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ART. 9. A RECENT FISSURE DEPOSIT IN
BEDFORD COUNTY, PENNSYLVANIA

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This paper is a report on a collection of vertebrate skeletal material recovered from the New Paris sink-holes. These fissures are located 1.5 miles northeast of New Paris, West St. Clair Township, Bedford County, Pa., on the property of Oscar Miller. Fig. 1.

The bone deposits were discovered by J. Howard Taylor of New Paris, Pa., who broke into the top of fissure (sink-hole) no. 2, then evidenced by a slight depression on the surface of the ground. Mr. Taylor made a small collection of elk bones which included the most interesting single specimen from the fissures, two elk vertebrae with an imbedded flint arrowhead. The locality was visited in February, 1932, by Charles E. Mohr, and reported on by him in Stone's "Pennsylvania Caves" (ed. 2, 1932) and "Descriptions of Pennsylvania's Undeveloped Caves" (1953). In April, 1948 a group composed of members of the Pittsburgh Explorers Club and the Pittsburgh Grotto, National Speleological Society, visited the area. Mr. Taylor led the group and volunteered valuable information about the site. As a result of this trip the major part of an elk skeleton was excavated and donated to Carnegie Museum. With the aid of a grant from the A. W. Mellon Educational and Charitable Trust, the Museum was able to institute field work at the site. Excavations were carried out during 1949 and 1950 under the direction of Dr. J. Leroy Kay. Actual field work was under the direction of Albert C. Lloyd. Oscar Miller not only granted the Museum permission to work at the site but also served as an active and enthusiastic member of the excavating party. The project is indebted to the Pittsburgh Grotto, National Speleological Society, whose members have put so much time and effort on it. Special thanks are due Albert H. Bauer, Ralph C. Bossart and John A. Leppla of Pittsburgh for their assistance in the excavation.

The writers would like to express their gratitude to Dr. J. Leroy Kay and Dr. J. Kenneth Doult for the privilege of studying the collection and for much helpful advice and assistance; to Neil D. Richmond, Curator of Amphibians and Reptiles, Carnegie Museum, for examining the snake remains; to George B. Thorp and Miss Lillian Heeren for the surveying and drafting of the map, respectively; and to Miss Caroline A. Heppenstall, Assistant Curator of Mammals, and Mrs. Alice M. Guilday for their assistance in the project.

A popular article concerning the fissures appeared in *Carnegie Magazine* (Guilday, 1948) and in 1955 a report upon the carnivores of the New Paris sink-holes by the junior author was submitted to the University of Pittsburgh in partial fulfillment of the requirements of a Master of Science degree, and is on file at the University of Pittsburgh library (Bender, [1955]).

The New Paris sink-holes treated in this report are a group of vertical limestone caverns. They occur in the Helderburg (lower Devonian) Limestone. It is not obvious whether the sink-holes are solution enlargements of

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structural rock joints or whether they were positioned by other factors, but the former seems more probable.

The Helderburg Limestone is exposed on the Schellsburg anticline (locally known as Chestnut Ridge) as a series of inliers which occupy the valley areas on the flanks of the anticline with low ridges between them. These inliers are surrounded by the outcropping Oriskany formations that form the high ground of the anticline.

Physiographically the New Paris sink-holes lie within the Ridge and Valley Province, just east of Allegheny Mountain. This mountain lies at the eastern boundary of the Allegheny Plateau. They are on the west flank of Chestnut Ridge, at an altitude of 1500-1600 feet. The immediate area of the fissures is well drained and covered with hardwoods. The surrounding areas are under cultivation. Biologically the area lies within a zone of transition between the Carolinian Biotic Province and the more northerly Canadian Biotic Province. (Dice, 1943). Gifford and Whitebread (1951) state that the Ridge and Valley section generally is difficult to assign to either of these two broad classes. They state (p. 18), "No groups of mammals were found that could be classed as either northern or southern. For the most part the mammals that occur together in any one locality here are determined by the availability of suitable habitats and the adaptability of the species."

The collection includes samples from three sink-holes, all geologically related but not in direct contact (See Fig. 1). Sink-hole no. 4 or "Lloyd's rock hole" is currently being excavated by the Pittsburgh Grotto, National Speleological Society, but, to date, the work has produced no fossil fauna.*
Sink-hole no. 1 or "Kantner's Sink".

Known as the "Round sink-hole". Excavated by the Museum party, this sink-hole proved unproductive and received only cursory attention. A small collection of small mammal bones was made.

Sink-hole no. 2 or the "Elk hole".

This was the original bone deposit discovered by Mr. Taylor and it was completely excavated by the Museum party. This sink-hole was not open to the surface at the time of discovery but was sealed by a cover of tree roots, dirt and organic debris. This fissure had an initial depth of 47 feet. Excavations were carried to a further depth of 12 feet at which point the bone deposit was flooded by ground-water and operations ceased. The bulk of this report concerns the collection from this fissure.

Sink-hole no. 3.

A small collection of both large and small mammal bones from this fissure was donated by members of the Pittsburgh Grotto, National Speleological Society, and the Pittsburgh Explorers Club. This was augmented by collections made by Arnold D. Lewis, Allen D. McCrady and the senior author of this paper, prior to the Museum excavations. This material was picked up on or close to the surface of the rock debris at the bottom of the fissure in two areas—one at the bottom of the first landing (approximately 50 feet) and the other at the bottom of the sink-hole (87 feet). The contemporaneity of these two deposits was indicated by the finding of frag-

*Since the above was written, an extensive Pleistocene fauna has been recovered from sink-hole no. 4, and is currently under study.

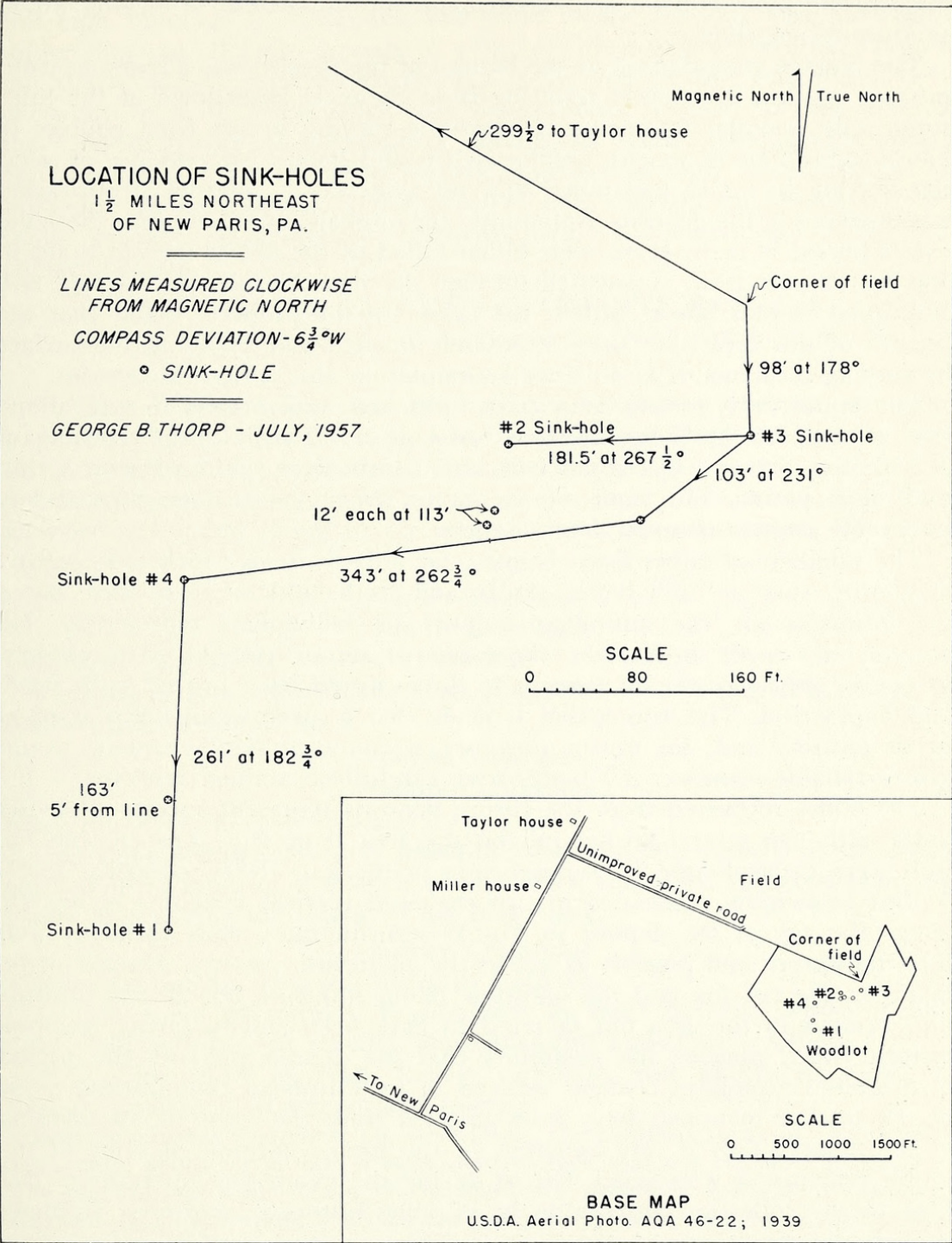


Fig. 1. Maps showing location of New Paris sink-holes

Main map gives detailed compass directions for individual sink-holes. Insert map gives general location of sink-holes described in this article. To reach the point marked Miller house, proceed north on Route 96, 0.3 mile from intersection in center of New Paris, take right fork (NE.) for 0.3 mile, turn right (SE.) 0.1 mile, turn left (NE.), continue straight 0.45 mile to Miller house.

ments of the same black bear skull at both levels. This fissure was not excavated and more skeletal material remains but any extensive digging would produce a rock slide.

The bone-bearing deposit at the bottom of the fissures was a heterogeneous mixture of clay, apparently resulting from chemical breakdown of the limestone walls, angular fragments of limestone varying in size from pebbles to blocks many tons in weight, organic debris and bones. No evidence of selective sorting by water was noted and no evidence of internal stratification was observed in the deposits. Apparently the animals blundered into the holes over a period of many years; were either killed by the fall or starved to death and the deposit grew, augmented through the years by falls of rock, soil and additional victims. Oscar Miller, the owner of the property, states that the fissures of this area have been alternately opened and closed to the surface by varying accidents of forest litter accumulation and periodical cave-ins.

The bones were, for the most part, unbroken, well preserved, and in the case of some of the skeletons from sink-hole no. 2 still lay in attitudes of articulation. Some of the bones from this fissure were spattered with a thin calcareous patina, but none of the bones from the fissures showed any noticeable degree of mineral replacement.

The numbers of bones listed below refer only to items which were readily diagnostic; such as limb bones, skulls, and teeth, and on these were based the estimates for the minimum number of individuals represented. No attempt was made to list the thousands of minor skeletal parts present, except in special cases. To attempt to do so would have proved both futile and impractical. The assumption is made that a given animal was trapped in its entirety and, for census purposes, a count of skull elements would give a reliable estimate. *All* bones were carefully examined however.

The bones recovered from the fissure deposits represent species all living today, although several do not inhabit the area at present. The elk and the wolf were exterminated in Pennsylvania in the late 1800's (Rhoads, 1903). A flint arrowhead, embedded in two coalesced cervical vertebrae of an elk, places the age of the deposit in Post-Wisconsin times, most probably well into the Recent and possibly as late as the eighteenth century. Absence of remains of the red fox and the opossum (from sink-hole no. 2), two animals now present in the area but believed to have been absent during late prehistoric times, suggests the possibility that the deposit predates the period of profound ecological changes ushered in by European colonization. Some of the smaller mammals have been trapped since the most recent opening of the fissure. This is very apparent in the fresh condition of some of the rabbit remains. A woodchuck fell in during the excavating operations. The bulk of the collection appears to be of some historical antiquity, although geologically recent.

There are 67 forms of mammals representing 47 genera recorded from Bedford County within recent times. (Gifford and Whitebread, 1951). By comparison, 26 species of 25 genera were found in the fissure.

While the animals recovered from the fissures in no way represent an adequate cross-section of the total mammalian fauna within the area during historic times, they do offer important clues to the environment of that area during the time the fissure traps were in operation. Remains of such

forms as the flying squirrel, red squirrel, gray squirrel and porcupine, and the high numbers of chipmunk and pine mouse remains (See discussion under *Pitymys*) all point directly to a former forest cover. The total fauna is one that would be expected in the area at the present day, with the obvious exception of those forms which were exterminated by man. In this instance the forested nature of the country during the recent past is well known and the fact comes as no great surprise, but it does serve to strengthen the reliability of fossil faunas as indicators of past climatic and ecologic conditions, provided the habitat requirements of the component species are well enough known.

ANNOTATED LIST OF VERTEBRATE REMAINS

(Unless otherwise noted, all specimens are from sink-hole no. 2)

AMPHIBIANS

Remains of three large toads, *Bufo* sp., represented by tibiotarsi and skull fragments. These agreed closely with specimens of *Bufo americanus* used for comparison and are probably referable to that species.

Two tibiotarsi were referred to the genus *Rana*. The wood frog *Rana sylvatica* was found living in the sink-hole and the surrounding woodland.

REPTILES

Order *Chelonia*

Family *Emydidae*

Box turtle. *Terrapene carolina* (Linnaeus)

Remains of four individuals. Shell fragments of one individual were recovered from sink-hole no. 3.

Order *Serpentes*

Family *Colubridae*

Black rat snake. *Elaphe obsoleta* Say

One right maxilla, one left mandible and vertebra could not be distinguished from those of a 52-inch female black rat snake collected from the fissure area during the course of the field work.

Family *Crotalidae*

Timber rattlesnake. *Crotalus horridus* Linnaeus

At least three individuals. Represented by skull elements which include three right and one left maxilla, mandibles and numerous vertebrae.

The unidentified material, largely vertebrae, was kindly examined by Neil D. Richmond who reports as follows:

Most of the snake vertebrae are *Crotalidae*. These appear to be of two types—a light, more delicate type and a large massive type that are referable to *Crotalus*. The maxilla and other bones of the skull are definitely referable to *Crotalus*. Whether the more delicate vertebrae are young *Crotalus* or are those of *Ancistrodon* (copperhead) can not be determined with the material at hand.

The most numerous Colubrid vertebrae are those of *Coluber*. The vertebrae from the sinks agree in minute detail with Pennsylvania *Coluber constrictor* skeletons.

One lot of several vertebrae agrees with *Elaphe*.

Two lots of vertebrae, apparently of quite different ages as one is discolored by iron salts, agree with *Heterodon* (hog-nosed snake).

Several small Colubrid vertebrae have been left unidentified as they were not found together and are probably anterior thoracic vertebrae of one of the other Colubrid snakes.

BIRDS

Order *Strigiformes*Family *Strigidae*

Great horned owl. *Bubo virginianus*

One partial skeleton.

Unidentified. Partial skeleton of one small perching bird.

MAMMALS

Order *Marsupialia*Family *Didelphiidae*

Opossum. *Didelphis marsupialis virginiana* Kerr

No opossum remains were recovered from sink-hole no. 2. One skull and one cervical vertebra of an adult opossum were picked up from the superficial deposits in sink-hole no. 3. It should be noted that the latter fissure had been open to the surface at the time of discovery. The opossum is a recent addition to the fauna of Pennsylvania. With the opening up of the country and the removal of much of the primeval forest the opossum spread to the north. It is a common animal in Bedford County today but was rare or absent during prehistoric times. Parker (1953) reports the finding of an opossum "in an advanced state of putrification" in one of the fissures subsequent to the Museum excavations.

Order *Insectivora*Family *Soricidae*

Long-tailed shrew. *Sorex* sp.?

At least three individuals.

Short-tailed shrew. *Blarina brevicauda* (Say)

At least 31 individuals represented by 74 skull and mandible fragments.

Family *Talpidae*

Hairy-tailed mole. *Parascalops breweri* (Bachman)

One right clavicle and one right humerus.

Order *Chiroptera*Family *Vespertilionidae*

Little brown bat. *Myotis* sp.?

At least three individuals.

One bat skull, without mandibles, from sink-hole no. 3, was identified by Dr. J. Kenneth Doult as *Myotis*, probably *lucifugus*.

Bat. species?

At least two individuals.

Order *Lagomorpha*Family *Leporidae*

Cottontail rabbit. *Sylvilagus floridanus* (J. A. Allen)

Two complete skulls. In addition, one complete skull from sink-hole no. 3; this appeared to be extremely recent in origin compared with other bones from the same fissure.

New England cottontail rabbit. *Sylvilagus transitionalis* (Bangs)

One complete skull and one pair of frontal bones seem to be referable to this species. Both are of adult animals and in both the supraorbital processes agree in size and shape with those of the *transitionalis* skulls used for comparison. In addition, two complete skulls from sink-hole no. 3 are referred to this species.

Cottontail rabbit. *Sylvilagus* (either *floridanus* or *transitionalis*)

At least 13 individuals represented by 48 skull and jaw fragments, plus 87 postcranial bones and fragments. Seven mandibles, five skull fragments, and 34 postcranial bones from sink-hole no. 3.

There is some evidence that *S. transitionalis* was the only form of the cottontail rabbit present in Bedford County during prehistoric times (Rhoads, 1903). Subsequent destruction of suitable habitat within the area has reduced its former range. The New England cottontail is now rare and local in Bedford County (Gifford and Whitebread, 1951, p. 31).

Order *Rodentia*

Family *Sciuridae*

Woodchuck. *Marmota monax* (Linnaeus)

At least eight individuals represented by four skulls, 13 disassociated lower jaws and 23 postcranial bones. During the period of excavation a woodchuck was found dead at the bottom of the fissure. It is preserved as a study specimen in the Section of Mammals, Carnegie Museum. Two mandibles and seven postcranial bones from sink-hole no. 3.

Chipmunk. *Tamias striatus* (Linnaeus)

At least 109 individuals, represented by 139 skulls and skull fragments, 215 mandibles and 553 postcranial bones. This was the commonest mammal encountered in the deposit. One right mandible was recovered from sink-hole no. 3.

Gray squirrel. *Sciurus carolinensis* Gmelin

Two skulls are certainly this species. Four skull fragments, six mandibles and 15 postcranial bones are referred on the basis of size. A total of four individuals is represented.

Red squirrel. *Tamiasciurus hudsonicus* (Erxleben)

One complete skull from sink-hole no. 3.

Flying squirrel. *Glaucomys volans* (Linnaeus)

At least 10 individuals, represented by 27 skull and mandible fragments and 50 postcranial bones. It is conceivable that the northern flying squirrel, *Glaucomys sabrinus* (Shaw), could be represented as well in this collection. It has been taken as close as 56+ miles at McGees Mills, Clearfield County, Pa. (Roslund, 1951). All of the flying squirrel bones from the fissure agree in size with specimens of *Glaucomys volans*, but the skeletal differences between the two species are too subtle to permit an accurate specific identification of the more or less fragmentary material. *Glaucomys sabrinus* has not been taken in the Ridge and Valley Section of Pennsylvania to date (Gifford and Whitebread, 1951).

Family *Cricetidae*

White-footed mouse. *Peromyscus* sp.?

At least 28 individuals represented by 74 fragments of skull and mandibles. The species is undoubtedly either *Peromyscus leucopus* (Rafinesque) or *Peromyscus maniculatus* (Wagner). An additional mandible was recovered from sink-hole no. 3.

Lemming vole. *Synaptomys cooperi* Baird

One individual, represented by a skull and associated lower jaws.

Meadow vole. *Microtus pennsylvanicus* (Ord)

Three individuals represented by three skulls.

Pine vole. *Pitymys pinetorum* (LeConte)

Fifty-one individuals, represented by 48 skulls, four additional skull fragments and three mandibles.

Remains of small mammals are generally assumed to be more reliable indicators of past environmental conditions than are those of the more widely ranging larger mammals (Hibbard, 1955, p. 200). The high percentage of pine vole remains and the low percentage of meadow voles is interesting. The pine vole is much more of a burrowing animal than is the meadow vole and appears to be limited to areas of loose friable soils irrespective of the type of ground cover. In the mountainous areas of Pennsylvania it is local in distribution and more commonly met with in heavily wooded areas than is the meadow vole which prefers a more open meadow habitat and is rarely taken by the collector in wooded areas. These requirements are approximations of optimum habitats and in periods of high vole abundance may have lessening significance. The ratio of 17:1 (51 *Pitymys*, 3 *Microtus*) in favor of the pine vole reflects the forested nature of the area during the time the sink-holes were open to the surface. Both of these rodents are present in Bedford County today, *Microtus* being the more common, but the amount of woodland is drastically different now from what it was in prehistoric times. In 1945 only 35.8% of Bedford County was classed as forested (Gifford and Whitebread, 1951).

Meadow mouse or pine mouse. *Microtinae* sp.?

Ninety-six mandibles and three skull fragments were either too fragmentary or had lost too many teeth to permit a satisfactory identification closer than subfamily. Most of the mandibles undoubtedly belong to the skulls listed above as *Pitymys pinetorum*. One Microtine mandible was recovered from sink-hole no. 3.

Muskrat. *Ondatra zibethicus* (Linnaeus)

Remains of at least one individual, represented by one skull and four postcranial bones from sink-hole no. 3.

Musk rats wander widely at times. The hilly nature of the sink-hole area is and was entirely unsuitable as muskrat range. This was undoubtedly a chance inclusion of a stray animal and has no bearing upon the past environment of the fissure area.

Family *Erethizontidae*

Porcupine. *Erethizon dorsatum* (Linnaeus)

At least two individuals represented by one skull, four mandibles and 12 postcranial bones. At least five individuals represented by two skulls, seven mandibles (two left, five right), 10 isolated teeth and 13 postcranial bones from sink-hole no. 3.

Order *Carnivora*

Family *Canidae*

Timber wolf. *Canis lupus lycaon* Schreber)

Two individuals, both adult but varying somewhat in size, were recovered. The bones were badly shattered and the remains of the two wolves were intermingled. The fragmentary skeletons were found immediately beneath an articulated, undamaged elk skeleton.

Gray fox. *Urocyon cinereoargenteus* (Schreber)

One adult and four pups, possibly litter mates. Represented by two skulls, two skull fragments, eight mandibles and eight postcranial bones. At least one individual (adult) represented by six fragments, from sink-hole no. 3.

Family *Ursidae*

Black bear. *Euarctos americanus* (Pallas)

One partial skull and associated teeth. This was a young animal, still retaining the milk dentition and with open sutures. In sink-hole no. 3 a right mandible, a right maxilla, and one right humerus of a large and, judging from the amount of tooth wear, very old black bear.

Family *Procyonidae*

Raccoon. *Procyon lotor* (Linnaeus)

One upper molar and one partial right mandible of an immature animal.

Family *Mustelidae*

New York weasel. *Mustela frenata* Lichtenstein

One skull and one left mandible. Judging from its large size this specimen was a male.

Striped skunk. *Mephitis mephitis* (Schreber)

At least five individuals (four adult and one juvenile) represented by four skulls, five mandibles and 11 postcranial bones. In addition, three postcranial bones from sink-hole no. 3.

Order *Artiodactyla*

Family *Cervidae*

Elk. *Cervus canadensis canadensis* (Erxleben)

Two articulated skeletons were found. The posterior half of a skull bearing the antler bases, several segments of antler, a humerus and two cervical vertebrae were found by J. Howard Taylor of New Paris, Pa., during his original investigations of the fissure. The remaining bones of the same skeleton were recovered by the members of the Pittsburgh Grotto, National Speleological Society. Both collections are now at Carnegie Museum. This was an adult male. Although the antlers were fragmentary, enough remains to show they were of some size and were firmly attached to the skull at the time of death. The antlers were broken from the skull at a point out on the antlers themselves, not at the pedicel where natural shedding occurs. With the exception of the antlers, which were badly rotted, the skeleton was in an excellent state of preservation. The following bones were missing: premaxillae; left maxilla and tooth row; nasals; palate; zygoma; cervical vertebrae, numbers one, two and four; thoracic vertebrae, number one; caudal vertebrae, all missing; 12 phalanges; all "dew claws"; ribs number 11, 12 and 13; two fibulae; right metatarsal; right patella; left radius; left metacarpal; all carpals and hyoids. Cervical vertebrae numbers six and seven were completely coalesced as a result of regenerative processes involved in the healing of what must have been a severe arrow wound. The flint arrowhead, with its base broken off, was embedded at the base of the left transverse process of the sixth cervical. The animal apparently survived and the wound had completely healed. The arrowhead was so extensively enveloped in new bone tissue that it can not be removed without destroying some of the vertebra itself. An x-ray of the specimen, taken by Dr. J. Kenneth Doult and

Dr. E. G. Meisel, yielded no additional information. Mr. Taylor is to be congratulated for his efforts to preserve this unique and important specimen as well as for his generosity in presenting it to Carnegie Museum.

The specimen is illustrated in Fig. 2.

The second skeleton, that of a doe, was found by A. C. Lloyd of the Museum field party. It was a more nearly complete skeleton than that of the bull. Its skull, protected from crushing by the surrounding rocks, was recovered intact.

Elk remains were also recovered from sink-hole no. 3. These were disarticulated, represented parts of more than one individual and in some cases were badly shattered. They include the following: 4 upper molars, 3 upper premolars, sacrum, 13 vertebrae, 7 ribs, 2 sternal ribs, 3 sternbrae, 1 pelvis, 2 femora, 2 tibiae, 2 metatarsals, 2 humeri, 2 radii, 2 ulnae, various carpals, tarsals and phalanges. Also a large number of bones of a very young elk fawn, including a complete but disarticulated skull.

White-tailed deer. *Odocoileus virginianus* (Boddaert)

Remains of three individuals, presumably two antlered bucks and one fawn. Represented by five skull fragments, three broken antlers and 14 post-cranial bones. In addition, a right tibia, a patella, fragmentary scapula, teeth and sacrum of apparently one adult, as well as one right mandible of a fawn were recovered from sink-hole no. 3.

There is ample evidence in Pennsylvania and neighboring states for cave deposits dating from the Pleistocene (Hay, 1923). While the fauna recovered to date from the New Paris fissures is recent and of no geological antiquity, it is possible that further prospecting along Chestnut Ridge (Bedford County) would be profitable. The area is rife with fissures and it is possible that some of them might contain the fossil remains of Pleistocene mammals.

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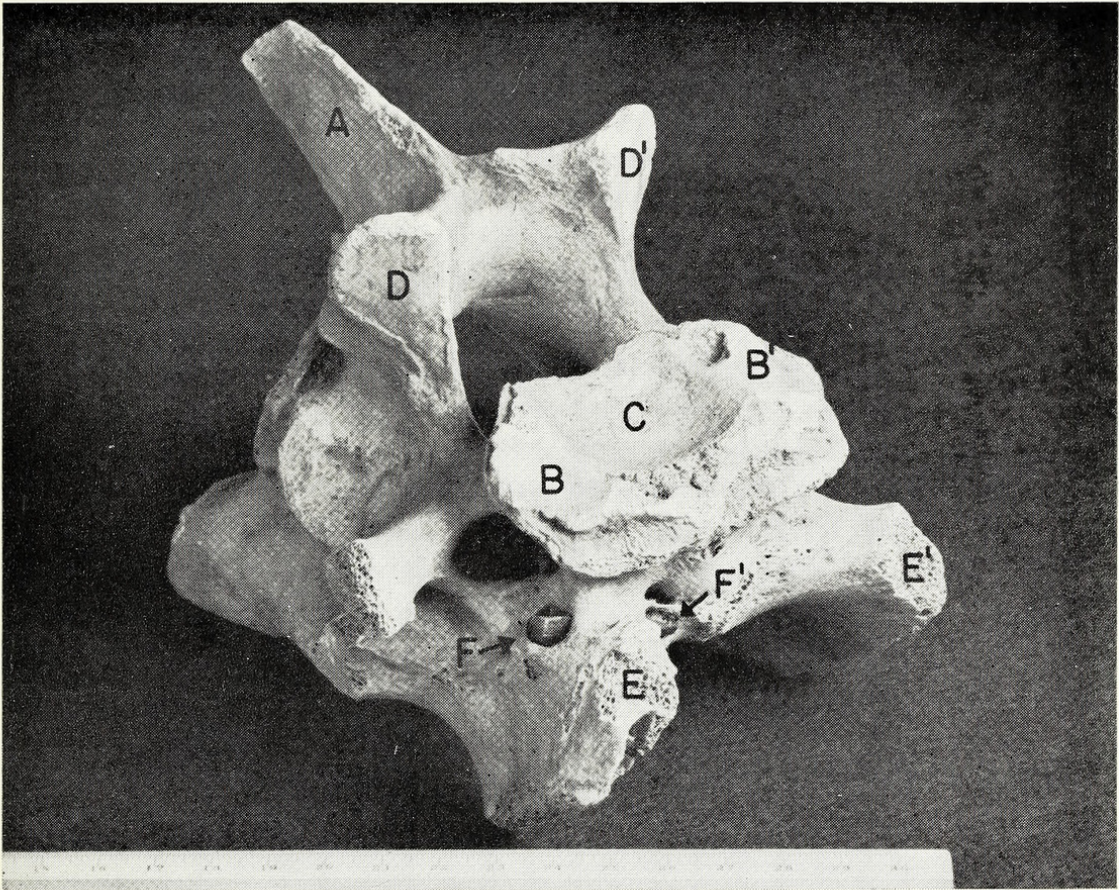


Fig. 2. Sixth and seventh cervical vertebrae of an adult male elk (*Cervus canadensis*), showing embedded arrowhead

A. Spinous process, 7th cervical. B, B'. Demifacets for the 1st ribs. C. Centrum of 7th cervical. D, D'. Postzygapophyses, 7th cervical. E, E'. Transverse process, 6th cervical. F. Embedded arrowhead. F'. Tip of arrowhead.

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