris*, and with the radius. In addition the terminal insertion *m. abductoris pollicis* is situated on this bone. *Os sesamoideum metacarpophalangealis volaris* (c) is clavate, has articular surfaces with the base of metacarpale V. *M. interosseus V* runs from this *os sesamoideum*, a wide ligament connects this bone on one side with the base of the V metacarpale, and on the other

Fig. 1. Skeleton of the right hand of *Rhinolophus hipposideros* from volar side.



with the *os falciforme*. The *ossa sesamoidea metacarpophalangealia volaria* (d) in the thumb are elongated, and in digits III—V are small, discoid, while they did not occur in digit II. The *os sesamoideum musculi extensoris pollicis* is situated in the tendon *m. extensoris pollicis* at the level of the base of metacarpale I, is narrow, elongated, narrowing evenly towards the tip.

F o o t: The *calcar calcanei* is cartilaginous, elongated, articulated with calcaneus. The *ossa sesamoidea metatarsophalangealia* are slightly elongated, paired, and situated in digits I—V. The *os sesamoideum tarsi dorsale* is at the level of the astragalus, and above it runs the tendon of the muscle extending the toe.

2. *Plecotus auritus* (Linnaeus 1758)

H a n d: *Os falciforme* (a) is flat, occupies the radial surface of the radiale — the articular surface of this bone is strongly convex; this *os sesamoideum* is connected by ligaments with the *os sesamoideum carpometacarpale volare* and with the radius. The terminal insertion *m. abductoris pollicis* is situated on this bone. The *os sesamoideum carpometacarpale volare* is massive, set transversely to the long axis of the hand, and as a result its articular surfaces coincide with the carpale distale I, II, III and IV + V. On the terminal surface of this bone there are two nodules: on the ulnar nodule there is the terminal insertion *m. flexoris carpi ulnaris*, and from the ulnar and radial nodule spring the initial insertions 2 *mm. interossei V*. This sesamoid is connected by a massive ligament with the *os falciforme*, and with the ulnar surface of the base of metacarpale V. The *ossa sesamoidea metacarpophalangealia volaria* are the largest, are massive and elongated in the thumb, the ulnar sesamoid, however, being even more strongly formed. In the remaining fingers the *ossa sesamoidea* belonging to this category are discoid. They did not occur in digit II. The *os sesamoideum musculi extensoris pollicis* is situated at the level of the trochlea of the nearest phalange of the thumb in the tendon *m. extensoris pollicis*. This sesamoid is elongated and drop-shaped. The *os sesamoideum musculi extensoris carpi radialis brevis* is situated at the level of carpale distale II, is small, and built into the tendon *m. extensoris carpi radialis brevis*.

F o o t: The *calcar calcanei* is elongated, has its articular surface with the calcaneus. The *os sesamoideum tarsi praeaxiale* is set at right angles to the tibial edge of the foot. It has its articular surface with the naviculare, and tarsale distale I. From this sesamoid a tendinous band including the tendons of the muscles flexing the foot passes in the direction of the skin on to the plantar surface of the foot. The *ossa sesamoidea tarsometatarsalia plantaria* number from 1—2, are very small, built either into the *m. interosseus V*, or into *m. quadratus plantae*. The *ossa sesamoidea metatarsophalangealia* are paired, elongated, most strongly developed at digit I. *Os sesamoideum tarsi dorsale* is set above the astragalus, is built into the base of the retinaculum surrounding *m. extensor pollicis longus*.

3. *Barbastella barbastellus* (Schreber 1774) — Figs. 2, 3.

Hand: *Os falciforme* (a) is flattened on the side of the radial surface, convex on the side of the ulnar surface, which at the same time is the articular surface with the radiale. The following ligaments run from this sesamoid to: the radius, the base of metacarpale II and to the *os sesamoideum carpometacarpale volaris*. On the *os falciforme* there is the terminal insertion *m. abductoris pollicis*. *Os sesamoideum carpometacarpale volare* (c) is elongated, has its articular surface with metacarpale II and V. On this bone there is the terminal insertion *m. flexoris carpi ulnaris*, and initial insertion of *m. interossei V*. In addition a wide ligament connects this bone with the *os falciforme*. The *ossa sesamoidea metacarpophalan-*

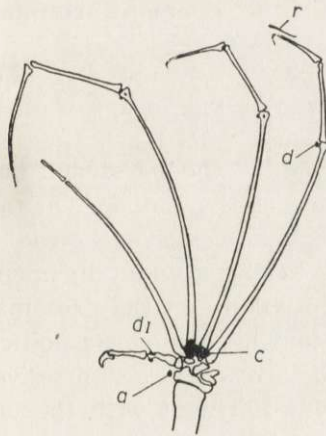


Fig. 2. Skeleton of left hand of *Barbastella barbastellus* from volar side.

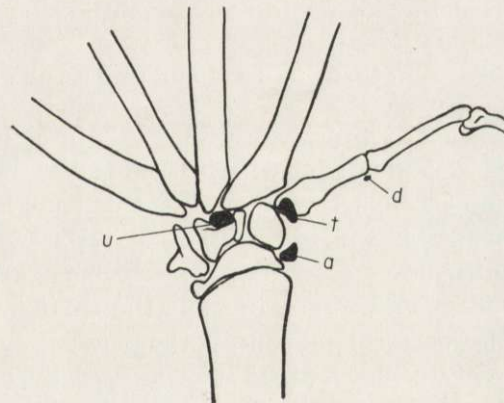


Fig. 3. Skeleton of the hand of *Barbastella barbastellus* from dorsal side.

gealia volaria (d) occurred in the I, III, IV and V digits. The *ossa sesamoidea* in the thumb are massive, elongated, and in the remaining fingers are flattened, discoid. These sesamoids are built into the *mm. interossei*. Additionally in the wall of the metacarpophalangeal bursa of the thumb there is a further small sesamoid on the side of the radial surface. On the dorsal side of the hand the *os sesamoideum musculi extensoris indicis* (t) occurs near carpale distale I in the tendon *m. extensoris indicis proprii*, and *os sesamoideum musculi extensoris carpi radialis brevis* (u) near carpale distale

II in the tendon *m. extensoris carpi radialis brevis*. The *cartilago accessorium plagiopatagii* (r) is osseous only in the central part, the rest of this element being cartilaginous, elongated, and attaining twice the length of the final phalange of digit V.

Foot: *Os sesamoideum tarsi praeaxiale* is flattened, piriform, the proximal end of this bone articulates with the naviculare and with tarsale distale I, the distale protruding on to the plantar surface of the tarsus. The *ossa sesamoidea metatarsophalangealia* occurred in digits I—V, the largest and most massive being the *os sesamoideum tibiale* of the toe. The *calcar calcanei* is relatively thin, elongated, articulates with the calcaneus. The *os sesamoideum tarsi dorsale* is built into the base of the retinaculum covering *mm. extensores digitorum communes*. In addition, on the dorsal side of the tarsus there is a flattened sesamoid in the ligament running from the tibiale to metatarsale II.

4. *Myotis myotis* (Borkhausen 1779) — Figs. 4, 5.

Hand: *os falciforme* is built into the wall of the bursa and has its articular surface with the radial surface of the radiale. On the side of the articular surface this bone is convexo-concave, the radial surface is smooth. This sesamoid is connected by a wide ligament with the *os sesamoideum carpometacarpale volare*, on the proximal end of its surface there is the final insertion *m. abductoris pollicis*. The *os sesamoideum carpometacarpale volare* is large, massive, richly sculptured. It is connected by a wide ligament with the ulnar surface of the base of the V metacarpal bone, and the *os falciforme*. *Mm. interossei* run from the two nodules there to digit V, and also the final insertion of *m. flexoris carpi ulnaris* is situated on the ulnar nodule. This sesamoid has its articular surfaces with III, IV and V *ossa metacarpi*. In the part occupied by the final insertion of the tendon *m. flexoris carpi ulnaris* there is the massive, oval *os sesamoideum muscoli flexoris carpi ulnaris*. The *ossa sesamoidea metacarpophalangealia volaria* in the thumb are elongated, massive, the *os sesamoideum ulnare* is slightly longer. In digit II the *ossa sesamoidea* of this category are absent, in the remaining digits they are small and discoid. All *ossa sesamoidea* belonging to this category are built into the final insertions of *mm. interossei*. The *cartilago accessorium plagiopatagii* is cartilaginous, elongated, and attains 1/3 of the length of the middle phalange of digit V.

Foot: The *calcar calcanei* is elongated, has articular surface with the calcaneus (1'). *Os sesamoideum tarsi praeaxiale* (b') is clavate, has articular surface with the naviculare, and tarsale distale I. It protrudes on to the plantar surface of the foot. *Os sesamoideum tarso-metatarsarium plantare* (i) is on a level with the depression in the head of the V metatarsal bone, is small, discoid, built into *m. interosseus*. *Ossa sesamoidea metatarsophalangealia* (d') are paired, elongated, massive, present in all five digits, and form the final

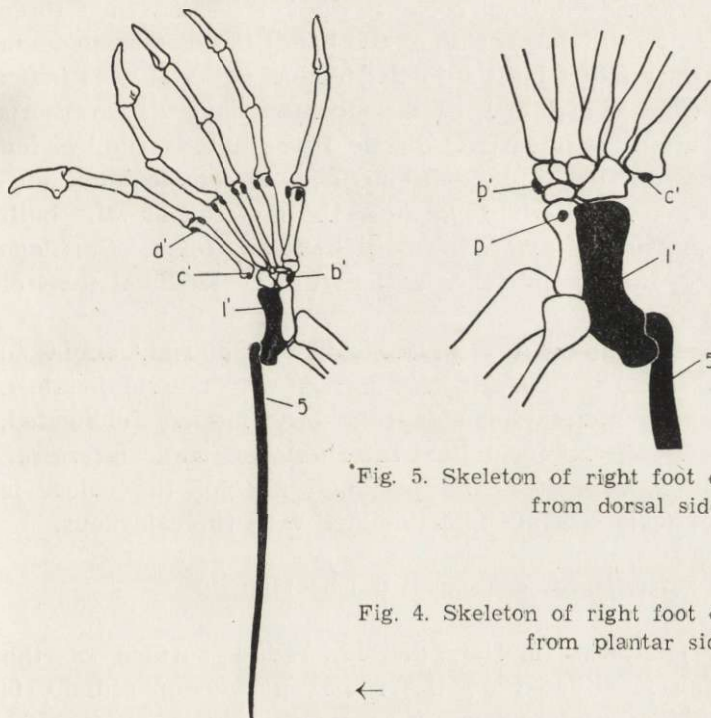


Fig. 5. Skeleton of right foot of *Myotis myotis* from dorsal side.

Fig. 4. Skeleton of right foot of *Myotis myotis* from plantar side.

insertions of *mm. interossei*. *Os sesamoideum tarsi dorsale* (p) is relatively large, is situated above the astragalus at the base of the retinaculum covering *m. extensor digitorum longus*.

5. *Myotis dasycneme* (Boie 1825)

Hand: *Os falciforme* is situated on the radial surface of radiale. From this sesamoid ligaments run to metacarpale II, radius, and to *os sesamoideum carpometacarpale volare*. The final insertion *m. abductor pollicis* is also situated on it. Two *ossa sesamoidea carpometacarpalia volaria* occurred: the first is elongated, set transversely to the long axis of the hand, has articular surfaces with the II and

V metacarpale, while the second is slender, elongated, situated at the level of the base of metacarpale IV. The first sesamoid belonging to this category is richly sculptured, is connected by ligaments with the base of metacarpale V, with *os falciforme*, and the final insertion of *m. flexoris carpi ulnaris* and initial insertion *m. interossei V* are situated on it. *Ossa sesamoidea metacarpophalangealia volaria* of the thumb are elongated, massive, the *os sesamoideum ulnare* is strongly developed; in digits III—V the *ossa sesamoidea* are discoid, while they did not occur in digit II. There are three *ossa sesamoidea* on the dorsal side of the hand: the *os sesamoideum musculi extensoris indicis* built into the tendon *m. extensoris indicis* situated near carpale distale I, *os sesamoideum musculi extensoris carpi radialis brevis* near carpale distale II, built into the tendon *musculi extensoris carpi radiale brevis*, and *os sesamoideum musculi extensoris carpi radialis longi* near the metacarpale I, built into the tendon *musculi extensoris carpi radialis longi*. *Cartilago accessorium plagiopatagii* is twice as long as the terminal joint of digit V.

Foot: *Os sesamoideum tarsi praeaxiale* is set at right angles to the edge of the foot, and has its joint surface with tarsale distale I. *Ossa sesamoidea metatarsophalangealia* are massive, elongated, occur in digits I—V, and form final insertions of *mm. interossei*. *Calcar calcanei* is elongated, the proximal part of the calcar is flattened, its articular surface is articulated with the calcaneus.

6. *Myotis daubentoni* (K u h l 1819)

Hand: *Os falciforme* is flat, discoid, radial surface of the sesamoid, which is situated on the radial surface of radiale, is convex. On this *os sesamoideum* there is the final insertion *m. abductoris pollicis*, and ligaments connecting the sesamoid with the base of metacarpale I, with the *os sesamoideum carpometacarpale volare* and base of the radius. Two *ossa sesamoidea carpometacarpalia volaria* occurred: one massive, large, set transversely to the long axis of the hand, the second small at the base of metacarpale IV. The first of these *ossa sesamoidea* has articular surfaces with the bases of the II and V metacarpal bones, is connected by wide ligaments with the *os falciforme*, and with the ulnar surface of the base of metacarpale V. In addition, on this *os sesamoideum* there is the final insertion of *m. flexoris carpi ulnaris*,

and the initial insertion *m. interossei* IV. *Ossa sesamoidea metacarpophalangealia volaria* are elongated in the thumb, do not occur in the second digit, and in digits III—V are discoid, relatively small. On the dorsal side of the hand there is the *os sesamoideum musculi extensoris indici*, built into the tendon *m. extensoris indici proprii*, at the level of carpale distale I, and *os sesamoideum musculi extensoris carpi radialis brevis* near the carpale distale III, built into the tendon *m. extensoris carpi radialis brevis*. *Cartilago accessorium plagiopatagii* is elongated, cartilaginous, about 3 times longer than the terminal phalange of digit V.

Foot: *Os sesamoideum tarsi praeaxiale* is flat, protrudes beyond the tibial edge of the foot in the direction of its plantar surface. This bone has joint surfaces with tarsale distale I and naviculare. *Os sesamoideum tarsometatarsale plantare* is situated at the level of the interstice of the tarsometatarsal joint in the depression of the base of metatarsale V. This sesamoid is built into *m. quadratus plantae*. *Ossa sesamoidea metatarsophalangealia* are elongated, massive, narrow in the proximal parts, which causes them to have a drop-like appearance. These bones are built into *mm. interossei*. *Calcar calcanei* is relatively thin, elongated. The proximal part of the calcar is cartilaginous. The *os sesamoideum* has its articular surface with the calcaneus. *Os sesamoideum tarsi dorsale* is on a level with naviculare, is elongated, built into the base of the retinaculum covering *mm. extensores digitorum*.

Cases of occurrence of the different categories of *ossa sesamoidea* in the species examined are given in table 2.

IV. AN ATTEMPT AT INTERPRETING THE FUNCTION OF OSSA SESAMOIDEA IN BATS, AND DISCUSSION

The skeleton of the limbs of bats has many modifications adapting it for flight. These modifications are expressed both in the qualitative changes taking place in the *ossa sesamoidea*: in bats new elements of the skeleton are forming, peculiar to these animals only. Among them is the *calcar calcanei*, built into the free edge of the uropatagium, which during flight helps to maintain the constant shape of the plane formed between the pelvic belt, the hind limbs and the tail. As Krüger (1958) assumes, the hind limbs and tail in bats play the part of a steering apparatus, and therefore the occurrence of the calcar in the plagiopatagium would appear

to be justified. The presence of the calcar, articulated (and therefore mobile) with the calcaneus, facilitates walking, and prevents the uropatagium from shifting on to the foot. In connection with the plagiopatagium there is also the *cartilago accessorium plagiopatagii*. As stated by Törne (1913) and other research workers cited by this author, and as is also confirmed by my own observations, this element occurs in all *Vespertilionidae* with the excep-

Table 1.

Homodynamic elements occurring in the hands and feet of bats.

Homodynamic elements	
Hand	Foot
<i>os falciforme</i>	—
—	<i>os sesamoideum tarsi praeaxiale</i>
—	<i>calcaneus</i>
—	<i>calcar calcanei</i>
<i>os sesamoideum carpometacarpale volare</i>	<i>os sesamoideum tarsometatarsale plantare</i>
<i>ossa sesamoidea metacarpophalangealia volaria</i>	<i>ossa sesamoidea metatarsophalangealia plantaria</i>
<i>cartilago accessorium plagiopatagii</i>	—
<i>os sesamoideum musculi flexoris carpi ulnaris</i>	—
<i>os sesamoideum musculi extensoris carpi radialis brevis</i>	—
<i>os sesamoideum musculi extensoris carpi radialis longi</i>	—
<i>os sesamoideum musculi extensoris indici</i>	—
<i>os sesamoideum musculi extensoris pollicis</i>	—
—	<i>os sesamoideum tarsi dorsale</i>

tion of *Plecotus*: it is absent in *Rhinolophidae*. The presence of this sesamoid is probably connected with the different shape of bats' wings. In forms with a more progressive wing structure, that is, a narrow and elongated wing (Revilliod, 1916), this bone occurs. In such forms *ossa sesamoidea musculorum extensorum* also occur in the region of the carpus. They probably play an im-

portant part in extending the wings and maintaining the digits strongly extended during flight.

Several categories of *ossa sesamoidea* occur in bats in common with other mammals (R o m a n k o w o w a, 1960). Of these, the *ossa sesamoidea metacarpophalangealia volaria* are discoid, small in digits III—V, more massive and elongated in the thumb. They did not occur in the regressive II digit. The different formation of this category of *ossa sesamoidea* in the thumb is probably caused by the movements made by the fore limb when the bat is moving over the ground. The *ossa sesamoidea metatarsophalangealia* in the hind limb are of similar shape to those in the thumb. An interesting component of the skeleton of the hand of bats is the *os falciforme*, which is always massive, connected, but freely mobile, by means of the convex articular surface with the radial surface of the radiale. The terminal insertion *m. abductoris pollicis* is situated on this bone, which in addition is connected by ligaments with the radius, and by a ligament running above the *canalis carpeus*, with *os sesamoideum carpometacarpale volare*. The presence of the *os falciforme* helps both to strengthen and render elastic this important section of the limb. In the hind limb the role of an element strengthening the tarsus is played by the *os sesamoideum tarsi praeaxiale*. It is a small, elongated bone, the terminal end of which protrudes on to the plantar surface. The proximal end of this sesamoid usually has its articular surface with tarsale distale I, and with the naviculare; from this *os sesamoideum* a band of filaments runs in an arch under the skin of the planta. This bone occurred only in representatives of *Vespertilionidae*. The *os sesamoideum tarsi dorsale*, which occurs in almost all species of bat, is situated at the level of the astragalus, is built into the base of the retinaculum covering the tendon *mm. extensores*. In insectivores and rodents I found ossification of the dorsal part of the retinaculum, which is perhaps connected with the execution of sudden movements by the foot, and in bats the ossification of the lower part of this retinaculum may be caused by the exertion of constant pressure by the *mm extensores*. *Ossa sesamoidea interphalangealia distalia digitorum volaria et plantaria* did not occur in any of the species of bat examined. The absence of these *ossa sesamoidea* in the hands is probably caused by the considerable elongation and gradual narrowing of the medial and terminal phalanges of digits III—V, and the preservation of the terminal phalanges in the

Table 2.

Occurrence of different categories of *ossa sesamoidea* in the species examined.

Sesamoid bones	<i>Rhinolophus hipposideros</i>	<i>Plecotus auritus</i>	<i>Barbastella barbastellus</i>	<i>Myotis myotis</i>	<i>Myotis dasycneme</i>	<i>Myotis daubentoni</i>
<i>os falciforme</i>	+	+	+	+	+	+
<i>ossa sesamoidea carpometacarpalia volaria</i>	+	+	+	+	+	+
<i>ossa sesamoidea metacarpophalangealia volaria</i>	+	+	+	+	+	+
<i>cartilago accessorium plagiopatagii</i>	-	-	+	+	+	+
<i>os sesamoideum musculi flexoris carpi ulnaris</i>	-	-	-	+	-	-
<i>os sesamoideum musculi extensoris carpi radialis brevis</i>	-	+	+	-	+	+
<i>os sesamoideum musculi extensoris carpi radialis longi</i>	-	-	-	-	+	-
<i>os sesamoideum musculi extensoris indicis</i>	-	-	+	-	+	+
<i>os sesamoideum musculi extensoris pollicis</i>	+	+	-	-	-	-
<i>calcaneus</i>	+	+	+	+	+	+
<i>calcar calcanei</i>	+	+	+	+	+	+
<i>os sesamoideum tarsi praeaxiale</i>	-	+	+	+	+	+
<i>os sesamoideum tarsometatarseum plantare</i>	-	+	-	+	-	+
<i>ossa sesamoidea metatarsophalangealia plantaria</i>	+	+	+	+	+	+
<i>os sesamoideum tarsi dorsale</i>	+	+	+	+	-	+

cartilaginous stage. In the thumb, and in the digits of the foot, the absence of these *ossa sesamoidea* is, in my opinion, caused by the considerable enlargement of the terminal phalanges, serving the bats as a means of hooking themselves on at the point of attachment during rest. The calcaneus occurred in all bats, while the *os pisiforme* is absent in the hands.

The identification of the bone situated on the volar surface of the boundary between the bones of the carpus and metacarpus was a controversial question. Leboucq (1899), Braus (1906) Schmidt-Ehrenberg (1942), Green (1951) considered this element as the *os pisiforme*. Holmgren (1952) identified this bone with the bony element occurring in the hypothenar of rodents. On the basis of comparative investigations made by me of *ossa sesamoidea* in insectivores and rodents (Romanikowowa, 1960), and examination of this bone in bats, I found that the *os pisiforme* is absent in the latter. The element of the skeleton, considered by the authors referred to above as the *os pisiforme*, and by Holmgren as the „ulnar border cartilage, which in other mammals forms the support of an ulnar carpal ball”, is the *os sesamoideum carpometacarpale volare*. It is situated similarly in relation to the bones of the carpus and metacarpus as that in rodents and insectivores. This bone is always situated on the volar surface of the hand. In the representatives of *Rhinolophidae* examined, this bone is small, clavate, and on it is the initial insertion of *mm. interossei*, while in *Vespertilionidae* it is massive, wide, and on it are the 1—2 initial insertions *mm. interossei*, and the final insertion *m. flexoris carpi ulnaris*. The stability of position of this bone, and the variability of the muscle system and structure, argue against the case for this element being the *os pisiforme*. In my opinion a counter-argument to Holmgren's statement is the fact that the *os sesamoideum* of the hypothenar occurs only in certain rodents, as an element assisting the grasping ability of the hand, while it does not occur in insectivores; it is always situated at a certain distance from the skeleton of the remaining bones of the hand, and has no articular surfaces with them. The *mm. interossei* never run from this bone. The *os sesamoideum tarsometatarseum plantare* occurred, of the bats examined, in three species only of the family *Vespertilionidae*. Contrary to the homologous *ossa sesamoidea* in the hand, this category of *ossa sesamoidea* is very weakly formed in the foot.

Comparison of the *ossa sesamoidea* occurring in the hands and feet of bats establishes the differences connected with the specialisation of the limbs. This is illustrated by table 1.

V. SUMMARY

Investigations of the *ossa sesamoidea* in bats reveal the following:

1. *Ossa sesamoidea* in bats are a constant component of the bone structure of the autopodia.

2. Some of the categories of *ossa sesamoidea* forming part of the structure of the autopodia, in insectivores and rodents occur also in bats. These include: *os falciforme*, *calcaneus*, *ossa sesamoidea metacarpophalangealia volaria et plantaria*, *ossa sesamoidea carpometacarpalia volaria* and *ossa sesamoidea metatarsophalangealia*, and *os sesamoideum tarsi praeaxiale*. The following, on the other hand, do not occur in the skeleton of limbs of bats: *os pisiforme*, *ossa sesamoidea volaria et plantaria interphalangealia distalia*.

3. The following belong among *ossa sesamoidea* formed in bats as the result of specialisation of the limbs: *cartilago accessorium plagiopatagii*, *ossa sesamoidea mm. extensores carpi et indici*, *calcar calcanei*.

4. In the material examined differences became apparent in the structure of *ossa sesamoidea*, and also in the number of categories of these bones in representatives of *Rhinolophidae* and *Vespertilionidae*, and within species of the family *Vespertilionidae*.

5. In bats with more highly specialised structure of the wings the number of categories of *ossa sesamoidea* is greater.

6. *Ossa sesamoidea* occurring in the hands and feet of bats are non-homodynamic in the majority of categories.

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STRESZCZENIE

W literaturze brak jest danych porównawczych, dotyczących wszystkich kategorii trzszczek występujących u nietoperzy. Wiadomości o trzszczkach znajdują się przeważnie w pracach dotyczących umięśnienia kończyn nietoperzy (Macalister, 1872). Szczegółowym badaniom poddano trzszczkę dodatkową błony lotnej („accessorium” — Törne, 1913).

Przedmiotem badań było: 10 osobników *Rhinolophus hipposideros* (Bechstein 1800) — *Rhinolophidae*; 5 *Plecotus auritus* (Linnaeus 1758), *Barbastella barbastellus* (Schreber 1774), 12 *Myotis myotis* (Borkhausen 1779), 1 *Myotis dasycneme* (Boie 1825) oraz 1 *Myotis daubentoni* (Kuhl 1819) — *Vespertilionidae*.

W wyniku badań ustalono następujące kategorie trzszczek dla ręki badanych nietoperzy: kość sierpowata, trzszczki dłoniowe nadgarstkowośródręczne, trzszczki dłoniowe śródręcznopalcowe, trzszczka dodatkowa błony lotnej, trzszczka zginacza łokciowego nadgarstka, trzszczka mięśnia prostownika promieniowego krótkiego nadgarstka, trzszczka mięśnia prostownika promieniowego długiego nadgarstka, trzszczka mięśnia prostownika wskaziciela, trzszczka mięśnia prostownika kciuka. W kończynie tylnej wystąpiły następujące kategorie trzszczek: kość piętowa, ostroga kości piętowej, trzszczka przedosiowa stępu, trzszczka podeszwowa stopowośródstopowa, trzszczki podeszwowe śródstopowopalcowe, oraz trzszczka grzbietowa stępu.

W wyniku przeprowadzonej analizy porównawczej elementów szkieletowych kończyn stwierdzono u nietoperzy brak kości grochowatej. Element uważany przez niektórych autorów za kość grochowatą (Leboucq 1899;

Braus, 1906; Schmidt-Ehrenberg, 1942; Greene, 1951), jest trzeszczką dłoniową nadgarstkowośródręczną, występującą poza nietoperzami u owadożernych i gryzoni (Romankowowa, 1960). U nietoperzy nie wystąpiły również trzeszczki dłoniowe i podeszwowe międzyczłonowe dalsze, występujące u ssaków czworonożnie kroczących.

Część kategorii trzeszczek wystąpiła u wszystkich badanych gatunków. Są to w ręce: kość sierpowata, trzeszczka dłoniowa nadgarstkowośródręczna, trzeszczki dłoniowe śródręcznopalcowe, oraz u *Vespertilionidae* za wyjątkiem *Plecoti* — trzeszczka dodatkowa błony lotnej. W stopie wystąpiły: kość piętowa, trzeszczki podeszwowe śródstopowopalcowe, ostroga kości piętowej (chrzęstna u *Rhinolophidae*), oraz u *Vespertilionidae* trzeszczka przedosiowa stępu.

U nietoperzy o wyższym stopniu specjalizacji skrzydła (Reveillod, 1916) wykształca się większa ilość kategorii trzeszczek w kończynach (Tab. 2). Największe różnice dotyczące ilości kategorii trzeszczek oraz ich budowy zaznaczają się między przedstawicielem rodziny *Rhinolophidae*, a przedstawicielami rodziny *Vespertilionidae*. Również w obrębie rodziny *Vespertilionidae* u poszczególnych gatunków zaznaczyły się pewne różnice w budowie badanych elementów.

W przeciwieństwie do trzeszczek występujących w odcinkach wolnych kończyn ssaków czworonożnie kroczących trzeszczki występujące w kończynie przedniej i tylnej u nietoperzy są w przeważającej liczbie niehomodynamiczne, co wywołane jest różną specjalizacją ręki i stopy u tych zwierząt.

Na podstawie przeprowadzonych badań nad trzeszczkami odcinków wolnych kończyn nietoperzy stwierdzić można, że trzeszczki stanowią stałą część składową szkieletu. Ilość kategorii trzeszczek, ich charakter, oraz budowa związane są ze stopniem specjalizacji kończyn.

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