

ON THE TRAIL OF AN IMPORTANT ICE AGE FOSSIL DEPOSIT

*Rediscovering the
Port Kennedy Cave
(Middle Pleistocene),
Valley Forge
National Historical Park,
Montgomery County,
Pennsylvania*

By Edward B. Daeschler, Matthew C. Lamanna, and Margaret Carfioli

INTRODUCTION

During the late 1800s a treasure trove of Ice Age fossils was uncovered by limestone quarrying operations at Valley Forge, Pennsylvania. The fossil site, known as Bone Cave or Port Kennedy Cave, was formed in the Irvingtonian stage of the Pleistocene epoch (approximately 750,000 years ago). In a series of important early scientific papers, C. M. Wheatley (1871), E. D. Cope (1871, 1895, 1896, 1899), H. C. Mercer (1895, 1899), and others described plant, insect, turtle, snake, bird, and numerous mammal fossils from the deposit, including several that were new to science. The Port Kennedy Cave is now recognized as one of the most significant Middle Pleistocene vertebrate fossil localities in North America (Kurten and Anderson 1980, Daeschler et al. 1993).

The Port Kennedy Cave was actually a vertical solution cavity in Paleozoic limestone that was briefly opened to the surface, forming a sinkhole in the forested Pleistocene landscape. Plant and rock debris accumulated in the shaft along with the remains of hundreds of animals that were trapped or carried to the edges of this sinkhole by predators (Daeschler 1996). Fauna from the site include giant ground sloth, mastodon, tapir, peccary, skunk, short-faced bear, saber-toothed cat, and many other taxa (fig. 1). Site excavations by Wheatley, Cope, and Mercer in the early 1870s and mid-1890s resulted in the collection of more



Figure 1. Partial skull of *Smilodon gracilis* from the Port Kennedy Cave, Valley Forge National Historical Park, Montgomery County, Pennsylvania. This gracile saber-toothed cat was first described by paleontologist Edward Drinker Cope from material collected at the Port Kennedy Cave. The reconstructed skull length is about 12 inches. TED DAESCHLER, ACADEMY OF NATURAL SCIENCES

than 1,200 fossils, which today are curated in the vertebrate paleontology and paleobotany collections at the Academy of Natural Sciences in Philadelphia.

Although the fossiliferous deposit was never exhausted (see fig. 2, page 32), excavation of the Port Kennedy Cave ceased in 1896 because of groundwater inrush that prevented further work (Mercer 1899, Witte 1957). Then in the early 20th century, the limestone quarry containing the fossil site was filled with asbestos-containing waste materials from the nearby Ehret Magnesia Manufacturing Company. The filling of the quarry and the passage of time have combined to obscure the exact location of this important fossil site, including which of at least three possible quarries holds the site.

At the behest of the Valley Forge National Historical Park, which now encompasses the land containing the fossil deposit, we conducted a study to determine, with as much precision as possible, the location of the Port Kennedy Cave. Rediscovery of this lost site is of great interest to Valley Forge National Historical Park and the scientific community.





FIG. 11.—THE PORT KENNEDY DORE CAVE.

East and west cross-section of the south end of Erwin's quarry (not drawn to scale for the sake of clearness), showing in the shaded parts A, B, C, D the probable original shape, size and relative position of the cavern. The continuous dotted line shows the area of rock and debris, and a portion of the original cave at present removed by the blasting and excavation of limestone at the quarry.

The lined shading of A shows the probable portion of the contents of the cavern removed by Wheatley in 1871.

The lined shading of B shows the part of the contents of the cavern removed by Dr. Dixon and Mr. Rhoads in 1874.

The cross shading of C C shows that part of the contents of the cavern removed by ourselves in 1884, '85, '86.

The dotted shading of D, D, D shows the position of the contents of the cavern still remaining at the site.

The lowest continuous dotted line marking the quarry floor is at the level of the scabbling river. The excessive and increasing influx of water at the point marked by the lower letter C, threatening danger to the quarry, prevented further digging in 1886.

Figure 2. This drawing (from Mercer 1899) illustrates a cross section through the fossiliferous fissure known as Port Kennedy Cave, source of more than 1,200 specimens of Middle Pleistocene fossils. Limestone excavation during the late 1800s exposed the fossil deposit first in 1871 and again in 1894.

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Using the evidence gathered for this project we attempted to answer two questions. First, because several former limestone quarries exist in the search area, we focused on information useful for the identification of the particular quarry containing the Port Kennedy Cave deposit. Once the quarry was tentatively identified, we then attempted to determine the position of the Port Kennedy Cave within the quarry.

RESULTS

The scientific literature on fossils from the Port Kennedy Cave consists of 15 scientific accounts spanning the years 1871 to 1996. The National Park Service included an account of the Port Kennedy Cave in a report on paleontological resources associated with caves in the National Park System (Santucci et al. 2001). Popular accounts and correspondence dealing with the Port Kennedy Cave span a period from

METHODS

Information pertaining to the location of the Port Kennedy Cave was gathered from scientific papers, newspaper and magazine articles, maps, field notes, photographs, and correspondence. We examined material archived at several Pennsylvania institutions, most important of which was the Spruance Library of the Bucks County Historical Society in Doylestown. During visits to the old limestone quarries near the village of Port Kennedy in Valley Forge National Historical Park, we surveyed the landscape, investigated the geology, and examined the size and shape of the principal quarry sites. At that time we were able to compare present-day geological and landscape features with those in several archival photos taken of the Port Kennedy Cave and vicinity during excavation (see fig. 3).

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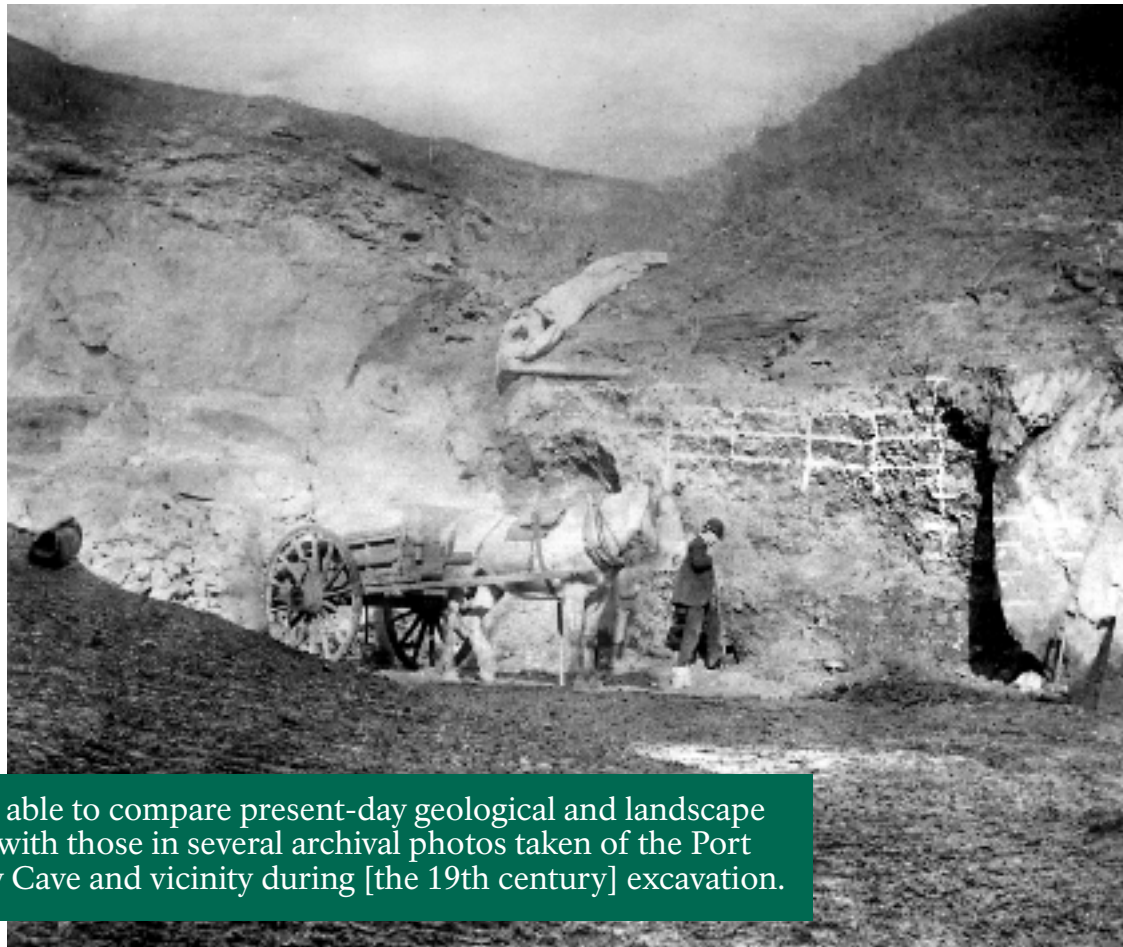


Figure 3. This old photo shows Port Kennedy Cave circa 1894 during excavation of the fossiliferous fissure fill (marked with a grid for recording the location of fossils). Note the upper part of the quarry wall in the left background where bedding of the Triassic shale is visible overlying the limestone.

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1848, when limestone caverns in the area received attention as a scenic wonder, to the present. These sources provide an abundance of general verbal descriptions of the site. For example, Mercer (1899) states that the quarry was located “on the right bank of the Schuylkill [River] two miles below Valley Forge” and “had transformed a gently sloping hillside into an amphitheater several acres in extent.” Hay (1923) determined that it was “about 800 feet away from the [Schuylkill] river and facing the valley of an unnamed streamlet.” These are typical descriptions from published sources and it is clear that many 20th century reports simply restated earlier accounts. Thus, the scientific and popular accounts of the Port Kennedy Cave provide valuable information, although none of it is specific enough to determine the quarry’s location with confidence.

Our search of library archives succeeded in producing more definitive information regarding the location of Port Kennedy Cave. Particularly important were the field notes of Henry Chapman Mercer during the period 1894–1896 when he directed excavations at the site. In his notebook are firsthand descriptions and sketches of the quarry and fossil deposit, including their dimensions. Along with this field notebook from the Spruance Library at the Bucks County Historical Society, we also located several photographs of the Port Kennedy Cave excavations circa 1894.

In our survey of the former limestone quarries near Port Kennedy we were able to match Mercer’s quarry illustration with the shape and dimensions of one of the old quarry sites. We were also able to examine the geological features in the background of the old photos (see fig. 3 for an example) and match them to a unique geological feature in the eastern end of the same quarry. This feature, an unconformity between the Cambrian-period Ledger Formation and the Triassic-period Stockton Formation, is uniquely well exposed in this location. Additionally, early illustrations of the Port Kennedy Cave (see fig. 2 for an example) clearly indicate red shale directly overlying the limestone at the site where the cave was located. Further evidence of the proximity of the site to this geological boundary comes from early accounts of the excavation indicating that the fill within the solution cavity included a large amount of the Triassic rock that had collapsed into the sinkhole. This suggests that the sinkhole was overlain by the shale.

The general descriptions from published accounts of the site, in combination with specific information from Mercer’s notebook and images, allowed us to exclude all but one of the possible quarries from consideration. We

concluded that the aptly named Cave Quarry contains the Port Kennedy Cave because it fits all of the descriptions and uniquely matches the physical and geological setting.

Interestingly, our research confirmed what had been conventional wisdom about the quarry containing the Port Kennedy Cave (Wiswall 1993, McCarthy 1994) but, more importantly, provided documentation and a level of confidence that was previously lacking. With the quarry identified, we then needed to determine the location of the relatively small fossiliferous fissure within the 2-acre (0.8-ha) quarry.

Mercer’s sketches from his field notebook confirmed that the fossil-bearing fissure was toward the easterly wall of the quarry and facing west. Additionally, Mercer’s notes revealed that the Port Kennedy Cave was in shade in the morning but in sunlight in the afternoon, thus located near the eastern margin of the quarry and facing west. Finally, Mercer’s notebook provided distances (in paces) between the fossil deposit and other features, some of

which still exist at the site, allowing us to triangulate the position of the fossil deposit within the quarry. Therefore, we were able to provide a good estimate of its location despite the fact that the unexcavated site is now buried in the floor of the abandoned quarry and covered by 30–40 feet (9–12 m) of fill materials.

With the location of the Port Kennedy Cave within Cave Quarry tentatively determined from the literature, Valley Forge National Historical Park could now make informed decisions relating to this resource. A study utilizing noninvasive technology to confirm the location, depth, and extent of the unexcavated deposit was undertaken in 2004 and, sure enough, the presence of the cave was revealed (see sidebar, page 35)! We now know that the unexcavated deposit is safely preserved in situ beneath the fill of asbestos-containing materials that currently covers it.

The Port Kennedy Cave has local and national significance and beckons exhibition, interpretive programming, and further research. The Academy of Natural Sciences welcomes and encourages the scientific study of its fossil collection from the site.

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CONCLUSIONS

Literary detective work involving careful review of scientific and popular accounts of Port Kennedy Cave, as well as correspondence relating to the site, furnished

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important clues for this research. Information from field notes, photographs, and interpretation of the geological setting provided the crucial evidence. The combination of these various sources of information allowed us to make a deter-

mination of the location of the Port Kennedy Cave with a high degree of confidence, and our work was confirmed with the use of modern exploratory technology. The management and interpretation of this unique resource within Valley Forge National Historical Park can now be accomplished on the basis of a thoroughly researched library of information.

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First and foremost, we recognize Mr. Brian Lambert, who initiated this project but passed away unexpectedly in November 2003 before the final report was complete. Brian was deeply dedicated to Valley Forge National Historical Park, and the Port Kennedy Cave fascinated him. He provided help and encouragement for our work and was always eager to learn and communicate the story of this interesting chapter in the history of the region. We also would like to acknowledge Ms. B. Lander of the Spruance Library at the Bucks County Historical Society. Mr. A. Shabel of the University of California at Berkeley visited the quarry with us and was part of useful discussions concerning the project. This study was supported by the National Park Service under cooperative agreement CA4560C0046.

LITERATURE CITED

- Cope, E. D. 1871. Preliminary report on the Vertebrata discovered in the Port Kennedy bone cave. *Proceedings of the American Philosophical Society* 12:73–102.
- Cope, E. D. 1895. The fossil Vertebrata from the fissure at Port Kennedy, Pennsylvania. *Proceedings of the Academy of Natural Sciences of Philadelphia* 47:446–450.
- Cope, E. D. 1896. New and little known Mammalia from the Port Kennedy bone deposit. *Proceedings of the Academy of Natural Sciences of Philadelphia* 48:378–394.
- Cope, E. D. 1899. Vertebrate remains from Port Kennedy bone deposit. *Journal of the Academy of Natural Sciences of Philadelphia* 11:193–267.

- Daeschler, E. 1996. Selective mortality of mastodons (*Mammuth americanum*) from the Port Kennedy Cave (Pleistocene; Irvingtonian), Montgomery County, Pennsylvania. Pages 83–96 in K. M. Stewart and K. L. Seymour, editors. *Palaeoecology and palaeoenvironments of Late Cenozoic mammals*. University of Toronto Press, Toronto.
- Daeschler, E., E. E. Spamer, and D. C. Parris. 1993. Review and new data on the Port Kennedy local fauna and flora (Late Irvingtonian), Valley Forge National Historical Park, Montgomery County, Pennsylvania. *The Mosasaur* 5:23–41.
- Hay, O. P. 1923. The Pleistocene of North America and its vertebrated [sic] animals from the states east of the Mississippi River and from the Canadian provinces east of longitude 95°. Publication 322. Carnegie Institute of Washington, Washington, D.C.
- Kurten, B., and E. Anderson. 1980. *Pleistocene mammals of North America*. Columbia University Press, New York.
- McCarthy, C. 1994. The case of the disappearing cave. *Lapidary Journal* 47(10):55–56, 58, 60, 126–129.
- Mercer, H. C. 1895. A preliminary account of the re-exploration in 1894 and 1895 of the "Bone Hole," now known as Irwins' Cave, at Port Kennedy, Montgomery County, Pennsylvania. *Proceedings of the Academy of Natural Sciences of Philadelphia* 47:443–446.
- Mercer, H. C. 1899. The Bone Cave at Port Kennedy, Pennsylvania, and its partial excavation in 1894, 1895, and 1896. *Journal of the Academy of Natural Sciences of Philadelphia* 11:269–286.
- Santucci, V. L., J. Kenworthy, and R. Kerbo. 2001. An inventory of paleontological resources associated with National Park Service caves. Technical Report NPS/NRGRD/GRDTR-01/02. National Park Service, Lakewood, Colorado.
- Wheatley, C. M. 1871. Notice of the discovery of a cave in eastern Pennsylvania, containing remains of Post-Pliocene fossils, including those of mastodon, tapir, megalonyx, mylodon, etc. *The American Journal of Science and Arts* 1(4):235–237.
- Wiswall, C. G. 1993. *Valley Forge National Historical Park*. Commonwealth of Pennsylvania, Topographic and Geological Survey, Harrisburg, Pennsylvania.
- Witte, W. H. 1957. The 1896 excavation of Port Kennedy Cave Pennsylvania and other recollections. *Netherworld News* 5(3):4.1–4.4.

ABOUT THE AUTHORS

Edward B. Daeschler is assistant curator in the Department of Vertebrate Zoology, Academy of Natural Sciences, 1900 Benjamin Franklin Parkway, Philadelphia, PA 19103-1195, daeschler@acnatsci.org. Matthew C. Lamanna is assistant curator in the Section of Vertebrate Paleontology, Carnegie Museum of Natural History, 4400 Forbes Avenue, Pittsburgh, PA 15213-4080, lamannam@cmnh.org. Margaret A. Carfioli is biological science technician, Valley Forge National Historical Park, P.O. Box 953, Valley Forge, PA 19482-0953, margaret_carfioli@nps.gov.

