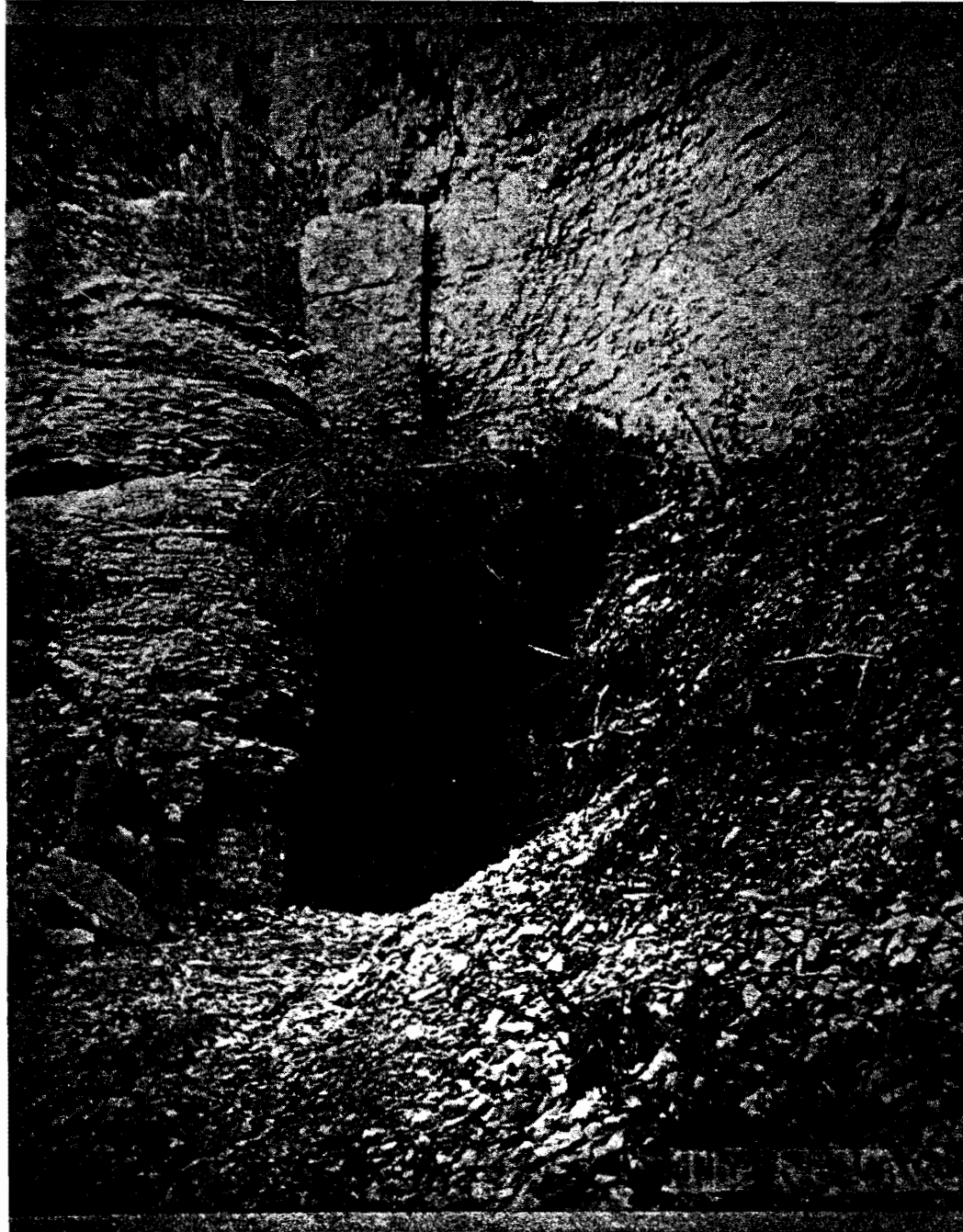


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THE ASSOCIATION

The American Spelean History Association is chartered as a non-profit corporation for the study, dissemination and interpretation of spelean history and related purposes. All persons of high ethical and moral character who are interested in these goals are cordially invited to become members. Annual membership is \$5.00; family membership \$6.00. Library subscriptions are \$4.00.

THE COVER

Entrance to the Decorah Ice Cave photographed by Hover and Wyer, of Decorah, Iowa, probably during the 1880's. Reproduced from a stereo view in the collection of James F. Quinlan.

THE JOURNAL

The Association publishes The Journal of Spelean History on a quarterly basis. Pertinent articles or reprints are welcomed. As a photo-offset process is used, the editor should be contacted in advance concerning the current type of manuscript preparation desired. Submission of rough drafts for preliminary editing is encouraged. Illustrations require special handling and arrangements must be made with the editor in advance.

BACK ISSUES

Some back issues are available of Volumes 1-6 from Dr. W.R. Halliday, 1117 36th Avenue E., Seattle, Washington 98102. All issues of Volumes 1-6 are available on microfiche from Kraus Reprint Company, Rt. 100, Millwood, New York 10546. Volumes 7 and 8 are available from the editor.

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EDITOR'S COLUMN

It has become increasingly obvious to me during the past two years that if I wish to pursue a career as an artist I would have to put aside some of my other activities. More than a year ago I informed the president of my intention to resign upon completion of Volume 8 of the journal. This is my last issue. I have tried to upgrade the quality of the journal and at the same time keep the cost within the budget. I think I have succeeded. This modest success has been attained with the invaluable assistance of and encouragement by Jim Quinlan, Harold Meloy, Charlie Larson, and Pete Hauer. To them I extend my appreciation and thanks.

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Additional Notes on the Decorah Ice Cave

JAMES HEDGES
and GEORGE KNUDSON

INTRODUCTION

Two portions of a study on the origin and history of the Ice Cave at Decorah, Iowa by George Knudson and James Hedges have recently been published in the Proceedings of the Iowa Academy of Science (Knudson and Hedges, 1973) and in the *Annals of Iowa* (Hedges and Knudson, 1975); a preliminary abstract previously appeared in this Journal (Hedges, 1972). This paper describes recent discoveries and presents material too specialized for inclusion in either of the previous reports.

The Decorah Ice Cave is the largest glaci re in North America east of the Black Hills, being slightly larger than the Carlisle Center Ice Cave, New York. While the exact date of its discovery is unknown, this Iowa cave has figured prominently in the literature on glaciers since 1860 and, during the last quarter of the Nineteenth Century, enjoyed an international reputation.

Ice deposits underground were the subject of much speculation, beginning in 1586, when Benigne Puissen t suggested that the cold of winter produced the ice at Chaux-les-Passavant, France. In 1898, however, Alois F. Kovarik, an instructor at the Decorah Institute, Decorah, Iowa published the results of an extended series of meteorological observations at the Decorah Ice Cave which clarified the mechanics of static glaciers and rationalized the seemingly incongruous features of such caves. The endorsement of Kovarik's work by E.S. Balch in his monumental "Glaci res or Freezing Caverns" (1900) assured its acceptance and established the Decorah Ice Cave as the type example of static glaci re in North America.

The Decorah Ice Cave was developed and shown to tourists by Stanley Scarvie and others from 1929 until 1941. Despite its scientific importance, however, the cave was found to be too small to support a commercial venture after larger and more scenic caves were discovered nearby. The cave now is included in the City of Decorah park system and, although described in many regional tourist handbooks, seems largely to have been forgotten until its dedication in 1973 as an Iowa State Preserve.

HMW

The Decorah Ice Cave had become so well known already in 1854, only five years after the arrival of the first White settler in the area, that a stranger in town visited it only two days after he reached Decorah (Crosby, 1854). Scattered reports on it had been published as early as 1860, and established scientists had visited the place in 1869 (C.A. White) and again in 1877 (Samuel Calvin). Widespread interest in the anomaly of summer ice did not develop, however, until 1879. In that year, someone identified only as "HMW" published a brief request for information on the Ice Cave in the *Scientific American* (ns vol. 40, p. 196). The international reputation of the Decorah Ice Cave is derived from the flood of articles which developed in response to HMW's plea.

"HMW" was identified by Merriam (1950) as "H.M. White." We have been unable to verify this. Preliminary investigation of contemporaneous historical accounts suggests that the author's name was Hiram M. Walters.

Hiram Walters was a prominent Ohio cattle trader and farmer in Mifflin Township, near Mansfield. Born in 1825, he was modestly successful in the California gold rush of 1850 but returned to Ohio to resume farming. In 1866, Walters travelled through Iowa and Illinois in search of another farm. Whether or not he knew William Painter, the miller at Dunning's Spring, is problematical, for Painter's former home (in Greene County, Ohio) lay at a great distance from Mansfield. It is a plausible hypothesis, though, that

Walters visited the Decorah Ice Cave during his travels in 1866 and that he is the "HMW, Mansfield, Ohio" who wrote the *Scientific American* article in 1879.

AN INTERNATIONAL CONTROVERSY

The first response to "HMW" appeared in the *Science Observer*, in which N.M. Lowe of Boston formulated an hypothesis that air is entrained by water descending along fissures above the cave, is compressed, and gives up its heat of compression to the adjacent rocks. Subsequently liberated in the cave, the air expands and absorbs heat from the cave, cooling it below the freezing point. Lowe thought that ice forms only in summer because the land surface above the cave is frozen in winter. Thus, the entry of air and water into the fissures leading to the cave is prevented. Lowe previously had visited some glaciers in New England, but had not himself seen the Decorah Ice Cave.

The following issue of the *Science Observer* contained three articles on the subject of subterranean ice. The authors of these were John Ritchie, Jr., a prominent Boston astronomer, conchologist, and meteorologist, Thomas Bland, a New York City naturalist, and an anonymous contributor. Ritchie editorially supported the air-entrainment theory. Bland, also, supported Lowe, noting that ice sometimes freezes in jack-hammers as a result of the expansion and cooling there of moist compressed air -- the heat of compression previously having been radiated from the feeder hoses. reported that the "state geologist" (White?, of Iowa?) doubted Lowe's theory but that the Astronomer Royal of Scotland, Piazzi Smith, agreed with it.

Ritchie, like Lowe, had seen a few New England glaciers but had not been to Decorah. Both his and Lowe's articles were reprinted in the *Kansas City Review* later that year. Lowe's appeared, also, in the *Scientific American Supplement*.

Nearer to the truth was an analysis of the Decorah Ice Cave presented in *The Decorah Republican* by A.I. Benedict. Benedict endorsed the viewpoint that cold air is trapped in the lower portions of the cave in winter, noting that cold winters and wet springs are followed by great amounts of ice, while warm winters and/or dry springs are followed by relatively little ice. Contradicting this first-hand account, however, was an article by Samuel Kneeland, a Boston MD, in the *Proceedings of the Boston Society of Natural History*, which supported Lowe's air-entrainment hypothesis.

The *Scientific American Supplement* published three letters-to-the-editor in reply to "HMW". The first, by one "AMW" of Waukon, Iowa, corrected "HMW"'s statement that the Decorah Ice Cave is developed in "Portland sandstone" and extended his description of the cave.

The author of the second, one "CBA", had visited the cave also. With "Q" and Lowe "CBA" correctly associated the frozen ground of winter with the absence of water (hence of ice) in the cave at that time of year. Continuing, however, "CBA" agreed with White that evaporation of water by air moving through the cave was the cause of freezing temperatures in it. The evaporation theory had been advanced by M.A. Pictet, a Swiss naturalist in 1822, but it is possibly important only in those rare "windr hrer" ice caves having an active circulation of air. In the Decorah Ice Cave, where the air is essentially stagnant throughout the warmer months of the year, evaporation is inconsequential.

The third letter contained no new information. None of the authors have been identified.

KOVARIK AND BALCH

Alois Kovarik grew up in the Decorah area and, no doubt, had made casual visits to the Decorah Ice Cave before undertaking the serious study of it in 1897. Kovarik's work may have been inspired by Balch's 1897 article, "Ice Caves and the Causes of Subterranean Ice" in the *Journal of the Franklin Institute*. It appears, however, that Kovarik did not meet Balch until after Balch visited the Ice Cave on 30 September 1898, for Balch states that he went to the cave with another Decorah resident.

Kovarik must have written his initial report (published in November of 1898) before the date of Balch's visit, for he does not mention having met Balch. The two men seem to have arrived at the correct explanation of static glaciers independently -- Balch by means of single observations of many such caves over a period of years; Kovarik as a result of the intensive study of a single cave. One assumes, however, that they must have met soon after Balch's visit to the cave, for Balch sent a complimentary copy of "Glaciers or Freezing Caverns" to the Decorah Institute library out of gratitude for Kovarik's assistance (Editorial, The Decorah Institute 1[12]:5 [1900]).

Kovarik's article on the Ice Cave on pp. 6-8 of the same issue includes a photograph of the Locus Glacialis credited to "Famous Caves of America". This publication is not listed in any library catalog available to us and we initially concluded that it must be one of Kovarik's unpublished manuscripts. Recently, however, a copy has turned up in a private collection in the Decorah area.

"Famous Caves of America" is about four by eight inches in size, in the style of the souvenir books of that period. It was published by Hanson and Dahl, of Decorah. No publication date is given, but Ice Cave observations from August 1899 are included and a photograph taken from it appeared in the December 1900 Decorah Institute. The first 14 pages are on the Decorah Ice Cave and were written by Kovarik. (About as many more pages are given to Mammoth Cave, Wind Cave, Howe's Cave, and Wyandotte Cave together.)

Another "phantom" publication is the "Aden S. Benedict" report in the 19 June 1881 Decorah Republican, cited by Balch (1900, p. 293). There was no Republican published on that date, nor is there an article on the Ice Cave in any nearby issue. Balch must have intended to refer to the article by A.I. Benedict in the 19 June 1879 Decorah Republican.

We (1975, p. 120) let slip a typographical error implying that there exists a Burlington Hawk-Eye article by "O". There is none. The only Hawk-Eye article is the one by "Q" (date unknown, ca. 1870).

The theory of static glaciers as propounded by Kovarik and by Balch has several antecedents in the literature. For instance, Lowe had made the annual thawing of the soil a basic part of his hypothesis, as had "CBA" and "Q". The other controlling factor, the retention by gravity of cold air in the ice chamber throughout the summer, had been invoked by Benedict. Balch was aware of this literature. Whether Kovarik was, or whether he deduced all this de nouveau, cannot be told from his writings.

Kovarik deserves more credit than usually is allowed him for his contribution to our knowledge of glaciers. His study was the first and, to date, only methodical investigation of the meteorology of a North American glacier. Unfortunately his work was overshadowed by Balch's later and more comprehensive opus. Kovarik, of course, contributed to the obscurity of his own speleological contributions by abandoning this line of research after 1900 and devoting himself to nuclear physics.

RECENT HISTORY

A short survey of glaciers, including the Decorah Ice Cave, was published in 1950 by Patricia Merriam. More interesting than her comments, however, is her bibliography ("supplemented by the Editors"), in which she attributes the 1879 Scientific American note, discussed above, to an "H.M. White." Her justification for doing so is not stated, and a letter of inquiry sent in 1972 went unanswered. William E. Davies (personal communication, 1972) stated that the Bibliography of North American Speleology (unpublished) contains the same identification and that he believed it to be anterior to Merriam's identification. However, the Mansfield, Ohio public library could supply no information about an H.M. White (Linda Courtwright, personal communication, 1972).

Merriam was a student at the University of Southern California at the time she wrote her paper. W.R. Halliday heard about it from a faculty member and obtained a copy for

publication. Omissions in Merriam's paper led Halliday to undertake his own (1954) study of glaciers in the United States (Halliday, personal communication, 1973).

Halliday did not visit the Decorah Ice Cave personally, but relied upon the descriptions of Kovarik and of Balch. He also used information supplied by William Petrie, a founder (1949) of the Iowa Grotto of the National Speleological Society and the son of NSS founder and peripatetic caver, John S. Petrie.

Petrie reported that "rockfalls have closed much of the cave and rendered the remainder too hazardous to warrant further study;" he must have been referring to the section beyond the ice chamber (recently re-discovered), because the forward portion of the cave has been continuously accessible since its discovery. All of the cave is mechanically stable, although the icy floor may be hazardous to the unwary.

The cave has undergone an unknown amount of human modification. "JWH" states that, in 1860, the entrance was wide enough for explorers to go in three abreast. It has been altered at least twice since that time to permit the installation of doors. (It is not and never was, however, 200 feet deep, as claimed by "Believe-it-or-not" Ripley in 1960.)

Several postcards have been issued which show the cave entrance: One is a white-bordered, tinted card published by Curt Teich & Co., of Chicago. Another is a white-bordered, black-and-white card published by Bailey and Son of Decorah. A third card, printed in Great Britain and published by Leff Button of Decorah, was postmarked in 1908. The fourth which has come to our attention contains no publisher's name, but is numbered "2932" and was postmarked 9 January 1914. The latter two cards are both black-and-white. The pictures in "Famous Caves of America" (view of bluff, entrance, ice speleothems, Ice Cave Bridge) include the notation "Sanders - St. Louis", as though they might originally have been postcards.

Commercial development at the cave included a "secondary attraction" -- a small zoo, located just east of Split Rock. This zoo contained rattlesnakes, coons, and a pair of monkeys.

The opening of several other, larger caves in the area contributed to the decline in admissions at the Decorah Ice Cave. Glenwood Cave was opened in 1931, featuring a 1300-foot tour entirely by boat (Decorah Public Opinion, 2 July 1931) Niagara Cave in 1934, Mystery Cave, the largest cave in the upper Mississippi valley, in 1935, Wonder Cave, only three miles from the Ice Cave, in 1936, Wompi Cave in 1937. Niagara, Mystery, and Wonder have been shown continuously; Glenwood and Wompi both "folded" after a few years. In addition to these a "Catacombs of Yucatan", believed to be somewhere southwest of Decorah, was advertised in 1935 (Decorah Public Opinion, 9 May 1935) but never opened for business. More information on these caves may be found in Hedges (1974).

THEORY OF GLACIERS

Kovarik's deductions as to the cause of the low temperatures in the Ice Cave were corroborated by Kimball's meteorological calculations. He also realized, unlike many of the early theorists, that the winter "cold" was stored primarily in the rock masses surrounding the cave, not in the air filling the cracks and crannies of the bluff: The heat capacity of air is only 3.9 cal/liter, while that of limestone is 5400 cal/liter.

The possibility that the cold temperatures of spring and summer are simply the cold of winter, delayed by transmission through the ground, was discussed by Ingersoll, Zobel, and Ingersoll ("Heat Conduction with Engineering and Geological applications", McGraw-Hill, 1948, pp. 54-55). The transmission of surface temperatures underground may play a role in glaciers at higher latitudes or elevations, where the mean annual temperature is very near freezing. Temperature fluctuations are so rapidly attenuated by transmission, however, that the annual minimum is no longer below freezing by the time it reaches the depth of the Locus

Glacials in the Decorah Ice Cave. A theoretical discussion of this problem with reference to caves was presented by Arthur Lange ("Rock Temperature Distribution Underground," 1959, Cave Studies 1:21-32). The transmission-lag theory was applied to the Decorah Ice Cave by "Q" in his article in the Burlington Hawk-Eye.

Glacières are highly sensitive to disturbances in their microclimatic regimes. The ice cycle in the Decorah Ice Cave once was badly damaged by the installation of a solid door at the entrance to the cave, but was quickly re-established when the door was removed. The Coal Bank Hill Ice Mine in Hardin County, Iowa is a former miner's prospect now containing ice. Mining in that area peaked about 1850. The Bixby Ice Cave in Clayton County, Iowa is another miner's prospect and is of about the same age as the Coal Bank Hill Ice Mine. It contains a permanent deposit of ice. Ice has been known to occur in the Bixby Cave for at least 55 years. Freezing conditions underground must develop very rapidly once the necessary cave geometry has been developed.

In a definitive test of the Kovarik/Balch theory, Sturgess placed check dampers in the lowest entrance to an abandoned mine near LeFever Falls, New York, thus preventing the outflow of mine air during summer while permitting the inflow of relatively colder outdoor air during winter. Higher entrances to the mine were not modified. The LeFever Falls mine was transformed into a pseudo-static glacière having a circulatory pattern similar to that of the Decorah Ice Cave. The maximum summer temperature of the mine was 4 1/2°F lower after five years of operation than it had been initially and Sturgess concluded: "From our experiment, it is apparent convection currents of winter air were responsible for cold conditions in ice caves, and that ice caves are effective traps for storing cold air the year 'round." (P.M. Sturgess, "Observations on Ice Caves as Heat Exchangers", 1962, NSS Bulletin 5:48-50.)

SUMMARY

The Decorah Ice Cave is the largest glacière in North America east of the Black Hills. No less than six distinct meteorological hypotheses were tested upon it: the evaporation theory of White and (earlier) Pictet, the transmission-lag hypothesis of "Q", the air-entrainment theory of Lowe, the atmospheric-expansion theory of Hoadley, the condensation theory of Lees, and the natural refrigeration theory of Kovarik and Balch. Few American caves, and no others in the Midwest, have had so great an influence on the development of scientific thought.

Many previous misconceptions about Iowa glacières were corrected by W.R. Halliday in his introduction to the Johnson Reprint Corporation edition of E.S. Balch's "Glacières or Freezing Caverns" (NYC, 1970, p. xiv). Unfortunately, however, Halliday confused scenic value with scientific importance and proceeded to deprecate the significance of the Decorah Ice Cave, saying: "The numerous early accounts of this cave were due to its accessibility rather than to its importance as a cave or a glacière."

In fact, it was the accessibility of the cave which made it important as a scientific site. Some of the larger western glacières were discovered at about the same time. None of those, however, were as accessible to scholars as was the Decorah Ice Cave and, lacking that necessary attribute of convenient location, they failed to play a significant part in the development of scientific thought on the causes of subterranean ice.

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(The following article is the text for an illustrated talk given at Mammoth Cave to the new guides as part of their training program on June 10th. It will be given again on July 17th in the auditorium of the Visitors Center. --Ed.)

Historic Maps of Mammoth Cave

HAROLD MELOY

1. EYE-DRAUGHT MAP 1811 (Ridgely ms. - colors)

This is the earliest known map of Mammoth Cave.

Background: Sometime before 1810, Charles Wilkins, a saltpeter dealer at Lexington, and Fleming Gatewood purchased Mammoth Cave by assignment from the McLean brothers who were producing saltpeter here in 1808. Prior to 1808 the cave was owned by John Flatt, assignee of Valentine Simmons who had obtained a Land Certificate for it in 1798.

In March of 1811, Dr. Frederick Ridgely of Lexington, Ky., a brother-in-law of Wilkins, sent this map to his old friend in Philadelphia, Dr. Benjamin Rush. The map is now in the Library of the American Philosophical Society of that city.

Comments: The map purports to show 14 miles of cave passages. A note reads that the farthest point shown is 7 miles from the entrance. Only four place-names are indicated: Narrows, Big Room, Haunted Chamber, and Sink Room. Most of the hand-written notations show the size of the passages, the abundance of saltpeter to be found there, and the location of large springs for use in leaching the saltpeter.

On the map the saltpeter "leeches" (sic) are located at the entrance on either side of the Narrows. Archibald Miller was the manager of the saltpeter works, and had been since 1808. There is no indication on this map that anyone contemplated the erection of saltpeter hoppers at the Rotunda or at Gothic Avenue.

Caution: This is not the first use of the name "Mammoth Cave" (It was used in 1810). Probably this map was copied in Lexington from an earlier map in the possession of Wilkins. Probably the earlier map was made in 1808 or 1809(?).

References: Ridgely 1811, Wilkins 1817, Titley 1967, Meloy 1968, Thomas 1970.

2. EYE-DRAUGHT MAP 1811 (duPont ms.)

Background: Charles Wilkins, the saltpeter dealer in Lexington sold saltpeter to Archibald McCall in 1808 and continued to do so at least through 1812. McCall was a purchaser for the duPont powder works at Wilmington, Delaware. Another copy of the Eye-Draught map is now in the duPont Library at Wilmington.

Comments: There is a significant difference. On this copy a handwritten notation appears which is not on the earlier copy. This reads: "At the Big Room (to which it is contemplated to convey the water and erect leeches (sic).)" Still the only leeches shown are at the entrance. This copy is dated sometime prior to June 11, 1811. Another copy of the Eye-Draught map was published in 1853.

References: Faust 1967, Meloy 1968.

3. BOGERT MAP 1813 (Medical Repository 1815)

This was the first publication of a map of Mammoth Cave.

Background: In 1812 Fleming Gatewood sold his one-half interest in the cave to Hyman Gratz of Philadelphia. Wilkins, the other co-owner, continued to live in Lexington. At the cave, their resident agent and superintendent of the saltpeter operations was Archibald Miller. Miller kept a map at the cave, which he probably made for use of the saltpeter mining operations. A copy of that map was made and sent to John Bogert, a New York attorney, who passed it on to Dr. Samuel Mitchell, the editor of the Medical Repository.

Comments: Here the entrance is at the bottom, and Broadway extends upward to the Cataracts. The passage to

the upper left is the Black Chambers "supposed to be 10 miles." The numbers refer to place names on another page, and 30 are given. The map purports to show 20 miles of cave passages. One passage stops at Bottomless Pit (No. 13). The passage extending to the left (No. 14-24) is the first part of Ganter Ave. No. 23 is designated as the "Basket Room." More about that later.

Another copy of Miller's original map was sent to Hyman Gratz in Philadelphia, who sent it to Dr. Mitchell in New York. Mitchell acknowledged the receipt of the map from Gratz, but did not publish it; for (as Mitchell wrote) "it was substantially like that which he had received before from Mr. Bogert."

Influence: This was the earliest map of Mammoth Cave known to Hovey, Call, and Jillson; and hence, their map studies began with this map.

References: Medical Repository 1815 and 1817, Wilkins 1817, Call 1896, Faust 1967, Meloy 1968.

4. BOGERT MAP 1813 (ms.)

Comments: This is the copy from which the published map was made. This manuscript copy was sent to Bogert and by him given to Mitchell for publication. The original of this copy is now in the New York Historical Society Library. Here we see the 30 numbered features named. The editor (Mitchell ?) added the numbers to the manuscript for use by the engraver. We note at least one mistake. The Sick Room at here (point) was numbered No. 9; but the engraver placed No. 9 at another place (point). This illustrates one way in which cave features may be known by different names; in this case, it was an error in making the copy.

5. EGNEW MAP 1817 (ms. --same lines at Bogert)

Comments: This is another copy of the same map, and has more information written on it than the others. In January 1817, a Mr. Agnew visited Mammoth Cave and made his own copy from the map there which Miller showed him. Miller told him about the features; and Egnew made appropriate notes on his map. Here the Sick Room is shown at its proper place.

In May of 1969, archaeologist Patty Jo Watson examined a splitcane basket found in Ganter Ave. From its craftsmanship it appeared to be a prehistoric Indian basket. Search was made in the Mammoth Cave literature for any previous reference to the basket. The Bogert Map located the "Basket Room" at the approximate location where Dr. Watson examined the basket; but this map shows more.

At the place where the basket was found in 1969, this map made in 1817 has the notation: "Basket room. A basket was found here, hence its name."

On the 1813 Bogert map, the location at the upper left was listed "supposed to be 10 miles." Here the notation reads: "formerly supposed to be 10 miles from the entrance. But now since it is more frequented it is believed to be less."

The original of this map is in the Tennessee State Library at Nashville.

Reference: Watson 1974

6. WARD MAP 1815 (from newspaper)

"Nahum Ward, who made this map, was the man who made Mammoth Cave famous."

Background: The saltpeter operations ceased in early 1815 with the termination of the War of 1812. Archibald Miller remained at the cave and showed it to infrequent visitors. One of these was Nahum Ward who came in October of 1815. Ward spent 18 hours in the cave with his two guides, and thereafter wrote a long descriptive narrative of his experiences and travels in the cave. This was published and republished in books, magazines, newspapers, and broadsides in this country and in Europe. Copies on single sheets were sold in bookstores. This is the map he made to accompany his published articles.

Comments: This version of Ward's map appeared in 1816 in the Massachusetts Spy, or Worcester Gazette newspaper. Like the others before it, the Ward map was made without benefit of compass or accurate measurements. Distances were flagrantly exaggerated; what we know as

Wright's Rotunda, Ward said was 6 miles from the entrance and he called it "Main City." Ward unblushingly shows three of the cave passages passing under the bed of Green River. As the name "Mammoth Cave" had not yet entered common usage, Ward designated the cave as "The Great and Wonderful Cave in Warren County, Kentucky," which it in fact was; and is -- except that after Edmonson County was created in 1825, the cave is now in Edmonson County.

References: Call 1896, Faust 1967, Meloy 1968.

7. WARD MAP 1815 (1816 Monthly Magazine)

Comments: This version of the Ward Map appeared in the Monthly Magazine or British Register (reprinted in Boston) 1816, Vol. 41, p. 577. We see the orientation arrow pointing South. The saltpeter hoppers are shown where we know them. "R" shows the three branches over which Green River passes. A copy of this map is included with the Drake papers in the Draper MSS.; and has been called the Drake Map. The Drake Map is merely another copy of the Ward Map.

8. WARD MAP 1815 (1817 Broadside)

Comments: The Ward Map was not only published in magazines and books; but also on Broadside. A broadside was a single sheet of paper, printed on one side, and sold in bookstores. We now call them posters. The original of this one is in the Lilly Library of Rare books, Bloomington, Indiana. It is on a standard size sheet 17" x 22" and includes a condensed version of Ward's narrative description of Mammoth Cave. A similar broadside was printed in Liverpool, England in 1817. An original of that broadside is in the Kentucky Library at Bowling Green. His description of the cave includes a brief description of the mummy.

Influence: It was the widespread publications of Ward's article (including this map and his description of the mummy) which made Mammoth Cave famous.

9. WARD MAP 1815 (1823 Holmes)

Comments: Another version of the Ward map was printed in London, England in 1823. It appeared in An Account of the United States of America, by Isaac Holmes, together with Ward's complete narrative.

Influence: These publications of the Ward article and map in England made Mammoth Cave as famous in England as it was in America. When Dr. John Croghan visited England in 1832, he was surprised to find the British as familiar with Mammoth Cave as most Americans.

10. LEE MAP 1835

"Made from the first instrument survey of Mammoth Cave."

Background: The supposed length of the cave varied, depending on the author. In 1817 Charles Wilkins wrote that it was 25 miles; an 1834 Lexington newspaper reported it to be 20 miles. In 1823 William Blane wrote the length was 3 miles, and he also observed that underground surveys were not permitted -- a condition which extended for most of the next 145 years. When Wilkins died in 1827, his interest was purchased by the surviving co-owner Hyman Gratz; and Gratz sold a part interest to his brother Simon Gratz in 1829.

Also after the death of Wilkins in Lexington, Archibald Miller who had lived at the cave house 19 years moved from the premises; and former owner Fleming Gatewood moved back into the cave house. Under his instructions, his sons became guides. The oldest, George S. Gatewood, became the principal guide.

Comments: Edmund F. Lee, a 24 year old civil engineer of Cincinnati, came to Mammoth Cave, and for 3-4 months, during the entire winter of 1834-1835 made a complete instrument survey of the entire cave then known. His map was prepared in colors. Scale 1 inch = 325 feet (approx). Not only was the horizontal plan shown, but also vertical profiles of each of the passages, with the vertical distances below the entrance for all places in the cave. The map shows the length from the entrance to the farthest point (end of Symms Pit Branch) to be a little over 2 1/4 miles, and the length of all of the branches taken together to be about 8 miles.

The view of the entrance shows old timbers which appear to be from the original saltpeter vats at the entrance. It would appear that they were V-shaped vats.

Lee also wrote a 30 page guidebook of the cave, published in 1835 at Cincinnati.

Influence: It was Lee's book and map which influenced Dr. Robert M. Bird to revisit the cave in 1836 and write his description.

Lee's map was used as the basis for Bishop's 1842 map and most later maps for the next 70 years.

References: Bird 1837, Call 1896, Meloy 1969, Lee 1835.

11. BISHOP MAP 1842

Background: The Gatewoods vacated the cave premises in October 1835. Robinson Shackelford and Archibald Miller, Jr. leased the cave during 1836 and 1837. In 1836 Dr. Robert M. Bird revisited the cave and wrote his book which influenced Franklin Gorin to purchase the cave in 1838. Gorin kept Miller, Jr. as manager and installed Stephen Bishop as guide. Bishop crossed Bottomless Pit in October 1838 and explored miles of virgin passages beyond the pit. The Lee map was obsolete, except for passages this side of Bottomless Pit. Dr. John Croghan purchased the cave in October 1839, kept Miller, Jr. as manager and Stephen Bishop as guide.

Comments: In January 1842, Croghan had Stephen at Locust Grove, the Croghan family home near Louisville, John's brother, Col. George Croghan was also there and helped Stephen prepare a new map of the cave. The Lee map was used as far as it was applicable; Stephen penciled the passages which he had explored beyond Bottomless Pit, and George inked the pencil drawing. Copies were made for friends and for use at the cave. The 1842 map was published in 1845 as a part of the new book: Rambles in the Mammoth Cave, which book became the standard reference about the cave for the next 6 years. The map shows perhaps 25 miles of passages.

Influence: This remained the most complete map of the cave for the next 40 years, and was the basis for later maps by Hovey and Call, published between 1882 and 1912.

References: Call 1896, Thomas 1970, Meloy 1973.

12. BLACKALL MAP 1871

Background: Croghan died in 1849, Stephen in 1857. The Rambles book was replaced in 1851 by a better book by Rev. Horace Martin but without a map. In 1856 Dr. David Dale Owen in his Geological Survey in Kentucky indicated that there were 150 miles of cave in the area. The management publicized this 150 miles; but in doing so, they could not permit any underground surveys for two reasons: First, such a survey would show less than 30 miles of cave; and second, such a survey would show the cave passages extending underground beyond the property lines of the owners. Adjoining owners could dig down and open another entrance on their own land, as one later did. The cave literature from 1835 to 1935 contains numerous statements that no surveys were permitted. Even the Bishop map was suppressed soon after 1856.

In 1870, Dr. C. R. Blackall came to Mammoth Cave to write a book and make a map. The new lessee, Mr. D. L. Graves, either did not know about the restriction against surveys, or thought it should be amended. He permitted Blackall to make a survey; but when completed and Judge Joseph R. Underwood, the Trustee in charge, learned of the map, he immediately suppressed it; and it was not published until 1899; and then under unusual circumstances.

Comments: The map shows orientation, and a scale in yards. The principal passages are in correct location; which was not to appear again in published maps until circa 1923. Distances are given in yards, both for the cave passages, and air-line distances on the surface. This map shows the avenue to "Mystic River," which has not appeared on any map before or since, and which has only recently been rediscovered. The map shows the "supposed Grand Entrance" (at Rafinesque Hall) which had figured in story and legend since 1844. By simple measurement one could tell that "Mary's Vineyard" (miscalled Martha's Vineyard) was beyond

the property line of the owners. And the map certainly does not show 150 miles of cave. Judge Underwood had good reason to suppress the map; and he did.

Influence: None, until it was published in 1899.

After that it added tangible evidence that the cave extended beyond the property lines.

Reference: Hovey 1899.

13. KLETT MAP 1881

Background: Major Francis Klett, formerly with the U.S. Geographical Survey, became manager of Mammoth Cave in 1881. He knew about the restrictions against underground surveys; but on his own, he undertook to make one. We don't know the extent of his survey, but this much was published before he left in 1883.

Comments: The map shows the area from the entrance to Chief City and beyond Bottomless Pit to Echo River. Of chief interest to us is the exact location of the old hotel with reference to the Rotunda. The map was published in the St. Nicholas Magazine, April 1882, page 431.

Influence: This map permitted Horace C. Hovey to correct a few errors on the Bishop map, which he used as a basis for his 1882 map.

Reference: Hovey 1882a, 1899.

14. HOVEY MAP 1882

Background: Rev. Horace C. Hovey had long been interested in geology and caves. In 1878 he wrote a short article about some Indiana caves; in 1880 he authored magazine articles on Mammoth Cave and Wyandotte Cave; and his classic work: Celebrated American Caves was published in 1882. This included a "complete" map of Mammoth Cave. No "complete" map of the cave, had been published since the Bishop map in 1845. Since that time books by Martin, Wright, Blinkerd, and Forwood had successively become standard reference books on the cave. Hovey's 1882 book replaced them all; and one reason was this map.

Comments: This purported to be a map of the "complete" cave. Hovey's draftsman used the Lee map for that portion this side of Bottomless Pit, the Klett map from Bottomless Pit to Echo River, and the Bishop map for all those parts beyond the rivers. It was not based upon any new surveys, and upon none beyond the rivers. The Mammoth Cave section of his book consisting of 70 pages and the map were republished as paperback guidebooks annually for the next 14 years; and the entire book appeared in a new edition in 1896. Hovey wrote that the cave was 150 miles long; and this was the figure used in the Britannica Encyclopedia beginning in 1883.

Influence: Hovey became the undisputed national authority on Mammoth Cave until his death in 1914. This map and later revised versions were published until 1912.

Reference: Hovey 1882b.

15. CALL MAP 1897

Background: Richard Ellsworth Call, M.D., Ph.D., a highschool science teacher in Louisville became interested in Mammoth Cave about 1890. He was the author of scientific articles which appeared in professional journals. When his prose was used to describe Mammoth Cave, it shone with the music of poetry. The L & N Railway used his writings on Mammoth Cave to promote their excursion trips to the cave; and the Mammoth Cave estate republished his articles for their own publicity. He expanded his original monographs into an 1895 book entitled Mammoth Cave, which for literary brilliance far surpassed anything written by Hovey. In 1896, his article on "The Evolution of the Map of Mammoth Cave" became a classic for historians. In it he traced the history of the cave through the maps of Bogert, Ward, Lee, Bishop, and Hovey, and he indicated that a far superior map (his own) was soon to appear. In the meantime, he was preparing a full sized book about the cave. Hovey conferred with Call and the new book appeared in 1897 as the combined efforts of Hovey and Call. It included Call's new map.

Comments: Like so many others before and after him, Call had been denied the right to make underground surveys. Yet his map was superior to Hovey's in several areas,

especially Cleaveland Avenue and the passages branching from it. The map appeared through six editions of the book, both hardback and paperback from 1897 until 1907 and was the standard reference book about the cave for those years.

Influence: This map replaced all previous maps as the "accepted map" of the cave.

References: Call 1890, 1895, 1896, Hovey & Call 1897.

16. HOVEY AND CALL MAP, 1897, 1899

Background: It is obvious that Call had borrowed from Hovey, just as Hovey had borrowed from Bishop. Hovey made a few minor changes in the Call map and republished it as the Hovey and Call map in 1897 and again in 1899. This slide is from the 1899 publication.

Comments: Here, Hovey has taken Call's map and rotated it 90°, so that the north is pointed toward the top. He also added a scale (in feet) which was a cardinal heresy in Mammoth Cave dogma, something which had not appeared on published maps since the Lee 1835 map.

Influence: Hovey published this map with the first publication of the Blackall map; and it was immediately apparent from a casual study of these maps together that the cave was not 150 miles long; and that it did extend beyond the property lines of the owners.

Reference: Hovey 1899.

17. KAEMPER MAP 1908

Background: Judge Albert Covington Janin of Washington, D.C. became the managing Trustee in charge of the Mammoth Cave Estate c. 1900. For over 50 years the legend that the cave was 150 miles long had been perpetuated for commercial purposes; and he knew it was necessary to continue it. But the rumors continued to be whispered that the cave passages extended beyond the surface property lines of the Mammoth Cave estate. He decided to determine for himself the truthfulness of these matters. It would be necessary to secure a secret survey. He could not risk employing a local surveyor. Through his connections in Washington, he secured the services of Max Kaemper a 23 year old German surveyor. In 1908 Kaemper came to Mammoth Cave and contacted Henry C. Ganter the cave manager. Ganter assigned his most trusted guide Edward Bishop to assist him. Kaemper worked for 8 months preparing notes for his map which for obvious purposes was considered top-secret.

Comments: Kaemper's map was intended to show all of the cave then known and the exact location of all the passages. It was by far the most accurate and extensive map made to that time and remains one of the outstanding maps in the history of the cave. A colored photocopy of this map used to be on display in the Exhibit Room. Kaemper used 5 different colors to show five different levels of the cave; and used the names for the passages and features which Ed Bishop gave him. Kaemper and Bishop discovered new passages, such as Violet City, which Kaemper added to his map. Kaemper correctly showed the locations of Chief City and Broadway in relation to Cleaveland Ave. The map shows perhaps 35 miles of passages (not the legendary 150 miles). But more important to Janin, he determined which passages went beyond the property lines of the Mammoth Cave Estate. This he did not indicate on this map. (It might fall into the wrong hands.)

Kaemper surveyed in the metric system. His scale was 1 cm = 40 m (1:4000).

Any surveyor would observe at once some unusual things about the map: First, the register points extending diagonally from the upper left to the lower right; second, no orientation is shown; and third, no scale is shown. From these a competent surveyor would conclude that Kaemper also made a surface map showing the location of the property lines, which surface map would include the same reference points, the orientation and the scale. Thus, Janin could determine which cave passages extended beyond the property lines. Used together, these maps showed that Mary's Vineyard and Boone Avenue to the east lay beyond the lands of the Mammoth Cave Estate. Both maps were delivered to Janin and he placed them under lock and key.

Influence: (a) The areas from the entrance to Violet City and to the Rivers were non-sensitive. Ganter obtained

copies of these areas as shown on the Kaemper map and prepared 3 route maps, which were used in cave literature. These route maps were published by Hovey in 1909 and again in 1912, they appear again in the Caverns of Enchantment, 1940, and were used in the NPS cave folders to and including 1957.

(b) During Kaemper's survey he found that Sandstone Ave. lay very close to the east end of Broadway, and an attempt was made to connect them by blasting. One of the charges placed at the end of Violet City broke through to the surface. This was immediately plugged and concealed. But Ganter and Ed Bishop were in on the secret. A few years later, when Ganter was no longer employed at the cave, he shared the knowledge of this secret access with George D. Morrison who used it for his profit.

(c) After the NPS assumed control of the cave, this map was given to the NPS. In 1963 members of the CRF traced it and used it to tremendous advantage in their project caving.

References: Hovey 1909a, 1909b, 1912; Quinlan 1964; Meloy's unpublished notes.

18. HOVEY MAP 1909

Background: Between 1897 and 1909, the only map available to the general public and to the guides themselves was the Call 1897 map. Call moved from the area to New York in 1897, and his interests turned to other matters. Hovey lived in Connecticut, but retained a consuming interest in all things pertaining to the cave. He felt he could improve the Call map; and prepared a new map in 1907. This was essentially the Call map, but he added the distances in yards, borrowed from the Blackall map, and in a marginal note indicated that he had consulted eight former maps.

Hovey prepared the new map in 1907; but the following year Kaemper and Ed Bishop discovered Violet City. Also, in the meantime Cathedral Domes had been discovered.

Comments: Hovey prepared this, his final map, in 1909. It shows the orientation, but not a scale. Part of Blackall's measurements in yards are given. There are nowhere near 150 miles of passages shown, though Hovey was still writing that the cave was 150 miles long.

Influence: This became the standard reference map available to the guides and general public for the next 50 years. It was published in Hovey's 1909 manual and again in his 1912 book. Hovey had larger prints made which he presented to his friends and which were sold at the cave. This slide is made from one of the larger prints. His 1912 book with this map is currently being reprinted by Zephyrus Press.

References: Hovey 1909a, 1909b, 1912.

19. PARRISH MAP 1922

Background: George D. Morrison came to the Mammoth Cave area in 1915. From his observations and conversations he became convinced that the cave passages went beyond the property lines; and that he could locate and open a "New Entrance" to Mammoth Cave. He became friendly with Henry C. Ganter (no longer connected with the cave) who lived just east of the estate property line. Ganter showed him the secret access to Violet City, in a sinkhole near Ganter's home. Of course, Morrison was not permitted to survey in the cave. He secretly employed surveyors to make a map for Morrison's personal use. From this map Morrison in 1916 opened a new entrance (Cox Entrance) on private lands leading to near Thorp's Pit in the cave. A law suit stopped him there.

Bruce Huffman, a surveyor from Louisville, made a secret survey for him of parts of the cave from the Natural entrance to the rivers. A local surveyor, Lewis Rogers, also did work for him. After Morrison opened another "New Entrance" in 1921, he employed Roger Mills Parrish, a civil engineer of Bowling Green, to make a complete survey of his part of the cave between his "New Entrance" and Mary's Vineyard. Huffman's survey was added to this, and Parrish completed this map of the cave for Morrison in 1922.

Comments: The map has a scale, orientation, and shows surface property lines. Also shown are the surface road to the cave and the tracks of the Mammoth Cave railroad.

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Frozen Niagara had not yet been discovered. Morrison used this map to prove that he was showing a new part of Mammoth Cave, and to show that the part he was showing was more extensive than "the old Mammoth Cave." The map shows Echo River as 2 hairpin curves, which is probably a sly ridicule of the "old entrance" section. We also see a feature that was to be continued in one way or another upon all future maps until 1970. I am speaking of this area where Broadway is shown passing over (under) part of Cleaveland Avenue. Actually it does not come that close.

Influence: Morrison published this map in his cave folders and in his book. It was published in the 1924 Randolph book, and by scientists in academic journals. In 1925, The Louisville Gas and Electric Co., used it in their surveys for a feasibility study for a proposed dam on Green River. For the scientists, this map replaced the Hovey map for over 10 years.

References: Morrison, n.d., Randolph 1924.

20. LOBECK DIAGRAM MAP 1928

Background: In 1925 the Mammoth Cave National Park Association was organized to convert and transform the cave operations from a private commercial venture into a National Park. This was to be a tremendous undertaking and would require the support of all Kentuckians, most of whom had little interest in the project at first. Almost everything written about the cave for the previous 100 years had been self-serving for commercial purposes. What was needed to present the case fairly to Kentuckians and to Congress was an objective monograph authored by a competent disinterested authority. Dr. Armin Kohl Lobeck, geologist of the University of Wisconsin was invited to prepare such a monograph. This was published by the Kentucky Geological Survey in 1928. He did a splendid job. Kentucky State Geologist Dr. Willard Rouse Jilison wrote: "In all the extensive literature descriptive of the Mammoth Cave area there is nothing like this -- nothing so readable, so scientific, so fine." Many things which we take for granted today were originated by Lobeck in this book. This diagram map is just one example.

Comments: This diagram map shows the principal cave features from the Natural entrance to Echo River in three dimensions. It is the best example in Mammoth Cave literature of one picture being worth a thousand words.

Influence: This diagram map was published and republished in this country and abroad. This map, more than any other map, helped to make the cave a National Park.

Reference: Lobeck 1928.

21. NELSON MAP 1956

Background: In 1936 the government sent their surveyors to survey the principal cave passages from the natural entrance to the five man-made entrances opened since 1921. This became known as the Walker survey and included a total of 21 miles of survey lines. In 1938 the New Discovery added 4 miles; and with 3 more miles of other surveys, the government surveys totaled 28 miles. The 1957 NPS cave folders still repeated that there were 150 miles of Mammoth Cave. The old guides privately indicated that there were perhaps 40 miles of cave, or between 40 and 60 miles; but no one knew for sure. Park Naturalist Ray L. Nelson made this map. He used the 1935 Walker survey and the surveys made during the following 20 years. To these he added in dashed lines other passages which the guides showed him.

Comments: His completed map shows 32 1/2 miles of cave passages. About 21 miles of which were known in 1908 and 11 miles of passages discovered and mapped between 1908 and 1956. It is still one of the best general maps of the cave for use by the guides.

Influence: After 1957 the NPS folders omitted any reference to the cave being 150 miles long.

In 1964, Jim Quinlan measured the passages on this map and the Kaemper map; and found that there were a total of 46 miles, surveyed and mapped in Mammoth Cave.

References: Quinlan 1964, Meloy's unpublished notes.

22. CRF MAP 1975

Background: In 1957 a group of research cavers organized the Cave Research Foundation (CRF), an organization dedicated to learning more about caves, especially those caves in the Mammoth Cave National Park. Since then scientists working with the CRF have become nationally known in their fields. The CRF surveyors and map makers each year added additional mileage to the Flint Ridge cave maps which by 1972 showed a total of 86 miles of cave in Flint Ridge. In 1969 carefully selected teams extended their CRF survey program to Mammoth Cave proper, and by 1972 had maps showing 58 miles in Mammoth Cave. In 1972 these two cave systems were joined for a total of 144 miles. The amount of detail work in making accurate surveys and plotting them on maps is staggering; and the CRF turned to computers to assist in their map making.

Comments: By 1973, there were 160 miles; and this 1975 map shows 169.2 miles. The map shows the surface features and the contour lines. Entrances to such well known caves as Salts, Colossal and Crystal, are shown. The computer-located cave passages are shown in black -- all 169 miles of them.

Influence: (a) This map is a good example of what can be accomplished by trained research cavers, as contrasted to recreational cavers or commercial cavers.

(b) The legendary length of 150 miles of Mammoth Cave is now a confirmed fact. In fact it is now over 170 miles long.

(c) A book to be titled "The Longest Cave" which describes the dramatic events which led to the making of this map was written by Roger Brucker and Richard A. Watson. The book is now in press and is expected to be released in 1976.

References: CRF publications.

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Other contributions were made by Willard R. Jillson who in 1961 furnished information regarding the Lee and Lobeck maps; by Mammoth Cave Geologist James F. Quinlan who in 1964 supplied a copy of the Blackall map and who made his 1964 study available; by Burton Faust who in 1965 supplied a copy of the duPont Eye-Draught map; by Joan Titley who in 1967 located the Ridgely Eye-Draught map; and by Carol Hill who in 1975 supplied a color print of the map; by William R. Halliday who in 1968 supplied a copy of the (Holmes) Ward map; by Gordon L. Smith who in 1970 supplied an original print of the Parrish map; by Duane De Paepe who located the Egnew map; by E. Lee Davis for use of his copy of the Lobeck map; and by Roger W. Brucker for use of the CRF map.

Prepared as a part of a
 historical research project
 on Mammoth Cave, Kentucky

Monograph No. 10

NOTE: Although the research on this subject extended over 15 years, the writer does not consider it to be in final form. Those who may have additions, corrections, or suggestions are invited to send them to

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 pg 8 Notes on "The tragedy of Sand Cave", Gordon L. Smith
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 pg 16 Memories of the past, by Lute Lee (a hand-written manuscript, courtesy of the Filson Club)
- 2:2 pg 22 Letter to the editor by W.R. Jillson concerning the new cave on Joppa Ridge and remembering when Mammoth Cave first became a national park.
 pg 23 Abstracts from History Session of the NSS Convention, June 1969
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- McLane, A. -- History of Cave Valley Cave, Lincoln Co., Nevada, 1858-1968
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- pg 38 Preliminary abstracts: 1973 NSS Convention
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- pg 41 Reprint of "Narrative report of Wyandotte and
Marengo Caves, Indiana, Robert Burns, NPS
- pg 44 Geologic evaluation of Wyandotte and Marengo
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- 6:3 pg 60 Obituary: Ken Perry
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pg 63 The American Antiquarian Society's Version of
Fawn Hoof, Halliday
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Introduction by Meloy
pg 66 Reprint: Biographical sketch of Nahum Ward
pg 69 Mammoth Cave as seen in a 1813 reference book
pg 72 Reprint of 1851 Covington paper "Jenny Lind at
Mammoth Cave"
pg 73 Reprint from 1842 Russellville Herald "A Visit to
the Mammoth Cave"
pg 79 Obituary - Arthur Stebbins
- 6:4 pg 88 Bermuda's caves and their history, Gerald Forney
pg 105 The caves on Lake Erie's Islands, John Bridge



Book Reviews

Oldham, Tony, 1975. The Caves of Scotland, except Assynt.
Oldham Publications*, Bristol, U.K. Mimeographed,
174 pp. £3.

As the author and publisher points out, this is not a definitive book. Yet it contains a wealth of information -- vastly more than has been compiled previously on Scottish caves, their history, and legends. In part this is because most Scottish caves are not in limestone, and this is the first British book to break with the tradition that caves are in limestone, and nothing else is worth consideration.

Discussion of the caves of Assynt is deliberately omitted in order to avoid duplication of the Grampian Speleological Society's book on this important area.

I cannot find anything on the caves of Glen Coe which have been recently attracting attention. The Journal of Spelean History item revealing the spuriousness of the "Bruce's Cave" near Kirkpatrick Fleming is not mentioned. Location data are garbled too much to be of use for the Prince Charlie's Cave I happen to have visited. There are probably other similar omissions and commissions. Yet I suggest that every American caver with a present or potential interest in Scottish caves order a copy immediately. Tony's Caves of Devon went out of print almost at once, and Caves of Scotland except Assynt is likely to do the same.

--W.R.H.

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Watson, Patty Jo (Editor). 1974. Archeology of the Mammoth Cave Area. New York, Academic Press. 255 pgs. \$16.00.

Patty Jo Watson has masterfully summarized the archeology of the Mammoth Cave area -- the first such comprehensive work of its kind. After reading this book I've become aware

of the amazing quantity and diversity of archeological data concerning this area. The caves are truly rich storehouses and Watson and her collaborators are to be commended for the work they have done.

I don't believe it requires (although it would help) to have an archeological background to understand much of it, and certainly it is not needed to appreciate Watson's book. The book is a monograph for the professional archeologist but most of it is likely to be understood and appreciated by the layman. It is written in a clear and concise manner, well organized and contains many good, clear illustrations and well-drawn maps. Especially good are the photos of Little Alice and the textile garments.

The majority of the book is devoted to Salts Cave and Mammoth Cave but a chapter on Wyandotte Cave is included for comparison. An enormous amount of data is presented and care was taken to make the information as complete as possible. I was impressed by Watson's inclusion of a list of Mammoth Cave area artifacts held by various museums.

There is more than I care to know about paleofecal matter but the work of contributors such as Yarnell and Bryant do lead to fascinating conclusions on the diet, and related habits of the Indian. The chapter on prehistoric people was the most interesting to me personally, as well as the notes on the construction of the fragments of footwear and cloths found in Salts and Mammoth. I must admit that my own interest is more directed toward what the Indians made with their hands.

Watson has given us a glimpse of a tremendous jigsaw puzzle in which only some of the parts have been discovered and analyzed. Much has yet to be done but most will be accomplished with the techniques discussed in this book.

--P.H.Q.

Matthews, Larry E. (Editor) 1974. Bibliography of Tennessee Speleology. 21 pp. Second Edition 1975. 65 pp. Knoxville, Tennessee Cave Survey

Through the capable hands of Larry E. Matthews and Marion O. Smith the Tennessee Cave Survey has undertaken a colossal task. By periodically up-dating the work done in Tennessee, the Survey has compiled a valuable contribution to speleology. The first edition largely consists of the works that were readily available to Matthews and Smith, and the much enlarged second edition contains major contributions by Tom Barr and David Culver. Much remains to be done. The Survey and its editor are to be commended for undertaking such a difficult project and this author appreciates the monumental contribution that Matthews and Smith have made to the field of speleology.

--W.R.H.



