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***Crocidura* WAGLER and other *Insectivora* (*Mammalia*) from the  
Quaternary Deposits of Tornewton Cave in England**

[Pp. 251—263, 6 text figs.]

***Crocidura* WAGLER i inne ssaki owadożerne z czwartorzędowych osadów Tornewton Cave w Anglii**

***Crocidura* WAGLER и другие насекомоядные млекопитающие из четвертичных отложений  
пещеры Торньютон в Англии**

Abstract. The Pleistocene deposits of Tornewton Cave in Devonshire, especially those of its small chamber named the Vivian Vault, the stratigraphy of which is not clear, contained remains of the following insectivores: *Sorex araneus* LINNAEUS, *Sorex minutus* LINNAEUS, *Sorex* cf. *minutissimus* ZIMMERMANN, *Neomys fodiens* (PENNANT), *Crocidura* WAGLER and *Erinaceus europaeus* LINNAEUS. Out of them, *Crocidura* and *Sorex* cf. *minutissimus* are new forms to the fossil fauna of Great Britain.

INTRODUCTION

By courtesy of Dr A. SUTCLIFFE I received the remains of insectivores from Tornewton Cave for study. The deposits of this cave, situated in the Torbryan Valley near Denbury in Devon, England, date back to the penultimate and last glaciations, separated by a mild interval. A detailed description of the cave, its strata and large mammals is given by A. J. SUTCLIFFE and F. E. ZEUNER (1962), whereas the rodents have been identified by K. KO-WALSKI (1967). Unfortunately, the vast majority of insectivore remains were found out of the main part of the cave, in a small chamber, called the Vivian Vault. The stratigraphy of this chamber is not clear and its fauna was probably

Table I

*Sorex araneus* LINNAEUS, dimensions of mandibles \*

Specimen No	Vivian Vault															Rodent Layer			
	1	2	3	4	5	6	7	8	9	10	11	12	13	15	16	21	1	2	3
Total length of mandible	11.2	11.3															11.4	11.4	
Cardinal length of mandible	7.8	7.8															9.3	9.1	
Height of coronoid process	4.35	4.57	4.57	4.57	4.50	4.46	4.57	4.40			4.68	4.93	4.50	4.57			4.50	4.28	4.50
Length of I — M <sub>3</sub>	7.6	7.8																	
Length of M <sub>1</sub> — M <sub>3</sub>	3.80	3.78	3.75	3.70	3.76			3.70	3.71	3.60					3.60	3.74			
Height of mandible below M <sub>2</sub>	1.30	1.36	1.51	1.50	1.30	1.47	1.44	1.36	1.54	1.36	1.36	1.47	1.44	1.44	1.51	1.50	1.44	1.44	
Thickness of mandible below M <sub>2</sub>	0.7	0.7	0.7	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	

derived from different periods. This supposition is supported by the fact that the material contained remains of *Lagurus lagurus* (PALLAS) and *Cricetus cricetus* (L.) typical of cold periods and those of *Cricidura* sp. present only in interglacials. Besides *Cricidura* sp., the deposits of the Vivian Vault contained the remains of the following *Insectivora*: *Sorex araneus* LINNAEUS (most numerous), *Sorex minutus* LINNAEUS, *Sorex* cf. *minutissimus* ZIMMERMANN, *Neomys fodiens* (PENNANT) and *Erinaceus europaeus* LINNAEUS. Moreover, in the main chamber of the cave the *Insectivora* were represented in two layers: *Sorex minutus* in the Reindeer Stratum, dating from the last glaciation, and *Sorex araneus*, *Sorex minutus* and *Neomys fodiens* in the Rodent Layer from the Holocene.

The finds of *Cricidura* sp. and *Sorex* cf. *minutissimus*, whose range does not cover the British Isles at present and which are new forms to the fossil fauna of England, are of special interest.

Order *Insectivora* BOWDICH, 1821  
 Family *Soricidae* GRAY, 1821  
 Subfamily *Soricinae* MURRAY, 1866  
 Genus *Sorex* LINNAEUS, 1758

*Sorex araneus* LINNAEUS, 1758

(Fig. 6)

Material. Vivian Vault: 2 complete halves of mandibles, 28 mandibular fragments, of which 12 with well-preserved coronoid process and 3 toothless, 3 detached lower incisors, 1 cranial fragment with its rostral part and complete unilateral dentition preserved, 1 maxilla with complete dentition and 11 maxillary fragments.

Rodent Layer: 2 nearly complete halves of mandibles and 1 coronoid process.

Description. Tops of teeth are red-brown in coloration. Mandibular incisor with 3 distinct cusps, last lower molar with 5 cusps. The anterior margin of the coronoid process and the mandibular ramus form an obtuse angle. The articular facets of the articular process are joined with a broad bony band. There are 5 unicuspid teeth on either side of the maxilla. The lacrimal foramen is situated at the level of the lower half of the infraorbital foramen, between the roots of M<sup>1</sup>.

Measurements (in mm), see Table I.

Systematic position. The characters and measurements of the specimens described above allow the statement that we are concerned with a member of the genus *Sorex* LINNAEUS belonging to the *Sorex araneus* L. group. Of this group, from the British Isles, HINTON (1911) described *Sorex runtonensis* from



the Cromerian interglacial, *Sorex* sp. from the Eemian interglacial, *Sorex kennardi* HINTON from the last glaciation and *Sorex araneus* L. This last species has occurred ever since the last glaciation.

A comparison of the specimens from the Vivian Vault with the description of *S. runtonensis* from the Upper Freshwater Bed, as well as with the measurements of the English specimens of this species presented in the paper by JANOSSY (1965) shows that they are larger than the fossil form. A direct juxtaposition of the shrews from Tornewton Cave and the specimens identified as *S. runtonensis* from Rebielice Królewskie and Kadzielnia in Poland (K. KOWALSKI, 1958, 1960) and Podumci in Yugoslavia (K. KOWALSKI, 1958) also reveals the larger size of the former.

„*Sorex* sp.“, described by HINTON (1911) from Grays Thurrock and known from a single specimen, differs from our remains in its smaller measurements and different shape of the fossa pterygoidea.

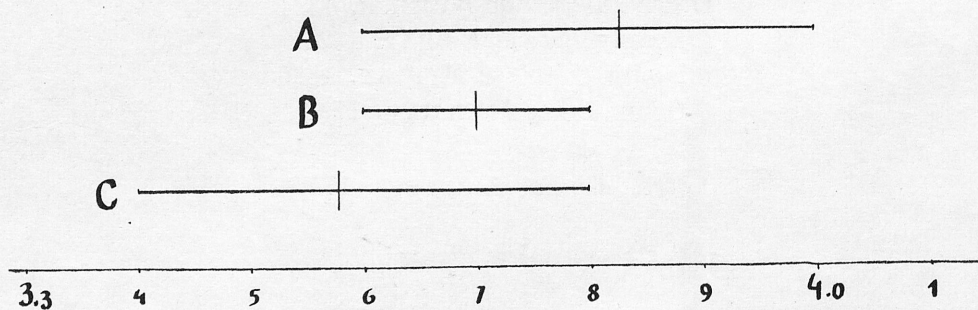


Fig. 1. Variability of the length of  $M_1-M_3$ . A — *Sorex araneus*, Poland, recent specimens, B — *S. araneus*, Vivian Vault, C — *S. runtonensis*, Hungary (after JANOSSY, 1965).

*Sorex kennardi* HINTON, described from the Third Terrace drift of the Lea Valley at Ponders End, Middlesex, is also smaller than the specimens from Tornewton.

On the other hand, the measurements of the specimens from the Vivian Vault agree, in general, with those of the contemporary specimens of *S. araneus* from Poland, with which I managed to compare them directly. Their reference to this species is also indicated by the relatively robust coronoid process, whose anterior margin and the mandibular ramus form an obtuse angle, and the shape of the articular facets of the articular process. As will be seen from the graph in Figure 1, the specimens from the Vivian Vault are somewhat smaller than average specimens of this species from Europe, though their measurements fall within the range of variation of the present population of the shrew, whereas the two nearly complete mandibular halves from the Rodent Layer, which seem to be the Holocene age, correspond in measurements to the modern specimens.



Table II

*Sorex minutus* LINNAEUS, dimensions of mandibles

Specimen No	Vivian Vault								Rodent Layer	Reindeer Stratum		
	1	2	3	4	5	6	7	8		1	2	3
Total length of mandible										9.1	9.2	
Cardinal length of mandible									7.3	7.4	7.5	
Height of coronoid process	3.09	2.80	3.20	3.06	2.91				3.06	3.13	3.20	3.06
Length of I — M <sub>3</sub>										6.2	6.1	
Length of M <sub>1</sub> — M <sub>3</sub>	3.10	2.90				2.95			2.90	3.35	3.27	
Height of mandible below M <sub>2</sub>	0.86	0.79	0.97	0.82	0.80	0.80	0.80	0.80	0.97	0.93	0.90	
Thickness of mandible below M <sub>2</sub>	0.6	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.5	0.5	0.5

*Sorex minutus* LINNAEUS, 1766

(Fig. 4)

Material. Vivian Vault: 8 mandibular fragments, of which 5 with well-preserved coronoid process.

Rodent Layer: 1 nearly complete mandibular half (damaged  $I_1$ ).

Reindeer Stratum: 2 nearly complete mandibular halves and 1 mandibular fragment with  $M_1$  and  $M_2$ .

Description. Tops of teeth red-brown in coloration. Last lower molar with 5 cusps. Mandible small and delicate. The anterior margin of the coronoid process and the mandibular ramus form a slightly obtuse angle. The articular facets of the articular process are joined with a broad bony band. The mental foramen is situated between P and  $M_1$  or it is slightly shifted under the anterior portion of  $M_1$ .

Measurements (in mm): see Table II.

Systematic position. The remains described show no morphological differences in relation to the contemporary specimens of *Sorex minutus* from Poland. Their measurements also lie within the limits of variation of the modern population, though the mean size of the specimens from the Vivian Vault and Rodent Layer is smaller than that of today specimens. On the other hand, the mandibles from the Reindeer Stratum are identical in respect of size with the mandibles of the contemporary form. In the British Isles, *Sorex minutus* has been recorded from numerous fossil localities, mainly caves, among other places, from the Ightham Fissures (HINTON, 1911). It has persisted ever since the late Pleistocene.

*Sorex cf. minutissimus* ZIMMERMANN (1780)

(Fig. 5)

Material. Vivian Vault: mandibular half with coronoid and articular processes and  $M_1$  preserved.

Description. Tops of teeth red-brown in coloration. Mandibular ramus very small and delicate. The articular facets of the articular process are joined with a broad bony band, with a slight narrowing in the middle. Mental foramen below  $M_1$ .

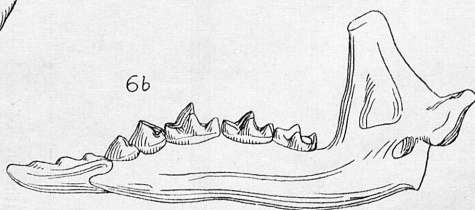
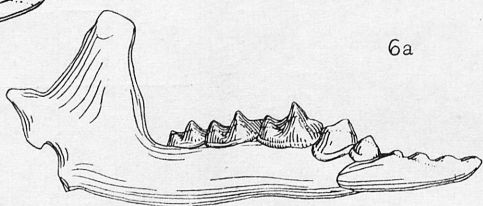
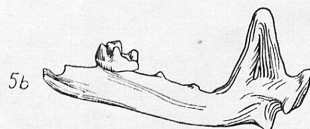
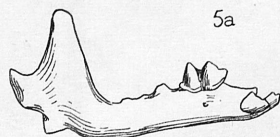
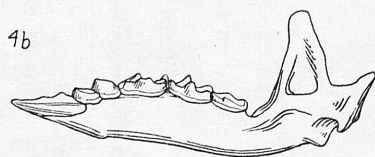
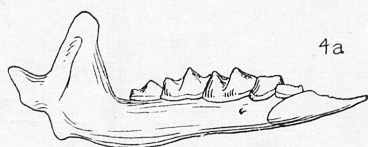
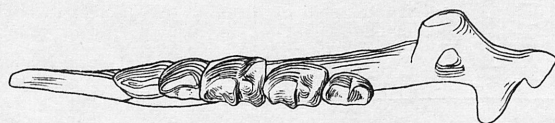
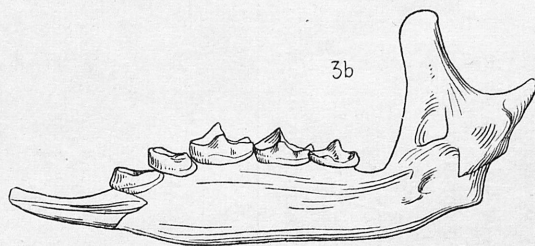
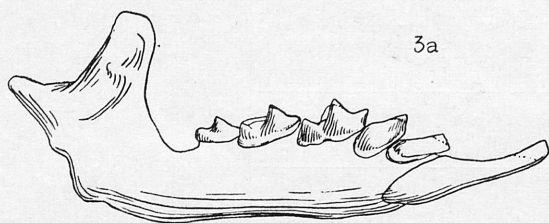
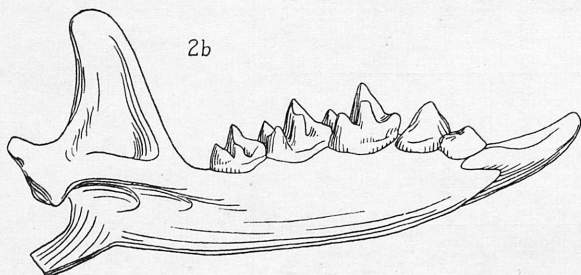
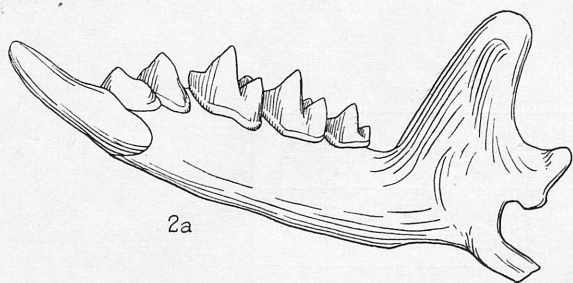
Measurements (in mm): cardinal length of mandible — 6.12, height of mandible below  $M_2$  — 0.79, thickness of mandible below  $M_2$  — 0.5, height of coronoid process — 2.77.

Systematic position. The mandible described comes very close both in measurements and in morphology to that of *Sorex minutissimus* ZIMMERMANN. The mandibular ramus is shorter and more delicate in structure than in *Sorex minutus* L. The surface of the articular process is only slightly narrowed in its middle portion. The mental foramen is situated below  $M_1$ , between

Table III  
*Neomys fodiens* (PENNANT), dimensions of mandibles

Specimen No	Vivian Vault		Rodent Layer	Poland <i>Neomys fodiens</i> recent				Poland <i>Neomys anomalous</i> recent			
	1	2		min	avg	max	n	min	avg	max	n
Total length of mandible			13.10	13.60	14.02	14.50	10	11.80	12.57	12.80	7
Cardinal length of mandible			11.5	11.3	11.7	12.1	10	9.7	10.15	10.6	10
Height of coronoid process			4.97	4.57	5.01	5.32	10	3.88	4.20	4.39	6
Length of I — M <sub>3</sub>			8.7	8.9	9.55	10.0	10	8.4	8.6	8.9	9
Length M <sub>1</sub> — M <sub>3</sub>	3.96	4.35	4.32	4.35	4.62	4.75	10	3.99	4.27	4.50	10
Height of mandible below M <sub>2</sub>	1.47	1.51	1.83	1.33	1.54	1.80	10	1.08	1.29	1.51	10
Thickness of mandible below M <sub>2</sub>	0.8	0.8	0.8	0.7	0.8	1.0	10	0.6	0.68	0.7	13





the trigonid and talonid, whereas in *Sorex minutus* it lies between P and M<sub>1</sub>, or is slightly displaced under the anterior part of M<sub>1</sub>.

A comparison of the specimens from the Vivian Vault with the description of *Sorex minutissimus* from the early Pleistocene of northern France given by H. de BALSAC (1940) shows that, morphologically, they are very much alike. Their measurements cannot, however, be compared, as they have not been given by this author.

Now *Sorex minutissimus* is widely spread in Asia, where its range extends as far as Kamchatka or Sakhalin; in Eastern Europe it inhabits its northern and central part (GROMOV et al., 1963), and thus its contemporary range does not include the British Isles, from which it has not been recorded as a fossil species, either.

The occurrence of remains of *Sorex minutissimus* in Poland (Mamutowa and Nietoperzowa Caves — unpublished data), France and England provides evidence that this species was widely distributed in the European Pleistocene.

#### Genus *Neomys* KAUP, 1892

##### *Neomys fodiens* (PENNANT, 1771)

(Fig. 3)

Material. Vivian Vault: 2 mandibular fragments without processes, one with M<sub>1</sub> — M<sub>2</sub>, the other with P—M<sub>3</sub>.

Rodent Layer: mandibular half with damaged angular process.

Description. Tops of teeth red-brown in coloration. Last lower molar with 5 cusps. I<sub>1</sub> with one cusp at its base. The articular facets of the articular process are joined with a broad bony band.

Measurements (in mm.): see Table III.

Systematic position. The colour of teeth, structure of I<sub>1</sub> and shape of processes, especially that of the articular process, indicate that the mandible from the Rodent Layer represents the genus *Neomys* KAUP, and its shape and measurements point to the species *Neomys fodiens* (PENNANT). The two mandibular fragments from the Vivian Vault, however, seem to have somewhat smaller measurements than the contemporary specimens of *N. fodiens* from Poland. Consequently, they might be compared with *Neomys browni*, described by HINTON (1911) from Grays Thurrock, also smaller than *N. fodiens*, but the fragmentary nature of the specimens from the Vivian Vault, especially the lack of processes, makes a closer determination impossible.

Fig. 2—6. 2a-c — *Crociodura* sp., Vivian Vault, left half of mandible, specimen No 1. 3a-c — *Neomys fodiens* (PENNANT), Rodent Layer, left half of mandible, specimen No 1. 4a-c — *Sorex minutus* LINNAEUS, Rodent Layer, right half of mandible, specimen No 1. 5a-c — *Sorex* cf. *minutissimus* ZIMMERMANN, Vivian Vault, right half of mandible, specimen No 1. 6a-c — *Sorex araneus* LINNAEUS, Vivian Vault, right half of mandible, Specimen No 1.

Nowadays, two species of the genus *Neomys* KAUP are known in the world fauna: *Neomys fodiens* (PENNANT, 1771) and *Neomys anomalus* CABRERA, 1907 (in Western Europe represented by the subspecies *N. a. milleri* [MOTTAZ, 1907]). In morphology and measurements *N. browni* corresponds with the smaller of them, *N. anomalus*. The occurrence of *N. anomalus* in the present fauna allows the presumption that it lived as early as the last interglacial. *N. browni* and *N. anomalus* seem therefore to be identical forms, which however needs additional close inquiries.

Subfamily *Crocidurinae* MILNE-EDWARDS, 1864—1874

Genus *Crocidura* WAGLER, 1832

*Crocidura* sp.

(Fig. 2)

Material. Vivian Vault: 1 complete mandibular half and 11 mandibular fragments with damaged processes or without them.

Description. Teeth white. Lower incisor elongated, with its cutting surface without cusps.  $M_3$  with talonid reduced to one cusp. The anterior margin of the coronoid process forms an obtuse angle with the mandibular ramus. The articular facets of the articular process are joined with a broad bony band.

Measurements (in mm.): see Table IV.

Systematic position. The characters given in the description allow the reference of the specimens from the Vivian Vault to the genus *Crocidura* WAGLER. At present 3 species of this genus live in Western and Central Europe: *Crocidura suaveolens* (PALLAS, 1811), *Crocidura leucodon* (HERMANN, 1780) and *Crocidura russula* (HERMANN, 1780). None of these species, however, includes the British Isles in its range. Only the smallest of them, *Crocidura suaveolens* inhabits the Scilly Islands, where it arrived probably in the recent times. The White-toothed Shrew numbered in the *Crocidura leucodon-russula* group and 2 species larger than it, *Crocidura zorzii* from Italy (PASA, 1952) and *Crocidura robusta* from Germany (HELLER, 1960) have been recorded from the mild periods of the European Pleistocene. Both these large species have been described on the basis of very scanty material and, morphologically, they do not, as a rule, differ from each other or from the specimens included in the *Crocidura leucodon-russula* group. Therefore, it seems that, if they are not only large members of the *Crocidura leucodon-russula* group, they probably belong to one and the same species.

Comparing the specimens from the Vivian Vault with *Crocidura suaveolens*, one finds that this last species is here out of the question, because it is far smaller. The remains under study do not differ morphologically from the basic type of the structure of mandibles in the species now living in Europe and having this element identical: *Crocidura leucodon* and *Crocidura russula*. Their measurements are, however, obviously greater and approach those in *Crocidura zorzii* or *Crocidura robusta*. This is especially true of mandible No 1, exception-



Table IV

*Crocidura* sp., dimensions of mandibles

Specimen No	Vivian Vault											
	1	2	3	4	5	6	7	8	9	10	11	12
Total length of mandible	13.8											
Cardinal length of mandible	11.7											
Height of coronoid process	5.76											
Length of I — M <sub>3</sub>	9.1											
Length of M <sub>1</sub> — M <sub>3</sub>	4.75	4.39		4.32		4.43	4.64					
Height of mandible below M <sub>3</sub>	2.08	1.62	1.65	1.80	1.65	1.62	1.94	1.72	1.65	1.80	1.58	1.54
Thickness of mandible below M <sub>2</sub>	1.1	1.0	1.0	1.0	0.9	1.0	1.1	1.1	1.0	0.9	1.0	0.9

ally large and robust. As the material from the Vivian Vault lacks a skull, which is essential in identifying species of *Crocidura*, and owing to the difficulties in the determination of the specific membership of a specimen on the basis of its mandible alone, the remains studied have been referred to *Crocidura* sp. The characters of the mandible given by HELLER in his description of *Crocidura robusta*, i. e., the more upright ascending ramus of the mandible and the top of the coronoid process without a bend to the rear, are very variable in the contemporary species and for this reason cannot surely be taken into consideration.

The finding of *Crocidura* sp. in Tornewton Cave provides evidence on the fact that in the Pleistocene its range was shifted far to the north and included also the British Isles.

Family *Erinaceidae* BONAPARTE, 1838

Subfamily *Erinaceinae* GILL, 1872

Genus *Erinaceus* LINNAEUS, 1758

*Erinaceus europaeus* LINNAEUS, 1758

Material. Mandibular fragment with M<sup>1</sup>.

Systematic position. The shape and measurements of this fragment refer it to the species *Erinaceus europaeus*.

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## STRESZCZENIE

Praca zawiera opis szczątków *Insectivora* znalezionych w Tornewton Cave, położonej w dolinie Torbryan, niedaleko Denbury w Devonie (Anglia). Osady tej jaskini datowane są na przedostatnie i ostatnie zlodowacenie oddzielone okresem ciepłym. Większa część opisanego w pracy materiału znaleziona została poza głównym profilem osadów, w małej komorze nazwanej Vivian Vault. Stratygrafia tej części jaskini nie jest jasna, a fauna jest prawdopodobnie mieszaniną z różnych okresów. Materiał zawierał następujące gatunki: z Vivian Vault — *Sorex araneus* LINNAEUS, *S. minutus* LINNAEUS, *S. cf. minutissimus* ZIMMERMANN, *Neomys fodiens* (PENNANT), *Crocidura* sp. i *Erinaceus* LINNAEUS, z Reindeer Stratum — *Sorex minutus* LINNAEUS i z Rodent Layer — *Sorex araneus* LINNAEUS, *S. minutus* LINNAEUS i *Neomys fodiens* (PENNANT).

*Crocidura* WAGLER i *Sorex* sf. *minutissimus* nie obejmują swym współczesnym zasięgiem Wysp Brytyjskich i nie były tam dotąd znalezione w stanie kopalnym.

## РЕЗЮМЕ

Работа содержит описание остатков насекомоядных, обнаруженных в Торньютонской пещере, расположенной в долине Торбрайен, вблизи Денбери (Девон, Англия). Отложения этой пещеры датируются последним и предпоследним оледенениями, разделенными теплым периодом. Большая часть материала, однако, была обнаружена вне основного профиля отложений, в небольшой полости, названной Вивьен Волт. Стратиграфия этой части пещеры неясна, а фауна, вероятно, представляет собою смесь разновозрастных элементов. Собранный материал содержал следующие виды. Из Вивьен Волт — *Sorex araneus* LINNAEUS, *Sorex minutus* LINNAEUS, *Sorex* cf. *minutissimus* ZIMMERMANN, *Neomys fodiens* (PENNANT), *Crocidura* sp. и *Erinaceus europaeus* LINNAEUS; из горизонта с северным оленем (Reindeer Stratum) — *Sorex minutus* LINNAEUS; из слоя с грызунами (Rodent Layer) — *Sorex araneus* LINNAEUS, *Sorex minutus* LINNAEUS и *Neomys fodiens* (PENNANT).

*Crocidura* WAGLER и *Sorex* cf. *minutissimus* в своем современном распространении не обнимают Британских островов, и до настоящего времени не были оттуда известны в ископаемом состоянии.



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