THE CAVES OF McKITTRICK HILL

EDDY COUNTY, NEW MEXICO

Edited By Carl E. Kunath

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Texas Speleological Survey

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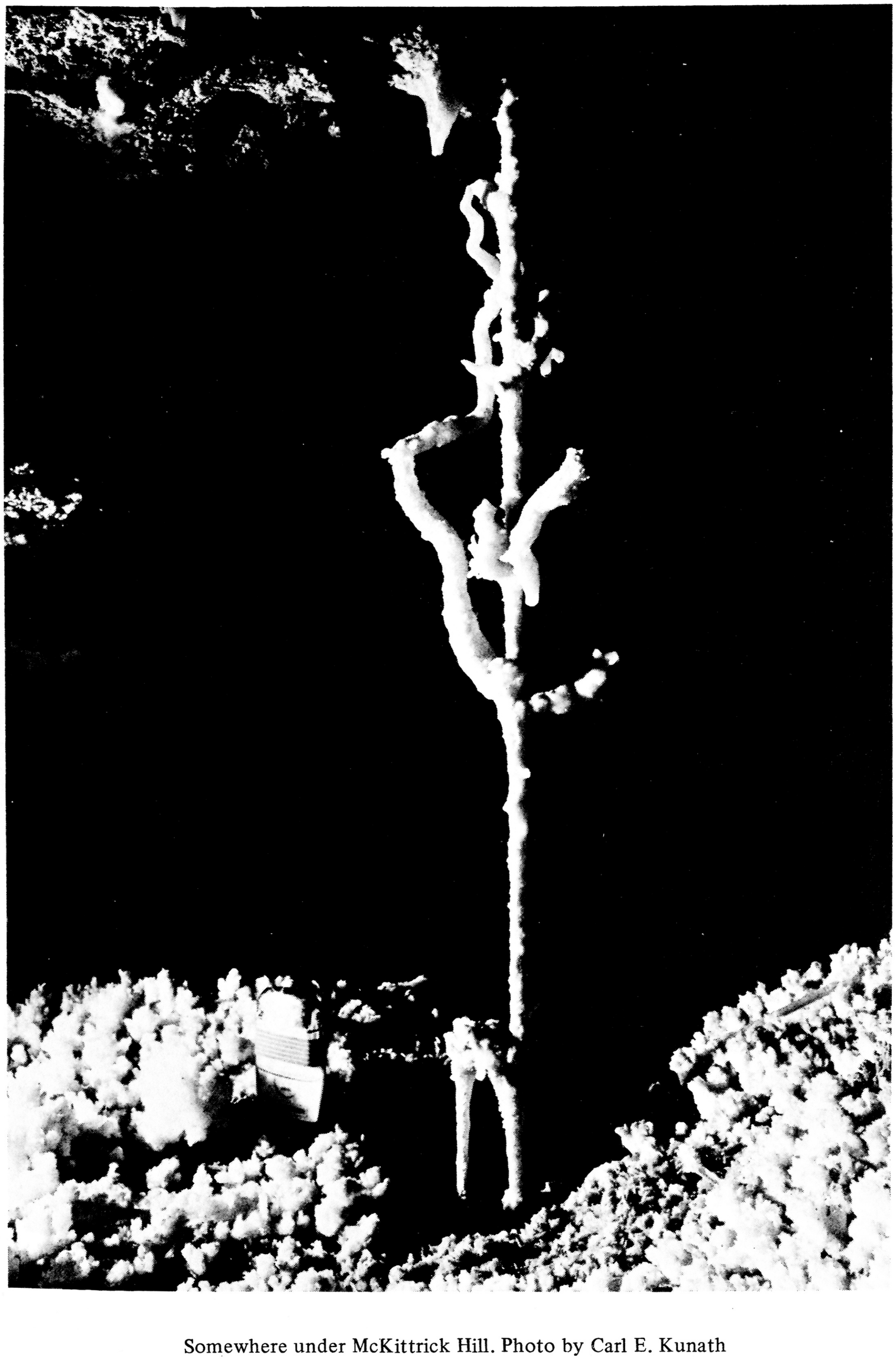

Somewhere under McKittrick Hill. Photo by Carl E. Kunath

THE CAVES OF McKITTRICK HILL

EDDY COUNTY, NEW MEXICO

HISTORY AND RESULTS OF FIELD WORK

1965 – 1976

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PREFACE AND ACKNOWLEDGEMENTS

McKittrick Hill is part of a large tract of Federal land in Eddy County, New Mexico, which is administered by the Bureau of Land Management (BLM). Although leased for ranching purposes, the area is open to the public for recreation. All the cave entrances are gated, and permits to enter must be obtained from the BLM District Office, P.O. Box 1397, Roswell, NM 88201.

In early 1965 all the factual information about the caves of McKittrick Hill would scarcely have filled a single page. Now, 13 years later, much has been learned but much remains unknown. On the following pages is essentially all that is known about the karst phenomena of McKittrick Hill. This is published in the hope that those who have worked on this project will now feel that their efforts were not in vain and so that others may be inspired to continue the work in this most interesting area.

This history of McKittrick Hill is only a summary. Vast amounts of information are available in the literature cited in the bibliographies. Where factual information was lacking or felt to be of questionable reliability, the information was either so qualified in the text or eliminated completely. It is felt that no significant information is lacking although future historians may yet assemble a more nearly complete account. Early versions of the cave maps have been included in the history section as they afford an unusual opportunity to trace the progress in surveying a cave and the evolution of the skills necessary to produce the final map.

A few obvious questions remain unanswered. What of the mysterious Mr. Carter? All that is known is his name and that from only a single reference in Burnet's work. Do the caves connect? At this time, there is no known connection between any of the five McKittrick Hill caves, and the possibility of such a connection is remote. Early explorers assumed that there were such connections, and in the case of McKittrick Cave and Sand Cave, such a connection was indeed expected. Alas, there are not even any tantalizing leads to hint that such is the case. Dry Cave continues to yield new passage to the determined explorer, but the distance to the nearest known cave passage in other caves is considerable. There are other "caves" in McKittrick Hill. At least one "blowing crack" is known and one small (dead-end?) crevice, not to mention several "suspicious" areas on the surface which have no obvious openings. There is a high probability that McKittrick Hill has not yet given up all its secrets.

No editor can realistically hope, in the usual space allotted, to sum up all the tribulations of an effort such as this; no one much cares if he does so or not. It seemed such a simple thing that was proposed: a report on the caves of McKittrick Hill. That was in 1966 at the conclusion of the first McKittrick Hill Project. Since so much remained to be learned, it was decided to postpone the publication until after the 1970 Project. Now, in 1978, 13 years after the work began and nearly 8 years since the last Project, we finally cry "Enough!"

A number of people made valuable contributions to this report. With a few notable exceptions, these contributions were excruciatingly slow in coming. This *manaña* attitude is perhaps the main reason for the relative dearth of *significant* speleological literature. Most editors have neither the time nor the inclination to wait YEARS for committments to be honored—the projects are abandoned.

Many people assisted in the preparation of this report—some with printed words, some with physical labor; a few with useful suggestions and constructive criticism. In particular, the contributing authors often assisted far beyond what their simple by-lines would suggest. Robert Nymeyer proved himself a tireless and faithful correspondent in answering a barrage of requests for historical information, and he also furnished a fine selection of photographs which are historically significant as well as artistic. Thanks to James Reddell for a near-perfect typesetting and proofreading performance and for his moral support over the years. Thanks to Gill Ediger and the Oztotl Supply Company for interested cooperation and assistance that only a caver could give. Thanks to all the people who pulled chains through the mazes in McKittrick Hill in response to requests which must often have appeared misguided at best. Finally, thanks to the many people who assisted, encouraged, and were there when I needed them.

Carl E. Kunath San Angelo, Texas
May 1978

HISTORY

by Carl E. Kunath

Fig. 1.—Main entrance to McKittrick Cave, August 4, 1910. L-R: Robert Ezell, Deatron Campbell, Frona Leck and her brother, Bert Leck. Couple at top are identified only as a niece and cousin of Bert Leck. Photo courtesy of Robert Nymeyer.

Early History—First Explorations

McKittrick Hill is a barren and generally cheerless place. Extremes of temperature and prevailing blustery winds cause many visitors to seek the relative tranquility of the caves beneath the hill. Climate notwithstanding, Felix McKittrick came to the area of present day Carlsbad, New Mexico, in 1867, and the county census of 1880 listed him as a cattle rancher in the Rocky Arroyo area west of town. It is probably safe to assume that the prominent hill, and one of the major caves therein, are named after this 19th century pioneer, but there is no information to indicate that he actually entered the cave which bears his name. Apparently, McKittrick did not actually own the land surrounding the cave for many people visited the cave with no mention being made of consulting the owner for permission. Also, the cave was referred to as the "Guadalupe Cave" as late as 1895 after which the name McKittrick is applied to the cave.

McKittrick Cave, with its large lower entrance sink, must have been discovered as soon as man arrived in the area.[1] Old records indicate that McKittrick Cave was known and visited in the middle 1880's, although the earliest dates observed on the cave walls are from 1894. Possibly the first written account of a visit to McKittrick Cave appeared in the June 3, 1893, edition of *The Eddy Daily Current.*[2] An anonymous article entitled "An Underground Wonder" describes in fanciful detail a tour of the larger portions of McKittrick Cave. This article includes a rather interesting comment: "It is believed that this whole mountain [McKittrick Hill] ...is honeycombed with these gloomy caverns. In time, all this labyrinth of underground caverns will be hunted out, explored and fully mapped."

McKittrick Cave was (and still is) a popular excursion destination for the more adventurous residents of Eddy and surrounding counties. Area newspapers printed frequent stories about visits to McKittrick Cave and, later to Sand Cave as well[3] (see Figure 1).

McKittrick Cave was the reported source of a "petrified man" which was placed on exhibit in 1894 at 25 cents a look. This hoax was probably inspired by the finding of a skeleton in Carlsbad Caverns in 1893.

The first of many mineral claims encompassing McKittrick Cave was filed in July 1900, although the value of the guano deposits was apparently recognized years earlier.

The first survey of McKittrick Cave was made in May 1909. It reported the cave to be smaller than imagined, "...about 600 feet in its greatest extent, although it seems much larger...."[4]

Robert G. Brookshire filed a claim on McKittrick Cave and a small area surrounding it in 1910. He built a small stone hut near one of the lower entrances and was reported living there as a hermit as late as May 1913. The ruins of his house may still be seen amid the brush. Brookshire was a sculptor and stone cutter who carved figures and tombstones from the formations and flowstone he removed from the cave. He was apparently a willing guide for the many visiting parties and is quite likely the discoverer of nearby Sand Cave.

[1] Indian middens near the entrances of McKittrick Cave and Dry Cave attest to the presence of early man, although no artifacts are known to have been collected from within any of the McKittrick Hill caves except for a single woven basket remnant found only a few feet within the entrance of Endless Cave. This isolated case suggests that it may have come from without, perhaps as material for a rodent nest.

[2] Eddy, New Mexico, is now Carlsbad, New Mexico.

[3] J. T. Meador has done considerable research on the speleo-history of McKittrick Hill and has published a lengthy series of loosely connected quotations. See Southwestern Cavers, (8)1, May 1969.

[4] The present survey shows a "length" of about 900 feet.

Newspaper accounts first mentioned Sand Cave in May 1911 and implied that it was newly discovered. Sand Cave was a great find for the visitors. Their accounts contain such phrases as "...it was all each one could do to climb the ladders, so loaded down with souvenirs of every size and description....," and "After filling our arms to overflowing with the beautiful onyx...." Horror stories to be sure.

By the spring of 1924 when the Fox Company visited the caves with the intention of making a movie, a spokesman commented: "These caves were considered very beautiful years ago, but constant use by visitors as camping sites smoked the interior to such an extent that they have lost some of their old time glory. The beautiful formations have become broken and carried away...." It is interesting to note that one of the members of the Fox Company expedition was Dana W. Lee, the son of Willis T. Lee who was then making the first "official" survey and exploration of Carlsbad Caverns. The account of the Fox expedition contains comments about a variety of automobile troubles while trying to reach the caves—not unlike such trips today!

In April 1924 Vernon Bailey was investigating the animal life of the Carlsbad Caverns area, and he extended his field work to McKittrick Hill. He reported taking two species of bats from McKittrick Cave in a 1928 publication.

It appears likely that Little Sand Cave and Endless Cave were discovered in the latter portion of the 1920's. Very little specific information has been found, but it is believed that Whitey Hughes and Roy Simmons discovered Little Sand Cave, and later, Hughes and George Stone, explored the entrance. Whitey Hughes is also credited with the discovery of Endless Cave a short time after the Little Sand discovery.[5]

In the early 1930's R. M. "Bill" Burnet was the curator of the Carlsbad Archeological and Historical Society and was well known for his interest in artifacts found in caves. One day in early 1933, a man named Carter came to Burnet with a story about a cave he thought Burnet would be interested in visiting. The record is unclear, but the implication is that Carter was the discoverer or at least among the first explorers of the cave. The two men soon visited the cave, which Burnet named "Carter's Cave" in honor of his informant. This is the cave presently known as Dry Cave. With Carter leading the way, the two descended a rope hand over hand into the "Big Room." Carter then led Burnet to what was later named the Camel Room. The floor of this room was carpeted with Pleistocene bone material.[6] A few weeks later Burnet returned to the cave with two mining engineers, two "young ladies," and a Catholic priest. This group used a Brunton compass and an altimeter to survey the cave[7] (see map, page 5). This time, they were prepared for the 20 foot drop into the Big Room, having a rope ladder with bamboo rungs. They laid out a grid in the Camel Room and made surface collections.

Early identification of the bone material Burnet collected from Dry Cave indicated at least three types of camel as well as horse, bison, and others. No human remains or artifacts were found within the cave although there was evidence of man in the entrance area. Burnet postulated the Camel Room was a now closed carnivore den.

On a third trip, Burnet discovered more bone material in the vicinity of station 17 (see map) and in another passage leading from the Big Room, which he named the Animal Fair Room.

[5]It is not known what names, if any, were given to these caves by Hughes. Little Sand Cave has sometimes been called North McKittrick Cave and Endless was named by Robert Nymeyer in 1934, years after Hughes' discovery.

[6]Burnet later wrote that some of the exposed bone material had already been crushed by the boots of earlier explorers.

[7]Presumably, they also used a tape. The map has been traced and redrafted from a Xerox copy of a tired old blueline print. The basic information is unchanged, although rearranged somewhat.

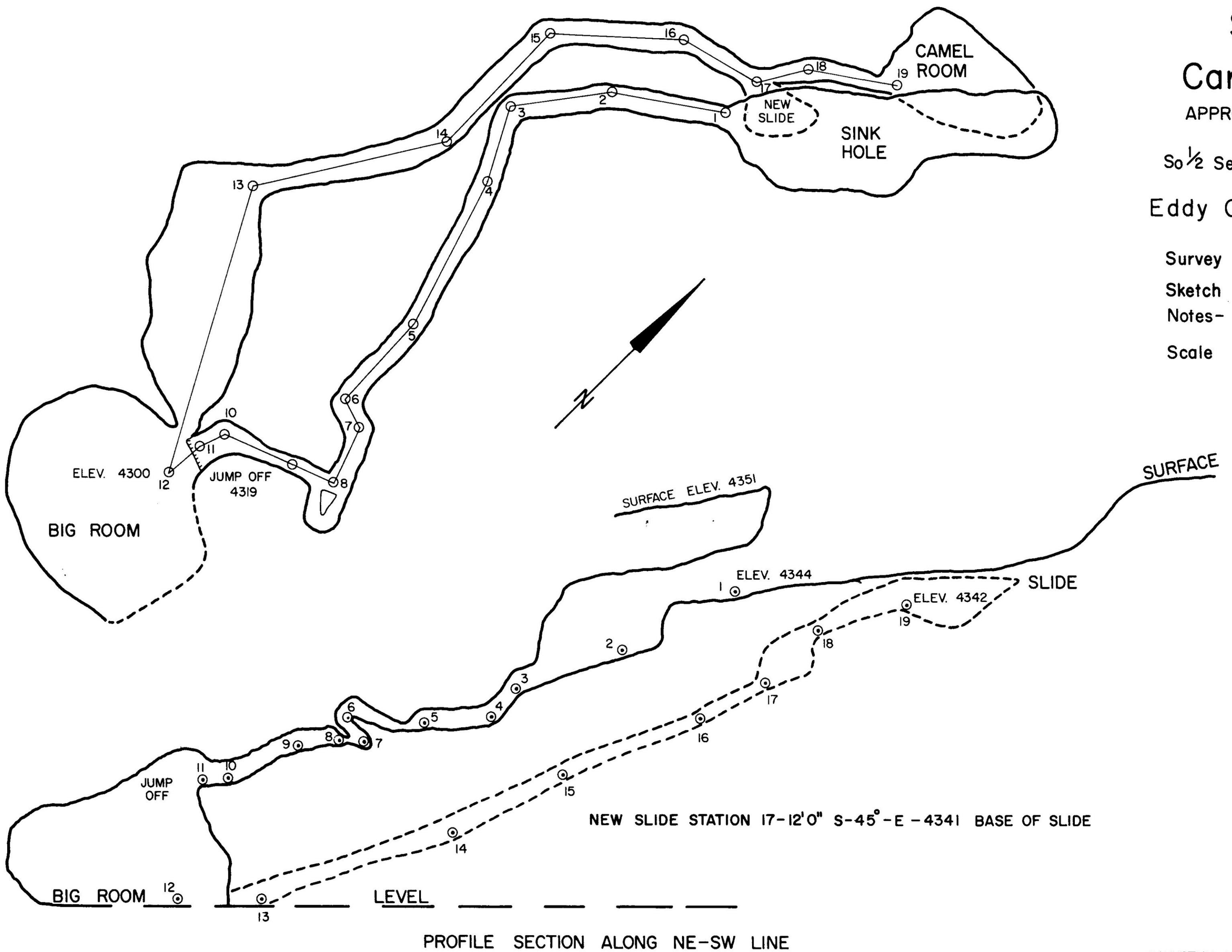
SKETCH

Carters Cave

APPROXIMATE LOCATION

So 1/2 Sec. 21. Tsp. 22. S. Rge 24E
N. M. P. M
Eddy Co. New Mexico

Survey by CA Pierce - EM
Sketch by RM Burnet
Notes - Miss Sally Pierce - B.S.
Scale 1" = 20'



DRAFTED BY R.M. BURNET JANUARY 3, 1934
REDRAFTED (ENLARGED PLAN OF CAMEL ROOM OMITTED)
BY CARL E. KUNATH 10-75

0 20 40 60 80 100
FEET

Fig. 2.–L-R: Tommie Futch, Robert Nymeyer, Glen Hamblen, and Dave Wilson at the entrance of Endless Cave, March 4, 1934. Photo by Robert Nymeyer.

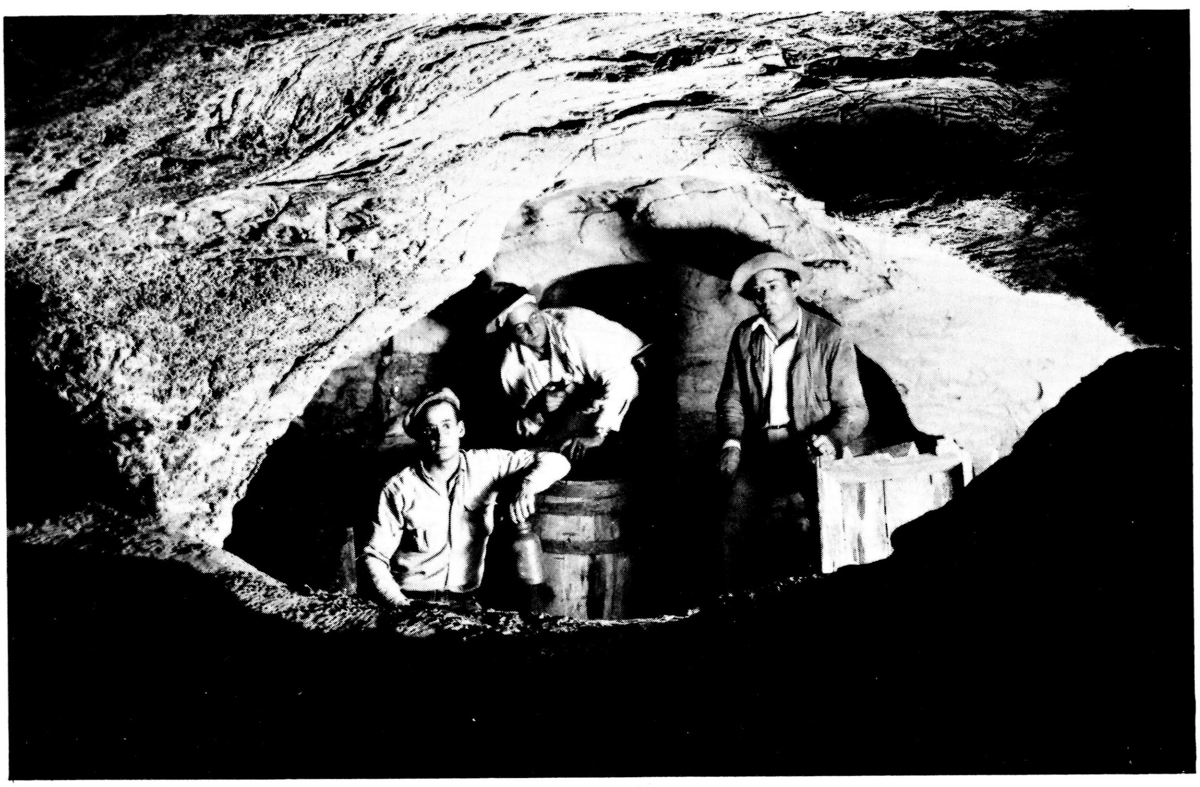


Fig. 3.–Old still in Endless Cave, March 11, 1934. L-R: Dave Wilson, Robert Nymeyer, and Ray Sims. Photo by Robert Nymeyer.

Burnet wrote an article for the October 1934 *New Mexico* magazine in which he mentioned some of his finds and adventures in the area caves.

Robert Nymeyer, Dave Wilson, and Sonnie Kindel "rediscovered" Carter's Cave on April 8, 1934. They had obtained directions from a hunter and were unaware that the Burnet group had preceded them. They progressed to the area beyond the Big Room and explored for a short time. They found only the usual small, dusty passages and, noting no signs of any previous exploration, thought they were the first to enter the cave.[8] When Nymeyer told Burnet about the cave and mentioned that they had seen some bones there, Burnet gave no indication of recognizing the cave—a curious reaction from a man who had mapped the cave only a few months before.

On March 4, 1934, Robert Nymeyer, Tommie Futch, Sonnie Kindel, Dave Wilson, and Glen Hamblen visited Endless Cave after hearing about the cave from a sheep herder (see Figure 2). Not far from the entrance they discovered a somewhat dilapidated still (see Figure 3). At this time the cave appeared to have been visited very little although there was some vandalism in the first portions of the cave. Nymeyer returned to the cave four times during 1934 with various associates including Ray Sims, Charles Stevens, miscellaneous girl friends, and those already mentioned above. These explorers were the first to see the portion of Endless west of the Expressway.[9]

At this time "formation mining" was being carried out in McKittrick Cave and Sand Cave, even to the extent of blasting massive areas. For a time Endless was spared this ignominious fate, but when Nymeyer returned to Endless in August 1936, the destruction was well advanced, and he learned that the location of the cave had been sold to a notorious vandal for the princely sum of $5.00.[10] Figures 4 through 7 tragically compare virgin Endless with post-vandal Endless. The speleothems were fashioned into paper weights and other souveniers and were sold at most of the area curio shops including Carlsbad Caverns. Of all the McKittrick Hill caves, Endless was easily the most beautiful. Today, only the War Club Room retains any semblance of its natural beauty.

In June 1936 Burnet and six companions made an archeological study of sites in the Guadalupe Mountains for the Pennsylvania University Museum. During their three day stay at Carter's Cave, they excavated test trenches in the Camel Room (and perhaps in the Balcony Room and Animal Fair Room as well).

With such a flurry of activity at Dry Cave in the mid 1930's, it is remarkable that so little exploration was done at the time. However, the Nymeyer group was intent on the unspoiled beauty of Endless Cave and never returned to Dry Cave. The Burnet group was interested only in the bones already discovered near the entrance of Dry Cave. It would be 30 years before Dry Cave began to receive the attention it deserved.

[8] As the Nymeyer group thought they were the first to visit the cave, they gave it the name Dry Cave to highlight its most obvious characteristic. To complicate matters, the cave is also known as Dry Pot, a name created by cavers from Dallas, Texas. The Nymeyer group also renamed the Big Room as the Balcony Room, the name in use presently.

[9] Robert Nymeyer and his friends were the first to see quite a few things. He wrote an article for the December 1938 issue of *New Mexico* magazine which highlighted many of their more memorable experiences while exploring caves.

[10] The Nymeyer group left written evidence of their visits on the walls of the caves. Nevertheless, they were appalled at the damage done to the other caves and were strong conservationists. Nymeyer was offered some rather impressive sums for the location of Endless Cave but declined to reveal it.

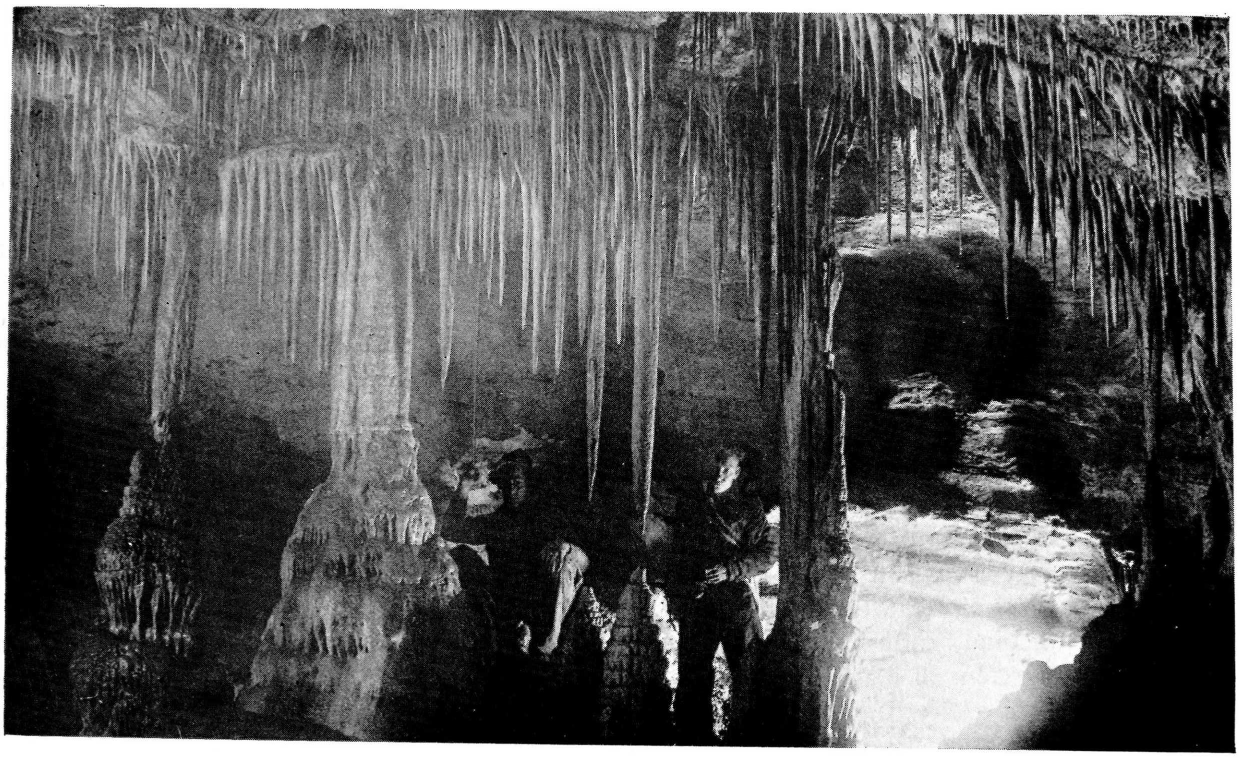


Fig. 4.—Dave Wilson (L) and Glen Hamblen in the Gypsum Room, Endless Cave, March 25, 1934. Photo by Robert Nymeyer.

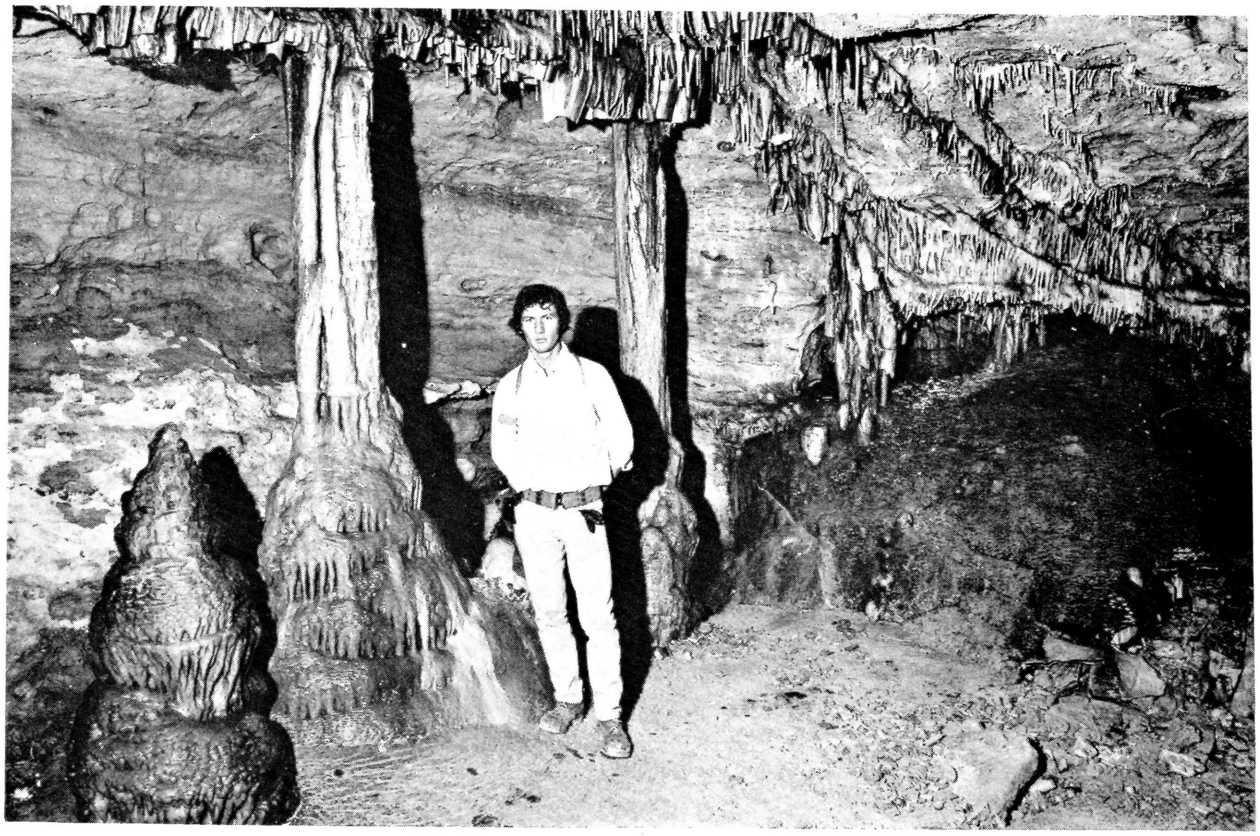


Fig. 5.—Steve Vallandingham in the Gypsum Room, Endless Cave, March 12, 1972. Photo by Carl E. Kunath.

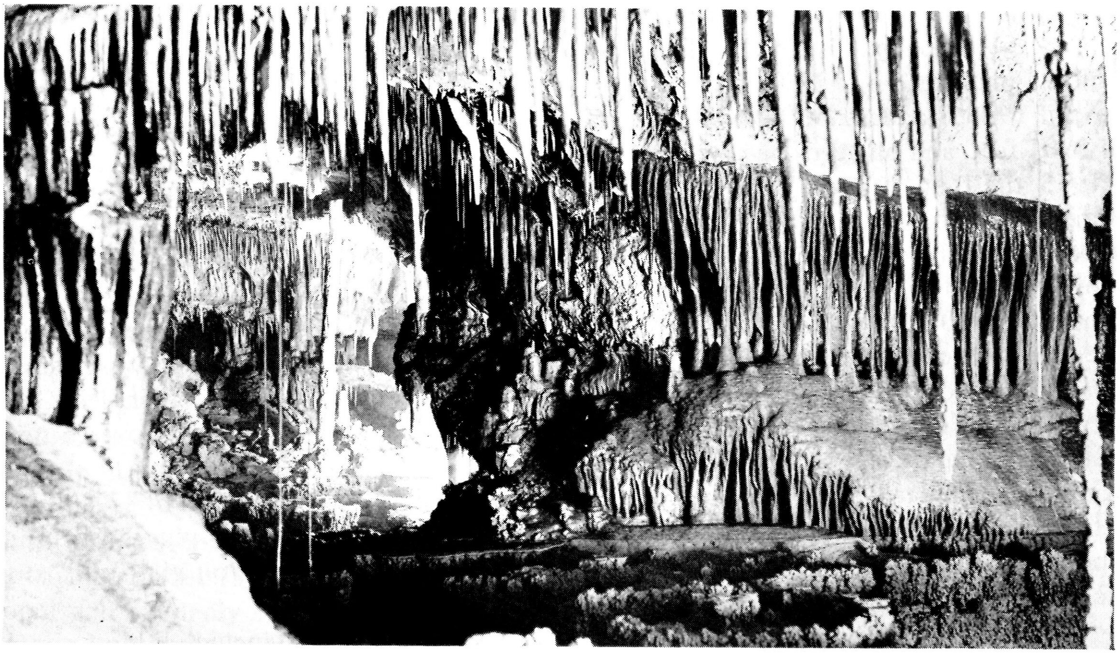


Fig. 6.—The Green Lake Room in Endless Cave, March 1934. Photo by Robert Nymeyer.

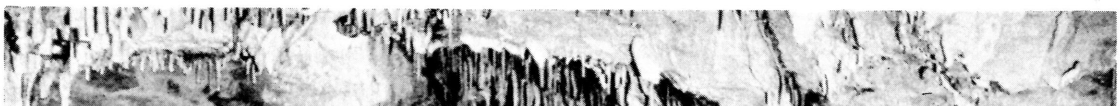


Fig. 7.—The Green Lake Room in Endless Cave, March 1961. Photo by Jerry Trout.

New Explorers: 1943 - 1963

In 1943 the USGS published the West Carlsbad quadrangle. This map included McKittrick Hill and noted the location of McKittrick Cave.

In April 1943 Standard of Texas began drilling an oil test atop McKittrick Hill, reaching a depth of 3901 feet, and plugged the dry hole in May 1944.

In 1953 the first "modern" cavers reached McKittrick Hill. During December members of the Colorado Grotto of the National Speleological Society (NSS) visited Endless, Sand, and McKittrick Caves. They reported the caves to be badly vandalized and that formations from them were being sold at "other caves."

In the mid 1950's Jerry and Bob Trout, of Carlsbad, began caving. They were very enthusiastic and spent considerable time exploring the McKittrick Hill caves. As a conservation measure, they attempted to conceal passages leading to the relatively undamaged portions of Endless Cave. Ultimately, they were unsuccessful although one "blocked" passage was not rediscovered until well into the mapping of that section of the cave.

Beginning in January 1957 Northern Natural Gas drilled a gas test to a depth of 11,890 feet only 75 feet from the Standard of Texas hole. This well was also dry and was plugged in April 1957. The stub of this well may be seen near the north end of the graded "oil platform" atop McKittrick Hill.[11]

The *Texas Cave Survey* temporarily expanded its field of interest to include Eddy County, New Mexico, and listed McKittrick Cave in a 1958 publication.[12]

In 1960 the NSS convention was held in Carlsbad, New Mexico. The Guidebook for that convention was prepared by Park Ranger Bob Crisman, a former Texas caver from Abilene. The guide contained a section on the caves of McKittrick Hill, and presumably a relatively large number of conventioneers visited one or more of the McKittrick Hill caves during the convention. It is interesting to note that Crisman mentions only three entrances to McKittrick Cave (there are actually five) and that Dry Cave is not mentioned at all. The omission of Dry Cave substantiates the theory that Dry Cave was essentially "lost" during the 1937-1963 period.

By 1965 some of the caves of McKittrick Hill had been known for at least 80 years, yet nearly all that was known of them was in the form of personal anecdotes and popularized newspaper articles. No significant factual data existed about any of the caves. The locations of the caves were so vague that the first mapping effort in Endless Cave took place without any certainty about which cave was being mapped.

[11] Drilling has continued in the vicinity of McKittrick Hill up to the present time. There is currently a gas well about two miles east of McKittrick Hill.

[12] The Texas Cave Survey was later replaced by the Texas Cave Index. Since the early 1960's, such work has been carried forward by the Texas Speleological Survey.

Recent History — Speleology Under The Hill

Notwithstanding the multitude of trips to McKittrick Hill prior to 1965, it was not until April of that year when the map of Endless Cave was begun that the first step was taken toward systematic speleological investigation of the area.

During the Easter weekend of 1965, Carl and Glenda Kunath with Jack and Diana White began the survey of Endless Cave with a base line of approximately 3,000 feet[13] (see map, page 13).

Within weeks of the first mapping effort in Endless Cave, momentous events occurred in Dry Cave. From 1937 to 1964 there was very little interest in the caves of McKittrick Hill. Burnet's work was unknown or at least forgotten and, except for the oil exploration companies and the Trouts, there was no particular interest in McKittrick Hill. During these 27 years, several capable cavers visited Dry Cave. Lee Skinner and Jack Hamm visited the cave in 1963, somehow missed the Balcony Room and, like most of their predecessors, concluded that the cave was rather small and uninteresting. The easily accessible portions of the other McKittrick Hill caves doubtless made the prospect of crawling about in the small, dusty passages of Dry Cave somewhat less attractive than it might otherwise have been.

In November 1964 Jim Peck, of Carlsbad, visited Dry Cave. Peck pushed beyond the Balcony Room and suddenly found himself in virgin cave with inviting passages by the dozen.[14] Lee Skinner learned of Peck's new discoveries within a few months and lost no time in returning to the cave in May 1965 with Pete Lindsley, Larry Register, and Tom Meador. Peck was to meet them at the cave later in the day. While waiting for Peck, they began the survey of the known area of the cave between the entrance and the Balcony Room. The survey ended at the Balcony Room and the group began to explore, eventually reaching the top of the "40 Foot Chimney." At this point, Skinner and Meador left the cave while Lindsley and Register descended the chimney and explored about 3,000 feet of virgin passage without beginning to exhaust the possibilities. This was a "classic" trip, complete with "momentary disorientation" lasting about two hours. As they returned to the bottom of the 40 Foot Chimney, they met Peck, who had arrived by a different route, and told him of their discoveries. A few weeks later a large group from Texas, New Mexico, and Arizona gathered at the cave for the Memorial Day weekend of 1965.[15] This group continued the survey of the cave and explored many new areas. During these explorations, bones were noticed in the fissure area near the Chamber of the Vanishing Floor and the Grand Canyon.[16] At the conclusion of this trip, several thousand feet had been surveyed in Dry Cave with several thousand additional feet explored but unsurveyed (see map, page 14).

In June 1965 Carl Kunath, Jimmy Ray, and David Wood surveyed an additional 2,000 feet in Endless Cave. In the last days of December 1965 Carl Kunath and George Bilbrey added 2,000 feet to the Endless survey, making a total of 7,000 feet at the end of 1965.

[13] According to Carl Kunath, it is doubtful that the survey of Endless Cave would ever have begun had the mappers suspected the complexity of the cave. Certainly, at that time, they did not have the expertise to map the cave. Perhaps no one did—it had never been done before.

[14] Jim Peck died in an automobile accident in 1975.

[15] This group included Lee Skinner, Jack Hamm, Pete Lindsley, John Corcoran, Ronnie Fieseler, and Carl Kunath.

[16] This information was eventually passed on to Dr. Arthur Harris of El Paso. Dr. Harris was sufficiently interested to visit the cave, and he began a serious study of the site. During his research he discovered that the Burnet group had studied bone material from sites nearer the entrance more than 30 years before!

It was now obvious that additional manpower would be required if these caves were to be completely explored and mapped in the near future. With the success of past TSA (Texas Speleological Association) projects in mind, Pete Lindsley and Carl Kunath began to make plans for a "Project Under the Hill."

During the Labor Day weekend of 1966, 80 cavers gathered at McKittrick Hill for the first Texas Speleological Association/Southwestern Region Project. The project was well organized and well attended but comparatively little was accomplished. Three teams surveyed a total of 3,895 feet in Endless Cave but only a small portion of that was new survey. Ronnie Fieseler led a team which completely surveyed Little Sand Cave (see map, page 55). Members of the Sandia Grotto (Albuquerque, N.M.) surveyed about 1,000 feet in Sand Cave before the sketch man revolted (see map, page 15). Dwight Deal led a team which, with 4,000 feet of survey lines, mapped the major sections of McKittrick Cave (see map, page 16). A small amount of mapping was done in Dry Cave, and Dr. Harris was at work on the bones.

On first consideration, it would appear that more should have been accomplished at the Project. Unfortunately, most of the potential mappers were not prepared for the complex mapping problems these caves presented.[17] Despite the limited success at mapping the caves the project was a social success, and the participants were able to get their fill of caving.

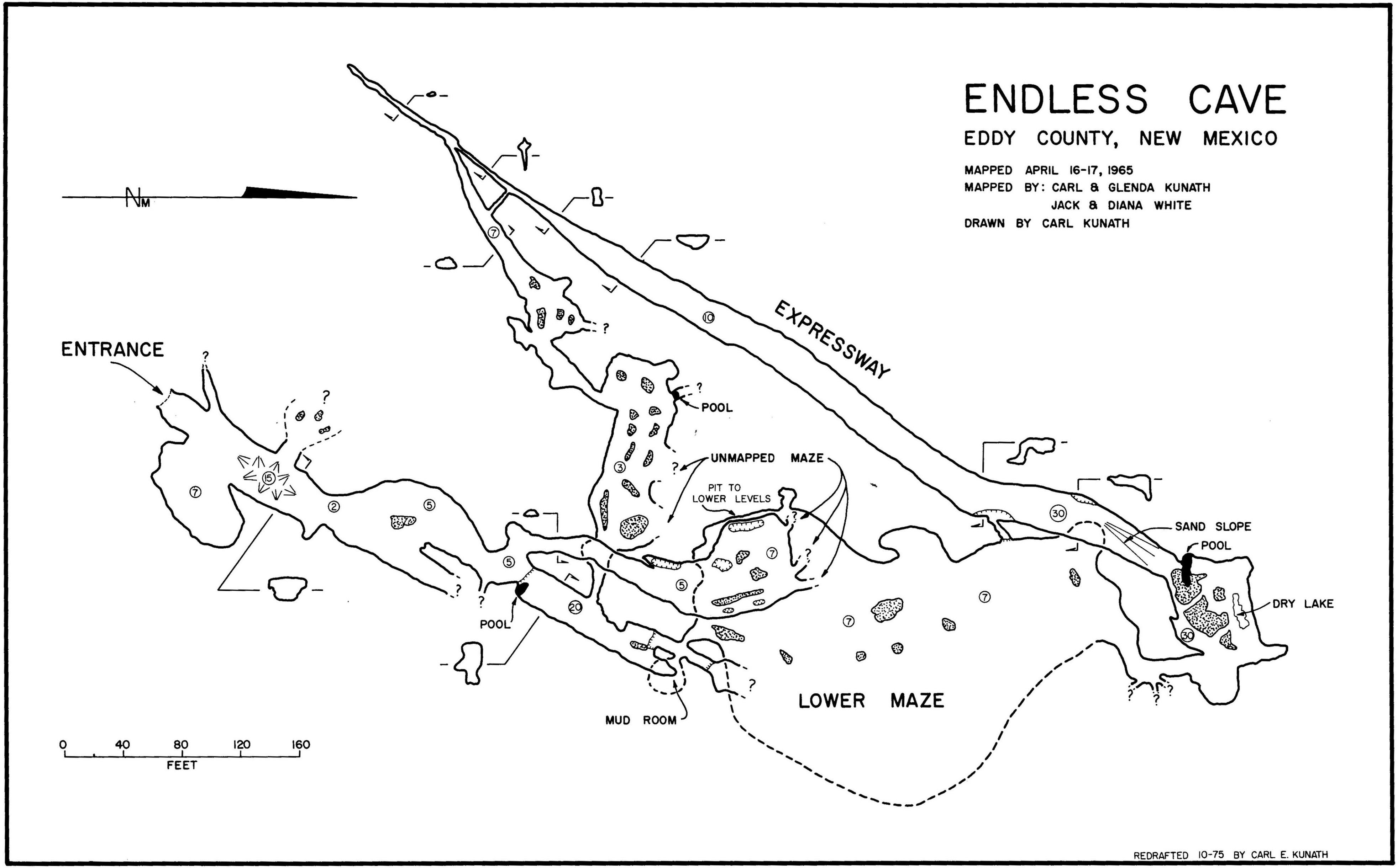
In the years following the 1966 project, the level of interest in the McKittrick Hill caves was relatively low. Dr. Harris continued to study the bone deposits in Dry Cave. Albuquerque cavers led by John Corcoran and Jim Hardy took over the Dry Cave mapping project and made quite a few trips resulting in the discovery and mapping of considerable new passage. By June 1972, 14,000 feet had been mapped in Dry Cave. Carl Kunath continued to lead the mapping effort at Endless Cave and organized three-day "expedition type" trips in December 1967 and November 1968. Sand Cave and McKittrick Cave were ignored as there were not enough interested people to go around.

In early 1970 the entrance to Dry Cave was gated through the cooperative effort of cavers from Albuquerque and the Bureau of Land Management.

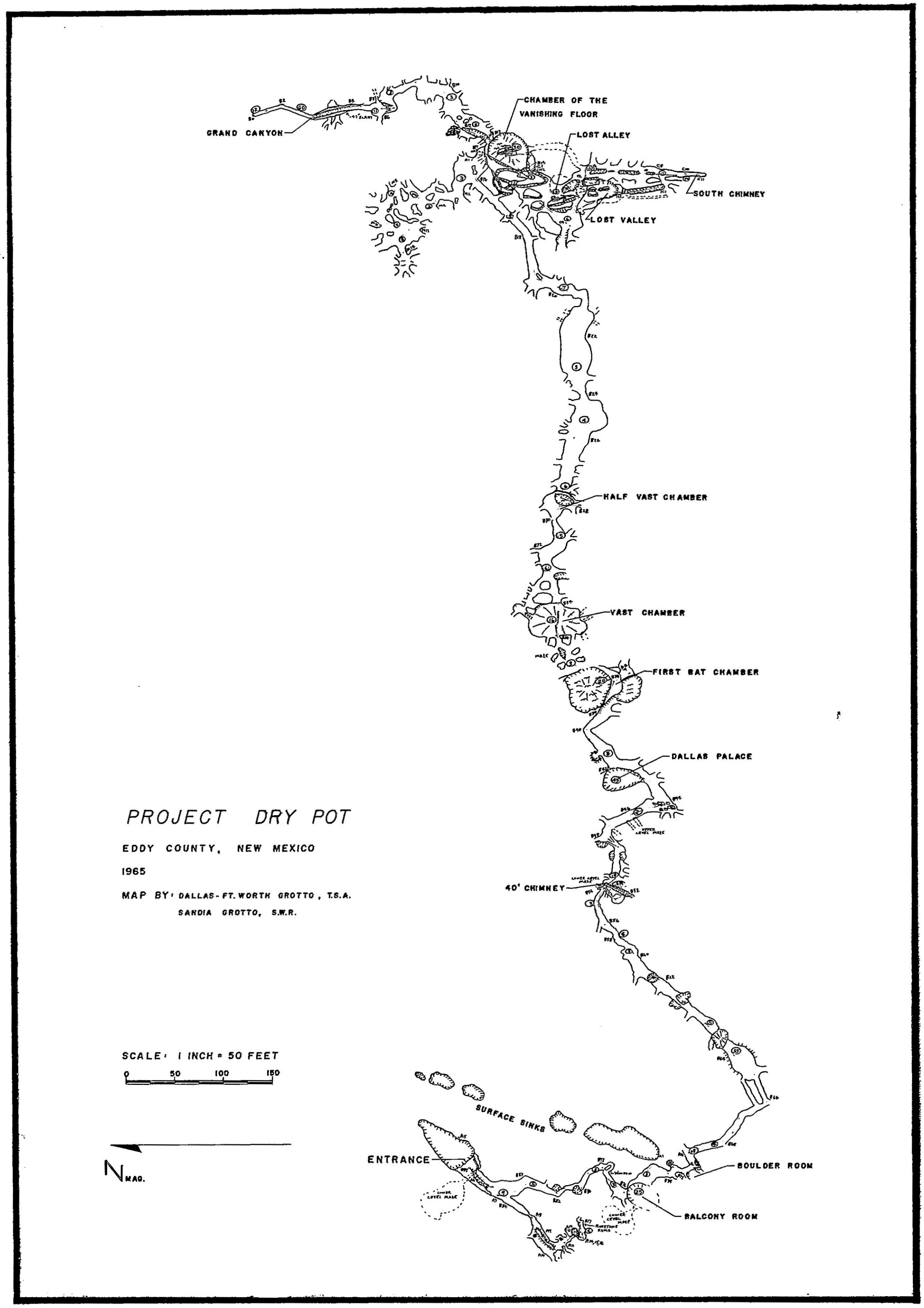
Finally, at the instigation of Carl Kunath and Ronnie Fieseler, a second TSA/SWR Project was held during the Labor Day weekend of 1970 (see Figure 8). This time, 148 people registered and, incredibly, even less was accomplished than in 1966. The survey efforts continued in Endless Cave and Dry Cave, although it was only the "veterans" who were at work. No attempt was made to improve on the 1966 map of McKittrick Cave, and those who sought to map Sand Cave were quickly discouraged just as others had been in 1966. Once again, a good time was had by all, but it was now obvious that the "Regional Project" type of attack was not going to work at McKittrick Hill as it had in many other places. The Hill caves are just too complex. Cavers who can map "ordinary" caves with little difficulty are often unable to cope with extensive, multi-level mazes.

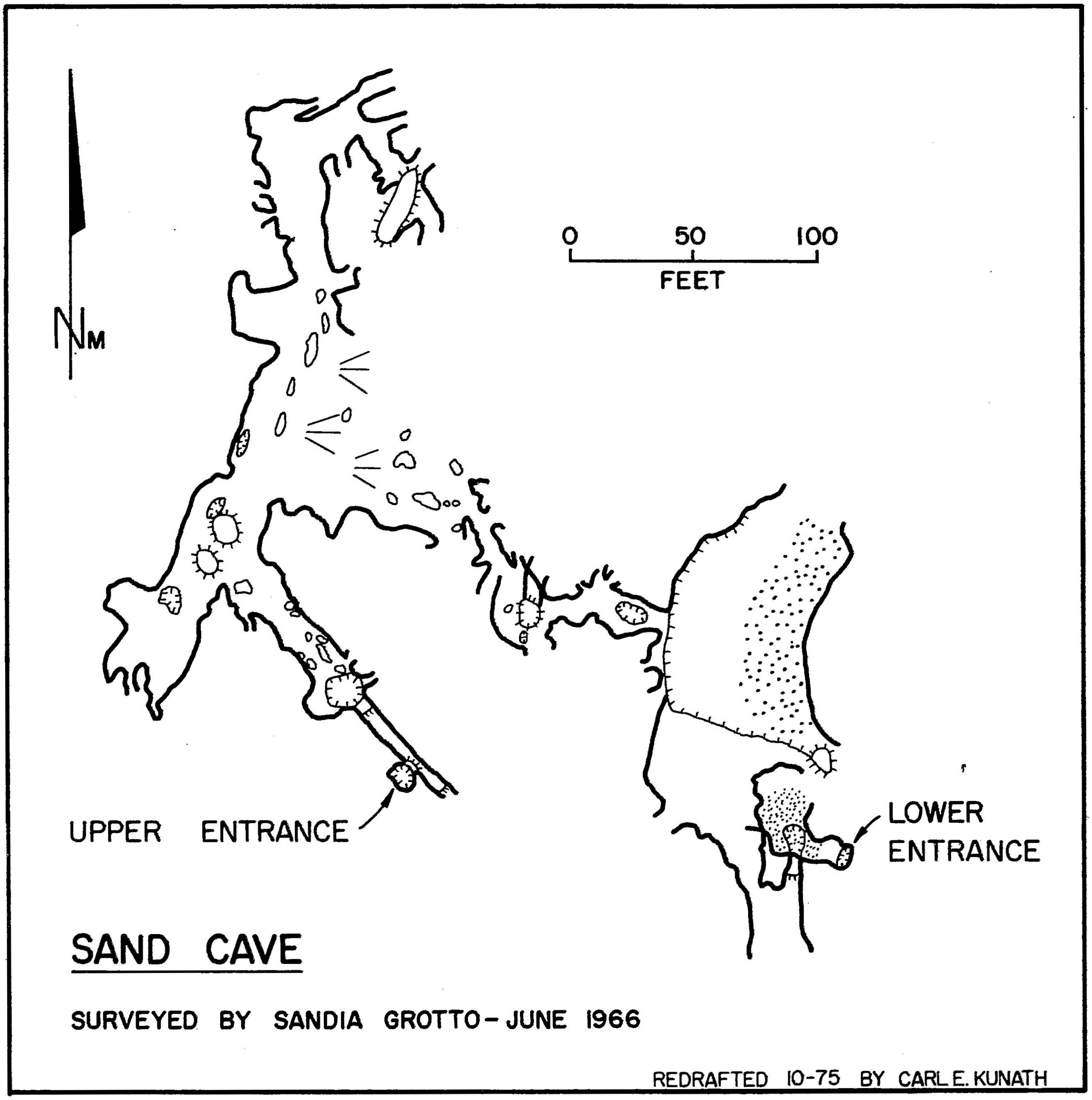
Following the 1970 Project, the Hill was again deserted except for the tenacious and committed veterans. Corcoran and Hardy coordinated the surveying work in Dry Cave, and in 1972 the map of Endless Cave was pronounced complete—after seven years (see map, page 31). Carl

[17] Slow progress in mapping the Hill caves should not be ascribed completely to a lack of motivation. Quite a few "surveys" made in these caves have been discarded as little more than scratch paper. While these are not "giant" caves, they have a tremendous wall area and foot for foot probably require four to five times as long to map as a more convential (linear) cave. Distance is also a factor. Most of the people active in the mapping of these caves live at least 300 miles away. Another major factor appears to be a psychological block at the thought of mapping many thousands of feet of passage at the average rate of only 100 feet per hour.



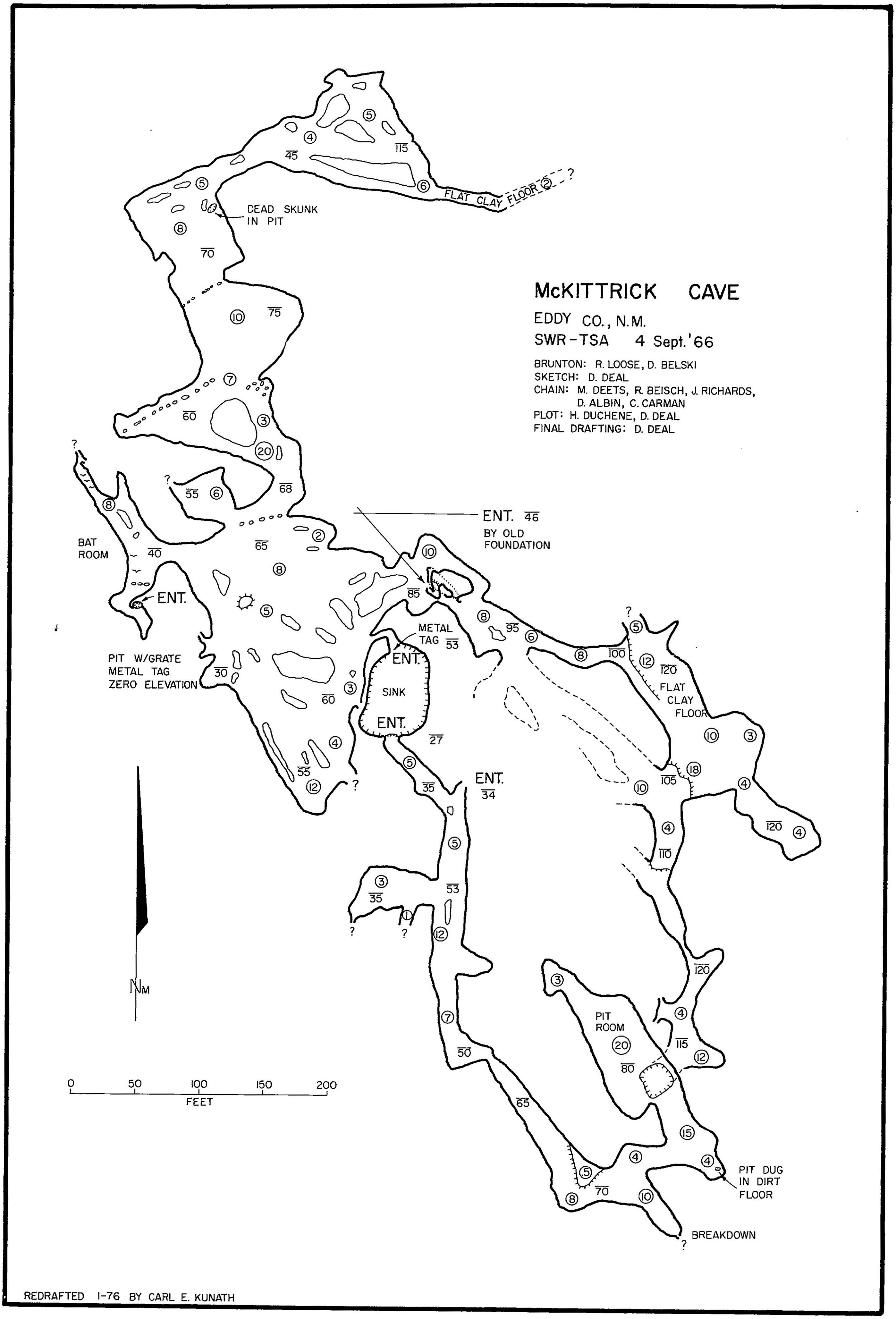
ENDLESS CAVE
EDDY COUNTY, NEW MEXICO
MAPPED APRIL 16-17, 1965
MAPPED BY: CARL & GLENDA KUNATH
JACK & DIANA WHITE
DRAWN BY CARL KUNATH
ENTRANCE
EXPRESSWAY
POOL
UNMAPPED MAZE
PIT TO
LOWER LEVELS
SAND SLOPE
POOL
DRY LAKE
POOL
MUD ROOM
LOWER MAZE
0
40
80
120
160
FEET
REDRAFTED 10-75 BY CARL E. KUNATH


CHAMBER OF THE VANISHING FLOOR
GRAND CANYON
LOST ALLEY
SOUTH CHIMNEY
LOST VALLEY
HALF VAST CHAMBER
VAST CHAMBER
FIRST BAT CHAMBER
DALLAS PALACE
PROJECT DRY POT
EDDY COUNTY, NEW MEXICO
1965
MAP BY: DALLAS-FT. WORTH GROTTO, T.S.A.
SANDIA GROTTO, S.W.R.
40' CHIMNEY
SCALE: 1 INCH = 50 FEET
0 50 100 150
SURFACE SINKS
ENTRANCE
BOULDER ROOM
BALCONY ROOM
N MAG.



Kunath had kept a log of all his trips and found that he had spent more than 100 hours actually surveying the cave.

In March 1973 Ronnie Fieseler, in what some considered an extraordinary display of optimism, organized the first mapping trip to McKittrick Cave since 1966. In one long day, teams led by Fieseler and Bill Elliott made a detailed survey of about 2,000 feet of the cave. With this as an incentive, plans to publish the existing McKittrick Hill information were suspended and all efforts were directed toward the completion of the McKittrick Cave map. The major survey effort in McKittrick Cave occurred during the Thanksgiving weekend of 1973 when Tom Byrd, Ronnie and Susan Fieseler, Carl Kunath, Mark Loeffler, and John Steele mapped more than 3,200 feet. One year later, during Thanksgiving 1974, the map was completed by Byrd, Fieseler, Kunath, and Dave Walker. The total surveyed length of McKittrick Cave is about 7,000 feet (see map, page 35).



McKITTRICK CAVE
EDDY CO., N.M.
SWR-TSA 4 Sept.'66
BRUNTON: R. LOOSE, D. BELSKI
SKETCH: D. DEAL
CHAIN: M. DEETS, R. BEISCH, J. RICHARDS, D. ALBIN, C. CARMAN
PLOT: H. DUCHENE, D. DEAL
FINAL DRAFTING: D. DEAL
DEAD SKUNK IN PIT
FLAT CLAY FLOOR
ENT. 46 BY OLD FOUNDATION
BAT ROOM
ENT.
PIT W/GRATE METAL TAG ZERO ELEVATION
METAL TAG 53
ENT.
SINK
ENT.
ENT. 34
FLAT CLAY FLOOR
PIT ROOM
PIT DUG IN DIRT FLOOR
BREAKDOWN
NM
0 50 100 150 200
FEET
REDRAFTED 1-76 BY CARL E. KUNATH

Fig. 8.—The camping area atop McKittrick Hill during the early hours of the 1970 Labor Day project. Photo by Carl E. Kunath.

In December 1973 Elbert Bassham directed a surface survey which located all the cave entrances with respect to the USGS bench mark atop McKittrick Hill. His survey was used to prepare the topographic overlay of the cave passages which appears on page 56. Several previous surveys were either unfinished, unsatisfactory, or unavailable.

The survey of Sand Cave was started on November 29, 1974, the same day the McKittrick Cave survey was completed. There seems to be no accounting for such seizures.[18] Doubtless the prevailing euphoria resulting from the completing of the McKittrick Cave map was an important factor. The group surveyed 1,200 feet of previously unmapped upper level passage connecting the two entrances.

Thinking that the map of Sand Cave could be finished with one mighty effort, two mapping teams attacked during the Memorial Day weekend of 1975.[19] One team resurveyed the passage shown on the Sandia Grotto map of 1966 (see map, page 15) while another completely mapped the south section of the lower level. Together, these teams added about 1,500 feet to the survey. Two weeks later, Fieseler led a major trip to Sand Cave with Byrd, Harold Ingersoll, and Mark Pennington. This group spent 24 hours in the cave and surveyed an additional 3,100 feet of passage. With more than a mile surveyed in Sand Cave, it was painfully obvious that the job was far from complete.

[18] Fieseler recalls that Kunath said something like: "Well, since we have several hours free, why don't we go over and map Sand Cave?"

[19] Even in 1975 Sand Cave was still something of a mystery. It was thought that it was the smallest of the four major Hill caves. As it turned out, not only was Sand Cave considerably larger than expected, it was far more complex as well.

In May 1975 there was a significant breakthrough in Dry Cave. While exploring the east wall of the passage just north of the Chamber of the Vanishing Floor, Bill Hinson and party discovered a passage which led east about 600 feet farther than any other known passage in Dry Cave.[20] After ten years of exploration and mapping, Dry Cave was still yielding new passage with nearly every trip!

In the fall of 1975 the Bureau of Land Management gated the remaining cave entrances at McKittrick Hill, thus affording protection to caves that had been ravaged continually since their discovery.

During Thanksgiving 1975 two teams mapped in Sand Cave and added about 1,200 feet to the survey, making a total of about 7,000 feet mapped in the cave during a 12 month period. The survey of Sand Cave was concluded on March 20, 1976, with a grand total of 8,000 feet having been mapped (see map,page 53). The collective sigh of relief may have been heard in Carlsbad.

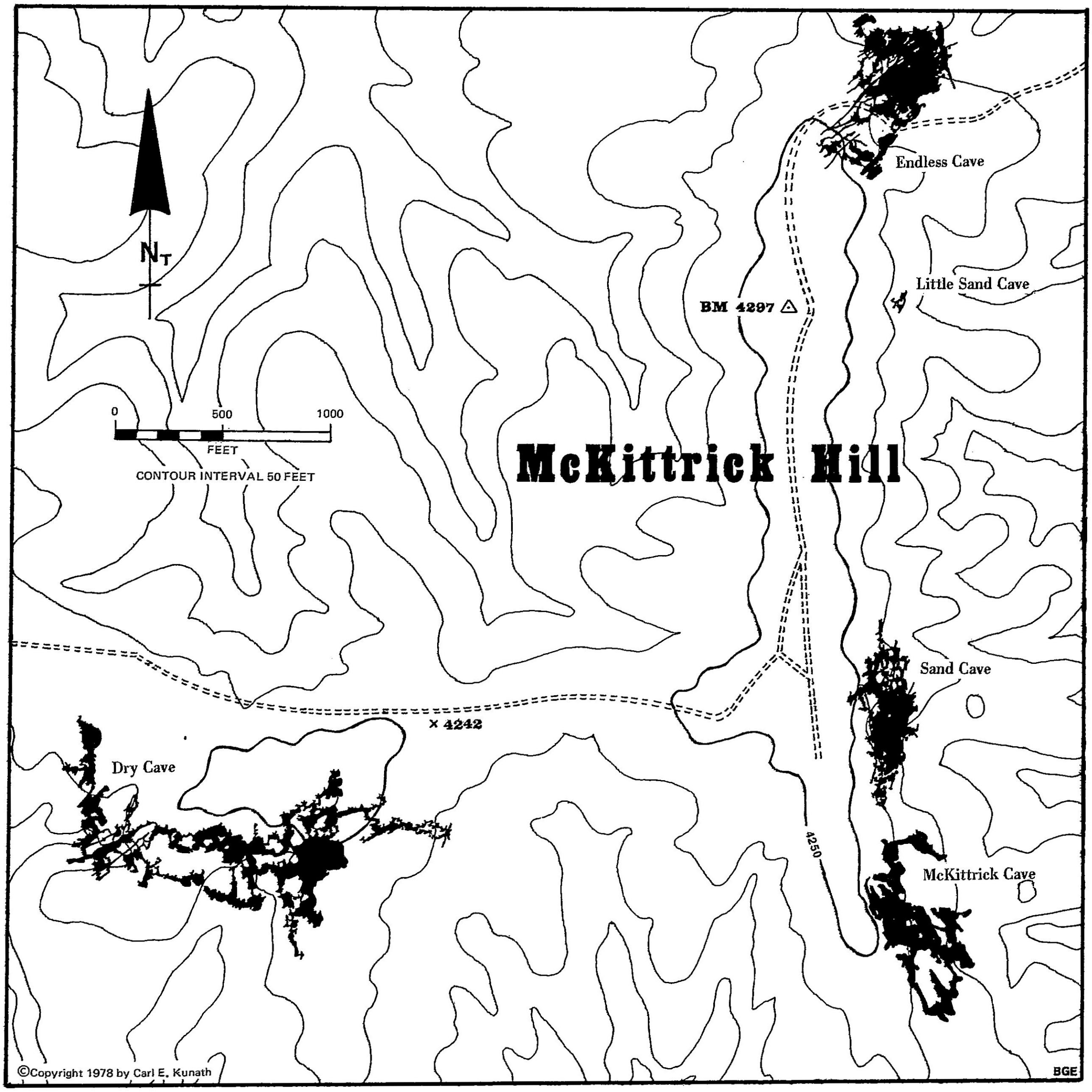
Endless Cave, McKittrick Cave, and Sand Cave have a combined total of about 27,000 feet of mapped passage. In May 1976 22,000 feet had been mapped in Dry Cave with no apparent end in sight. Current estimates indicate that many thousands of feet remain unsurveyed in Dry Cave, and it is likely to have no less than 6 miles of passage when and if the survey is completed. This would mean that a total of 11 miles of cave passages lie beneath a surface area of less than one square mile! Truly, this whole mountain is honeycombed with gloomy caverns!

[20]With this discovery, it was only 1,945 feet to the nearest known passage in McKittrick Cave and 1,970 feet to Sand Cave.

CAVE DESCRIPTIONS AND MAPS

TOPOGRAPHIC OVERLAY OF THE McKITTRICK HILL CAVES

Topography based on the U.S.G.S. West Carlsbad 15 minute quadrangle. Cave locations surveyed by Elbert Bassham. Drafted by Gill Ediger.



ENDLESS CAVE

by Carl E. Kunath

It is a difficult task to describe a cave of this type without resorting to a novel-length narrative. A few points should be mentioned prior to beginning the description.

The map folds out from page 31. This is a rather difficult map to follow, especially at such a reduced size. However, it is believed that the persistent reader can successfully interpret it. Do not overlook the information available through a careful study of the cross sections.

No climbing equipment is required anywhere in the cave; therefore, it is possible to move through the cave in any direction. Vertical separation of levels is usually only a few feet, and levels will "merge" in places.

Owing to space and clarity considerations, numerous breakdown areas have not been indicated on the map. Also, some detail has been sacrificed in the areas where mazes overlap, but it is felt that nothing significant has been omitted.

All "partitions" (stippled) are surrounded by passage at a uniform level. Things which look like partitions but are not stippled are the walls of passages on two or more levels.

In several very limited areas, dotted passage has been shown beneath passage which is already dotted. While technically incorrect, close scrutiny will yield the correct passage relationship without further confusing an already difficult map with yet another symbol.

The description is presented as a series of "tours" into various portions of the cave with key areas used as starting points. Both "left" and "right" as well as compass directions are included with the distance figures.

Fig. 1.–Glenda Kunath at the Entrance. Photo by Carl E. Kunath.

The entrance to the cave is a 3 foot high, 10 foot wide slit in a shallow sink on the north side of a small arroyo which begins near the peak of McKittrick Hill (see Figure 1). The entrance is at an elevation of 4,164 feet (133 feet below the peak of McKittrick Hill).

The ceiling rises immediately to 5 or more feet, and after 35 feet passages branch left (W) and right (E). The area around the east passage is a good camping spot which was used several times while surveying the cave (see Figure 2).

Fig. 2.–Camp site in Endless, December 1967. L-R: Danny McDonald, Danny Moore, Jon Vinson, and Glenda Kunath. Photo by Carl E. Kunath.

The right (E) passage leads to a large, low room with no leads, while the left (W) passage leads to more than 1,200 feet of passage which is known as the West Maze. Several strong joints are encountered in this maze, each nearly paralleling the Entrance Passage. A small crevice continues at the south end of one of these joints, but it is not considered a promising lead. The highest surveyed point in the cave at 30 feet above the entrance is at the western limit of this maze where the passage turns right (NE) abruptly and leads downward at a 10 degree angle for 150 feet before coming to a sudden end beneath another passage. At one time this area of the cave was utilized for an illegal whiskey manufacturing operation. The equipment was fairly well preserved as recently as 1934, but only a few barrel remnants are present currently (see Figure 3, page 6, History section).

Continuing in the Entrance Passage, the ceiling gradually lowers to about 3 feet, and 180 feet from the entrance a partition divides the passage for 60 feet before it reunites at the "Y" (see Figure 3). To the left (W), a stoop/crawl leads 80 feet over a flowstone floor to the Upper Maze Room. This elliptical room is about 120 feet long, 70 feet wide, and averages 8 feet high. The NW

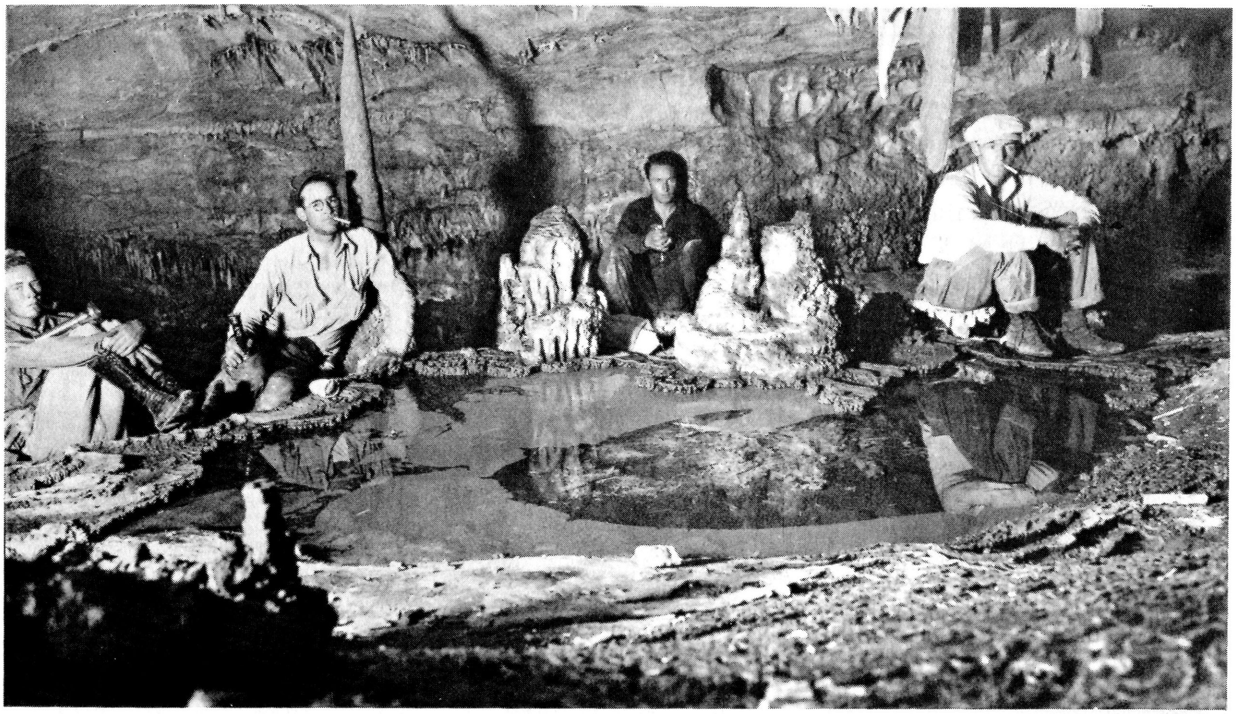


Fig. 3.—The "Y" in Endless Cave. L-R: Sonnie Kindel, Dave Wilson, Glen Hamblen, and Tommie Futch. Photo by Robert Nymeyer, March 4, 1934.

"wall" of this room is formed by an irregular series of partitions separated by small holes at various levels, all of which lead immediately into the middle level maze. The Upper Maze Room is a most important area of the cave since all 3 levels connect in this room. The floor is quite irregular, and many partitions further confuse the overall scene. Along the left (W) wall are 5 pits, 4 of which drop about 15 feet into the Lower Level Maze. The remaining pit (second on the left) drops 6 feet and leads west into the middle-level maze which surrounds the Upper Maze Room to the west and north. The third of these pits bears the signatures of Dave Wilson, Ray Sims, and Robt. Nymeyer, all early explorers of the cave. The date is November 1934. Also along the west wall of this room are several "windows" into the middle level maze to the west which are too small to permit passage. Along the right (E) wall are 4 small pits, each dropping about 4 feet to yet another middle-level maze. At the extreme north end of the room, a passage trending NE reaches the Little Expressway after 200 feet.

To the right (NE) at the "Y," a 15 foot deep canyon is encountered. On the immediate right is a deep pool. Above the pool, a plugged well hole about 6 inches in diameter pierces the passage. The canyon may be traversed along the left (W) wall where, after 25 feet and 60 feet, passages lead west from small ledges. These passages join immediately in the middle level maze. This maze is low and wide, with a floor of solution modified gypsum and a multitude of partitions making it very confusing. Following the right (N) wall for 100 feet will allow a connection with the Upper Maze Room by way of the second pit in the Upper Maze Room as previously mentioned. About 50 feet past the pit connection, a passage on the right (E) leads to the north section of the middle level maze which is now only a few feet below the Upper Maze Room. Following the right (NE) wall for an additional 70 feet beyond this passage, another passage on the right (N) leads over a small lake into the same middle level maze. Immediately upon crossing the lake, a passage leads south toward the Expressway. On the left (W) is a large breakdown area beneath the Expressway and east of the Easy Chair Maze. There is no connection between these two maze areas. Turning left (S) before crossing the lake, the passage climbs updip toward the Expressway. After 100 feet, there is a junction with the passage leading north to the maze area beyond the lake. Approximately 90 feet past this junction, there is a small connection with the Expressway on the right (W) wall, and 50 feet farther is the major connection with the southern end of the Expressway. A small crevice leading south from this junction soon ends. This is the second highest surveyed point in the cave at 28 feet above the entrance.

The upper end of the Expressway begins as a high, narrow fissure with pretty flowstone walls. After 60 feet it enlarges considerably and remains about 15 feet wide and 5 to 10 feet high for almost its entire length (see Figure 4).

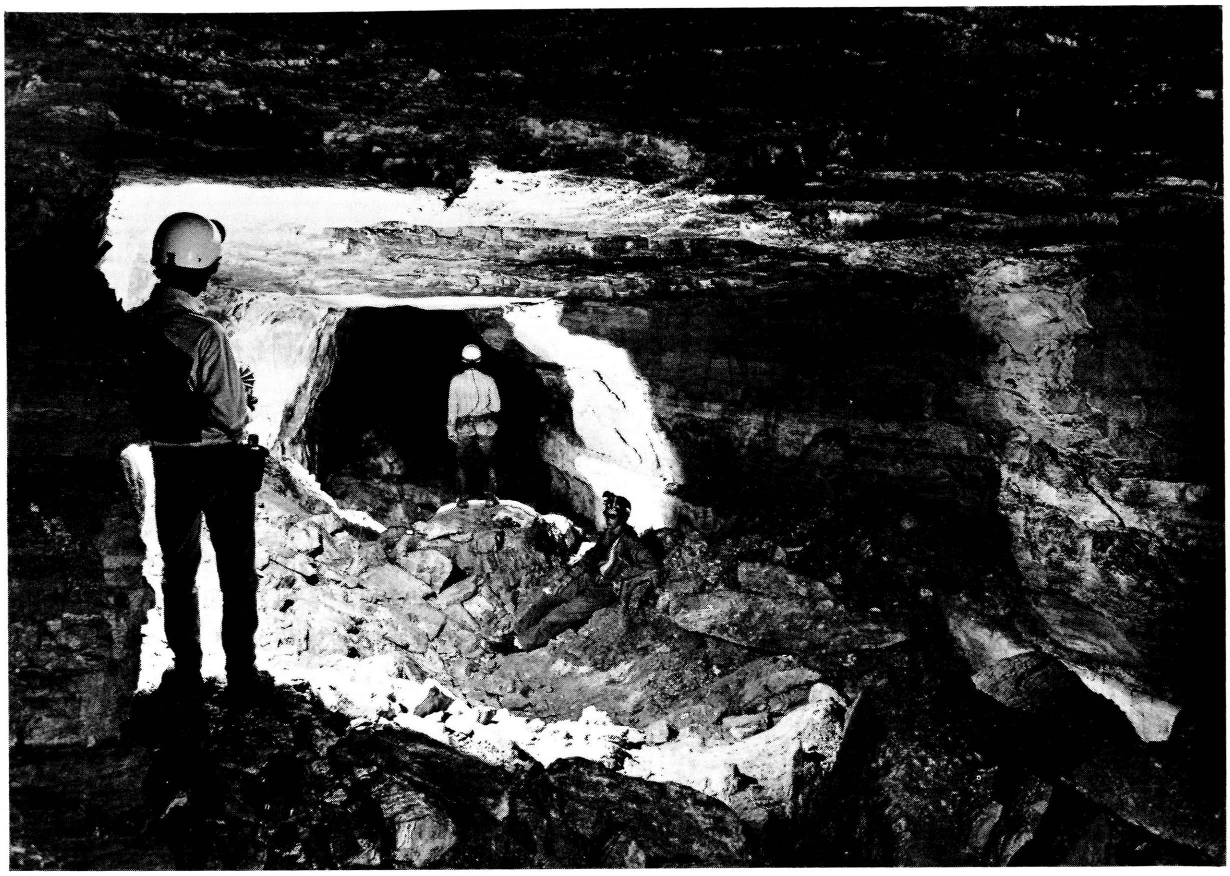


Fig. 4.–The Expressway. L-R: Steve Vallandingham, Ronnie Fieseler, and Ed Fomby. Photo by Carl E. Kunath.

Once again at the "Y", but ignoring the side passages and continuing NE, after 90 feet there is a 15 foot drop into a room 30 feet high. To the right is the Mud Crack Room, a 2 to 5 foot high area with cracks up to 2 feet deep in the moist mud floor. Ahead, up a steep breakdown slope, a middle level maze to the left (W) leads, after 40 feet, to the Upper Maze Room by way of the 4 pits along the right (E) wall of the Upper Maze Room. Directly across (W) from the Mud Crack Room, a 2 foot wide hole at floor level opens immediately into the extensive Lower Level

Maze (see Figure 5). This maze extends 400 feet from north to south and 230 feet from east to west and has a floor area exceeding 60,000 square feet. Ceiling heights in the Lower Maze are as much as 12 feet, with 7 feet being common. The floor is covered with breakdown and solution-modified gypsum, and the passage follows the bedding which dips NE at 7 to 10 degrees. Along the left (W) wall domes lead to the Upper Maze Room. Following the right (E) wall will eventually lead to a breakdown slope, at the top of which is a 25 foot high dome. From the SW side of the dome, upper level passages may be followed in several directions, but all soon end in breakdown. Two pits in this area drop 20 feet into the Lower Level Maze. About 100 feet past the dome is a large passage called the Little Expressway. There is a pit along the right (E) wall, and opposite, a large passage leading SW. The pit drops 20 feet to a low crawl through breakdown which passes beneath the Little Expressway to make a connection with the Lower Maze after 60 feet. The passage heading SW leads under a 12 foot high dome, goes through a small maze area, and emerges in the extreme NE corner of the Upper Maze Room. About 50 feet beyond the pit, breakdown rises to within 3 to 5 feet of the ceiling and after an additional 80 feet, the passage ends in breakdown with only a small continuation beyond. This is one of the better leads in the cave as the Expressway and Little Expressway joints appear to converge in this area. However, excavation is dangerous due to loose rocks, and the cave is leading away from McKittrick Hill at this point.

Fig. 5.—The Lower Level Maze. L-R: John McDowell, Bill Elliott, and Mike Moore. Photo by Carl E. Kunath.

In the northern portion of the Lower Level Maze is an area with interesting gypsum features. Here are several gypsum "blisters," among them the famous "Commode" (see Figure 6), and some "postholes" 4 to 6 inches in diameter and up to 8 feet deep (see Figure 7). There is a maze

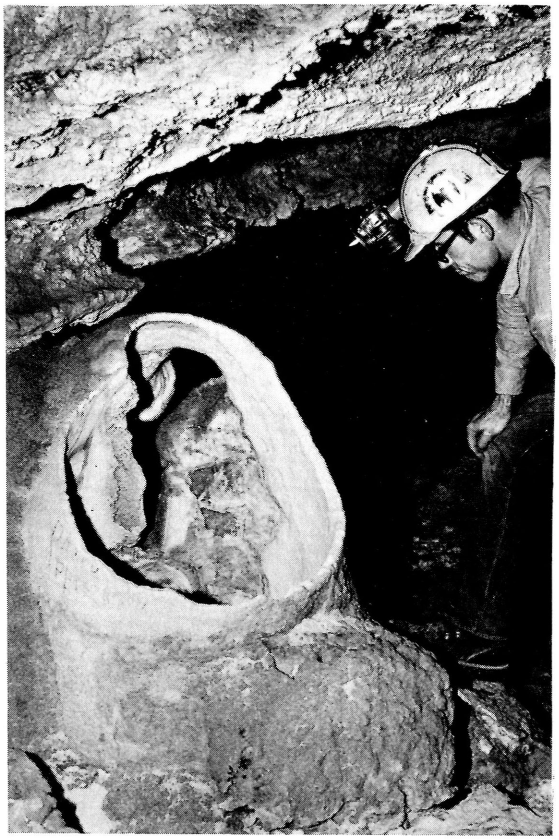


Fig. 6.—Jon Vinson studies the Commode. Photo by Carl E. Kunath.

Fig. 7.—A "posthole" in Endless Cave. Photo by Carl E. Kunath.

above this area, and breakdown from the Expressway forms the NW wall. Also in this area is a deposit of a curious, blue clay which has been tentatively identified as halloyosite by Dr. E. C. Jonas of The University of Texas and is considered a very unusual find.

Near the northern limit of the Lower Level Maze is a 30 foot high dome which appears to be a nearly perfect ellipse (see Figure 8). The lowest surveyed point in the cave, 72 feet below the entrance, is just east of this dome. North of the dome, the passage turns abruptly left (W), the ceiling lowers, and there is a series of dry lakes rimmed with "lily pads." After 70 feet, there is a small lake about 10 inches deep and just beyond the ceiling rises abruptly to 40 feet. Ahead, up a 40 degree sand slope about 35 feet high, the Expressway begins. Continuing south at the top of the sand slope, after 80 feet there is a connection with the Lower Level Maze through a complicated upper level passage on the left (E) wall. After an additional 60 feet, a blocked pit on the right (W) wall makes a connection with the Easy Chair Maze. At the bottom of this pit, the names D. C. Wilson and Robt. Nymeyer with the date 1934 and John L. Kindel with "went in this hole 6-4-37 at 11:45 pm" are on the NE wall. It should be noted that the entire cave is quite liberally coated with graffiti of all sorts, not to mention several miles of string, many yards of plastic flagging, and innumerable "IN" and "OUT" arrows, some of which are to be found in direct opposition to each other. From this pit, the Expressway continues without further side passages for another 330 feet before joining the middle level maze as mentioned previously.

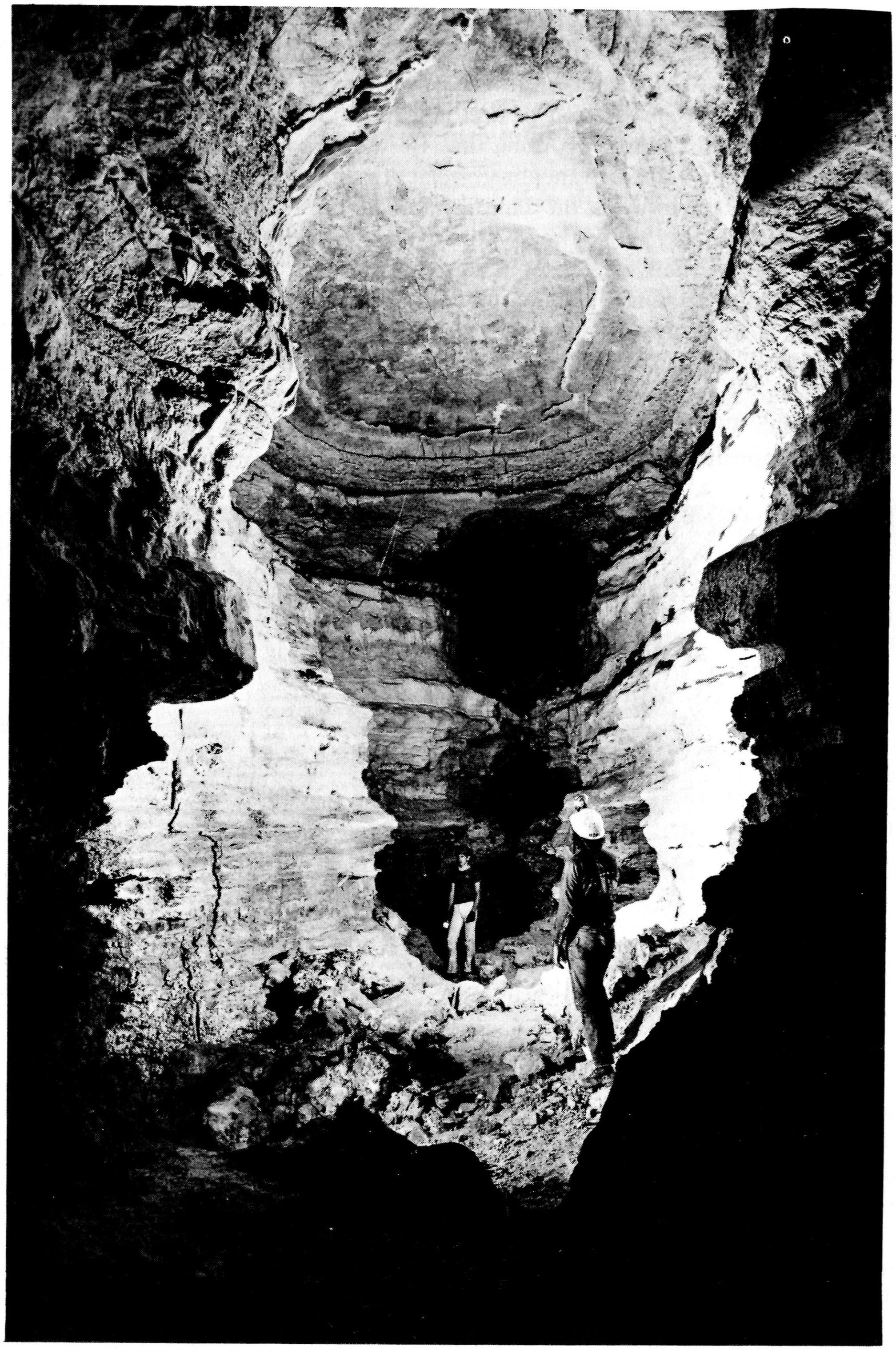


Fig. 8.–Mike Moore (L) and Bill Elliott in the Elliptical Dome. Photo by Carl E. Kunath.

To the right (W) at the base of the sand slope, a crawl leads a few feet to the Gypsum Room. This crawlway and the pit along the west wall of the Expressway are the only entrances to this section of the cave. In the mid 1950's, both these passages were concealed with rocks. In 1965, the crawlway was open, but the pit was still well concealed and was not located until some years later when the mapping effort progressed to that area. The Gypsum Room averages 8 to 10 feet high and was originally well decorated. Along the NW wall are a few large columns and the remains of several others. The stubs of vandalized stalactites line the ceiling (see Figure 5, page 8, History section). A few feet away is the famous "Breast of Venus" stalagmite, the subject of many a photograph (see Figure 9). To the SW, the passage rises over a terraced gypsum floor and enters a low maze area. At the west end of the Gypsum Room, a passage leads up a flowstone slope to some pretty draperies, turns left (S), and continues a few feet to the Canyon.

A large boulder is wedged at floor level in the north end of the Canyon. Directly ahead is a prominent totem pole about 10 feet high (see Figure 10). Near the base of the totem pole, a small hole drops a few feet to a connection with the Gypsum Room Maze to the left (E) and the Green Lake Maze to the right (W). Above the boulder, to the right (NE) is a small maze area over the Green Lake Room. Opposite this maze is a stalagmite-studded balcony which is the extreme NW

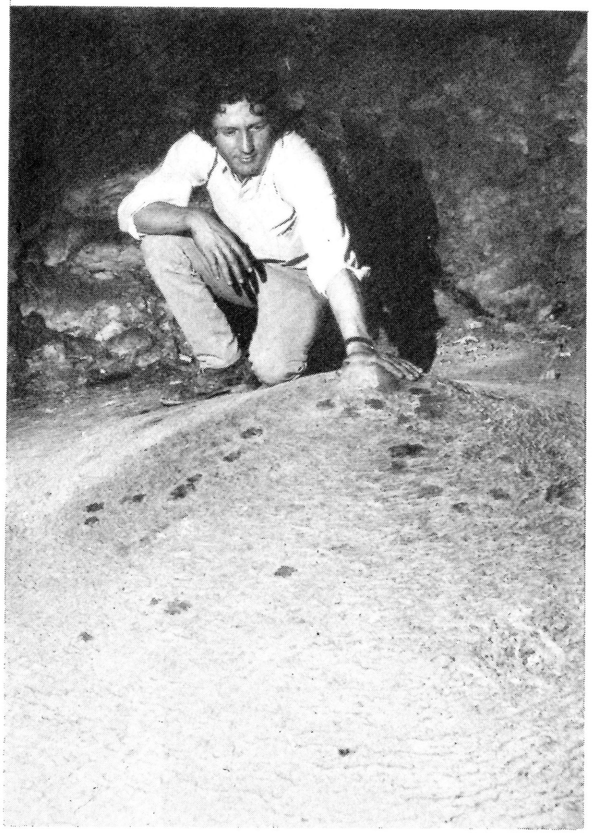


Fig. 9.—Steve Vallandingham ponders the Breast of Venus. Photo by Carl E. Kunath.

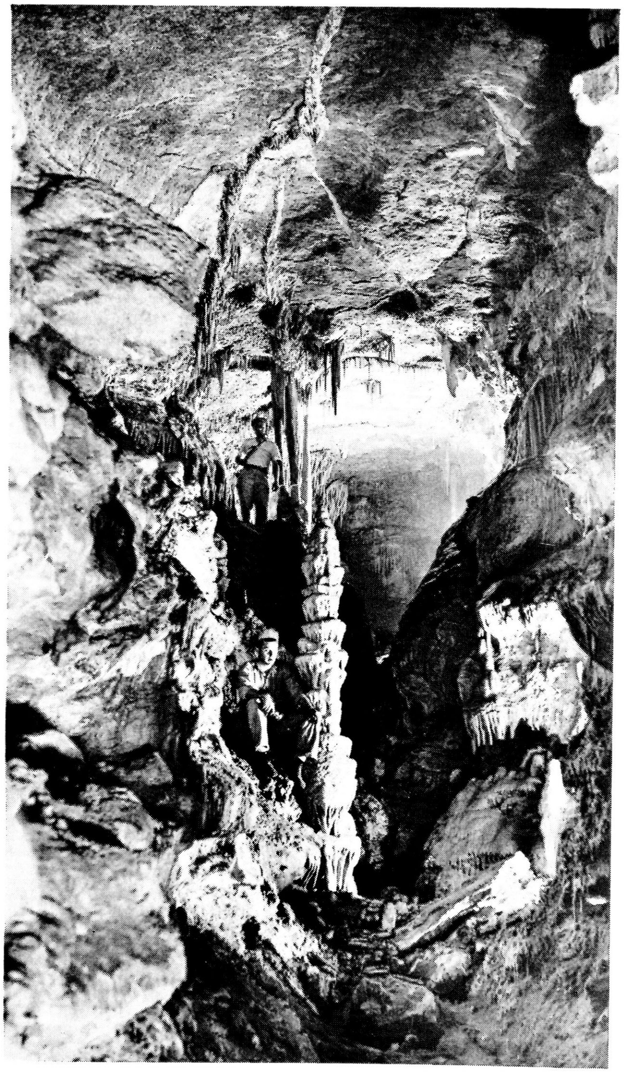


Fig. 10.—Sonnie Kindel (top) and Charlie Stevens in the Canyon. Photo by Robert Nymeyer, June 8, 1937.

edge of the Easy Chair Maze. By climbing the wall of the Canyon and taking the first passage to the right (S), two small lakes are crossed, and the stooping passage continues 130 feet to a somewhat larger area averaging 5 feet high. Two passages to the right (SW) pinch out after 50 to 70 feet. Ahead, breakdown from the collapse of the Expressway blocks the connection to the maze passages SE of the Expressway. The passage then turns left (N) and leads 125 feet past a curiously eroded "mound" on the floor which resembles a plush armchair and rejoins the balcony area about 60 feet SE of the Canyon. Continuing to follow the right (SE) wall, after 90 feet, the passage ends in a wall of boards and rock. This is the connection to the Expressway which was concealed in the mid 1950's. Just before this wall, on the east side of the passage is a crevice leading through breakdown to the extreme SE corner of the Gypsum Room. At the entrance to this crevice are the signatures mentioned previously.

The Green Lake Room is immediately to the lower right of the boulder in the Canyon. This room retains but a sad remnant of its former beauty (see Figures 6 and 7, page 9, History section). The rim of the lake is adorned with large, graceful "lily pads," and the water appears as a beautiful shade of green. Unlike the other lakes in the cave the water level of the Green Lake varies considerably (see Figures 11 and 12).

A small maze SW of the lake may be followed to the left (S) past several small pools, under the Canyon, and finally to the Gypsum Room. West of the lake, a 50 foot crawl leads to the War Club Room. In contrast to the rest of the cave, the War Club Room is virtually undamaged. A few broken speleothems and occasional carbide dumps detract only slightly from the beauty and unusual aspects of this room. In view of the extensive damage to the nearby Green Lake Room, it is all the more remarkable that the War Club Room has survived. The War Club Room exhibits an interesting history. After the room was initially drained and speleothems had developed for a time, it was partially flooded at least once. Evidence of several distinct water levels may be seen on the walls, but these may be the result of a single flooding which receded in stages. Some of these water levels were sufficiently stable for the formation of calcite "rafts" on the surface of the water. The rafts remained behind, stuck to the speleothems and scattered on the floor, when the water drained for the last time. The stalactites that were long enough to reach beneath the temporary water level were encrusted with calcite to remarkable proportions, making spectacular "war clubs" (see Figure 13).

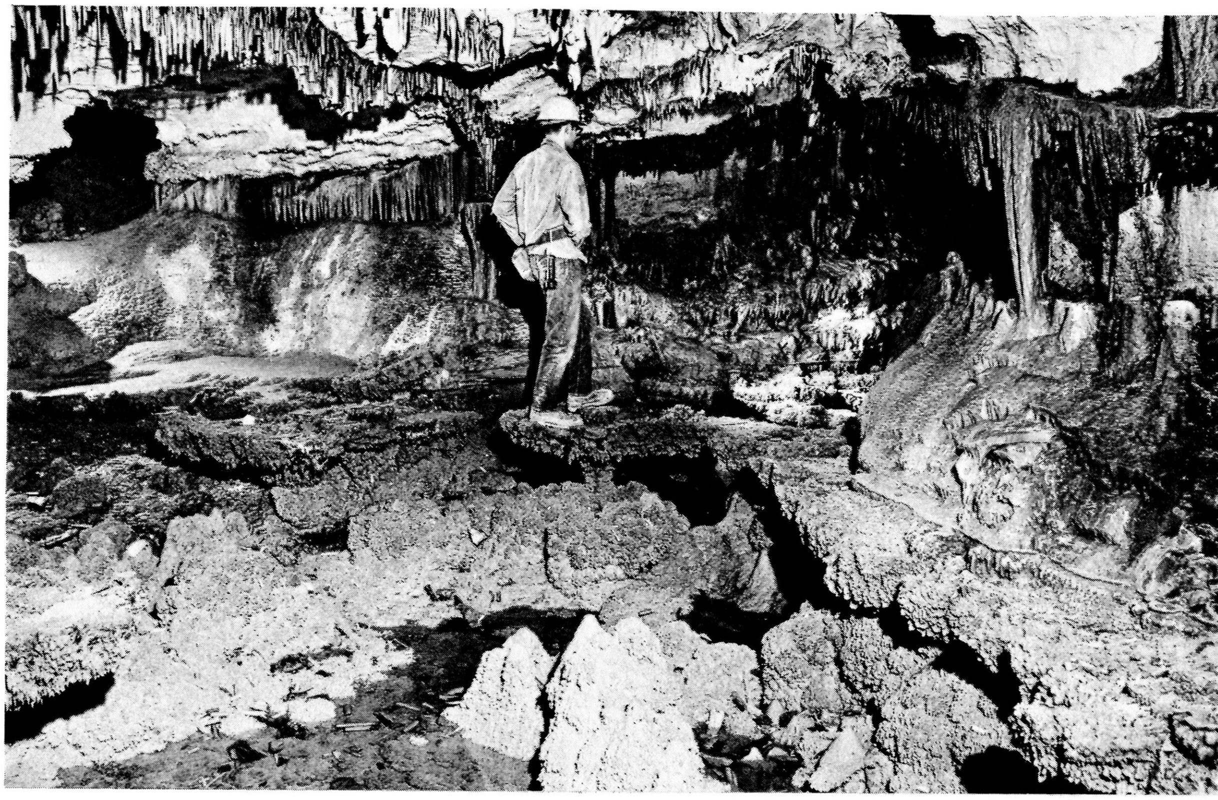


Fig. 11.—Danny Moore at the Green Lake in December 1967. Photo by Carl E. Kunath.

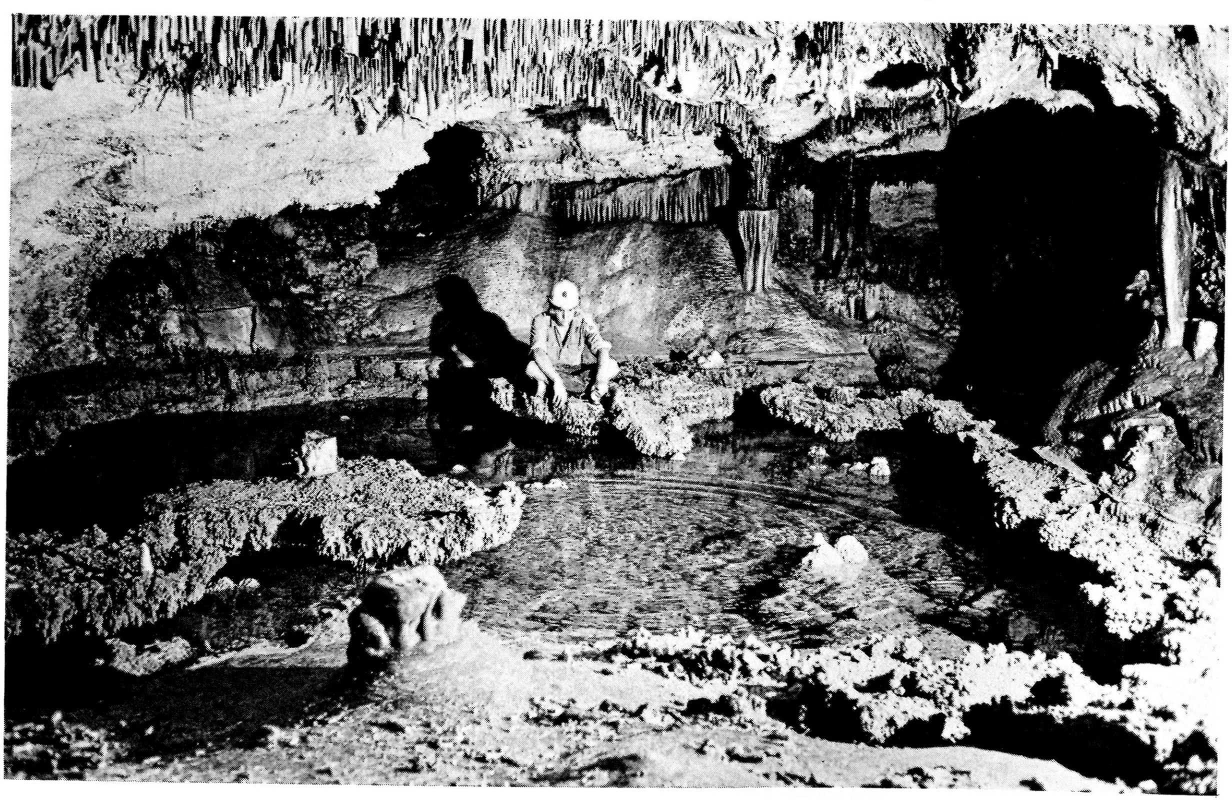


Fig. 12.—Harold Ingersoll at the Green Lake in June 1975. Photo by Tom Byrd.

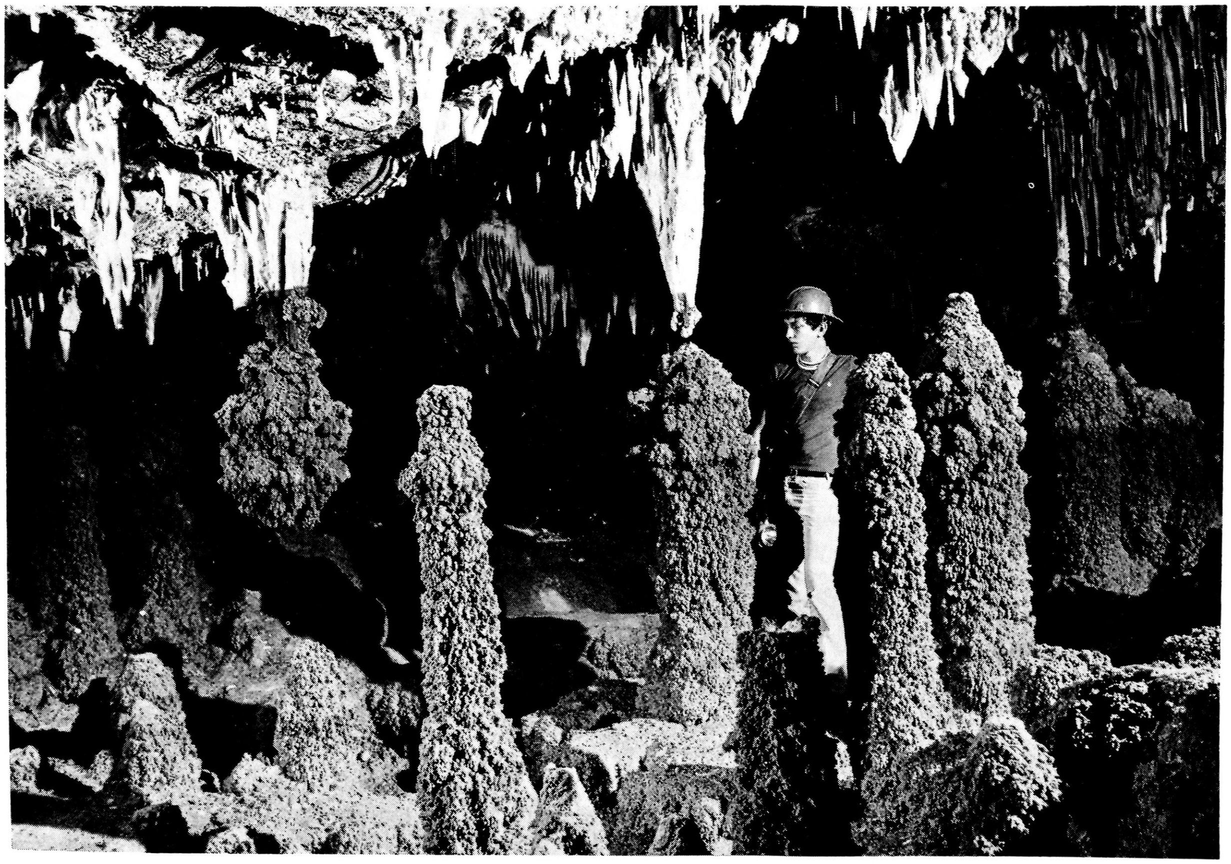


Fig. 13.–Mike Moore in the War Club Room. Photo by Carl E. Kunath.

McKITTRICK CAVE

by Ronald G. Fieseler and Carl E. Kunath

Of the four major McKittrick Hill caves, McKittrick Cave is by far the least complex. Despite having at least a mile of passage (7,000 feet of survey lines were required to map the cave), there is minimal overlap of passages on the two levels (as opposed to the massive overlap of three or more levels in Sand, Endless, and Dry Caves). With few exceptions, the cave follows the dip of the beds; the floor and ceiling of the cave slope downward at an average of 8° from west to east. Were it not for the complex area of truncated passages caused by the collapse of a large area of the Main Entrance Maze (forming the surface sink and associated entrances), the cave would be quite straightforward for McKittrick Hill.

There are five entrances to McKittrick Cave. The Upper Entrance was once the most obvious but its steel grill and pipe frame have now been removed. Four additional entrances lie in and around a shallow 60 foot by 100 foot sinkhole SE of the Upper Entrance and somewhat lower on the hillside. What is commonly known as the Main Entrance is in the bottom of the sink (see Figure 1, History section, page 2). The Ledge Entrance is located at the SW corner of the sink, the Crawlway Entrance is 50 feet SSE of the sink, and the Foundation Entrance is located in a shallow depression amid the ruins of Brookshire's hut at the NE corner of the sink.[1] The map of McKittrick Cave folds out from page 35.

The Upper Entrance is a barely climbable 20 foot drop into the east side of a breakdown-floored room 20 feet in diameter. To the NW, a passage slopes down past a duckunder to a formation area. Past the formation area, a walking passage continues for 100 feet over a sand and dirt floor before constricting to a belly crawl which continues for another 40 feet to a 90° turn which is impossible to negotiate. The parallel passage lowers to a 3 foot high crawl and quickly ends.

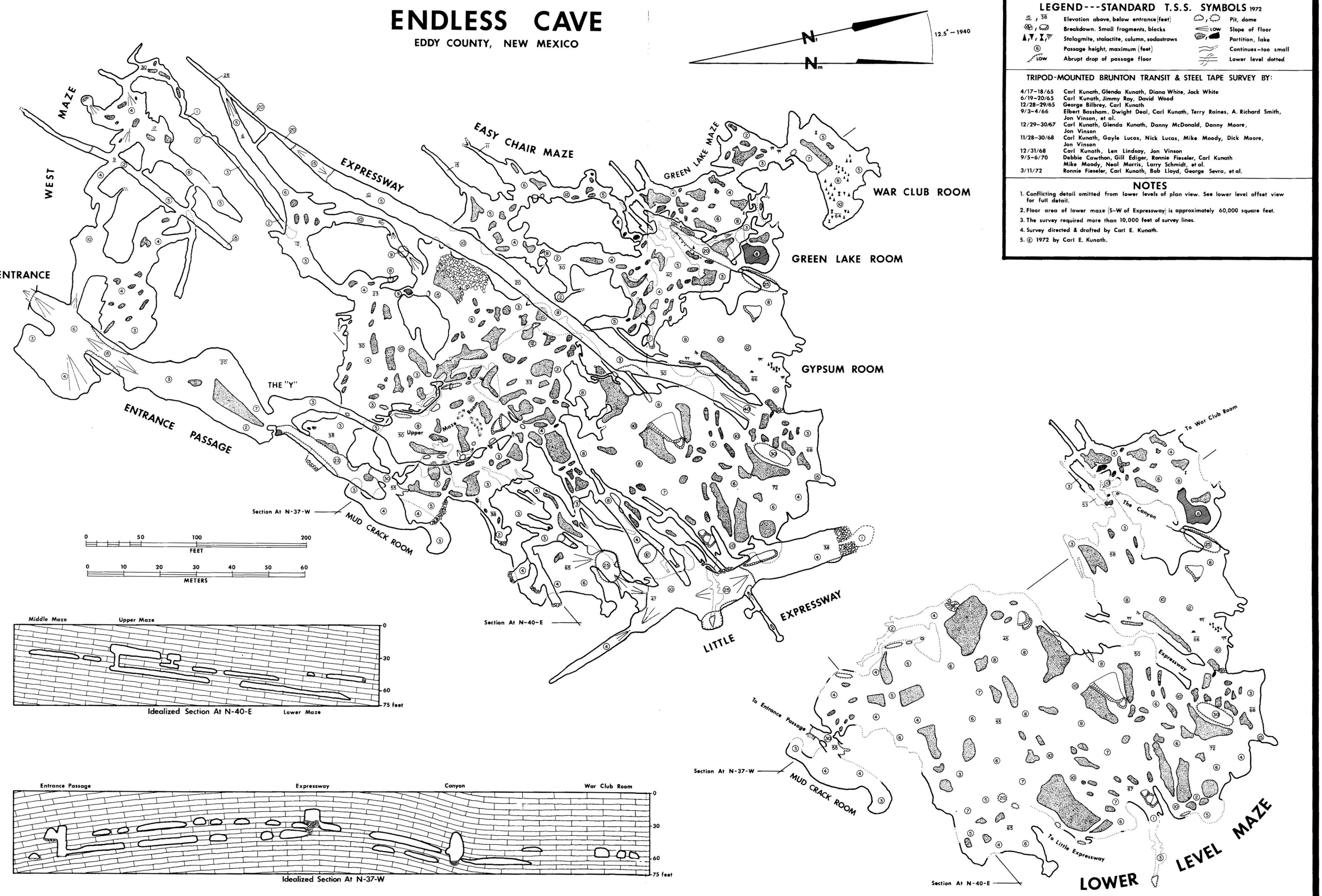
From the formation area, a low crawl to the right (E) leads to the Main Entrance Maze. This maze is about 125 feet in diameter (divided in many places by columns and pillars), averages 6 feet high, and slopes downward from west to east.

Moving east through the Main Entrance Maze, and keeping to the north end of the Maze, will lead to a 15 foot high dome. Northwest of this dome, a 30 foot wide, 6 foot high, upward sloping passage leads through a formation area and ends after about 80 feet. Northeast of the dome, the passage is almost choked with columns for 40 feet before a 20 foot wide, 8 foot high opening into the Formation Area, an isolated section of the cave containing about 1,000 feet of passage. After 50 feet the passage branches at a flowstone area. The left (W) branch ends after 100 feet of well-decorated walking passage. An E-W formation "wall" divides this area and is encountered again if the right (N) branch is chosen at the flowstone area. The right branch leads through the formation "wall" into a well-decorated room about 6 feet high and 60 feet in diameter. On the north side of this room the cave continues into another room 60 feet wide, 100 feet long, and 6 feet high with a dry lake, a rimstone dam, and a blind pit 15 feet deep along the east wall. From the NE corner of this room, the cave turns east as a 15 foot wide, 5 foot high passage extending 70 feet over a rocky floor to a maze area which immediately offers the explorer six possible routes. These dirt-floored passages lead around pillars and, after 100 feet or more, join in a passage which rapidly fills with dirt and becomes too low to follow. Here, the passage is about 245 feet from Sand Cave, but the extensive dirt fill makes a connection unlikely.

[1] See History section, page 3, , for notes on Brookshire.

ENDLESS CAVE

EDDY COUNTY, NEW MEXICO



LEGEND---STANDARD T.S.S. SYMBOLS 1972

15, 38	Elevation above, below entrance (feet)		Pit, dome
	Breakdown. Small fragments, blocks	LOW	Slope of floor
	Stalagmite, stalactite, column, sodastraws		Partition, lake
6	Passage height, maximum (feet)		Continues–too small
LOW	Abrupt drop of passage floor		Lower level dotted

TRIPOD-MOUNTED BRUNTON TRANSIT & STEEL TAPE SURVEY BY:

4/17–18/65	Carl Kunath, Glenda Kunath, Diana White, Jack White
6/19–20/65	Carl Kunath, Jimmy Ray, David Wood
12/28–29/65	George Bilbrey, Carl Kunath
9/3–4/66	Elbert Bassham, Dwight Deal, Carl Kunath, Terry Raines, A. Richard Smith, Jon Vinson, et al.
12/29–30/67	Carl Kunath, Glenda Kunath, Danny McDonald, Danny Moore, Jon Vinson
11/28–30/68	Carl Kunath, Gayle Lucas, Nick Lucas, Mike Moody, Dick Moore, Jon Vinson
12/31/68	Carl Kunath, Len Lindsay, Jon Vinson
9/5–6/70	Debbie Cawthon, Gill Ediger, Ronnie Fieseler, Carl Kunath Mike Moody, Neal Morris, Larry Schmidt, et al.
3/11/72	Ronnie Fieseler, Carl Kunath, Bob Lloyd, George Sevra, et al.

NOTES

1. Conflicting detail omitted from lower levels of plan view. See lower level offset view for full detail.
2. Floor area of lower maze (S–W of Expressway) is approximately 60,000 square feet.
3. The survey required more than 10,000 feet of survey lines.
4. Survey directed & drafted by Carl E. Kunath.
5. © 1972 by Carl E. Kunath.

Returning to the 15 foot high dome in the Main Entrance Maze, and proceeding south leads to the NW portion of the Main Entrance Maze. Many names and dates can be found on the walls and formations in this area.[2] Notable among these inscriptions are the following: Nov. 11, 1894, Lucy Rush, Jennie Brunyon, Eva———, Jeannie Potter, Ada Hogle, J. A.———, H. L. Potter, Wm. Richards, Mrs. C. M. Richards; July 13, 1913, Geo. Truitt. "'Grub' to eat and people who could eat it Salem" is an interesting quote found in this area.

Farther south of the Upper Entrance is the Upper Maze, a sizeable area about 20 feet above the Main Entrance Maze. The eastern area of this maze turns east, passes under the Crawlway Entrance, and subsequently merges with the Lower Maze.

The Main Entrance is about 140 feet southeast of the 15 foot dome mentioned earlier. A breakdown slope 40 feet east of the Main Entrance leads upward through a small hole to the Foundation Entrance. Seventy feet south of the Foundation Entrance, the Main Entrance Maze connects to the left (SE) with the Flat Floored Room, while the major passage continues past some shallow pits and merges with the Lower Maze to continue SE toward the Flat Floored Room.

The Ledge Entrance (see Figure 1) drops 8 feet to a 15 foot wide, 5 foot high passage extending SE for 65 feet to a 20 foot long crawlway on the left (NE) which leads to the Crawlway Entrance. Continuing 70 feet beyond the Crawlway Entrance junction, the ceiling rises to 13 feet,

Fig. 1.—Ronnie Fieseler and Hanna at the Ledge Entrance. The gate was installed in late 1975. Photo by Carl E. Kunath.

[2]Like Endless Cave and Sand Cave, McKittrick Cave is heavily vandalized. Wall grafitti is most prominent (some of historical interest), but the floors are also littered with trash and speleothem breakage is extensive.

and there is a duckunder to a 4 foot high passage on the right (W). One branch of this passage leads south for 40 feet before ending, while the main portion leads west as a 20 foot wide, 4 foot high passage which becomes too small after a total of 60 feet from the main passage. The main passage continues an additional 100 feet as a 25 foot wide, 7 foot high passage before constricting to a tight squeeze. Past the squeeze, the passage is 25 feet wide for 125 feet before turning NE at a large breakdown block. Here, the passage enlarges to 40 feet wide and continues 50 feet to a duckunder with a short passage on the right (SE). Past the duckunder, the cave turns left (NW). This portion of the cave is known as the Pit Room. The Pit Room averages 40 feet wide with ceiling heights up to 20 feet, and is about 230 feet long. The breakdown-covered floor slopes toward a pit 20 feet in diameter in the center of the room (see Figure 2). The pit is 13 feet deep and climbable at the SE edge. The bottom of the pit is floored with breakdown and slopes steeply eastward into a dirt-floored lower level passage about 5 feet high. This passage immediately turns north, and after 80 feet of 15 foot wide passage, there is a tight squeeze and the passage lowers to 3 feet and narrows for the next 60 feet. Here, pillars divide the passage with the left (W) branches leading toward the Lower Maze, while the right (E) passage leads down a breakdown slope to the Flat Floored Room. This irregularly-shaped room has ceiling heights up to 15 feet and is about 200 feet long. Sediment has collected in the Flat Floored Room, filling the cave to an unknown depth, blocking any possible continuation of the cave to the east, and forming an exceptionally flat floor (see Figure 3). At the NW end of the room, a 7 foot high, 8 foot wide passage leads to the Lower Maze from a ledge along the left (NW) wall of the room. Ahead, the ceiling lowers and a complex breakdown area begins. Several small rooms and a few rimstone dams may be reached by exploring these low passages. One room at the extreme NE limit of the cave is 20 feet wide, 40 feet long, and 7 feet high.

BRUNTON AND TAPE SURVEY
TEXAS SPELEOLOGICAL SURVEY, TSA-NSS

3/10/73	FRANK BINNEY, JOHN DOBLER, BILL ELLIOTT, RONNIE FIESELER, SUSAN HARDCASTLE, BOB LLOYD, BARBARA VINSON (2005')
5/28/73	BILL ELLIOTT, RONNIE FIESELER, SUSAN FIESELER (811')
11/22-24/73	TOM BYRD, RONNIE FIESELER, SUSAN FIESELER, CARL KUNATH, MARK LOEFFLER, JOHN STEELE (3237')
11/29/74	TOM BYRD, RONNIE FIESELER, CARL KUNATH, DAVE WALKER (1769')

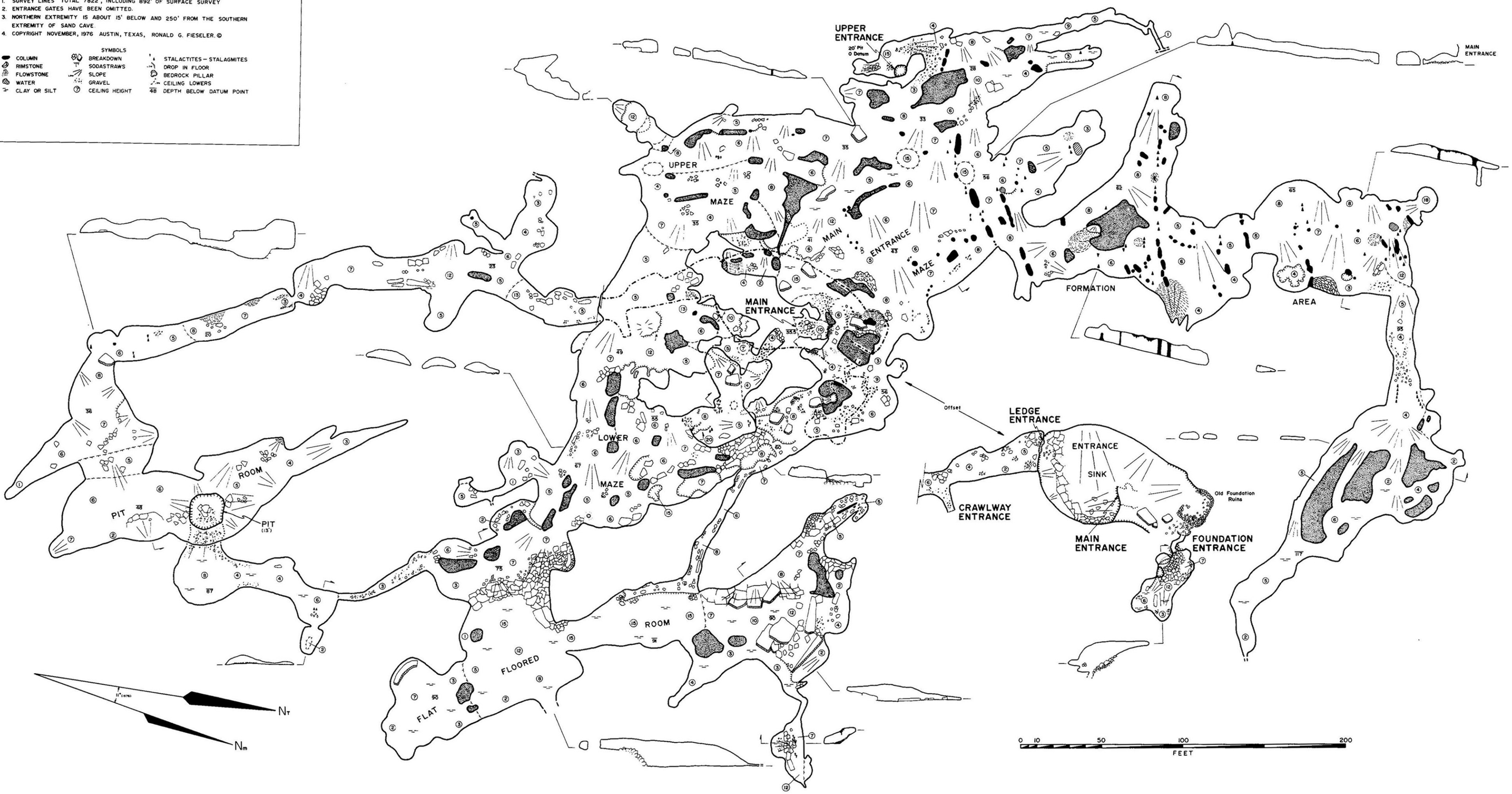
DRAFTED BY RONALD G. FIESELER
HASSLED BY CARL E. KUNATH

NOTES:
1. SURVEY LINES TOTAL 7822', INCLUDING 892' OF SURFACE SURVEY
2. ENTRANCE GATES HAVE BEEN OMITTED.
3. NORTHERN EXTREMITY IS ABOUT 15' BELOW AND 250' FROM THE SOUTHERN EXTREMITY OF SAND CAVE.
4.

SYMBOLS

COLUMN	BREAKDOWN	STALACTITES – STALAGMITES
RIMSTONE	SODASTRAWS	DROP IN FLOOR
FLOWSTONE	SLOPE	BEDROCK PILLAR
WATER	GRAVEL	CEILING LOWERS
CLAY OR SILT	CEILING HEIGHT	48 DEPTH BELOW DATUM POINT

McKITTRICK CAVE
EDDY COUNTY, NEW MEXICO



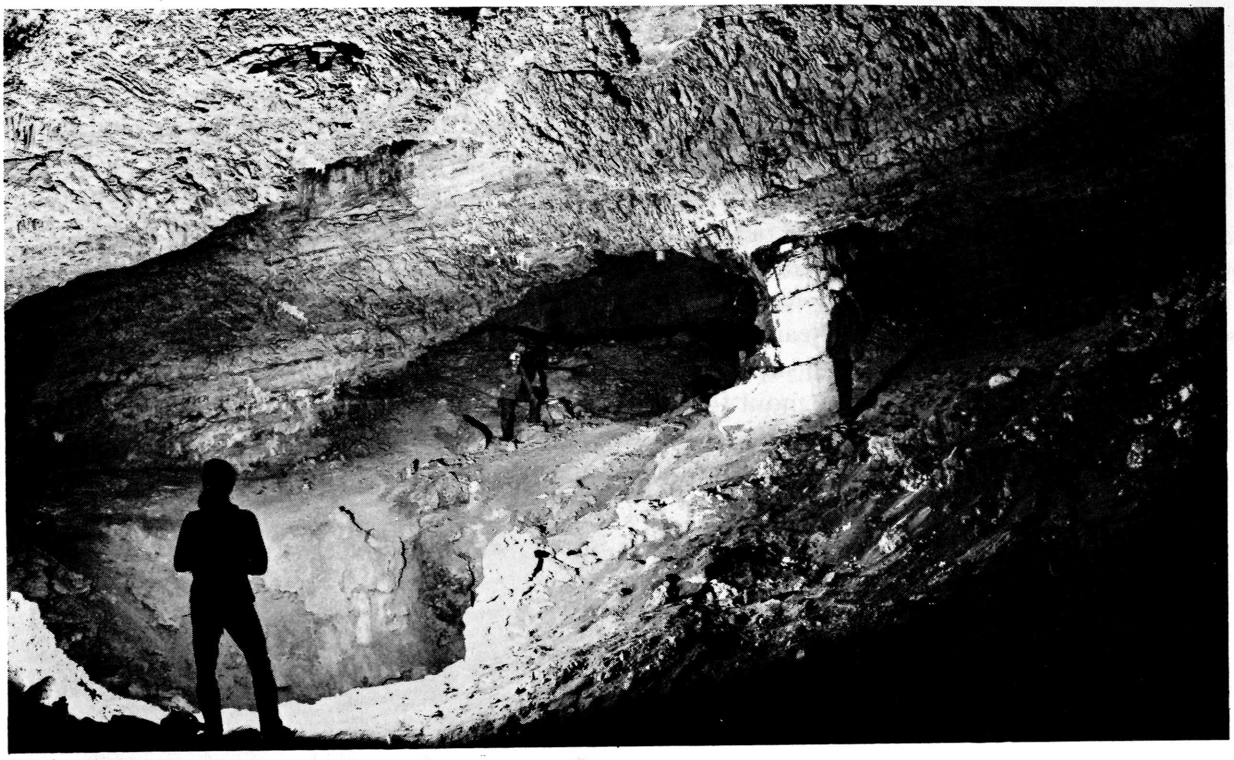


Fig. 2.–The Pit in the Pit Room is in the foreground. View is to the SE. L-R: Mark Loeffler, Ronnie Fieseler, Tom Byrd. Photo by Carl E. Kunath.

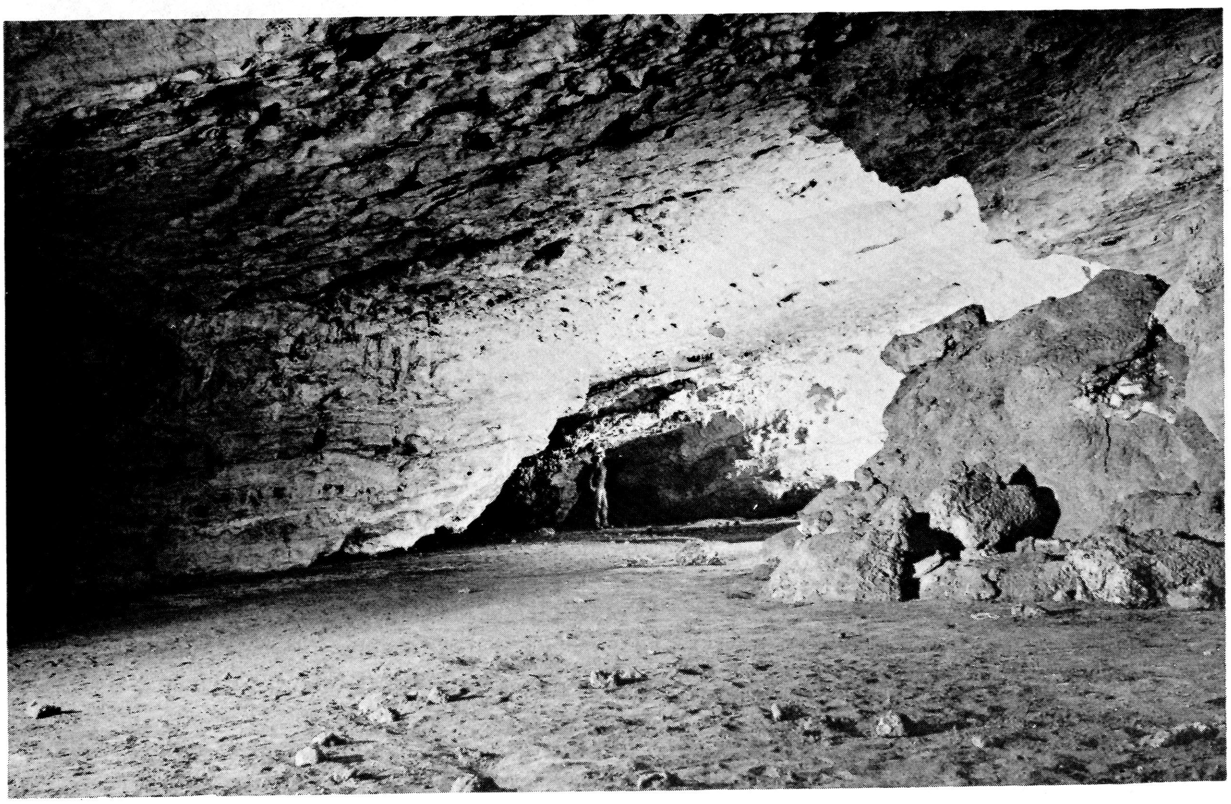


Fig. 3.–Mark Loeffler in the SE area of the Flat Floored Room. Photo by Carl E. Kunath.

DRY CAVE

by Pete Lindsley[1] and Karen Lindsley[1]

Dry Cave (also called Dry Pot) is a complex, multi-level maze cave with strongly joint-controlled features in many areas. Located in the lagoonal or back-reef facies of the Capitan reef, the entrance is in the Yates formation and most of the cave lies at the Yates/Seven Rivers contact. The dip of these formations varies throughout the cave and this is a key factor in the interpretation of the cave passages. Near the entrance (refer to the map, page 47, for locations mentioned in the text) a line of small surface sinkholes indicates a joint alignment that is shown with slight variations by features throughout the cave (see Figure 1). In the western part of the cave the dip is to the southwest. In the eastern part of the cave it changes to the southeast and finally the east. The dipping beds are quite prominent on the surface.

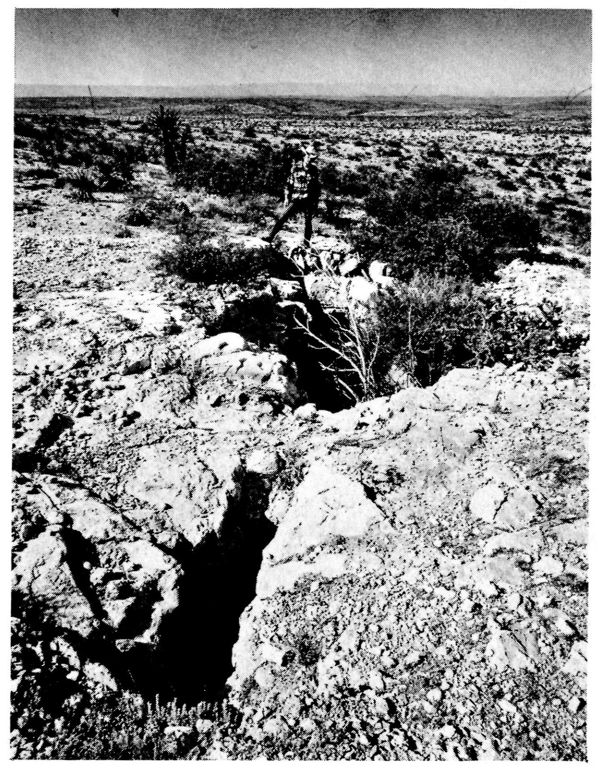


Fig. 1.–Tom Byrd at surface sinks near the entrance. The view is approximately south. Photo by Carl E. Kunath.

Much of the passage in Dry Cave may be classed as a boneyard type maze with passage heights averaging 5 feet. The Expressway and the 40-Foot Chimney are good examples of the strong joint control orientation and development of certain passages. The outstanding structural feature of the cave is the major fissure that runs in a north-south direction for over 800 feet. It was probably through surface openings at the top of this fissure system that the generous animal bone deposits were introduced into the cave. Today, only faint evidence of this fissure system may be found on the surface.

[1]Cave Research Foundation. Assistance from James Hardy and John Corcoran is appreciated.

Of the McKittrick Hill caves, Dry Cave is the most remote and the most demanding of its explorers. As the name implies, Dry Cave is almost totally lacking in water. The lower level stream bed (in the Stream Passage) only receives water following a rain. Approximately twice the length of Endless Cave, the next largest of the McKittrick Hill caves, Dry Cave also covers a much greater vertical extent. In December, 1975, cave surveys totaled 10,308 feet and surface surveys totaled 27,917 feet. The map, which shows about 3 miles of passage, is a composite of surveys initiated by members of the Dallas-Fort Worth Grotto (NSS) and the Sandia Grotto (NSS) in 1965. Two bi-regional projects added small portions to the surveys and the most recent survey work in the cave was coordinated by the Cave Research Foundation. Most of the surveyors have been members of the two NSS Grottoes that began the original survey efforts. Where several levels of the cave overlie each other, the best known level is shown. Additional maze-type passage has been omitted due to the complexity of graphically presenting the multi-level maze without reversion to a jumble of lines. A glance at the map reveals bizarre names—a result of the intense competition between explorers in the assignment of new and unusual names.

"Do not enter without permit, contact the Bureau of Land Management, 1902 S. Main Street, Roswell, New Mexico" reads the warning on the entrance gate to Dry Cave (see Figure 2). Although the gate was constructed with generous bar spacing, apparently it still hindered free movement of the bat population which has declined from an estimated 10,000 bats (1965) to only a few isolated individuals at present.

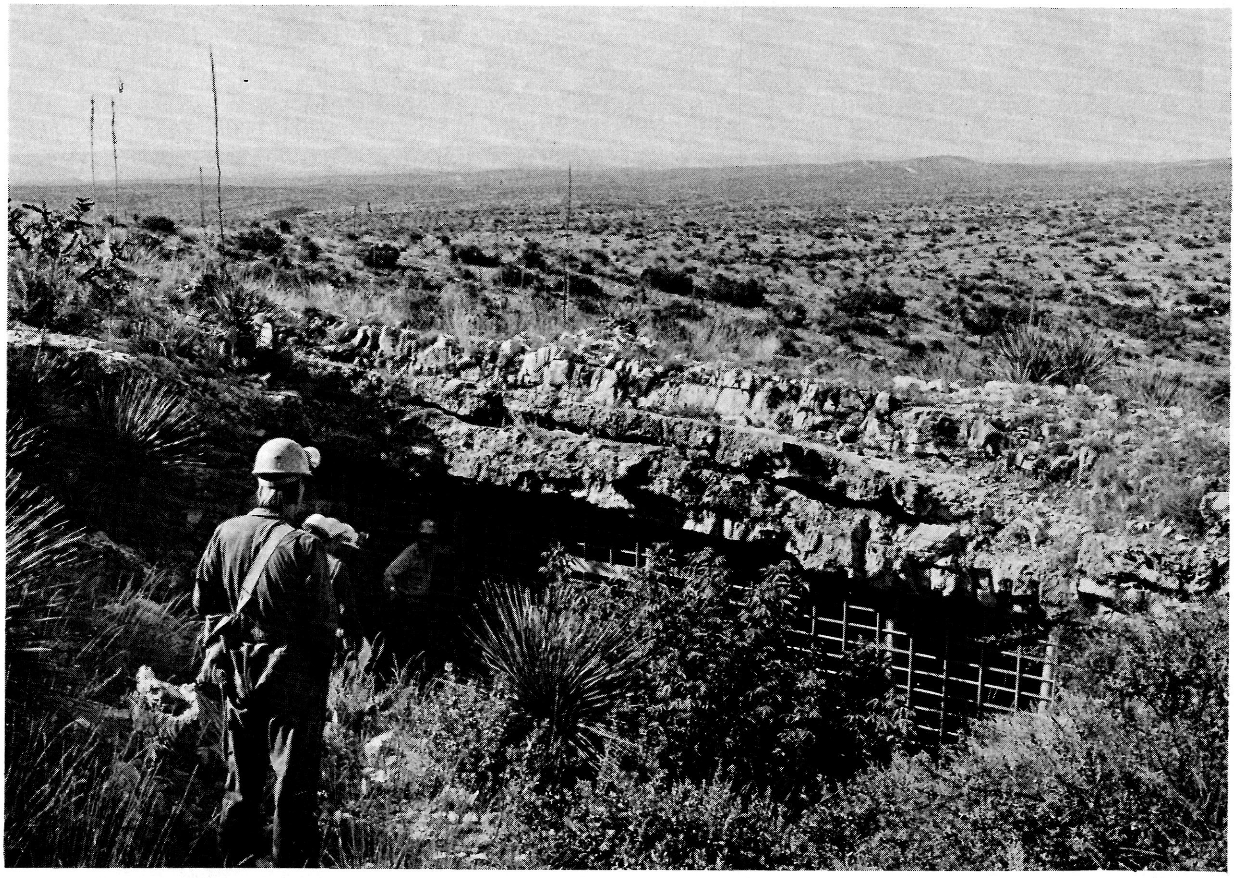


Fig. 2.—Entrance to Dry Cave. View is approximately south. L-R: J. Goodbar, W. Burks, C. Welbourn, J. Hardy, B. Hinson. Photo by Pete Lindsley.

The large entrance sink is about 50 by 100 feet and the entrance (elevation 4200 feet) takes water during the infrequent storms in this semi-arid region (see Figure 3). At the entrance the passage slopes down dip (20° SW) and erosion grooves are visible where the water runs off the bedding planes. Ledges 4 feet wide on the left (southeast) side and 1.5 feet wide on the right narrow to just over a foot wide after 30 feet. About 12 feet into the entrance fissure a large boulder has lodged in the joint and the breakdown-floored passage 12 feet below may be reached by chimneying. The rubble below is mostly loose material washed in from outside the cave and perhaps from the ceiling. A small joint-controlled solutional passage with small rocks and breakdown on the floor doubles back below the entrance passage.

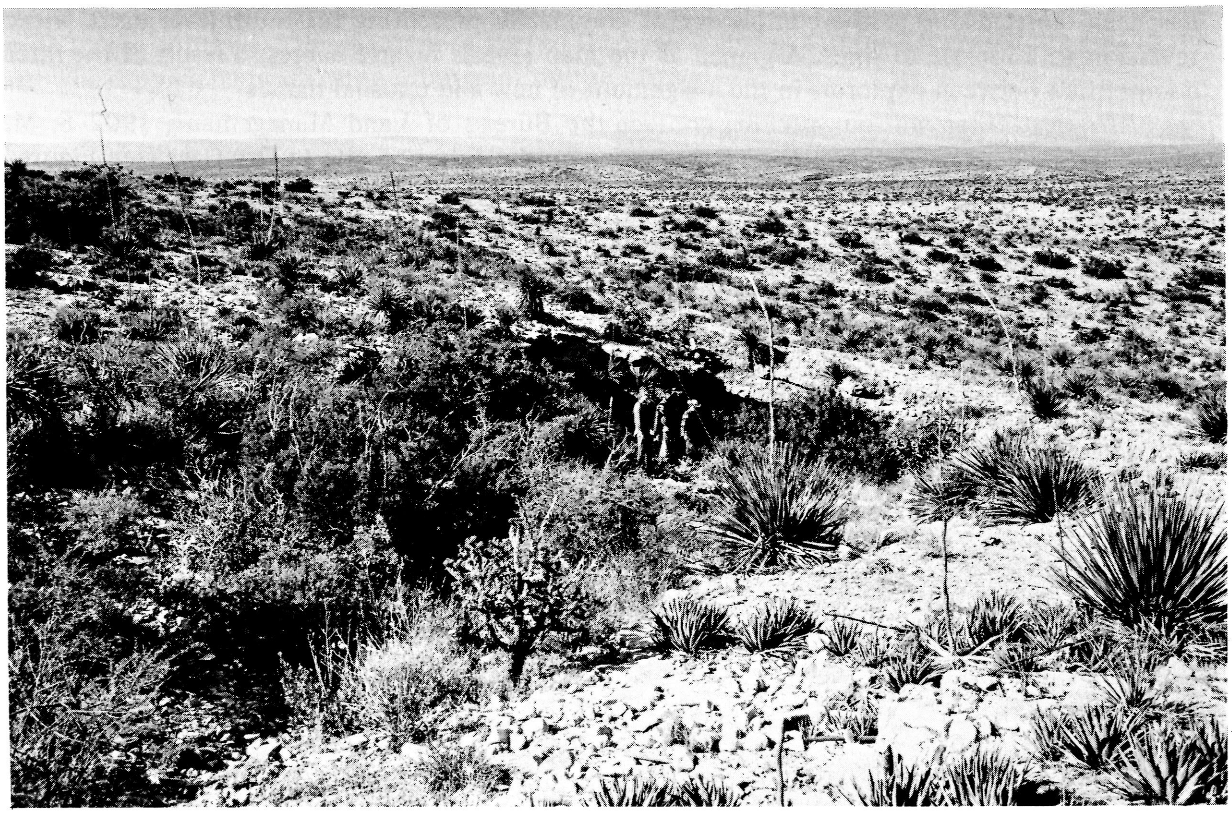


Fig. 3.–Looking approximately south at the Dry Cave entrance sink. L-R: Bill Elliott, Jon Everage, and Tom Byrd. Photo by Carl E. Kunath.

In contrast to the 8-inch thick layers of limestone at the top of the entrance the limestone becomes more massive about 25 feet below the entrance and has no visible rock unit boundaries. Farther along, in a crawlway heading toward the Balcony Room, stratification becomes visible but there are no distinctive bedding planes. Beetles and cave crickets can be seen crawling on the gypsum sand floor. First appearing about 8 feet into the crawlway, massive gypsum blocks and crusts buckled and broken in places seemingly from their own weight, are common features in the cave. Water taken in the entrance continues down the crawlway and slowly filters into the floor to reappear farther below in the Balcony Room and Hampton Court Maze passages.

The gypsum, a secondary formation, is located mainly on the floor and on dry ledges. Successive layers have been deposited to form a thick, crumbly formation. These layers are distinctive due to the alternate layers of dark and light gypsum. Similar forms of gypsum have been reported in Carlsbad Caverns. In the crawlway the ceiling and upper 3 feet of wall are white, while the lower portions are stained brown. This suggests that the ceilings haven't been under water for many years. However, the lower dirt-stained areas may be related to the bat habitation. The crawlway begins as a 6-foot high boneyard area and then becomes a stooping 3.5-foot high passage. In places sandy floors sparkle with gypsum crystals.

Fool's Hole shortcuts a bend in the crawlway, after which the floor slopes more steeply to the level at the top of the Balcony Room. Water that was formerly channeled through Fool's Hole has downcut the floor several inches. The dark brown hard-crusted gypsum on top of the limestone floor resembles a solidified lava flow, appearing as if it flowed into the cave in a molten state to ooze over the edge into the Balcony Room.

The entrance to the Balcony Room is an 8-foot wide by 5-foot high opening which bells out into the Balcony Room. The floor is 25 feet below. On the left is a sloping ledge that precariously "aims" the caver toward the Balcony Room floor below. One of the key survey markers, a brass disc inscribed "DCBM-NSS", is located on the Balcony Room ledge. The ledge is the obvious route, but the crawlway to the right (the Chicken Route) leads safely to the Boulder Room. About half way through the 2-foot diameter Chicken Route crawl is a ledge on the left that overlooks the Balcony Room. An easy climb down 6 to 10 feet leads to rocks stacked on the floor. This vantage point gives a spectacular view of the gypsum formation that has "overflowed" the walls into the Balcony Room at the upper entrance. See Figure 4.

Fig. 4.—Jim Goodbar on the ledge at the entrance to the Balcony Room. Photo by Pete Lindsley.

The floor of the Balcony Room is soft clay for the most part with scattered small breakdown. Trenches have been dug in the floor by people searching for bone material. Excavations reveal that the floor consists of 18 inches of soft dirt material, 6 inches of 2-inch size breakdown rocks and more dirt material on the bottom of the trench. Recently, surface waters have flowed into the Balcony Room. In-washed rocks are angular and sub-angular. Layers of rocks alternating with dirt suggest a succession of floodings.

Hampton Court and the Hampton Court Maze area are reached by a route beginning at the southwest side of the Balcony Room under some speleothems. The passage is 5 feet high and leads uphill toward a recent water influx. Some calcite stalactites and cave coral adorn the ceiling. A few bone-hunting excavations have been filled to within 5 inches of the floor level by recently in-washed material. The distance between the Balcony Room and Hampton Court is about 300 feet in a general northwest direction through a boneyard maze. It is easy to miss Hampton Court as the route is not obvious and requires low squeezing in a few places.

Hampton Court is a silt-floored circular pit about 20 feet in diameter and 25 feet high. This easily-climbed pit connects two levels of boneyard maze. Passages leading from Hampton Court require strenuous belly crawling over rough gypsum.

The Hampton Court Maze area is the northwesternmost part of the known cave, and is approximately 350 feet northwest of the entrance. It is well-developed, confusing boneyard passage. Rocks in this area dip 10 to 12 degress to the southwest.

The second half of the Chicken Route is combination belly and hands-and-knees crawling over gypsum covered floors with the ceiling height averaging 2 feet. At the south end of the Chicken Route it is apparent that water, which enters from the surface sinks above the southwest side of the Balcony Room, drains down a 4-foot high passage to the south. By following upstream for 20 feet and climbing up 8 feet the Boulder Room may be reached. This climb-up point is also the junction of the shortcut passage around the northeast side of the Balcony Room.

At the Boulder Room the character of the cave changes significantly. This room is partially joint-controlled and is 60 feet in length and 25 feet wide. Overall, the ceiling height is 20 to 30 feet, and a pile of breakdown boulders in the middle of the room extends upward to within 10 feet of the ceiling. Massive breakdown on the north side of the room contains individual boulders as large as 4 feet square. The southeast side of the room is a flowstone covered ledge. Around the room are a few columns, stalagmites and soda straw stalactites. A hard gray coating covering the flowstone on the walls was apparently deposited when water continued to flow over the flowstone. The same gray coating is also found on stalactites and flowstone in a 20-foot deep joint-controlled fissure in the southeast portion of the room. Additional speleothems are located in the southwest fork of the Boulder Room in a small chamber.

Evidence of stratification can be seen in the ceiling of the Boulder Room. The flat area of the ceiling is the bottom of one bed. The 20- by 40-foot oval chamber roof indicates the source for much of the breakdown on the roof below. In places the beds are up to 10 feet thick while in others the rock unit is broken into several layers less than a foot thick. One prominent rock feature near the top of the Boulder Room is interesting; an ochre colored layer containing sand lies between more massive limestone units. This layer is approximately 1 to 1.5 inches thick. Just above this sandy layer is a 4-foot thick layer of differentially compacted, partially fractured limestone. Dip of the rocks in this area of the cave is 20 degrees to the southwest.

The main route farther into the cave from the Boulder Room passes through a joint-controlled area called the Expressway. Another route, through higher passages, takes one to the same location (the bottom of the 40-Foot Chimney). The lower route out of the Boulder Room passes through 70 feet of boneyard maze with the characteristic gypsum flooring. The Expressway is a fissure passage paralleling the Boulder Room and has a flat ceiling at about the same level as that of the Boulder Room. Passage width averages 15 feet with a ceiling height of 20 feet. Sandy floors are covered in places with gypsum layers up to 5 feet thick.

Above the Expressway is a room 30 to 40 feet wide, while to the southwest there is more boneyard. Heading northeast in the Expressway, the ceiling breaks out into an upper level in several places. Occasional pits in the floor lead to a lower level. Brown and white "etched-out" areas on the ceiling indicate discarded bat roosts. Numerous boneyard passages lead from the main route as the Expressway heads up dip. Halfway to the 40-Foot Chimney from the entrance to the Expressway, the ceiling lowers to 3.5 feet and the passage width remains about 15 feet. Shortly thereafter, the ceiling lowers to 2.5 feet and the dry, dusty floor is clay with small breakdown rocks, but no gypsum. At the northeast end of the Expressway layers of gypsum 2.5 inches thick with 0.5 inch long crystals may be seen in the brown colored areas. Airflow increases near the 40-Foot Chimney. A small hole on the right wall of the passage leads to the easiest place to climb the 40-Foot Chimney. Shortly beyond this hole one can look down about 30 feet. This part of the chimney may also be climbed, but with greater difficulty (see Figure 5). The rock units of the formation in the small room at the top of the chimney are 2 to 3 inches thick. From the room atop the chimney, the route is through a small hole in the ceiling of the chimney and along the right hand wall to the end of the fissure; then down the chimney and back to the left to a point almost directly beneath the top chimney overlook.

Another route bypassing the 40-Foot Chimney is easier but is seldom used. From the Boulder Room an upper passage intersects the same joint that forms the 40-Foot Chimney. Instead of crossing the narrow portion of the Boulder Room, this route leads southwest up the breakdown slope in the main part of the room, down the other side of the breakdown to a natural bridge into the left wall. Staying fairly high one goes through the wall then left into a fissure. The route leads past a large stalagmite and a dry area with flowstone and stalactites. Continuing up a breakdown slope to an 8-foot high by 25-foot wide passage, the route skirts around the edge of a pit and into a fissure. Going left about 75 feet, then back east through a 3-foot high elliptical tube to an obvious chimney fissure, the route continues left as a walking passage to a point about 5 feet wide where one can see down the fissure. The 40-Foot Chimney is reached by simply crawling up-dip in the boneyard at the bottom of this fissure.

Surrounding the bottom of the 40-Foot Chimney is a large area of boneyard maze. The passage height averages 4 feet with several pits leading down to lower levels. The bottom of the 40-Foot Chimney is a fissure which continues to a lower level. On the northwest side of the fissure gypsum crystals, crusts and gypsum stalactites may be seen. Another small pit drops to a lower, less explored level with unexplored crawls leading in several directions.

Continuing east toward the Dallas Palace the route from the bottom of the 40-Foot Chimney passes through a rather large gypsum boneyard maze area. Some of the thickest gypsum layers in the cave cover the floor of this maze and some of the large blocks of gypsum have water-drilled holes 5 feet deep. Where the floor is scuffed, white gypsum crystals may be seen beneath the reddish clay which covers the floor and extends to the south side of the Dallas Palace. The Dallas Palace is a room about 35 feet in diameter and is first seen from a ledge near the top, 20 feet above the floor. A 25-foot rope is required to enter the Dallas Palace. On the south and southeast side of the Dallas Palace a beautiful example of pisolitic limestone is visible. Pisolites up to 5/8 inch diameter are arranged in thin concentric layers. A small dome on the northeast side of the Dallas Palace contains an unusual vertical fracture filled with a red, moist sandy clay (see Figure 6). This layer, about 3 inches thick, appears to come straight through the walls, up over the top of the dome 4 feet above and back down to eye level at the edge of the Dallas Palace.

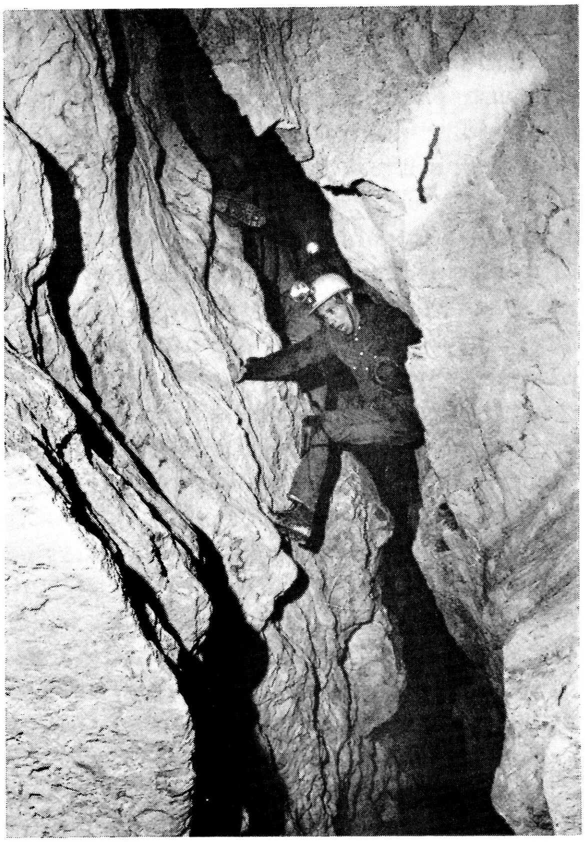


Fig. 5.—Jack Burch in the 40-Foot Chimney. Photo by Pete Lindsley.

Fig. 6.—Karen Lindsley inspecting a clay-filled fracture near the First Bat Chamber. Photo by Pete Lindsley.

The First Bat Chamber is the next major landmark east of the Dallas Palace and may be reached through an obvious gypsum-floored crawlway leading from the Dallas Palace. In the mid 1960's, before the cave was gated, this room housed a large population of bats. Now there remains only a large mound of guano under the old roosting place, a 100 square foot ceiling area, discolored and brown. The guano pile is about 6 feet deep and rests on gypsum blocks with water drilled holes. A smaller guano pile is adjacent to the large one, and a large dirt pile on the floor may well be an older guano pile. The floor of this room is extremely slick due to the guano. In the lower part of the First Bat Chamber is a 15-foot thick layer of white colored limestone with gypsum above it. The limestone in the upper half of the room is a reddish brown color, different from that in most of the cave as well as appearing more massive than the white limestone unit.

The old route from the First Bat Chamber is through some calcite speleothems on the east wall, but it has been bypassed with a new and better route to the northeast. This new route enters a boneyard passage to the left and the passage constricts until after 50 feet it has become a hand-and-knees crawl. A right turn leads into the Vast Chamber.

Slightly smaller than the First Bat Chamber, the Vast Chamber is 40 feet wide and 60 feet long with several domes in an otherwise flat ceiling 10 to 30 feet high. In the center of the room the ceiling domes upward leaving some rock layers cantilevered. Large breakdown boulders on the floor, up to 6 feet on a side, have fallen from the ceiling above. The rocks in this room dip about 4 degrees to the south.

North of the Vast Chamber more boneyard passages averaging 4.5 feet high lead in every direction. This confusing area appears to have been explored only 100 feet out from the trail and there is good potential for additional discoveries in this area. Survey station N-26 in the boneyard is at the northern edge of a 25-foot deep pit, which forms a room about 30 feet in diameter. Just past this pit is a standing-up place with a flat ceiling 6.5 feet high. In a little dome area on the north side of the boneyard is more gray flowstone that has been partially cut by flowing water.

The Half Vast Chamber is the next large open area in this boneyard and is about 25 feet in diameter and has an average height of 15 feet. A hole in the floor of the Half Vast Chamber, called The Guano Pit, is the original discovery route to the lower level maze. Gypsum covering the floor is obscured by the brown clay deposit associated with the numerous piles of guano located throughout the lower level maze area, 300 feet east of The Guano Pit. There are many interconnecting pits in the floor of this complex area, and rounded pillars 4 to 6 feet in diameter partially separate the rooms into a complex maze.

Passage height in the upper maze level is about 5 feet while the lower level averages 4-foot ceilings. The most popular route east toward the Chamber of the Vanishing Floor leads from the upper maze level in a generally eastern direction. As the passage nears the Chamber of the Vanishing Floor the ceiling gradually lowers to 3.5 feet and the rock units start to dip more steeply. The maze area pillars increase to 10 to 15 feet in diameter and the boneyard passage averages 10 feet in width. Several small piles of guano are sprinkled throughout the maze. Near the major fissure system of the cave which forms the Chamber of the Vanishing Floor the dip is 7.5 degrees to the south.

The route through the maze level at the top of The Guano Pit joins the major fissure just above the entrance area to Lost Valley, which is a lower level room (see Figure 7). Just past a small floor fissure about 2 feet wide is the main fissure with joint-controlled features extending well up into the ceiling. The major fissure, a primary structural feature of the cave, runs north and south for several hundred feet. A brass benchmark (1969 DCBM-1 NSS-GCS) identifies the main tie point for the surveys in this part of the cave.

Immediately south of this benchmark, the fissure leads to the South Chimney. A talus floor slopes upward into the chimney to a point almost directly under the small crawlway that leads to the upper level, Skinner's Attic passages. The South Chimney is about 4 feet wide at the floor and narrows to about 3 feet wide at the top. From the top, a crawlway leads into Skinner's Attic, an upper level maze with evidence of joint control in several places. The Attic, one of the highest points in the cave, lies 20 feet above the entrance. A few small pits in the floor of the Attic lead to unexplored areas, probably at about the same level as the bottom of the South Chimney. Finally, about 250 feet south, there is evidence of a small dry watercourse in the floor of the passage. This is called the Insane Rain Drain Trench and it leads to the southernmost survey point in the cave. Should water enter this area it would finally drain into a pit called the Insane Rain Drain Trench Pit which is about 300 feet south of the benchmark. As of June, 1976, the Insane Rain Drain Trench Pit area was still unexplored due to its remote location.

On the east side of the main fissure system at the DCBM-1 benchmark is a most confusing maze level positioned primarily in a 20-foot thick layer. The layers in this area dip about 2 degrees to the south. To the southeast through this maze is the Lost Chasm and to the east on the next level down is the Saber-Tooth Camel Maze. Although originally discovered from this upper maze level, the Saber-Tooth Camel Maze may be reached more easily from the fissure just north of the South Chimney.

Fig. 7.—Karen Lindsley lights up the passage above Lost Valley, south of the Chamber Of The Vanishing Floor. Photo by Pete Lindsley.

By heading north and down about 20 feet from DCBM-1, one soon comes to the edge of the pit that drops into the Lost Valley room. Going east into the maze level leads into a fairly spacious maze area that has a small dry stream channel running through a portion of the passage. In the sides of this stream channel Dr. Arthur Harris found the "sabertooth" bones (see Paleontology Section). When asked about some strange big "rocks," Dr. Harris replied "those are camel toe bones! " Such is the arbitrary naming of various features and passageways in Dry Pot!

The Saber-Tooth Camel Maze averages 4.5 feet high and 50 feet wide. Surface sediments have entered the Maze and in places are 2 to 3 feet deep on the floor. Sediments apparently were brought in along a recent stream channel, from the north and east. Water probably comes down the main fissure system in the area of the Chamber of the Vanishing Floor and Lost Valley, but is diverted and flows through the Saber-Tooth Camel Maze.

Along the main fissure north from the DCBM-1 benchmark, the limestone is brecciated in several places in a discontinuous layer 4 to 6 inches thick. This breccia probably originated as debris from above and has been cemented together. The north-south fissure system is one of the more distinctive and puzzling features of the cave. Was there once an opening to the surface at the top of the 400-foot long fissure that allowed numerous bones to filter into the cave? Do the articulated skeletons found indicate that these openings were once large enough to admit the whole animal? In summary, the fissure system is complex, with signs of solutional action, joint control, clay fills and breccia and is an area worthy of future study.

Continuing north in the fissure, several small guano piles are seen, averaging two cubic feet of guano per pile. Farther along the main fissure development to the north, entry to the Chamber of the Vanishing Floor is gained on the southeast side of the room. This room is one of the larger in the cave and is about 60 feet wide, 75 feet long and 20 feet high. The floor is guano-covered breakdown and the sides of the room slope dangerously towards the lower center portion of the chamber. The guano-covered boulders and ledges at the top western side of the room are extremely slick and can send an unwary caver on a quick and certain fall to the bottom of the room. (The room was named when Larry Register, one of the first explorers to enter the room, lost his footing and almost disappeared into the floor between some hidden guano-covered boulders near the bottom of the room.)

Near the ceiling a passage leads north from the Chamber of the Vanishing Floor toward the Grand Canyon, the northernmost extent of the main fissure system. From the level at the top of the Chamber of the Vanishing Floor the Grand Canyon drops sharply and several maze levels intersect the deep chasm. Also in this area, but not shown on the map, is Whiz Pit—the deepest known pit in the cave. Whiz Pit is reached by chimneying up near the Chamber of the Vanishing Floor and crawling through a maze level. This blind pit drops 80 to 100 feet free fall.

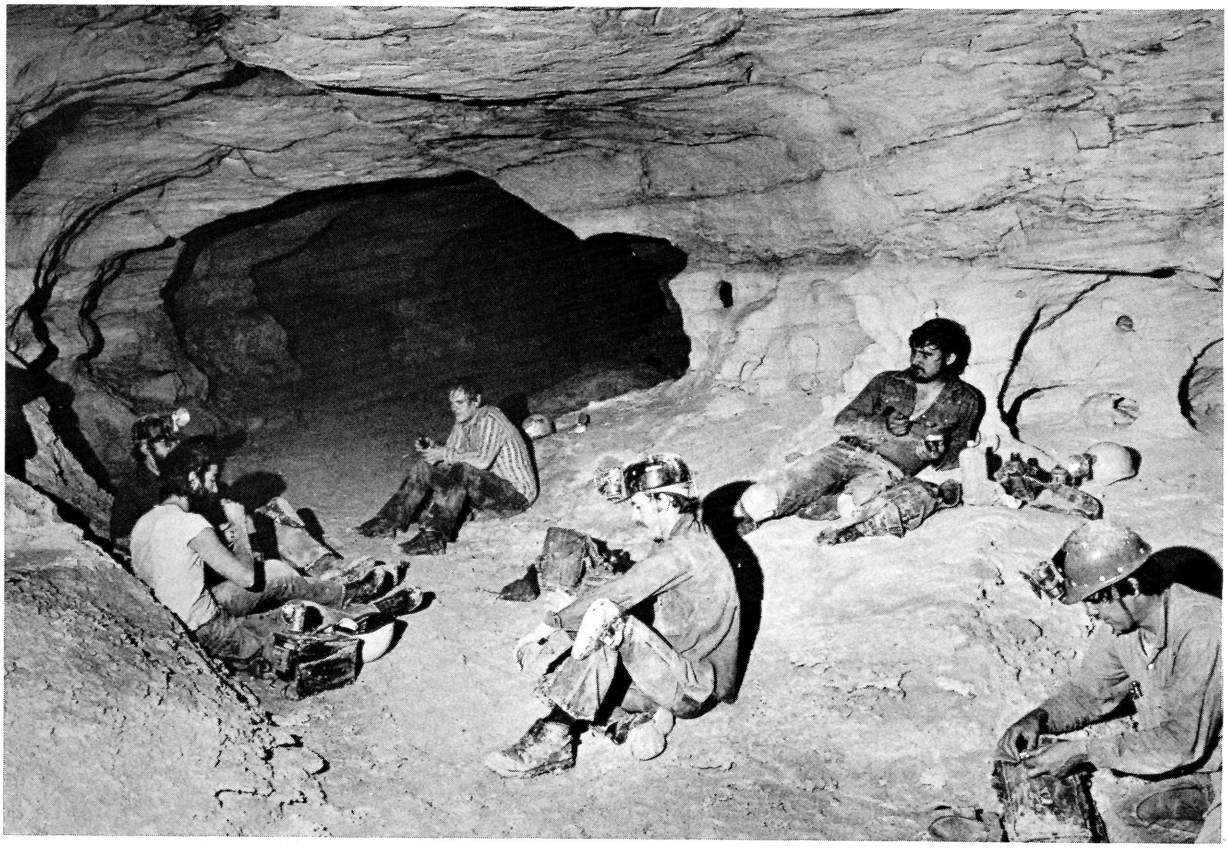


Fig. 8.—The view to the west in the Recovery Room. L-R: J. McLean, G. Sevra, D. Townsend, D. Hurst, B. Hinson, and C. Welbourn. Photo by Pete Lindsley.

Leading northeast at mid-level from the Chamber of the Vanishing Floor is a series of maze passages which lead to the New Section (discovered in 1975). An integral part of the complex fissure zone, the area has several breakdowns and many levels. It was through one of the breakdown areas that the New Section passage was uncovered after movement of a few rocks. The new passage leads east for about 200 feet through a small maze level and becomes progressively smaller. Here, the rocks are horizontal rather than dipping eastward. Becoming a crawl, the passage twists and turns, requiring "S" bending to squeeze through the passage to the brink of Recovery Pit. Beware: One can easily fall! The pit may be free-climbed on the right (southwest) wall and is approximately 30 feet deep. At the bottom the passage splits with the larger passage going back under the entrance crawl to the pit. (The pit and next large room were named after one of the original explorers fell a respectable distance into the pit.)

The room beyond is a welcome place to eat lunch and recover from the unpleasant aspects of Dry Cave (see Figure 8). The Recovery Room is one of the longest, large rooms of the cave, averaging 20 feet wide, 150 feet long and 11 feet high. The room ends in a small terminal breakdown that is under the fissure system in the area of the Chamber of the Vanishing Floor and Grand Canyon. Several bones are in the Recovery Room, both along the wall on the floor and in the terminal breakdown at the southwest end of the room (see Figures 9 and 10).

Fig. 9.—Bones found on the floor of the Recovery Room. Photo by Pete Lindsley.

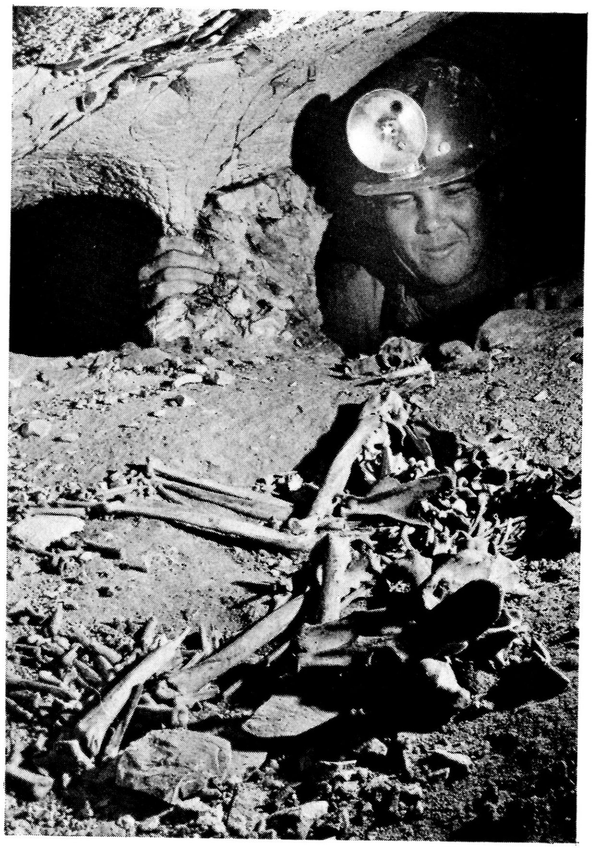
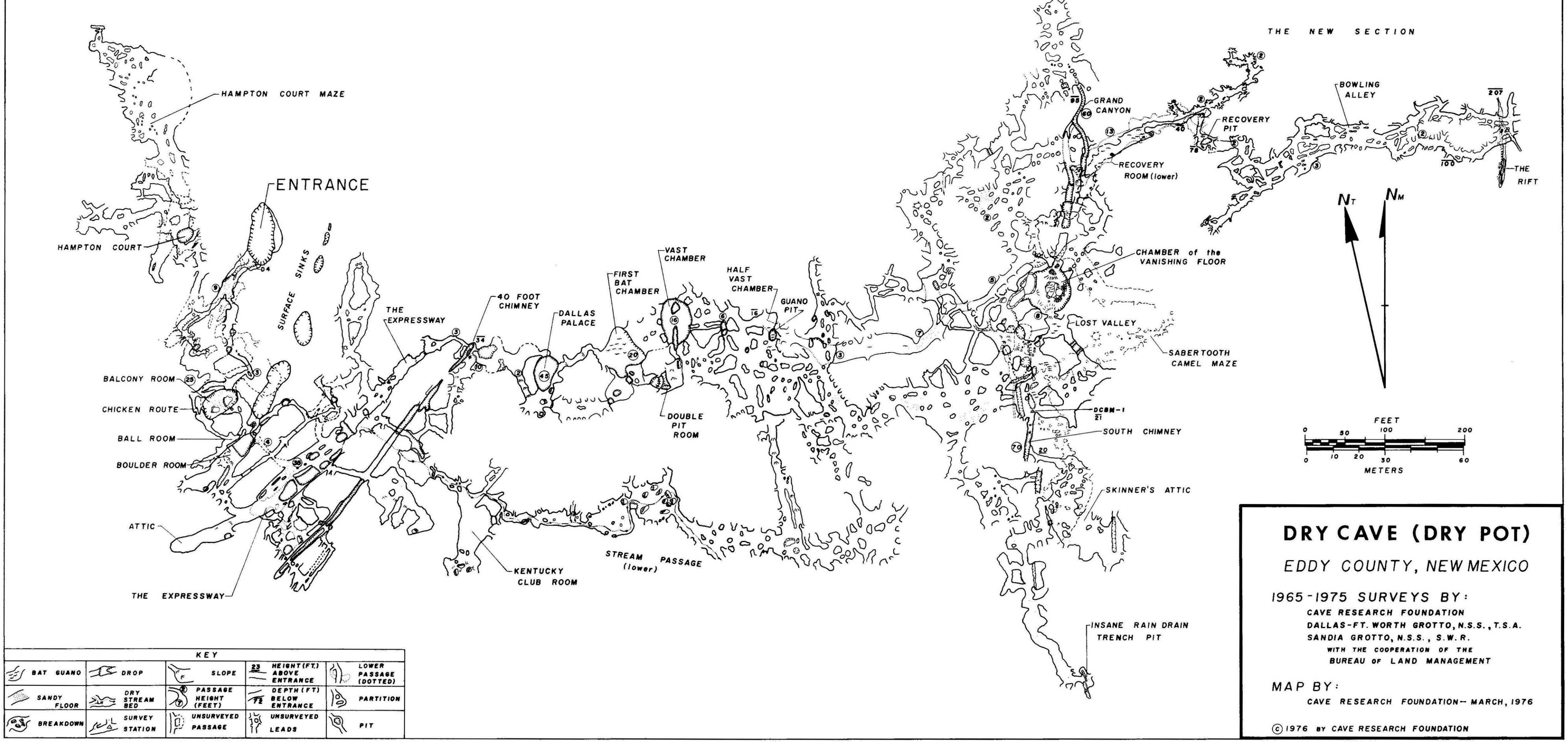


Fig. 10.—Cal Welbourn inspecting an articulated skeleton at the bottom of The Rift. Photo by Pete Lindsley.

At the bottom of Recovery Pit, the passage continues east for at least 400 feet. The dip increases at such a rate in this area that the cave passage is forced to follow the beds at a considerable angle. Extensive maze passages have developed in these tilted rocks (see Figure 10). The name Bowling Alley was suggested by a comment that a bowling ball released on the floor probably would roll down the passage a long distance—perhaps going all the way to the Rift at the end. The Rift mirrors the main fissure system in a small way: it is developed in a north-south direction, intersects several levels, and is one of the main controlling features at the east end of the cave (see Figure 11). Beyond the Rift to the east the small passage is quite painful to explore. The bottom of the Rift, which may be reached by free climbing, is the deepest surveyed point in the cave at -207 feet.

Fig. 11.—Cal Welbourn surveying in the boneyard area of the Bowling Alley. Photo by Pete Lindsley.



DRY CAVE (DRY POT)

EDDY COUNTY, NEW MEXICO

1965-1975 SURVEYS BY:

CAVE RESEARCH FOUNDATION
DALLAS-FT. WORTH GROTTO, N.S.S., T.S.A.
SANDIA GROTTO, N.S.S., S.W.R.
WITH THE COOPERATION OF THE
BUREAU OF LAND MANAGEMENT

MAP BY:

CAVE RESEARCH FOUNDATION — MARCH, 1976

SAND CAVE

by Thomas M. Byrd and Carl E. Kunath

Like the other caves in McKittrick Hill, Sand Cave is a complex maze cave which almost defies description. Generally speaking, its three levels slope correspondingly with the dip of the limestone, and in several places are interconnected. Although length is hard to define in a maze cave, the total surveyed distance is 7688 feet. All parts of the cave are accessible without vertical gear, although some interconnecting domepits and dome leads would require equipment.

Upon first consideration, the cave appears to sprawl endlessly into darkness, bounded here and there by pillars and irregular walls. As one becomes accustomed to the cave, certain landmarks leave their impressions, often serving as proof that one is traveling in circles. There are certain features which make portions of the cave unique from others. These features may be such things as smooth dirt floors, rough gypsum floors, dry crusty soda straws or massive columns. Some areas are typified by well-defined walking passages; others by low agonizing crawlways over wet flowstone and broken formations. Little by little this large, confusing cave becomes familiar.

Any description should show how these landmarks, features and characteristic areas are related. Often, they are best described in the way a person might systematically observe them: one place after another, connected by the space and features in between.

The Upper Entrance is located on the steep, rocky hillside and is a small sink (now guarded by a hefty steel gate) with a pit at one side dropping 15 feet to the cave floor. The Lower Entrance (also gated) is 200 feet away and 60 feet below the Upper Entrance. It is a hole in the bare limestone about 4 feet long and 2 feet wide dropping 4 feet to the floor of a small room which leads west under McKittrick Hill. The map folds out from page 53.

Entering the cave from the Upper Entrance, one can chimney down into a 20-foot high joint-controlled passage. This, the Upper Entrance Passage, extends in two directions and is a major connection between the Upper and Lower levels of the cave. To the northwest, the passage splits. The larger branch slopes steeply down several climbable drops, while the other, known as the Upper Joint Passage, continues straight and narrow up against the ceiling. Both of these northwest-trending passages lead to the Dome Room in the Lower Level (to be described later). Southeast of the entrance drop a 3- to 4-foot wide, 20-foot high passage slopes downward over talus. The ceiling gradually lowers to 7 feet high and the passage begins to level off about 40 feet from the entrance. Here, the passage widens and continues with a flat dirt floor and a 3-foot high ceiling.

This widening passage is divided by several pillars which are solutional remnants of the bedrock. Beyond them to the left (east) is a wide room with a 6-foot high ceiling. To the right is a 20-foot high dome. This area is the high portion of the Upper Level Maze. Surrounding this dome are several flowstone columns and passages leading in different directions.

High on the wall to the northwest, a small passage leads from the dome area and parallels the Upper Entrance passage for 60 feet before becoming too small to follow.

Twenty feet south of the dome the passage makes a left turn and slopes downward. After 60 feet several low alcoves are encountered on the left side of the passage and one can crawl over breakdown and squeeze under a false wall. A one-foot high passage floored with breakdown and porcupine droppings loops back to the dome area, the highest portion of the Upper Level Maze.

From the dome area one can enter the Upper Level Maze by following the downward-sloping flowstone floor to the northeast. The 30-foot wide walking passage is divided by flowstone columns and stalagmites. Soon, the flowstone floor gives way to a dusty dirt floor and the ceiling lowers to 2 feet. Beyond this low area the ceiling rises to 6 feet. Here, one can see that the wide room is rendered into a series of narrow passages by virtue of the large rock pillars dividing the room. The maze effect is enhanced by the three side passages leading from the northwest wall of the Upper Level Maze. Each passage dead-ends after about 50 feet. Along the east wall of the maze a pillar and a large breakdown block guard the way to two 25-foot deep pits which connect the Upper Level Maze with the Lower Level Maze. Neither of these two pits can be safely entered without vertical equipment. East of these pits a path leads from the Upper Level Maze to the Lower Entrance. The Lower Entrance thus provides access to the Upper Level Maze and the Lower Level Maze by way of the 25-foot deep pit.

Returning once again to the Upper Entrance passage, one can follow the northwest passage downward over several climbable drops. The last of these drops ends in a small, talus-floored room from which a talus-strewn crawlway shortcuts downward to the Lower Level Maze, while the main passage continues in a southwesterly direction to the Dome Room.

The Dome Room and vicinity must once have been the most beautiful area of the cave, though its many columns have now been marred by vandals. Several 40-foot high domes dominate the area and at the tops of two of these domes are connections with the Upper Joint passage. To the northeast a long, wall-like line of stalagmites and columns divides the passage. To the right, the ceiling height lowers to eight feet and the passage slopes downward into the western portion of the gypsum-floored Lower Level Maze. To the left, the passage continues northward into an area known as The Boondocks.

The Boondocks is a wide, breakdown-floored area comprising the northern portion of the Lower Level Maze (see Fig. 1). From here, the Lower Level Maze slopes downward to the east

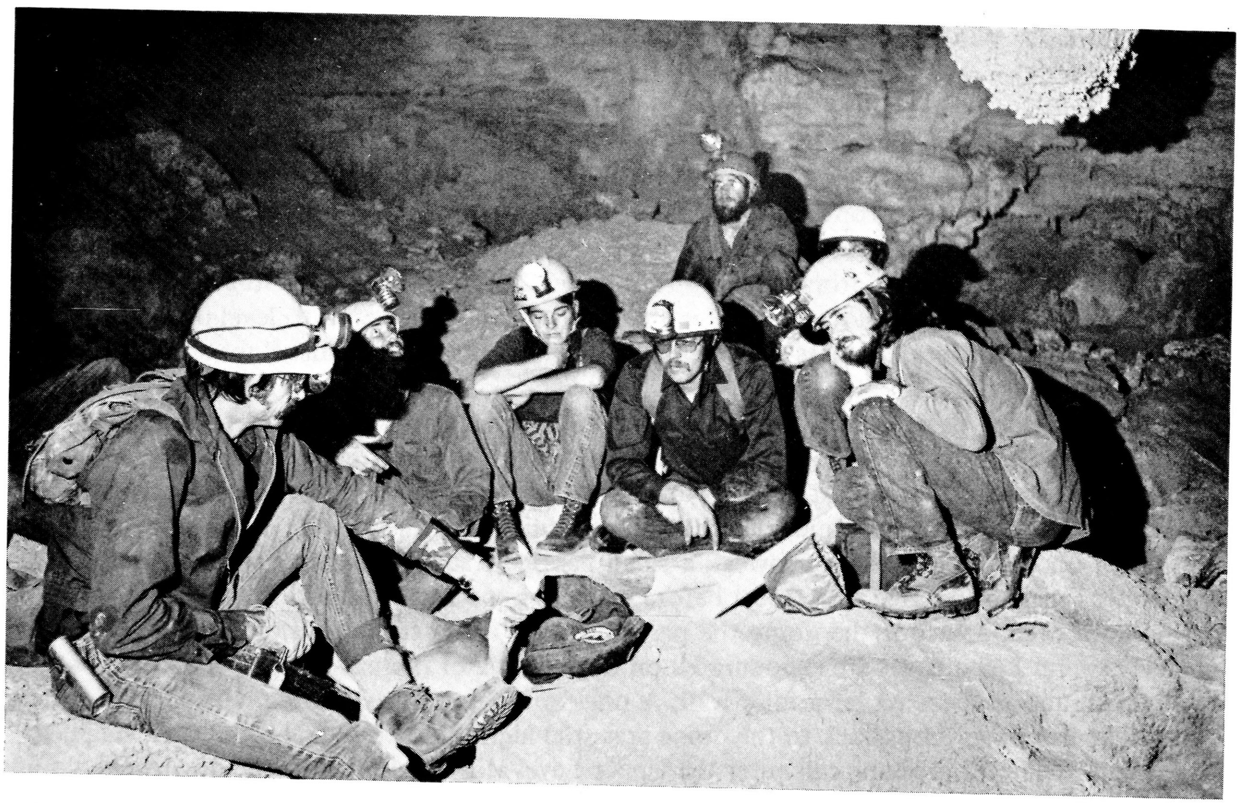


Fig. 1.—Surveying party in the Lower Level Maze. L-R: Jon Vinson, Neal Morris, Laura Denison, Ronnie Fieseler, Mike McKee, Barbara Vinson, Tom Byrd. Photo by Carl Kunath.

and southeast over an area 600 feet long and up to 160 feet wide. Its typically low passage follows the bedding plane and is divided by dozens of rock pillars and columns varying from a few inches to tens of feet in diameter.

From The Boondocks the wide, 8-foot high passage slopes downward toward an increasing number of pillars until it is no longer a wide passage; instead it is funneled into seemingly well-defined corridors which further split into many directions. The passages in this portion of the cave average 3 feet high. The area along the eastern wall is typified by an abundance of formations and wet flowstone floors, particularly in the Wet Room. Notable in this area is the connection between the Wet Room and the north end of the Lily Pad Passage[1]. The connection is too tight to crawl through but hands can touch from either side.

South of the Boondocks is a perplexing area known as Midget's Maze. Located updip from the wet, eastern portion of the Lower Level Maze, the Midget's Maze is dry and typified by breakdown-covered floors. Passages in Midget's Maze are well defined by long, rock pillar walls. Farther updip from the Midget's Maze the passages are low and wide with floors covered by resolutioned gypsum flowstone and ceilings decorated with dry, crusty soda straws.

Along the wet eastern wall of the maze (downdip from Midget's Maze) the Flowstone Dome is a notable feature. This 10-foot high dome connects the Lower Level with a part of the Middle Level in the vicinity of the Lily Pad Passage (see Fig. 2). South of the Flowstone Dome, the Lower Maze passages lead to the Sandy Floored Room.

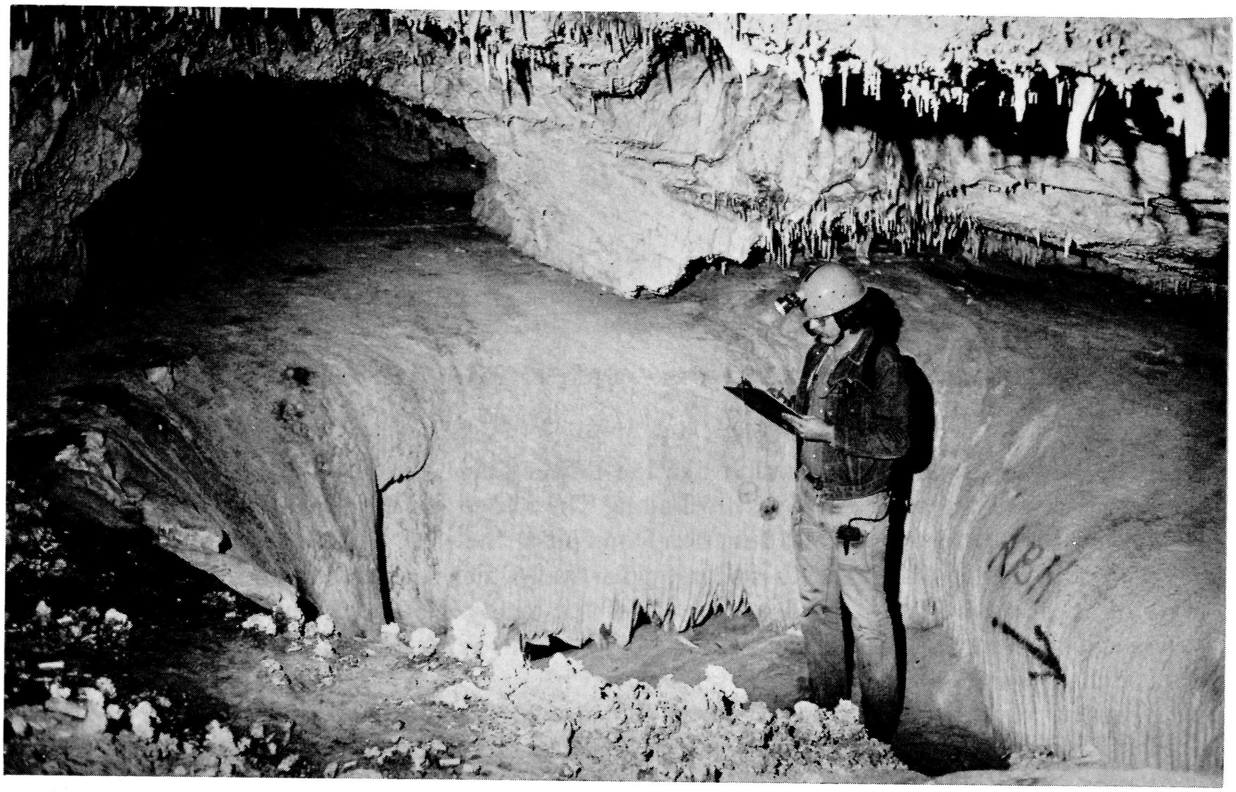


Fig. 2.–Bill Elliott in the Flowstone Dome (Pit). Photo by Carl Kunath.

[1]The Lily Pad Passage at the northern end of the Middle Level is so named because of the table sized lily pads resting on stout pedestals. The old lake there is now dry.

The Sandy Floored Room is the lowest area in the cave at 106 feet below the datum point at the Upper Entrance. It is a flat, dirt-floored north-south trending room with an average height of 12 feet although there are several higher domes. The southernmost dome in this room connects to the Upper Level Maze near the Lower Entrance. Along the west side of the Sandy Floored Room is The Ledge, a 2-foot thick strata separating the Middle Level from the Lower Level. Here, one can clearly see how the two maze levels are related (see Fig. 3).

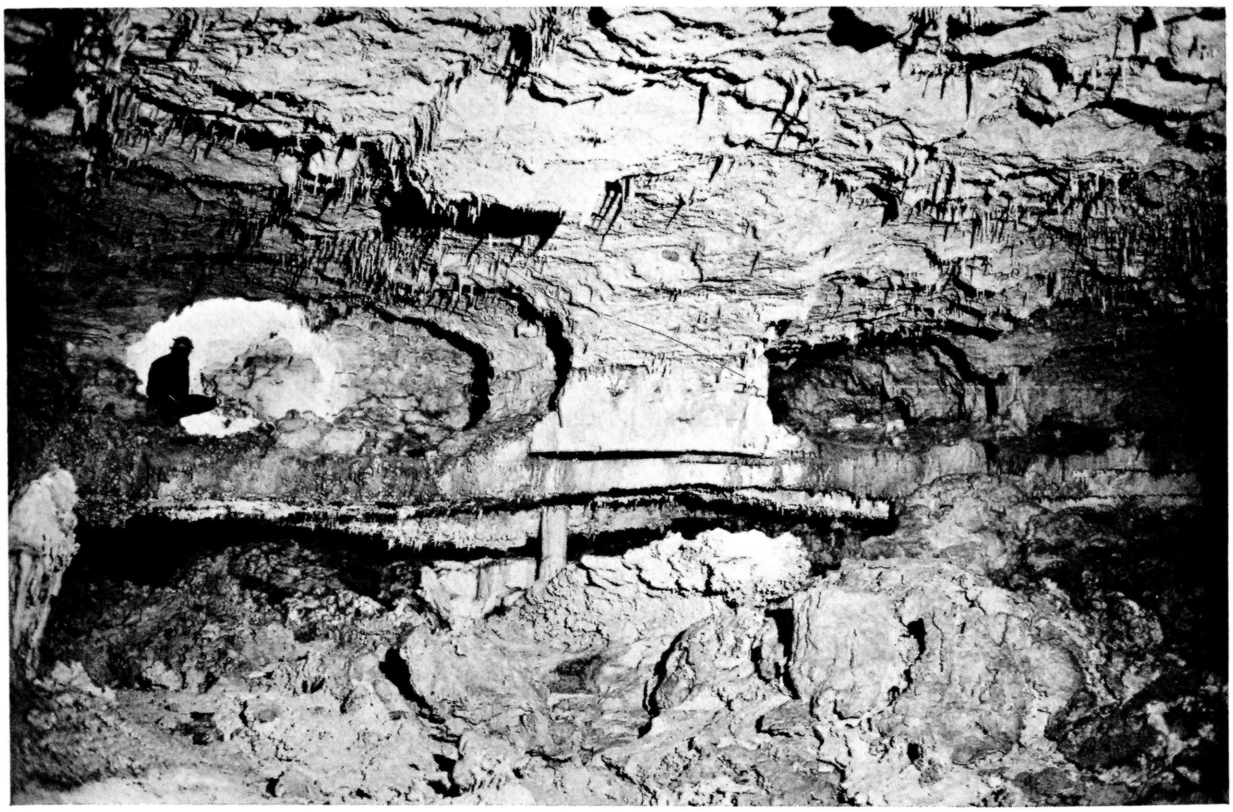
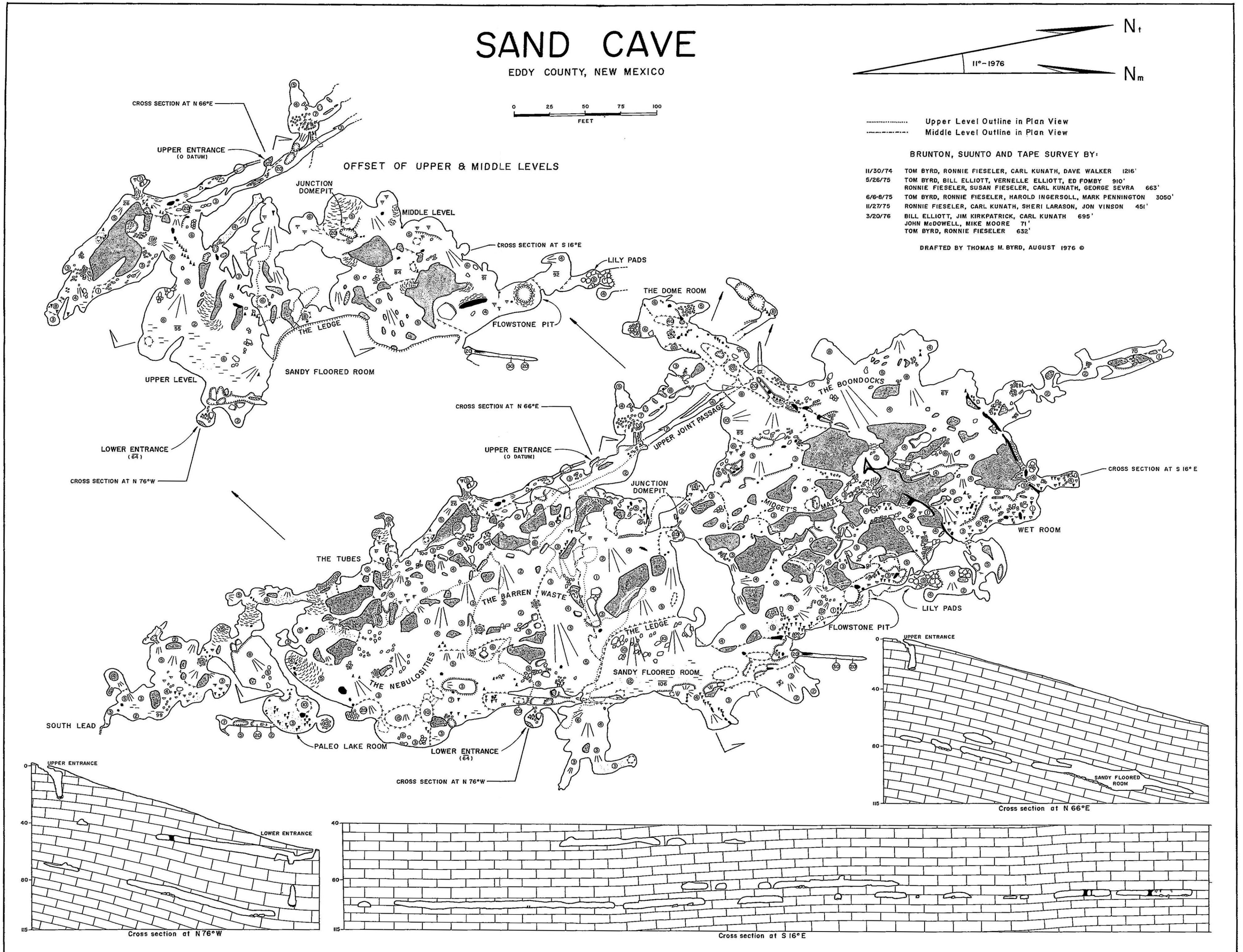


Fig. 3.—The Ledge. Lower and Middle Levels converging at the Sandy Floored Room. Jon Vinson at the left. Photo by Carl Kunath.

The Middle Level Maze is much like the Lower Level Maze but with a flowstone-covered floor. It is connected to the Lower Level along The Ledge and by two domepits: the Flowstone Dome (previously mentioned) and Junction Domepit at the west side of the Middle Level.

Supporting the Middle Level is a large pillar/wall which separates the northern and southern parts of the Lower Level. Uphill, southwest of the Sandy Floored Room, there are fewer rock pillars and more open space laterally. This area, The Barren Waste, has a ceiling height of 2-3 feet and rough gypsum floors.

Further south of the Sandy Floored Room and The Barren Waste are The Nebulosities, another confusing area where adjacent pillars and passages are just beyond the range of most headlamps. Small domes in the ceiling are interconnected by tube-like crawlways. Along the east wall a large passage leads north to a dome connecting the Lower Level with the Upper Level. This interconnecting domepit is larger than the one connecting the Sandy Floored Room with the Upper Level and it once contained a ladder enabling travel between the two levels without vertical equipment.


SAND CAVE
EDDY COUNTY, NEW MEXICO
0 25 50 75 100
FEET
11°-1976
Nt
Nm
Upper Level Outline in Plan View
Middle Level Outline in Plan View
BRUNTON, SUUNTO AND TAPE SURVEY BY:
11/30/74 TOM BYRD, RONNIE FIESELER, CARL KUNATH, DAVE WALKER 1216'
5/26/75 TOM BYRD, BILL ELLIOTT, VERNELLE ELLIOTT, ED FOMBY 910'
RONNIE FIESELER, SUSAN FIESELER, CARL KUNATH, GEORGE SEVRA 663'
6/6-8/75 TOM BYRD, RONNIE FIESELER, HAROLD INGERSOLL, MARK PENNINGTON 3050'
11/27/75 RONNIE FIESELER, CARL KUNATH, SHERI LARASON, JON VINSON 451'
3/20/76 BILL ELLIOTT, JIM KIRKPATRICK, CARL KUNATH 695'
JOHN McDOWELL, MIKE MOORE 71'
TOM BYRD, RONNIE FIESELER 632'
DRAFTED BY THOMAS M. BYRD, AUGUST 1976 ©
OFFSET OF UPPER & MIDDLE LEVELS
CROSS SECTION AT N 66°E
UPPER ENTRANCE
(0 DATUM)
JUNCTION DOMEPIT
MIDDLE LEVEL
CROSS SECTION AT S 16°E
LILY PADS
FLOWSTONE PIT
THE LEDGE
SANDY FLOORED ROOM
UPPER LEVEL
LOWER ENTRANCE
(64)
CROSS SECTION AT N 76°W
THE DOME ROOM
THE BOONDOCKS
UPPER JOINT PASSAGE
CROSS SECTION AT N 66°E
UPPER ENTRANCE
(0 DATUM)
JUNCTION DOMEPIT
MIDGET'S MAZE
CROSS SECTION AT S 16° E
WET ROOM
THE TUBES
THE BARREN WASTE
LILY PADS
FLOWSTONE PIT
THE LEDGE
SANDY FLOORED ROOM
THE NEBULOSITIES
SOUTH LEAD
PALEO LAKE ROOM
LOWER ENTRANCE
(64)
CROSS SECTION AT N 76°W
UPPER ENTRANCE
LOWER ENTRANCE
Cross section at N 76°W
Cross section at S 16°E
UPPER ENTRANCE
SANDY FLOORED ROOM
Cross section at N 66°E

LITTLE SAND CAVE

by Ronald G. Fieseler and Carl E. Kunath

The 3 foot in diameter entrance is in a shallow sink 334 feet southwest of Endless Cave. What appears to be talus from the excavation of the entrance surrounds the sink.

Just inside the entrance, a chimney drops 10 feet to a small room with a low, muddy crawl leading east about 10 feet to a N-S junction. To the south, the passage ends after 20 feet in a small room 4 feet high. To the north, after 15 feet, a crawlway leads south to a triangular room about 5 feet high. A low passage leads north from this room, but the ceiling soon lowers to 4 inches.

Returning to the crawlway junction and continuing east for an additional 20 feet leads to a left turn and a slope downward into a room 6 feet high, 20 feet wide, and 30 feet long. A low crawl from the SE corner of this room connects with the crawlway leading north from the triangular room. This crawlway is known as the Frantic Fingers Passage due to the difficult gropings required to pass the tape through during the survey.

The cave is generally floored with damp dirt and breakdown, and contains no speleothems or other distinctive features. Total length of the cave is about 245 feet, with the deepest point 35 feet below the entrance. No leads are presently known and there is little chance of a connection with Endless Cave, about 250 feet distant at its nearest approach.

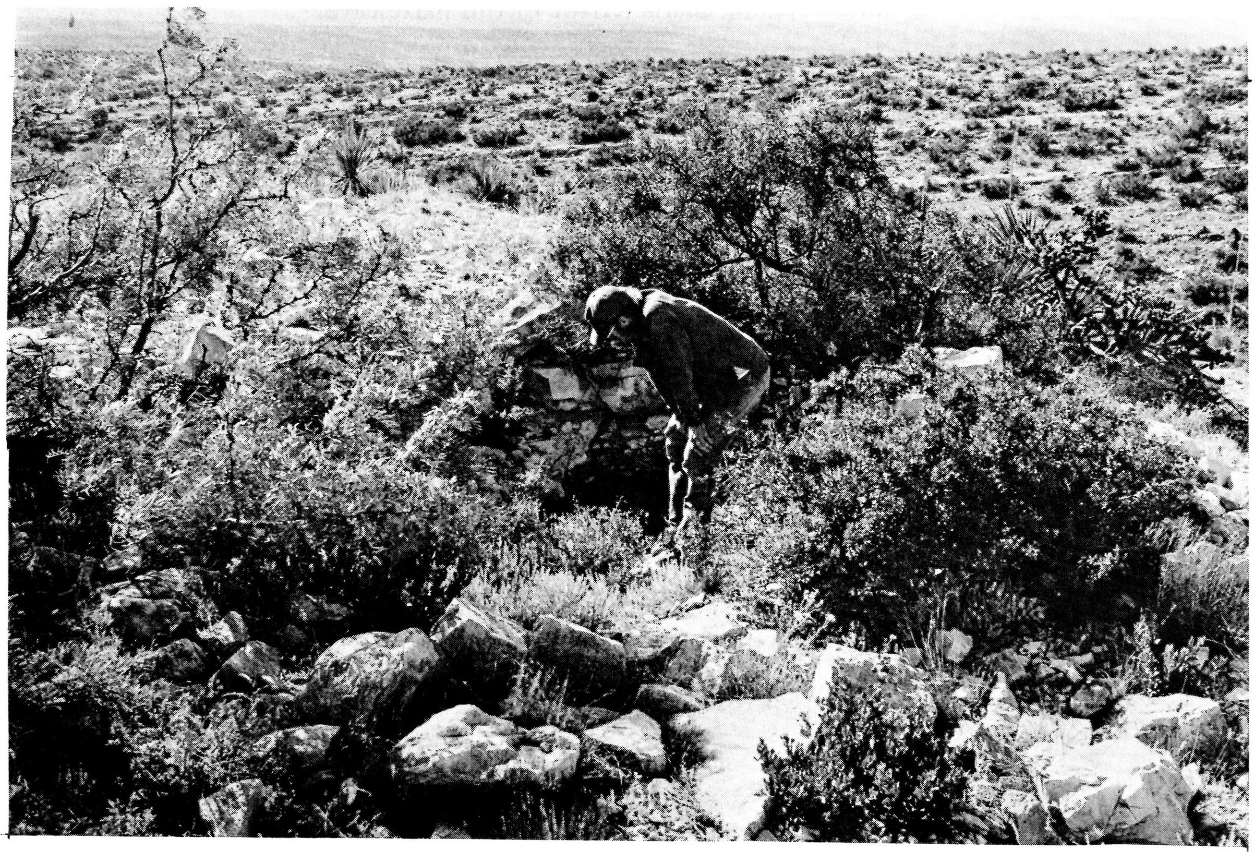
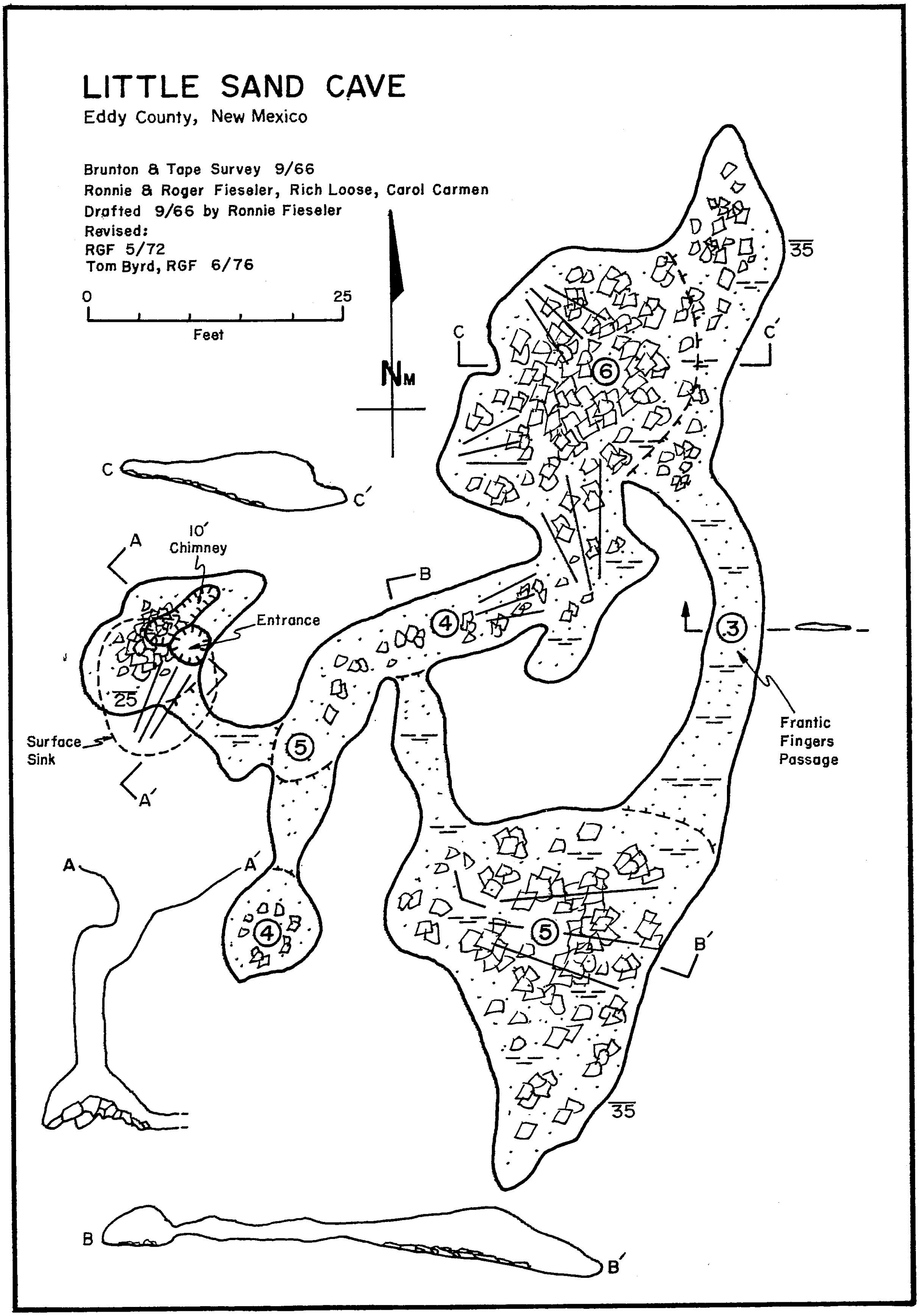


Fig. 1.—Ronnie Fieseler at the entrance of Little Sand Cave. Photo by George Sevra.

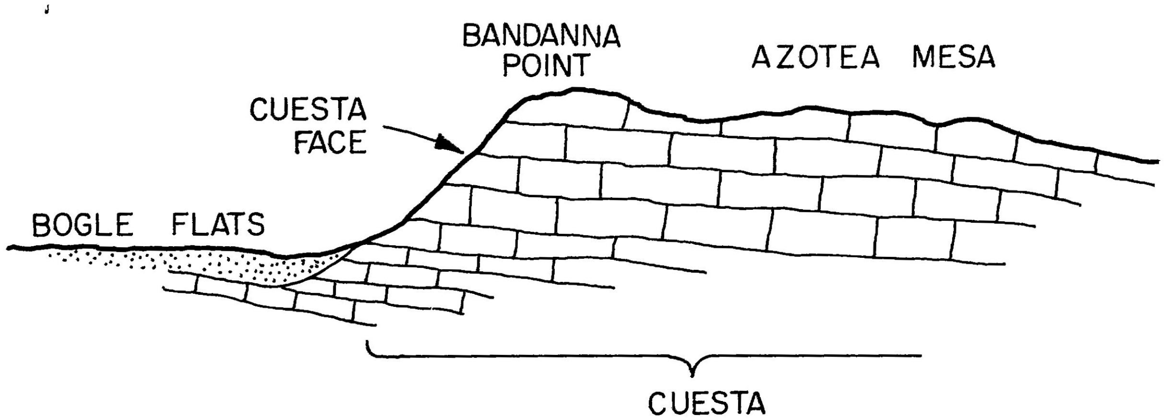

LITTLE SAND CAVE
Eddy County, New Mexico
Brunton & Tape Survey 9/66
Ronnie & Roger Fieseler, Rich Loose, Carol Carmen
Drafted 9/66 by Ronnie Fieseler
Revised:
RGF 5/72
Tom Byrd, RGF 6/76
0
25
Feet
NM
C
C′
A
A′
B
B′
10′
Chimney
Entrance
Surface
Sink
25
35
35
Frantic
Fingers
Passage
3
4
5
6

GEOLOGY

by A. Richard Smith

Pertinent (and important) questions are:
Why are the caves in McKittrick Hill such irregular mazes?
Why are they in McKittrick Hill at all?
And, even, why is McKittrick Hill there?

Last question first, why is McKittrick Hill there? To answer this question, we must take a larger view and see how McKittrick Hill, its physiography and its rocks, fit into the surrounding region. McKittrick Hill, as the name is used here, is the north-south ridge with a small westward extension, and is only one of many high hills and ridges in the rugged relief of Azotea Mesa (Fig. 1). The mesa is an irregular highland 8 to 10 miles east-west and 10 to 12 miles north-south. It is also a west-facing cuesta (see sketch) overlooking Bogle Flats (Fig. 2), bounded on the north by Rocky Arroyo and on the south by Last Chance Canyon. Hilltop elevations range from 4633 feet at Bandanna Point, the westernmost extension of the mesa, to about 3800 feet on the east. Erosion has dissected the mesa into irregular hills on the west, and into north-south trending ridges and draws on the east. McKittrick Hill is one of the north-south trending ridges; it lies near the center of Azotea Mesa, about 15 miles west of Carlsbad, N. M.



Just east of Azotea Mesa prominent hills, such as Carnero Peak and McGruder Hill, rise from alluvium-filled valleys of the Pecos River terraces. Radial drainage is characteristic of these hills, which are up to 500 feet above the adjacent draws. Farther east is the Pecos River valley in which Carlsbad is located. At Carlsbad the elevation of the Pecos is about 1300 feet, some 2200 feet lower than the crest of McKittrick Hill.

The Pecos is the only permanent through-flowing stream within many miles of the Hill, although a number of springs supply water for nearly permanent flow in short stretches of some Azotea Mesa draws. The draws and valleys in the area carry large volumes of floodwater during infrequent storms but are usually dry.

A general lack of soil exposes bedrock over much of Azotea Mesa and surrounding regions, permitting a detailed study of the rocks. Based on published studies, I describe below the strata that are important to the relief of the mesa and particularly to the genesis of the McKittrick Hill caves.

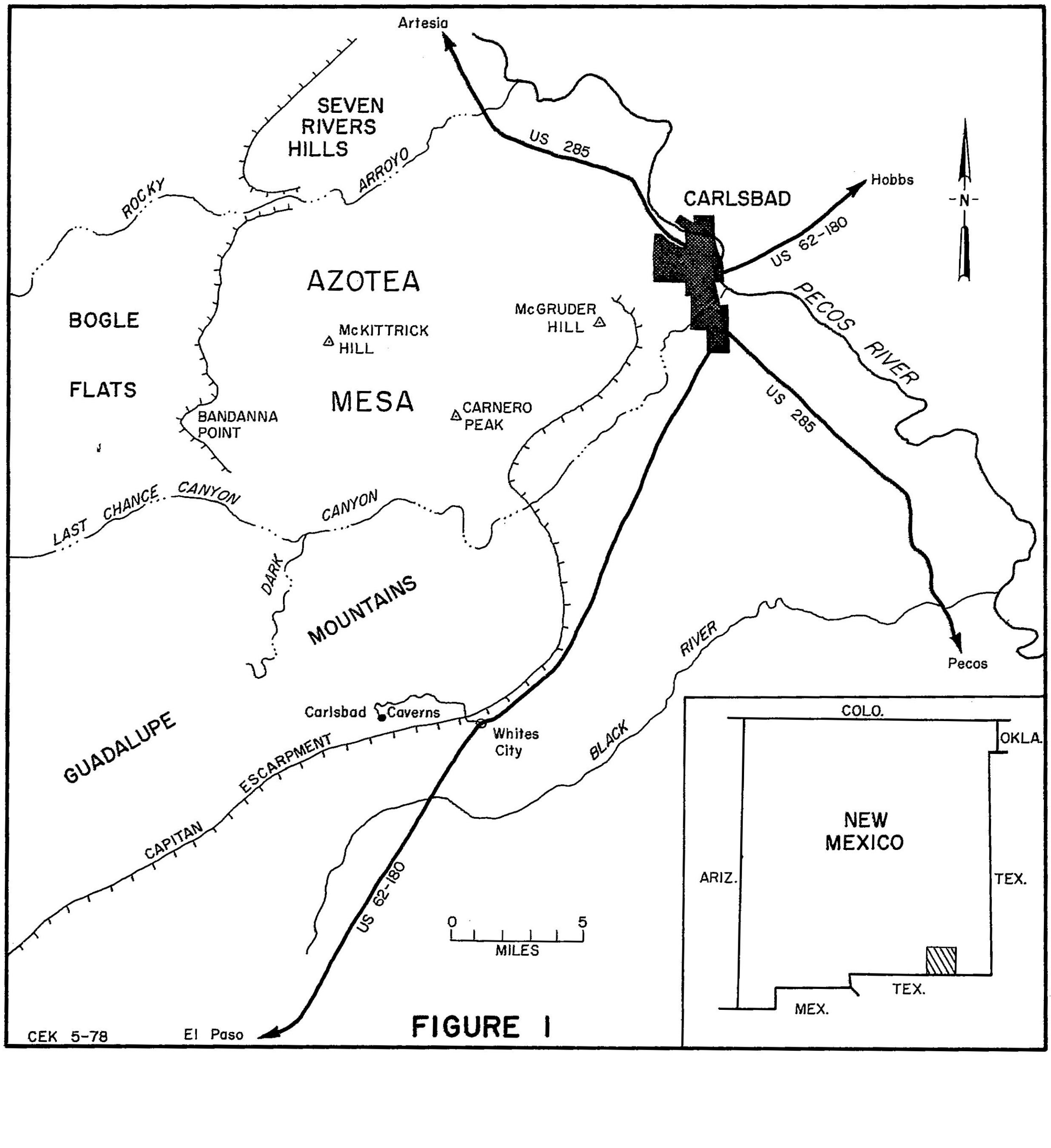

Artesia
SEVEN RIVERS HILLS
ROCKY ARROYO
US 285
CARLSBAD
Hobbs
-N-
US 62-180
AZOTEA
MESA
BOGLE
FLATS
McKITTRICK HILL
McGRUDER HILL
CARNERO PEAK
BANDANNA POINT
PECOS RIVER
US 285
LAST CHANCE CANYON
CANYON
DARK
MOUNTAINS
GUADALUPE
Carlsbad Caverns
Whites City
CAPITAN ESCARPMENT
BLACK RIVER
Pecos
US 62-180
0
5
MILES
COLO.
OKLA.
NEW MEXICO
ARIZ.
TEX.
TEX.
MEX.
CEK 5-78
El Paso

FIGURE 1

In the Late Permian (250 million years ago) the topography of the Carlsbad area may have been similar to that of the Great Barrier Reef off the Australian coast today. A deep marine basin (now known as the Delaware Basin) began to form by subsidence along an axis extending from Carlsbad south toward Fort Stockton, Texas; around its rim a fringing reef began to grow. As the basin deepened, the rim also subsided, and the reef grew upward. On the shelf behind the reef (north and west) thin beds of limestone and gypsum were deposited in very saline water. Eventually, the reef died, either because it couldn't grow as fast as the rim subsided or because the marine water became too salty in the basin. The deep basin was mostly filled with gypsum, salt, and potash as the basin became more isolated from the open ocean to the south.

The rocks that remain as a result of this long depositional episode are now exposed in the Carlsbad region. Fig. 3 is an idealized cross-section showing the names of the formations, the rock types, and their depositional environments. Compare this with Fig. 2, which is an actual cross-section showing the relationship of McKittrick Hill to the shallow and exposed rocks.

The Capitan Formation ("Capitan Reef"), best known to speleologists and cavers because it contains Carlsbad Caverns, does not crop out on Azotea Mesa, nor do several other formations shown in Fig. 3. Only the Yates and Seven Rivers formation crop out at McKittrick Hill, and only they are described below. More details on the geology of the area may be found in several of the references listed at the end of this section.

The Yates Formation, in its exposures on McKittrick Hill, consists of dolomite ($CaMg(CO_3)_2$) with some interbedded siltstone and sandstone. It is about 350 feet thick immediately behind the Capital reef, thinning to about 200 feet at McKittrick Hill. Like all the backreef formations, the Yates grades laterally away from the reef into gypsum. The irregular transition zone, where dolomite with minor limestone is interbedded with gypsum, lies 2 to 3 miles west of McKittrick Hill; a tongue of siltstone with gypsum lies about 4 miles north-northeast of the Hill. Sandstone and siltstone beds increase in number and thickness away from the reef (toward land during the Late Permian), finally dominating the Yates northwest of Azotea Mesa (Motts, 1962; Kelley, 1971; Tait and others, 1962).

The Seven Rivers Formation comprises a thick sequence of limestone, dolomite, and dolomitic sandstone that grades mostly into gypsum several miles northwest of McKittrick Hill. The Seven Rivers is about 270 feet thick at McKittrick Hill. In general the Seven Rivers and Yates are much alike, except that the Yates has more sandstone and siltstone beds.

In addition to Permian bedrock in the area, sediments of Quaternary age (up to 2 million years old) occur in the major valleys. These sediments, making up the Orchard Park Terrace of the Pecos River, consist of limestone gravel washed from the hills and veneered with more recent brown soil and alluvium. They are mostly less than 50 feet thick, and, although not involved with the caves directly, they are important in clarifying the geomorphic history of the area.

A view of the rocks of Azotea Mesa, along with some knowledge of their origins, suggests that several things have happened since the rocks were deposited as soft sediments in the shallow seas. It is obvious that these rocks are now some thousands of feet above sea level, that they don't all lie in their near-horizontal attitudes, and that they are quite fractured. What has happened?

The things that have happened are part of the structural history of the area. Evidence for part of the history is subtle, even absent, and no historian was present to record the events of the millions of years since deposition of the rocks. We can, nevertheless, postulate that history, following the work of Kelley (1971) and others.

Very late in Permian time, after deposition of all the bedrock now exposed on Azotea Mesa, slight uplift of southeast New Mexico and West Texas raised the region above sea level, resulting

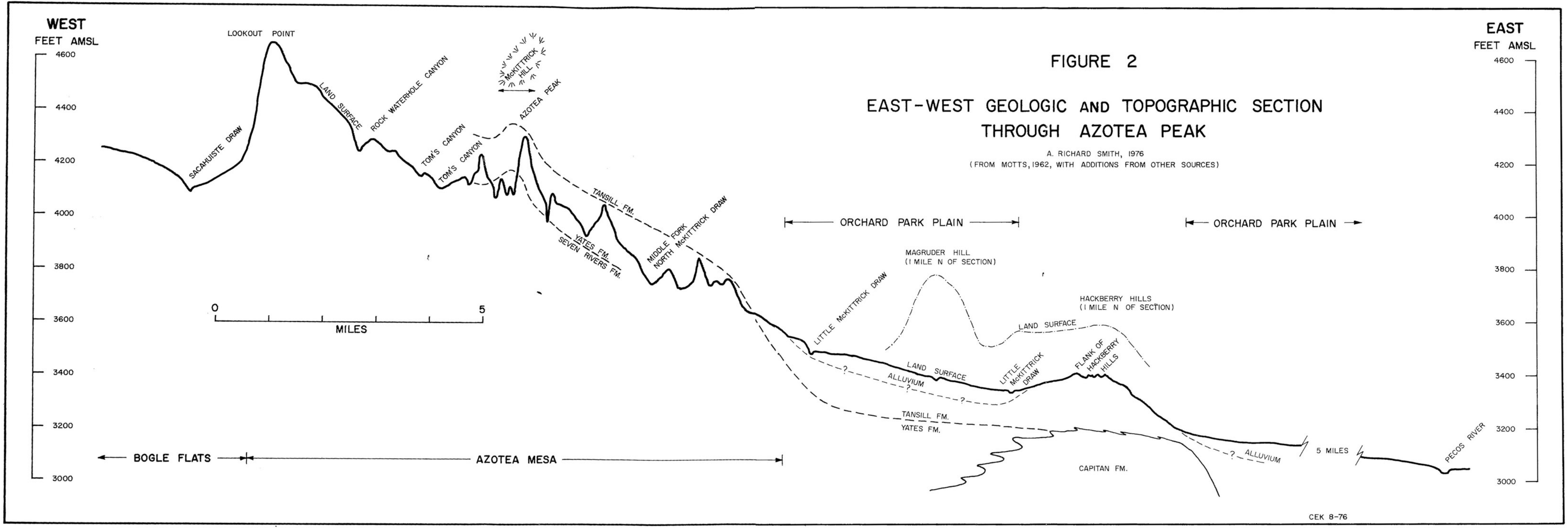


FIGURE 2

EAST-WEST GEOLOGIC AND TOPOGRAPHIC SECTION THROUGH AZOTEA PEAK

A. RICHARD SMITH, 1976
(FROM MOTTS, 1962, WITH ADDITIONS FROM OTHER SOURCES)

in erosion and widespread deposits of redbeds (red shale and siltstone). By the late Triassic (210 million years ago) the area was reduced to a broad, nearly featureless plain. On this surface were deposited mud, sand, and gravel of the Dockum Group. The Dockum sediments probably came from the northwest where the Sierra Blanca area was rising.

There is evidence for slight tilting of the area down toward the northeast during early Cretaceous time (140 million years ago) along with gradual regional subsidence so that the area was again near sea level. Shallow marine and near-shore floodplain sediments of Cretaceous age occur in this region. During late Cretaceous and early Tertiary time (90-50 million years ago) the Guadalupe region was uplifted and arched in response to major mountain-building in the Rocky Mountains in northern New Mexico and the Sierra Madre Occidental in northern Mexico. As arching continued into late Tertiary time (15 million years ago), the strata were faulted, especially along the west side of the Guadalupes. The general eastward dip of strata on Azotea Mesa resulted from the arching. Concurrent with and following the uplift, faulting and folding, erosion occurred in the raised area (including Azotea Mesa), stripping away rocks deposited during earlier times. Much of the eroded material was redeposited as the Ogallala Formation, a broad sheet of silt, sand, and gravel along the east side of the Rockies stretching as far as northwest Texas.

To summarize the structural history and related deposition:

Late Permian	Marine deposition ends with uplift
Early Triassic	Erosion to featureless plain
Late Triassic	Uplift in northwest and deposition of clay, sand, and gravel
(Jurassic)	(no record)
Early Cretaceous	Tilting to the north, subsidence, deposition of marine and floodplain sediments
Cretaceous and Early Tertiary	Major uplift in west and northwest with volcanoes, faulting, folding, erosion
Late Tertiary	Deposition of Ogallala sediments; local erosion

McKittrick Hill, because it is a part of the Guadalupe region, has been affected by the same structural history and depositional episodes. In particular, it is one of the more western anticlinal folds in the Waterhole Anticlinorium (a group of related folds). Kelley (1971) speculated that the arcuate Waterhole Anticlinorium is related to some other local structural features; it is a boundary between the domed hills on the east and the relatively undeformed Seven Rivers area to the west. As might be expected from the orientation of McKittrick Hill, the fold along which it is formed trends north-south. The strata exposed on the hill dip generally away from the crest of the ridge. All the rocks younger than the Yates Formation have been eroded from McKittrick Hill (if they were present), as has part of the Yates. The Seven Rivers Formation is barely exposed and then only in the arroyos that are cutting headward into the Hill (Motts, 1962).

Two of the questions proposed at the beginning of this paper remain:

Why are the caves on McKittrick Hill such irregular mazes?

Why are they in McKittrick Hill at all?

Answers to both depend on the solution of a mystery: How did the caves form?

A variety of hypotheses have been propounded for the origin of caves in general and for the origin of a particular cave or group of related caves. Any hypothesis for the genesis and development of the McKittrick Hill caves should explain the shape of the caves, locations of the caves within the Hill, the origin of the massive gypsum on the cave floors, and the timing of all steps from cave initiation through growth to ultimate destruction. To this end the first step is to summarize those characteristics of the caves that seem to be most important.

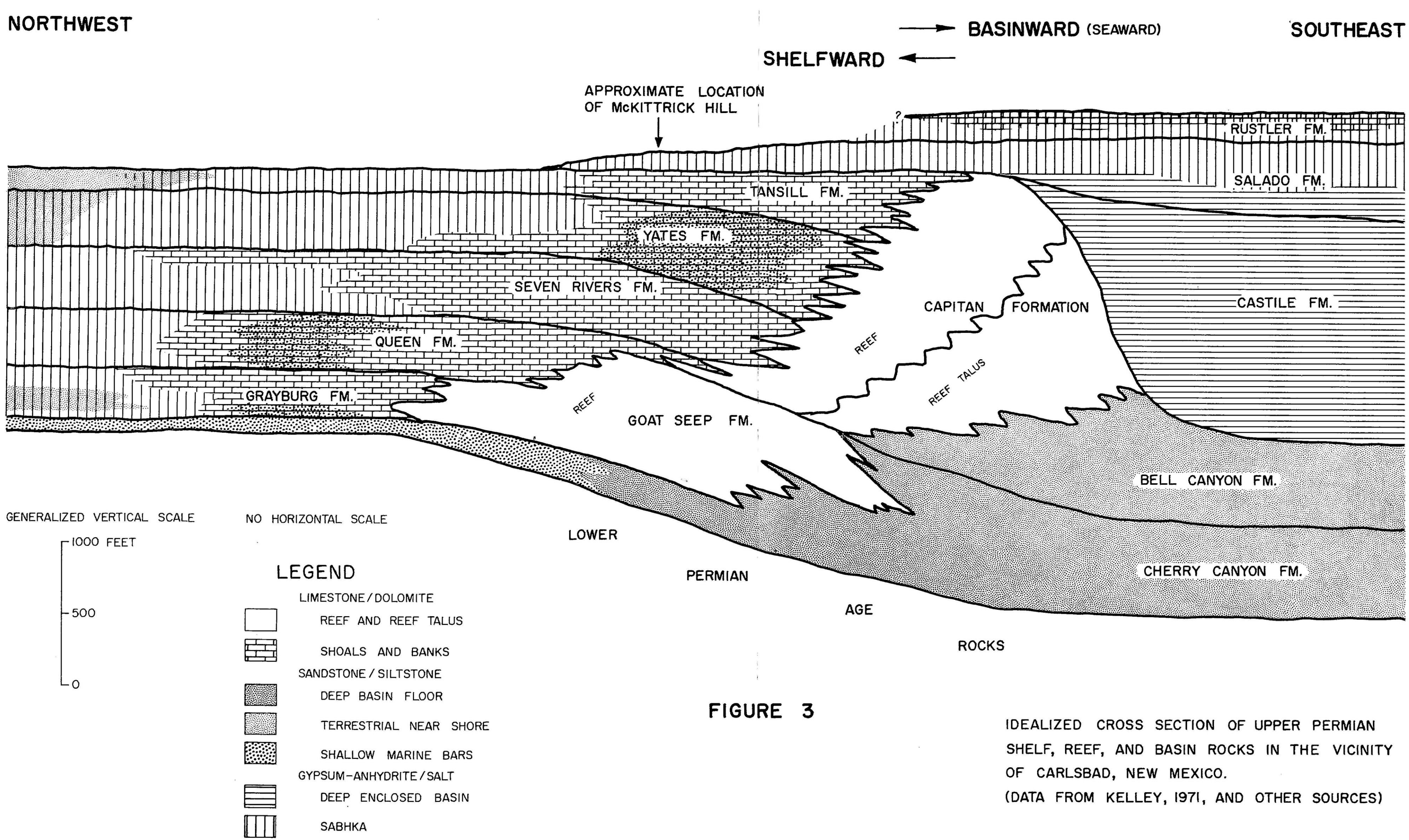


FIGURE 3

IDEALIZED CROSS SECTION OF UPPER PERMIAN SHELF, REEF, AND BASIN ROCKS IN THE VICINITY OF CARLSBAD, NEW MEXICO.
(DATA FROM KELLEY, 1971, AND OTHER SOURCES)

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The four principal caves of McKittrick Hill are similar in many ways. They all have:

1. Complex maze areas at two or more distinct levels;
2. Irregular shaped rooms that have no obvious fracture control;
3. Passages, walls, and speleothem groups that show clear guidance by fractures;
4. Levels that are guided by strata (that is, some strata seem to be selectively dissolved); and
5. All enterable passages, except entrances and the deep eastern part of Dry Cave, lying between altitudes of 4195 and 4092.

Except for Endless, all the caves have greater extent along the strike of the beds (perpendicular to the dip). The three caves on the east side of the Hill (Endless, McKittrick, Sand) all terminate in their lowest levels at flat sandy or clayey floors. The Sandy Floored Room in Sand Cave and the Flat Floored Room in McKittrick Cave are good examples. Approximate elevations of the fills are: Endless Cave, 4092; Sand Cave, 4092; and McKittrick Cave, 4101. Dry Cave, on the southwest side of the Hill, does not have the same kind of fill termination. It is also much deeper, reaching down to an altitude of 4004 in The Rift, although most of the cave is above 4130.

Gypsum is common in all the caves, especially in the maze areas. Thickness of the gypsum exceeds 6 feet in several places. Round vertical holes, "post holes," up to a few inches in diameter have been "drilled" through the gypsum by dripping water (Quinlan and Smith, 1968; Palmer and others, 1977; see Fig. 7 on page 26 of this volume). Similar gypsum deposits are well exposed in the Big Room of Carlsbad Caverns and are present in several other caves of the region. Gypsum sand is also fairly common in each of the caves.

Endless Cave has two main maze levels (Lower and Middle) with floors 12 to 15 feet apart. The Lower Maze is 3 to 10 feet high, and the Middle Maze, 2 to 5 feet high. An Upper Maze is relatively limited in area; it is 17 to 20 feet above the Lower Maze and is 8 to 12 feet high. All three maze levels suggest strong control by differences in the solubility of the strata. Collapse into lower levels has occurred where pronounced joints are present—Expressway, Entrance Passage near Mud Crack Room, the Canyon into Green Lake Maze. The upper end of Endless seems to be less developed, solution being mainly along joints following the dip with "immature" maze areas.

Floor elevations in Endless show a fairly uniform slope, averaging about 8½° to the east-northeast (mag.). The mazes on the northwest side of the Expressway are 10 to 15 feet lower than those on the southeast side, suggesting a fault or strong down-to-the-northwest flexure along the Expressway. The Little Expressway is anomalous: it is much "too high" (stratigraphically) and it follows the strike (N 20-30 W mag.).

Sand Cave has three maze levels, but unlike Endless, the Upper Maze is separated 35 to 45 feet from the Middle Maze, itself only 7 to 12 feet above the Lower Maze. The Lower Maze is by far the largest in area. All three maze areas average 3 to 6 feet high.

Floor elevations on the Sand Cave map show a downward slope about N 80 E (mag.), averaging slightly more than 16°. Like Endless, passages oriented along the strike are present, especially the Upper Joint Passage. Except for the Upper Entrance, the Upper Joint Passage is the highest part of Sand Cave and is stratigraphically above the Upper Level.

McKittrick Cave "is by far the least complex" of the caves in McKittrick Hill (p. 32, this vol.). The maze level, although separated on the map into Upper Maze, Main Entrance Maze, and Lower Maze, is essentially a single level modified by collapse and by speleothem growth. The Formation Area may be included in the maze level. Ceiling heights range generally from 4 to 8 feet, and in places reach 15 feet.

Scattered floor elevations suggest that McKittrick Cave slopes northeast to east-northeast from 7° to as much as 14°. The slope seems to be steeper in the lower part of the mazes. The long passage extending southeast from the Main Entrance and the Pit Room are relatively high passages (above the maze levels), and both trend subparallel to the strike. A similar but shorter passage segment is at the northwestern extremity of the cave.

Dry Cave is the largest and most complex of the Hill caves. It has several maze areas (see map), although there may be only two main maze levels. Lindsley (p. 36, this vol.) describes the mazes as "a boneyard type maze with passage heights averaging 5 feet."

The general slope of Dry Cave varies markedly from west to east, more or less following the dip of the strata. Lindsley reports slopes/dips of 10° to 12° to the southwest at the west end of the cave (Hampton Court Maze), 20° to the southwest in the entrance area and nearby Boulder Room, 4° to the south in the Vast Chamber, and 7½° to the south near the Chamber of the Vanishing Floor. In the Recovery Room area, only 300 feet northeast of the last measurement, the rocks are horizontal; east along the Bowling Alley, the strata dip eastward at an increasing rate.

In contrast to the three other caves, Dry Cave has anomalous fracture guided passages that are approximately parallel to the dip; these include The Expressway and its parallel passages and the major fissure system running through the Chamber of the Vanishing Floor. These are in areas of steeper dip. The Rift at the end of the cave is parallel to the strike but is the lowest part of the cave.

Bretz (1949) proposed a hypothesis of genesis for McKittrick Cave, the only one of the McKittrick Hill caves visited during the studies of the geomorphology of the Carlsbad area by Bretz and Horberg (Bretz, 1949; Bretz and Horberg, 1949; Horberg, 1949). Bretz stated (p. 459-460):

> McKittrick Cave, early in its development, was a network of linear passages along two sets of joints, one in the strike, north 50° west, the other along the maximum dip. Widening of the intersecting joint slots of the original rectangular pattern has been so great that many of the once separating blocks, pillars, and partitions have been destroyed except near the upper end of the cave. But the ceiling throughout and the surviving attenuated pillars record the earlier joint control. Splendid dome cavities in the ceiling are also products of phreatic solution. Under late vadose conditions, the ceiling joints have determined lines of stalactites and stalagmites. Some partitions have been constructed by the growth of rows of coalesced columns. The cave is an excellent example of an intermediate stage between an early network and a late complete coalescence into a large room.

In the same paper Bretz (p. 460) also commented on the gypsum in McKittrick Cave:

> The only gypsum cave flowstone known to the writer covers a large portion of McKittrick's floor. ...It originally had depositional terracings on its surface, the steepened fronts still recognizable.
>
> ...If the gypsum came from Ochoa strata [once overlying the Yates, according to Bretz], as seems probable, the cave became vadose while denudation lacked at least 200 feet of producing the present topography.

Finally, to quote the abstract to Bretz's paper (p. 447):

> The limestone caves of this region (Guadalupe block including McKittrick Hill] were made under completely saturated conditions long before the present erosion cycle began and probably before the Pliocene Ogallala was deposited.

Good (1957), after studying the massive gypsum deposits in the Big Room of Carlsbad Caverns, proposed a hypothesis for origin of these deposits. The massive gypsum deposits in Carlsbad are similar to those in the McKittrick Hill caves. Good concluded (p. 19) "that the gypsum is a phreatic deposit formed during a second cycle after the cave had been made in the first." He speculated that a general rise in water table flooded the lower levels of Carlsbad Caverns and that saline surface lakes formed in the area. "If these lakes or their discharge stream developed subsurface drainage, their gypsum-laden waters could have entered the cavern. As the waters cooled they would be forced to deposit some of the gypsum."

It was Good's opinion that the gypsum was deposited during Ogallala time, that is, when (he thought) Ogallala sand and gravel had filled the Pecos lowland to a level higher than the Big Room floor. The elevation of the Big Room floor is about 3,650 feet, 450 feet higher than the McKittrick Hill caves. It is unlikely that gypsum was precipitated from cooling waters because the saturation point of gypsum in water increases with falling temperatures.

Expanding on an earlier idea by Queen (1973), Palmer and others (1977) have suggested an unorthodox history for some of the caves in the Guadalupe Mountains, possibly including those in McKittrick Hill. A. N. Palmer (personal comm., 1978) cautions against accepting the hypothesis without substantial field evidence.

Essential to the hypothesis proposed by Palmer and others is the concept of massive replacement of carbonate rocks (limestone, dolomite) by gypsum as a result of fresh meteoric water mixing with gypsum-saturated brine already in the rocks. The proposed reaction is

$$2H_2O + \underset{\text{limestone}}{CaCO} + SO_4^{=} \longrightarrow CO_3^{=} + \underset{\text{gypsum}}{CaSO_4 \cdot 2H_2O}.$$

Replacement of carbonate rocks by gypsum has been documented in a variety of geological situations, but this proposal, and its precursor (Queen, 1973), is the first involvement of the idea in speleogenesis.

Based on the replacement concept, Palmer and others revise the history of cave origin and development in the Guadalupe area (p. 336):

> a. Rain falling on the newly uplifted Guadalupes forms a fresh water lens atop the gypsum-saturated brines of the adjoining basin. Infiltration and flow of fresh meteoric waters was influenced by solutionally enlarged joints and ancient (Permian?) cave remnants.
> b. Mixing occurs at the fresh water-brine interface and results in mixing replacement.
> c. Deepening of the Pecos drainage lowers base level: rocks originally in the mixing replacement zone are subjected first to fresh water phreatic, then vadose conditions. Replacement gypsum is dissolved and often recrystallized; peripheral joints are enlarged by back flooding and/or Mischungskorrosion.
> d. Lowering base level still further drains the caves and results in collapse and vadose decoration.
> e. Deposition of the Ogalala [sic] Formation raises base level. Aggressive waters dissolve some rocks while elsewhere subaqueous deposits are formed.
> f. Ogalala Formation is eroded, base level falls, and decoration takes place.
>
> ...Gypsum formation by replacement of carbonates played a critical role in initiating and controlling cavern formation and morphology. Replacement probably took place in the interface between fresh water and hypersaline phreatic water bodies. Freshwater recharge was diffuse at the surface, but concentrated at depth along enlarged joints and ancient cave remnants. Speleogenesis commenced in the Cretaceous triggered by increased rainfall resulting from Laramide orogenic uplift, and was largely complete by the upper Pliocene.

Jagnow (1978, p. 14-15), in a discussion of the speleogenesis of Ogle Cave in Carlsbad Caverns National Park, has made a strong argument for the role of sulfuric acid in development of caves of the Guadalupe region. Pyrite (FeS_2) is widely disseminated in the Yates Formation, and Jagnow suggests that the pyrite reacted with oxygenated water yielding sulfuric acid which in turn reacts with limestone bedrock to yield caves and gypsum. An alternative to the strictly inorganic reaction is the production of sulfuric acid as pyrite is metabolized by iron bacteria. The net reaction is the same in either case (Howard, 1960):

$$\underset{\text{pyrite}}{4FeS_2} + 15O_2 + 14H_2O + \underset{\text{limestone}}{16CaCO_3} \longrightarrow$$

$$2Fe_2O_3 \cdot nH_2O + \underset{\text{gypsum}}{8CaSO_4 \cdot 2H_2O} + 8Ca^{++} + 16HCO_3^{-}$$

Jagnow concludes

> ...the sulfuric acid reaction (inorganic, organic, or both) was a major solution reaction during the development of the Guadalupe caves and is responsible for the numerous occurrences of thin crusts beds of massive gypsum.

Palmer (1975) mentions Dry Cave (Dry Pot, p. 59) as a representative example of specific maze cave types. Some of his ideas about the origin of maze caves may be applicable to an understanding of the McKittrick Hill mazes. Palmer (pers. comm., 1978) points out, however, that the McKittrick Hill caves are unusual and do not necessarily fit into his maze cave types. He notes that he visited only Dry Cave and not the other three main caves.

Bretz (1949), Horberg (1949), Bretz and Horberg (1949), Good (1957), Palmer and others (1977), and Jagnow (1978) believe that the Pecos River valley was filled with Ogallala deposits and that the Ogallala veneered the Guadalupe Mountains. They ascribe some part of the development of the caves in the region to that depositional episode. Recent work by Bachman (1976) and Leonard and others (1975) suggests that the Ogallala thins to the southwest into Eddy County and probably did not cover the Guadalupes and may not have filled the Pecos Valley.

One may now suspect that unanimity is lacking in ideas about the origin and development of caves in the Guadalupe region including McKittrick Hill. The situation for the McKittrick Hill caves is now in the "multiple working hypotheses" stage. With the main caves fairly well mapped, McKittrick Hill and its caves are ready for more detailed study: surface and underground bedrock geology, cave morphology, speleothem and sediment mineralogy and distribution. Such study should lead to a single hypothesis for origin and subsequent history of the caves. For the moment we can only quote Bill Russell (pers. comm., 1976). "Investigations have proved that the caves of McKittrick Hill predated the speleothems! "

At this point I will not presume to propose a unified hypothesis of speleogenesis for the caves but will only discuss one aspect of the caves. That aspect, linear cave passages, leads to a conclusion that is not incompatible with some of the other ideas about the caves' origins.

A joint is a fracture in the rock along which little or no movement has taken place (otherwise, it would be a fault). Joint sets consist of a group of more or less parallel joints in an area, usually the result of stresses acting in a particular direction; it is not unusual for two or more joint sets, with different trends, to be present.

Solution of limestone and dolomite commonly begins along joints because they offer ready-made openings for groundwater. As a result, most caves have some relatively straight passages which were initially guided by a joint or set of subparallel joints. The proper combination of joint trend and preferred groundwater flow direction produces prominent passages aligned along a joint set. Ordinarily, the trends of shallow, straight (joint-guided) passages correlate with the trends of joints observed on the surface.

At McKittrick Hill joints probably occur in all the strata, but since no measurements of joint trends have been made, we must rely on other methods of determining these trends. Aerial photos of McKittrick Hill record many linear features, and we may conclude that these linears (exclusive of roads, fences, powerlines) represent joints and/or faults. As nearly as can be seen, little or no displacement occurs along the linears, so they are all presumed to be joints.

The linears on the air photos should have the same trends as the straight, presumably joint-guided, passages of the shallow McKittrick Hill caves. To compare these trends, I prepared the linear and passage half-roses on page (Fig. 4). (For methods of preparing such roses, see Smith, 1968). These half-roses show the percentages of the length of the linears or straight passage segments in each 5 or 10 degree interval, respectively. All directions are given in terms of true north.

First, look at the half-rose of the linears observed on the air photos. By far the most—71%—lie between N 10 E and N 30 E, averaging N 20 E. A very minor trend lies between N 80 W and N 90 W.

Second, examine the half-roses for the straight passage segments, and compare them to the half-rose for the linears. The trends are:

	Major trends	*Minor trends*
Air photo linears	N 20 E	N 85 W
Endless Cave	N 45 E	
McKittrick Cave	N 10 W	N 55 E, N 85 E
Sand Cave	N 25 W	
Dry Cave	N 50 E, N 15 E*	

*The Dry Cave trends are N 40 to 55 E in the west part of the cave and N 15 E in the east part.

Note that only the N 15 E trends in Dry Cave correlate at all well with the air photo linears. A major N 45-50 E trend appears in two caves.

Why is the correlation so poor between cave passages and the obvious surface linears and between the caves themselves? What does this all mean?

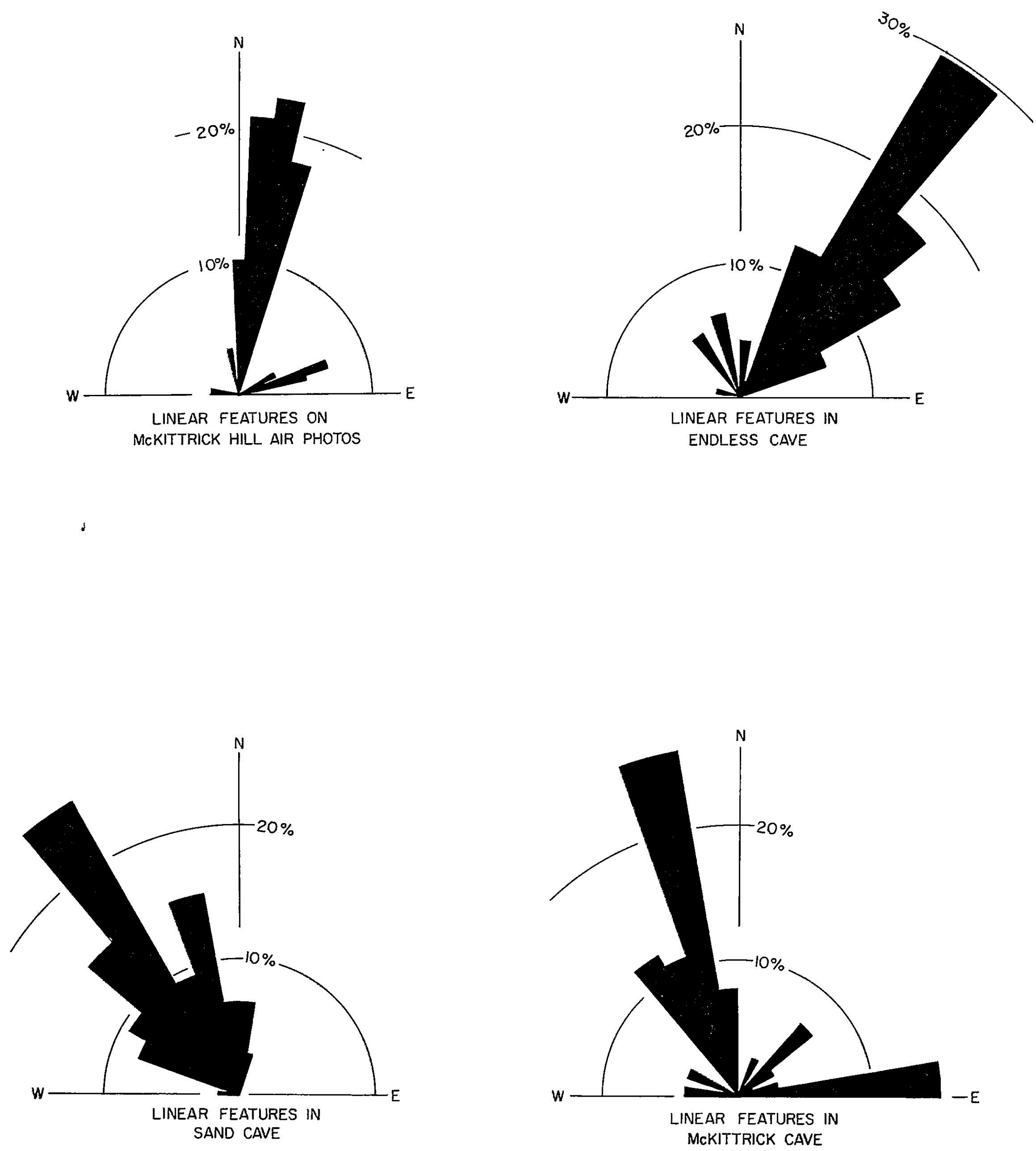
Based on an examination of the air photos, the major N 20 E and minor N 85 W trends of the linears appear to be unrelated to the folding in the McKittrick Hill anticlinorium and are probably the result of stresses acting later than those which caused the folding. Possibly, the linears are related to mountain-building in the Rockies during late Tertiary time. Most of the straight-passage trends in the caves parallel the strike of the strata (strike is a horizontal line perpendicular to the dip), a direction along which joints commonly form during gentle folding (Cloos, 1946, p. 74).

Because the straight cave passages mainly follow joints related to the folds, we may speculate that folding of the strata and related jointing occurred prior to formation of the major fractures visible on the air photos. Further, solution must have begun along the fold-related joints, presumably after the Late Permian and during the Triassic, Jurassic, and Cretaceous when the land was above sea level. Later, the linears (major fractures) formed. Since solution had already widened the earlier joints, these later fractures were only rarely selected for groundwater movement and subsequent enlargement to cave passages. If this hypothesis is correct, the original solution openings were formed as long as 200 million years. Additional solution took place later when these original openings were in the shallow phreatic, and possibly vadose, zone.

The remaining question: Why don't the fold-related joints show on the air photos? Answer: They are probably too short.

W. M. Davis wrote a treatise on speleogenesis (1930), now considered a classic work. His paper has been criticized by others because he based many of his conclusions on a study of cave maps, not on actual visits to the caves. Many of his critics overlook the impetus he gave to studies of cave origin in the U. S.; indeed, it seems that some of the work done later was simply an effort to prove Davis wrong.

A similar criticism may be leveled against my discussion of the McKittrick Hill caves. Many of my comments and conclusions are based on the excellent cave maps and not on extensive fieldwork. I hope that my efforts will encourage a detailed study of the caves and geology of McKittrick Hill, an area that merits a thorough investigation.



ALL MEASUREMENTS GIVEN AS A PERCENT OF THE TOTAL LENGTH OF LINEAR FEATURES MEASURED ON THE AIR PHOTOS OR ON EACH CAVE MAP.

FIGURE 4

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PALEONTOLOGY

by Arthur H. Harris[1]

My introduction to the McKittrick Hill caves was during the 1966 Project Under the Hill (where I learned, among other things, that the hours kept by field biologists and speleologists are not compatible). I was there at the invitation of Pete Lindsley, recommended (on purely geographic grounds, no doubt) by Bob Slaughter, paleontologist at Southern Methodist University. I was to check out a 1965 discovery of fossil bones within Dry Cave.

By the end of the project, it was clear that there were at least two important sites within Dry Cave: one near the entrance and another far back in the cave.

Since Project Under the Hill, at least portions of 78 days have been spent inside Dry Cave by Museum of Arid Land Biology (MALB) personnel, with additional people working outside the cave, surveying the vegetation and animals. The number of persons actually working within the cave varied from one (when I discovered I was safer with my accident prone assistant waiting outside than with him at my side) to about nine (during the first field expedition of 5-30 June 1970).

Those 78 days have revealed about a dozen more sites—still divisible, however, into a group near the front of the cave and a group farther back. As the work progressed, it became evident that fissures intersecting the ground surface were the sources of the fossils. Today, only one (the Entrance) of at least three (and probably four or more) such fissures remains open.

Material in and adjacent to the fissures posed excavation problems. In most cases, the fissure tops were inaccessible or blocked by large boulders. It was necessary to remove material by working into the fissure fill from the sides, with consequent collapse of the sides and roof. Under these conditions, excavation by measured levels was impossible. At the "back of cave" site, the matrix was hand picked to concentrate it to a removable bulk. Near the Entrance, difficult areas of access were handled similarly; elsewhere material was removed in bulk for concentration outside the cave.

Where fissures intersect or lead to large rooms, material has been deposited on the chamber floors. These were gridded and the matrix removed by levels (usually 10 cm). Matrix from such areas in the "front of cave" was removed in bulk and transferred to the surface in burlap bags in "bucket brigade" fashion for screening (see Figures 1, 2).

The potential fossils entered originally in several ways. Some died nearby on the surface and were washed in; some large forms, perhaps racing in panic from predators, found themselves unable to turn away from the almost concealed fissure mouths, and so plunged into the depths. A third group utilized the fissures as dens, roosts, or for nesting. The vast majority of the smaller animals, however, were carried in as the stomach contents of predatory birds.

Owls, and, to some degree, hawks and vultures have evolved a mechanism useful both to themselves and to paleontologists. Rather than passing indigestible bone and fur or feathers through the complete digestive system, these items may be regurgitated in the form of "pellets." This action usually occurs at the roost—and many of these birds roost within the mouths of caves. Literally millions of bones have been disgorged into Dry Cave in this manner, giving us a tremendous sample of vertebrates that occurred within the hunting ranges of the raptors.

Division into "front-of-cave" and "back-of-cave" groups is of more than geographic distinction. These two areas were open to the surface at different times and so differ in faunal makeup. The sites near the cave's present entrance ("front-of-cave") are the most recent (Figs. 3, 4). Depo-

[1]Museum of Arid Land Biology, The University of Texas at El Paso.

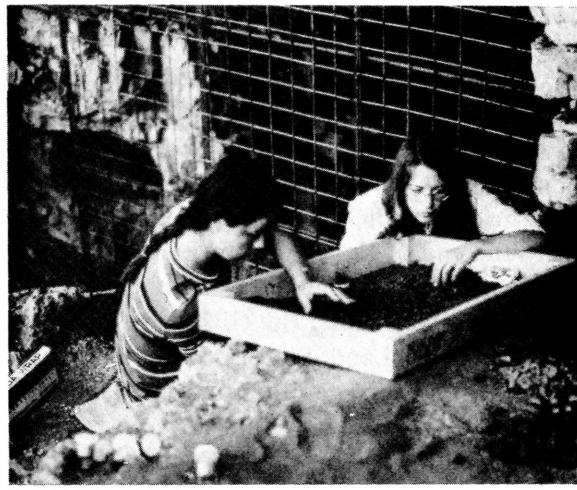


Fig. 2 (above).—Kathy Barrie (L) and Tina Harris "picking bone" after screening. Entrance gate in background.

Fig. 1 (opposite).—Test trench in Balcony Room.

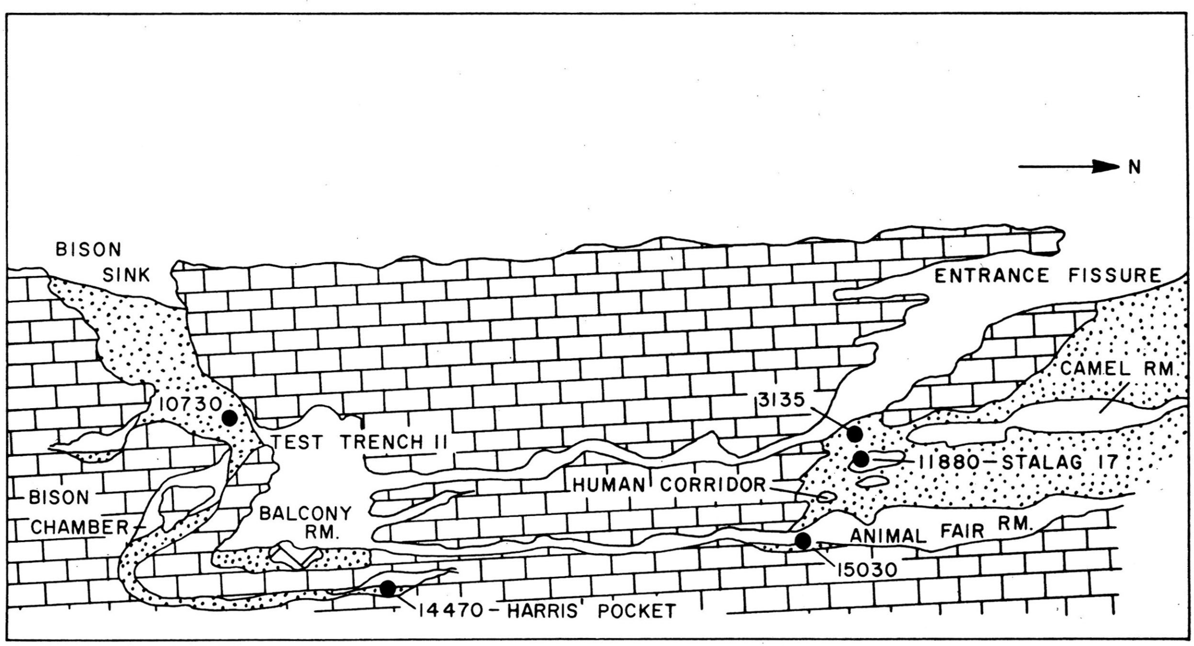


Fig. 3.—Vertical relationships of fossil localities near the present entrance of Dry Cave. Horizontal relationships are greatly distorted to bring the localities into a vertical plane. Fill is represented by stipple; C^{14} date localities by dots. Dates are in years before present. Highly diagramatic and not to accurate scale. (After Harris, In Press, Natl. Geogr. Soc.)

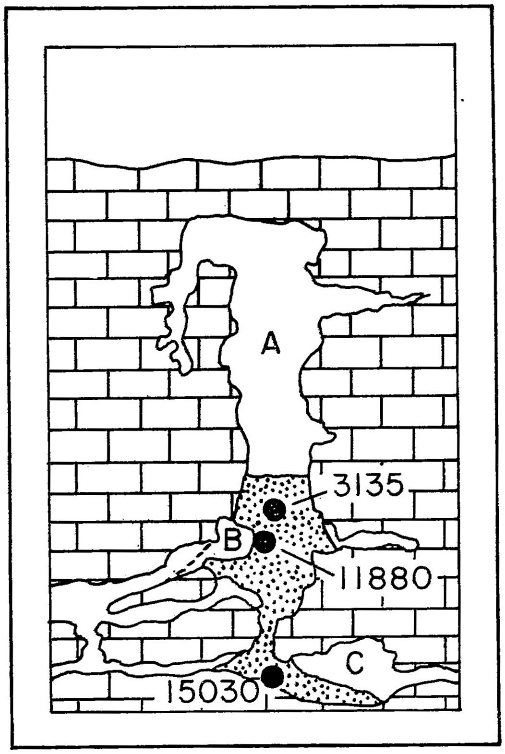
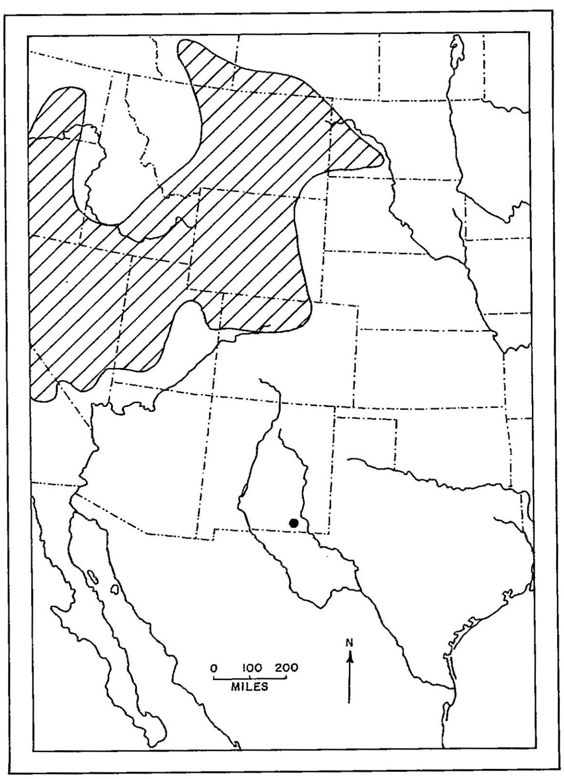
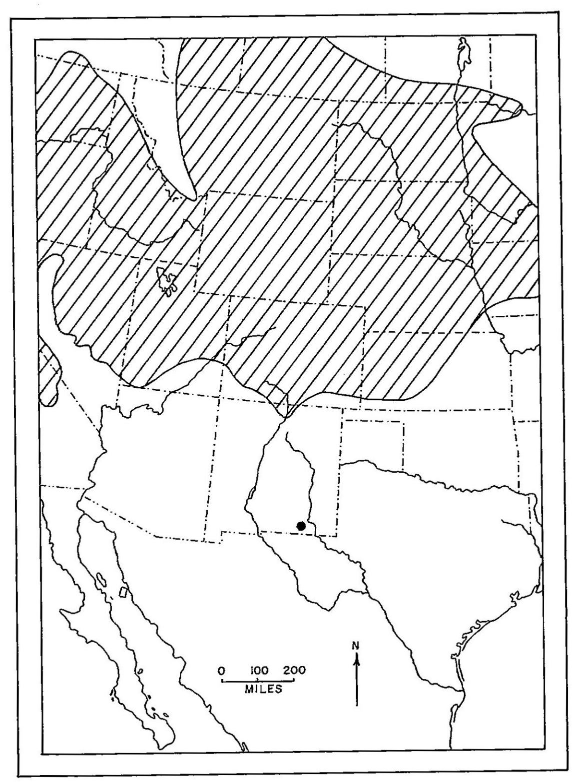


Fig. 4 (opposite).—Diagramatic vertical section through the Entrance Chamber and associated fissure fill. Horizontal relationships are greatly distorted. A = Entrance Chamber. B = Stalag 17 (dashed line is extent of original fill). C = Animal Fair Room. Other symbols as in Fig. 3.

Fig. 5 (below, left).—Current range of the sagebrush vole (hatched) in relation to Dry Cave (dot).

Fig. 6 (below).—Current range of the white-tailed jack rabbit (hatched) in relation to Dry Cave (dot).





sition is still occurring in the Entrance Fissure, some 15,000 years after the fissure opened to the surface. Nearby Bison Sink opened at about the same time, but clogged some time after about 10,700 BP (before present). We have, then, a magnificent record of vertebrates and mollusks that occurred in the vicinity of Dry Cave from well within the last cool, moist time of the Pleistocene to the present. Unfortunately, pollen and most other plant materials have not survived in the sediments.

Considerable work remains on this late Pleistocene fauna, but much already is clear. Animals (and thus, probably, plants) now occurring far to the north (northern Great Plains, Wyo-

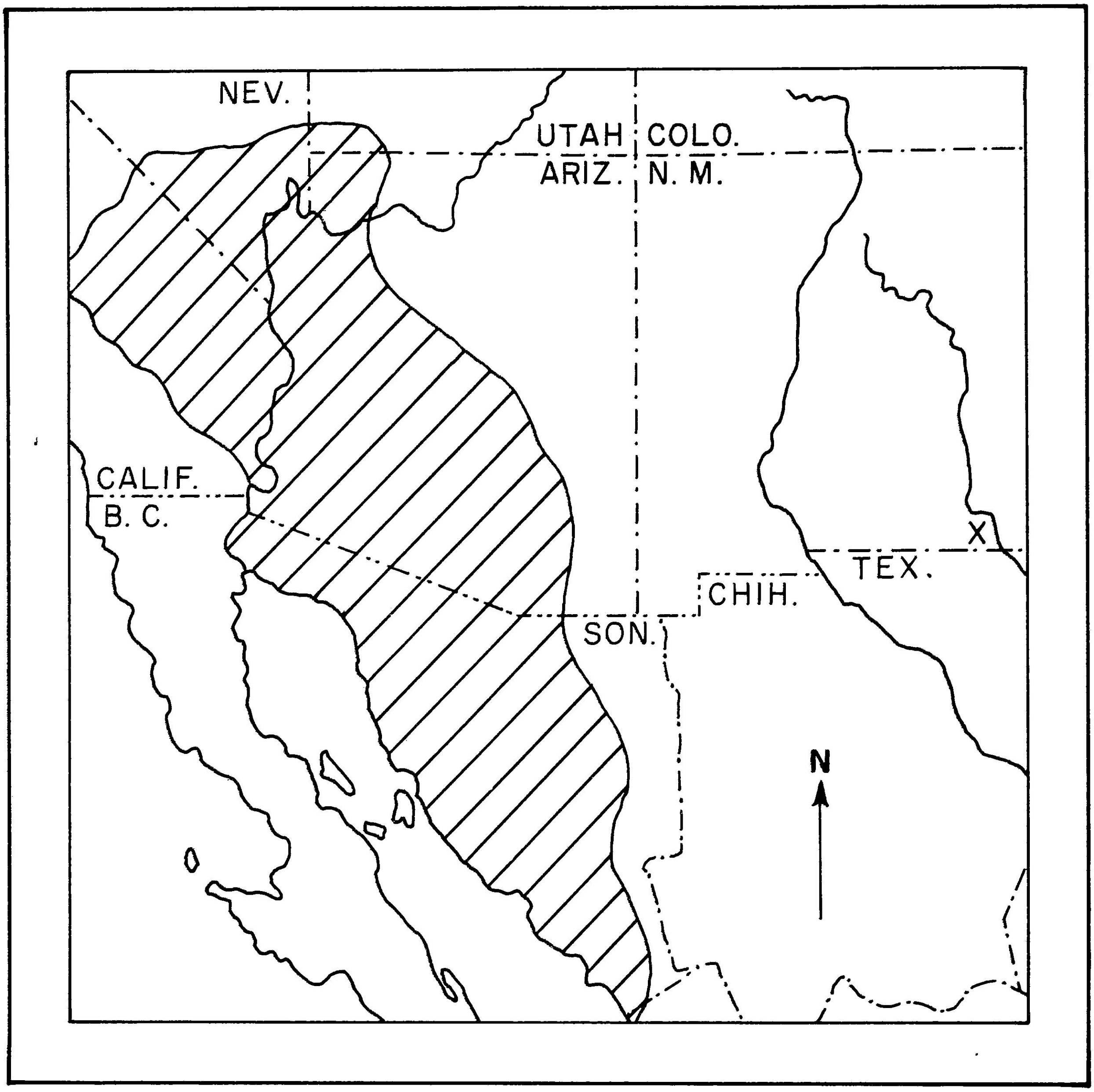


Fig. 7.–Approximate current geographic range of *Gopherus agassizi* (hatched area). The position of Dry Cave is marked by an X. Redrawn from Van Devender et al., in press.

ming, etc.) and/or northwest (Utah, Nevada, Idaho) occurred in the vicinity of McKittrick Hill; others, now occurring in the New Mexican highlands, moved down slope to the lower elevations near the cave; and some animals occurring today in the area remained there then, mingling with species now far separated from them.

The evidence for these changes has appeared and will continue to appear in professional publications (see Bibliography), and is much too lengthy to include here. However, a few of the more dramatic range changes are shown in Figs. 5 and 6, and a tentative list of organisms identified from the sites dating between 15,000 and 11,000 years ago is given in Table 1.

Contrasting with the faunas just mentioned, those from deep within the cave differ mostly from those of today in the presence of many extinct species and in relatively minor distributional changes of still living kinds. The climatic implications are of only slightly cooler summers, winters without the extreme cold waves of the present, and with only slightly greater effective moisture. Radiocarbon dates running from 25,160 to 33,590 BP peg these fossils as representing conditions before the last severe glacial advances in North America, but well after the warm Sangamon Interglacial.

Although range changes of living forms during this period mostly were minor, presence of the Desert Tortoise (Fig. 7) and armadillo does seem to indicate less severe winter conditions than those of today.

Dry Cave animals known from this time span are listed in Table 1. Since these older faunas have been less well studied than the younger, many forms now absent should eventually be identified.

The importance of Dry Cave can hardly be overemphasized. In an area of important Pleistocene sites, (Burnet Cave, Dark Canyon Cave, Rocky Arroyo Cave, Pratt Cave, Williams Cave), it is currently the largest in terms of numbers of specimens and numbers of species, and it is the best dated. It is the only site surely having deposits dating to before the last major episode of the Pleistocene. The estimated one-quarter million elements in the MALB collections still have many secrets to yield.

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Table 1. Fossil biotas of Dry Cave. In the scientific name column, classes are given in capital letters, orders or suborders in capital and lower case letters, and genera and species are italicized. A = "Front of Cave"; B = "Back of Cave"; X = Organism Present; O = Organism Not Known from Sites; † = Organism Extinct.

Scientific Name	Common Name	A	B
ANGIOSPERMAE	Flowering Plants		
Urticales	Elms and Relatives		
Celtis sp.	Hackberry	X	X
GASTROPODA	Snails		
Pulmonata	Fresh-water & Land Snails	X	X
Stagnicola cockerelli		X	O
Gastrocopta procera		X	O
Gastrocopta pellucida hordeacella		X	O
Gastrocopta armifera armifera		X	O
Pupoides hordaceous		X	O
Pupilla blandi		X	O
Vallonia perspectiva		X	O
Vallonia cyclophorella		X	O
Vallonia gracilicosta		X	O
Succineidae		X	O
Bulimulus dealbatus		X	O
Helicodiscus singleyanus		X	O
Retinella indentata		X	O
Hawaiia minuscula		X	O
Thysanophora horni		X	O

OSTEICHTHYES	Fish	X	X
AMPHIBIA	Amphibians		
Caudata	Salamanders		
Ambystoma tigrinum	Tiger Salamander	X	O
Anura	Frogs and Toads	X	X
Scaphiopus bombifrons	Central Plains Spadefoot	X	O
Scaphiopus hammondi	Western Spadefoot	X	O
Bufo punctatus	Canyon Toad	X	O
Bufo woodhousei	Woodhouse's Toad	X	O
Pseudacris triseriata	Chorus Frog	X	O
Rana pipiens	Leopard Frog	X	O
REPTILIA	Reptiles		
Chelonia	Turtles		
Gopherus agassizi	Desert Tortoise	O	X
†*Geochelone sp.*	Extinct Tortoise	O	X
Lacertilia	Lizards		
Cophosaurus texanus	Greater Earless Lizard	O	X
Crotaphytus collaris	Collared Lizard	X	X
Sceloporus undulatus	Eastern Fence Lizard	X	X
Phrynosoma cornutum	Texas Horned Lizard	X	O
Phrynosoma douglassi	Short-horned Lizard	X	X
Phrynosoma modestum	Round-tailed Horned Lizard	O	X
Serpentes	Snakes		
Elaphe guttata	Corn Snake	X	O
Salvadora sp.	Patch-nosed Snake	X	O
Thamnophis proximus	Ribbon Snake	X	O
Thamnophis sp. (*elegans* group)	Garter Snake	X	O
Crotalus sp.	Rattlesnake	X	X
Crotalus atrox	Diamondback Rattlesnake	X	O
AVES	Birds		
Anseriformes	Ducks and Geese	X	O
Falconiformes	Diurnal Birds of Prey		
†*Breagyps clarki*	Extinct Condor	O	X
†*Coragyps occidentalis*	Western Vulture	X	X
Accipiter cooperi	Coopers Hawk	X	O
Buteo jamaicensis	Red-tailed Hawk	X	O
Buteo swainsoni	Swainsons Hawk	X	O
? *Buteogallus anthracinus*	Black Hawk	X	O
Aquila chrysaetos	Golden Eagle	X	O
†*Caracara prelutosa*	Extinct Caracara	X	O
Falco peregrinus	Peregrine Falcon	O	X
Falco sparverius	Sparrow Hawk	X	O
Galliformes	Galliform Birds		
------	? Grouse	X	O
†*Parapavo* sp.	Extinct Turkey	O	X
Strigiformes	Owls		
Tyto alba	Barn Owl	X	O
Otus sp.	Screech or Flammulated Owl	X	X
Bubo virginianus	Great-horned Owl	X	X
Speotyto cunicularia	Burrowing Owl	X	O
†*Strix* cf. *brea*	Extinct Owl	O	X

Asio otus	Long-eared Owl	X	O
Asio flammeus	Short-eared Owl	X	O
Piciformes	Woodpeckers	X	O
Passeriformes	Perching Birds		
Corvus corax	Common Raven	X	X
†*Corvus* sp.	New Mexican Raven	O	X
MAMMALIA	Mammals		
Insectivora	Insectivores		
Sorex vagrans	Vagrant Shrew	X	O
Sorex merriami	Merriam Shrew	X	O
Notiosorex crawfordi	Desert Shrew	X	O
Cryptotis parva	Least Shrew	X	O
Chiroptera	Bats		
†*Myotis* cf. *magnamolaris*	Extinct Bat	X	O
Myotis velifer	Cave Bat	X	O
†*Myotis* cf. *rectidentis*	Extinct Bat	X	O
Eptesicus fuscus	Big Brown Bat	X	O
Lasiurus cinereus	Hoary Bat	X	O
Plecotus sp.	Big-eared Bat	X	O
Tadarida brasiliensis	Mexican Free-tailed Bat	?	X
Tadarida macrotis	Big Free-tailed Bat	O	X
Edentata	Sloths, Armadillo, and Anteaters		
†–––––	Sloth	X	X
Dasypus sp.	Armadillo	O	X
Lagomorpha	Hares and Rabbits		
Sylvilagus auduboni or *S. floridanus*	Desert or Eastern Cottontail	O	X
Sylvilagus nuttalli	Nuttall Cottontail	X	O
Lepus townsendi	White-tailed Jack Rabbit	X	O
Lepus californicus	Black-tailed Jack Rabbit	O	X
Rodentia	Rodents		
Marmota sp.	Marmot	X	O
Spermophilus sp.	Ground Squirrel	X	X
Spermophilus cf. *tridecemlineatus*	Thirteen-lined Ground Squirrel	X	O
Spermophilus ? richardsoni	Richardson Ground Squirrel	X	O
Cynomys sp.	Prairie Dog	X	X
Thomomys bottae	Botta Pocket Gopher	X	O
Thomomys talpoides	Northern Pocket Gopher	X	O
Pappogeomys castanops	Yellow-faced Pocket Gopher	X	X
Perognathus sp.	Pocket Mouse	X	X
Perognathus sp. (small)	Silky Pocket Mouse	X	O
Perognathus ? hispidus	Hispid Pocket Mouse	X	O
Dipodomys sp. (small)	Kangaroo Rat	O	X
Dipodomys spectabilis	Bannertailed Kangaroo Rat	X	O
Reithrodontomys sp.	Harvest Mouse	X	O
Peromyscus sp.	White-footed Mice	X	X
Peromyscus cf. *crinitus*	Canyon Mouse	X	O
Peromyscus cf. *maniculatus*	Deer Mouse	X	O
Peromyscus leucopus	White-footed Mouse	X	O
Peromyscus ? boylii	Brush Mouse	X	O
Peromyscus cf. *difficilis*	Rock Mouse	X	O
Onychomys leucogaster	Northern Grasshopper Mouse	X	X

Sigmodon sp.	Cotton Rat	O	X
Neotoma sp.	Wood Rat	X	X
Neotoma cf. *albigula*	White-throated Wood Rat	X	X
Neotoma ? floridanus	Eastern Wood Rat	X	O
Neotoma mexicana and/or *N. cinerea*	Mexican and/or Bushytailed Wood Rat	X	O
Microtus mexicanus	Mexican Vole	X	O
Microtus longicaudus	Long-tailed Vole	X	O
Microtus ochrogaster	Prairie Vole	X	X
Lagurus curtatus	Sagebrush Vole	X	O
Ondatra zibethicus	Muskrat	X	O
Erethizon dorsatum	Porcupine	X	O
Carnivora	Carnivores		
Canis latrans	Coyote	X	X
Canis lupus	Gray Wolf	X	X
†*Canis dirus*	Dire Wolf	O	X
Vulpes velox	Swift Fox	X	?
Urocyon cinereorgenteus	Gray Fox	O	X
Ursus americanus	Black Bear	X	O
Bassariscus sp.	Ringtail	X	X
Mustela frenata	Long-tailed Weasel	X	X
Taxidea taxus	Badger	X	O
Spilogale sp.	Spotted Skunk	X	X
Mephitis mephitis	Striped Skunk	X	O
Conepatus mesoleucus	Hog-nosed Skunk	X	O
†*Felis ? atrox*	Extinct Lion	X	O
Felis onca	Jaguar	O	X
Lynx rufus	Bobcat	X	X
Perissodactyla	Tapirs, Horses		
†*Tapirus* sp.	Extinct Tapir	O	X
†*Equus* spp.	Extinct Horses	X	X
†*Equus* cf. *conversidens*	Extinct Horse	X	?
Artiodactyla	Artiodactyls		
Odocoileus sp.	Deer	X	?
†*Camelops* sp.	Extinct Camel	X	X
†*Hemiauchenia* sp.	Extinct Llama	X	O
Antilocapra americana	Pronghorn	X	O
†*Breameryx* sp.	Extinct Small Pronghorn	X	X
Bison sp.	Bison	X	O
Ovis canadensis	Mountain Sheep	X	O

BIOLOGY

by William R. Elliott[1]

INTRODUCTION

No concerted biological collecting program has yet been carried out in the caves of McKittrick Hill. However, over the years, the many visits to these caves by various surveying teams, and occasional biologists, have yielded specimens or sightings of value. Included in the following list are 25 zoological names, representing, probably, 24 species. Nineteen species are arthropods and five are vertebrates. Four of the arthropods were reported from Dry Cave by Szerlip (1965). Four arthropods were reported from one or more of the McKittrick Hill caves by Barr and Reddell (1967), who also reported all but two of the other arthropods (two spiders) from some other cave in the Carlsbad region. Both bat species were reported from McKittrick Cave by Bailey (1928).

The following symbols have been used to indicate the probable ecological status of each species: troglobite (**), troglophile (*), trogloxene (+), and accidental (++). A troglobite is an obligate cave-dweller, usually exhibiting some marked morphological adaptation such as eyelessness and depigmentation. A troglophile is an animal found frequently in caves, which reproduces and completes its life cycle there, but which may be found in similar habitats outside of caves. A trogloxene is an animal, such as a bat, often found in caves, but which usually does not complete its life cycle there. An accidental is an animal which has strayed into, or been accidentally transported into the cave. These ecological classifications are not always very distinct, and the status of any particular species is often uncertain.

The cave fauna of McKittrick Hill is essentially the same as that of Carlsbad Caverns National Park. The number (3) and percentage (13%) of troglobites, compared to cave areas with higher organic input, is low. There is a preponderance of troglophiles (9 or 38%), and trogloxenes (9 or 38%), as reported by Barr and Reddell (1967).

This report increases the known fauna of the McKittrick Hill caves by 15 species. Probably most of the species listed here could eventually be found in any of the five caves. So far, McKittrick Cave has the greatest number of species (13), followed by Dry Cave (10), Endless Cave (7), Sand Cave (7), and Little Sand Cave (5).

It is hoped that in the future a thorough biological study will be carried out in each of the caves. Such an effort was recently begun by W. C. Welbourn, and has resulted in several interesting records, particularly of troglobitic isopods and millipeds. Bat colonies in the caves should be located and observed so that cavers and the Bureau of Land Management can formulate conservationist policies that take them into account. To my knowledge, no bats have been observed in McKittrick Cave recently, although Bailey collected two species there in 1924.

[1]Department of Biological Sciences, Texas Tech University, Lubbock 79409.

SYSTEMATIC LIST AND ANNOTATIONS

Phylum Arthropoda

Class Crustacea

Order Eucopepoda

Family Cyclopidae

**Cyclops vernalis* Fischer

Records.—McKittrick Cave.

Comment.—This species was also reported from pools in Carlsbad Caverns and from Border Cave, Culberson Co., Texas. It is common outside of caves over most of North America.

Bibliography.—Barr and Reddell (1967).

Order Isopoda

Family Trichoniscidae

***Brackenridgia* sp. — det. W. C. Welbourn, W. R. Elliott

Records.—Endless Cave, Little Sand Cave, McKittrick Cave.

Comment.—This probable new species of blind isopod has also been taken in several caves in Carlsbad Caverns National Park (Welbourn, 1978) and in Border Cave, Culberson Co., Texas (Barr and Reddell, 1967). It usually occurs in very moist areas, such as near drip spots. The genus is also represented by several troglobitic species in Texas and Mexico, and by an epigean species in the mountains near San Francisco, California (Mitchell and Reddell, 1971).

Class Diplopoda

Order Polydesmida

Family Trichopolydesmidae

***Speodesmus tuganbius* (Chamberlin) - det. W. C. Welbourn

Records.—Dry Cave.

Comment.—This milliped, described from Carlsbad Caverns, has been collected in several caves in Carlsbad Caverns National Park (Barr and Reddell, 1967; Welbourn, 1978), in Culberson Co., Texas (Reddell, 1970), and in other areas of southern New Mexico (Shear, 1974). The genus is also represented by several troglobitic species (most undescribed) from Central Texas (Elliott, in litt.).

Class Insecta

Order Diplura

Family Campodeidae

***Plusiocampa* sp.

Records.—Dry Cave.

Comment.—A single specimen was taken from a guano mound in August 1965. A number of species of this genus occur in caves in the United States. Specimens of this, or possibly a new genus, have been collected in several caves in Carlsbad Caverns National Park (Welbourn, 1978) and are currently being studied by L. M. Ferguson, Virginia Polytechnic Institute.

Bibliography.—Szerlip (1965), Barr and Reddell (1967).

Order Saltatoria

Family Rhaphidophoridae – det. T. H. Hubbell, G. D. Campbell, W. R. Elliott, W. C. Welbourn

+*Ceuthophilus carlsbadensis* Caudell

Records.–Dry Cave, McKittrick Cave, Sand Cave.

Comment.–This species was first reported from Dry Cave by Szerlip (1965) and has recently been collected by W. C. Welbourn (pers. comm.).

+*Ceuthophilus conicaudus* Hubbell

Records.–Endless Cave, McKittrick Cave, Sand Cave..

Comment.–This cricket, as well as the preceding species, is common in caves of the Carlsbad region and Culberson Co., Texas. It is also frequently encountered in caves in West Texas.

**Ceuthophilus longipes* Caudell

Records.–Dry Cave.

Comment.–First reported from Dry Cave by Szerlip (1965), this species was collected again by W. C. Welbourn recently (pers. comm.). This somewhat pale, cave-adapted cricket is now known from several caves in Carlsbad Caverns National Park, where it is sometimes found in the same cave with the preceding two crickets (Welbourn, 1978). It is usually found in deeper cave areas than the other two, but it is known to feed outside of Spider Cave (G. D. Campbell, pers. comm.).

Order Coleoptera

Family Alleculidae

++Genus et species

Records.–Dry Cave.

Comment.–An unidentified beetle was found "...about 300 feet inside the cave and may just be an ordinary surface dweller."

Bibliography.–Szerlip (1965).

Family Carabidae

**Rhadine longicollis* Benedict – det. T. C. Barr, Jr.

Records.–Dry Cave, Endless Cave, Little Sand Cave, McKittrick Cave, Sand Cave.

Comment.–The last three records are new. One specimen was taken near a porcupine nest in McKittrick Cave. This is a common troglophilic beetle in New Mexico and Culberson Co., Texas. It is abundant in the Bat Cave section of Carlsbad Caverns. Its nearest relative, *R. longiceps* Van Dyke, occurs near Alpine, Texas, in caves and cellars.

Bibliography.–Barr and Reddell (1967).

Family Staphylinidae

++Genus et species

Records.–Little Sand Cave.

Comment.–An unidentified, eyed rove beetle was collected on 21 March 1976.

Family Tenebrionidae

**Embaphion contractum blaisdelli* Benedict

Records.–Dry Cave, McKittrick Cave.

Comment.–The latter record is new. Two darkling beetles collected in Sand Cave will probably prove to be of this species. This is a common troglophile in caves of the Carlsbad region.

Bibliography.–Barr and Reddell (1967).

Class Arachnida

Order Araneae – det. W. J. Gertsch

Family Agelenidae

**Cicurina* sp.

Records.–Endless Cave.

Comment.–One penultimate male was collected. *Cicurina varians* Gertsch and Mulaik, a common troglophilic spider in Central Texas, has been taken in Beetle Cave, near Artesia, Eddy Co., New Mexico (Barr and Reddell, 1967).

Family Lycosidae

++*Schizocosa* sp.

Record.–Sand Cave.

Family Nesticidae

**Eidmannella pallida* (Emerton)

Records.–Dry Cave, Endless Cave.

Comment.–A single female with an egg sac was taken in Dry Cave. The second record is a new one. This is a common troglophilic spider in Texas, Mexico, and the eastern United States. It is usually found in webs under rocks, or among breakdown on the cave floor. Three spiders collected in Little Sand Cave on 21 March 1976 may belong to this species.

Bibliography.–Barr and Reddell (1967).

Family Pholcidae

**Physocyclus* sp.

Records.–Dry Cave, Endless Cave.

Comment.–These may be the following species. The second record is from an immature specimen.

**Physocyclus enaulus* Crosby

Records.–Dry Cave, Endless Cave, McKittrick Cave.

Comment.–This species was described from the Bat Cave section of Carlsbad Caverns, but is widely distributed in caves from eastern Arizona to West Texas and adjacent Mexico (W. J. Gertsch, pers. comm.).

**Psilochorus* sp.

Records.–Sand Cave.

Comment.–This, or a similar, and possibly new, species has been collected in several caves in Carlsbad Caverns National Park (Welbourn, 1978).

Family Scytodidae

**Loxosceles* sp.

Records.–McKittrick Cave.

Comment.–One immature specimen was collected. This genus contains *L. reclusa* Gertsch and Mulaik, the poisonous Brown Recluse Spider, which has been reported from Tampke Ranch Cave, Uvalde Co., Texas (Reddell, 1970).

Order Opilionida

Family Phalangiidae

+*Leiobunum townsendii* Weed – tentative det. W. R. Elliott

Records.–McKittrick Cave, Sand Cave.

Comment.–This is a common harvestman in Texas, and has been reported from Carlsbad Caverns (Bailey, 1928). Congregations may be found on the walls and ceiling just inside the entrance. Specimens have been taken in many caves in Carlsbad Caverns National Park (Welbourn, 1978).

Order Scorpionida

Records.—Endless Cave.

Comment.—A scorpion was seen in the Little Expressway in 1971. It escaped into a crack in the wall (Carl Kunath, pers. comm.). Barr and Reddell (1967) reported a black scorpion (probably *Vejovis* sp.) from Spider Cave. *Vejovis reddelli* Gertsch and Soleglad is a common troglophile in Texas caves.

Phylum Chordata

Class Amphibia

Order Anura

Family Bufonidae

+*Bufo punctatus* Baird and Girard – Canyon Toad – det. J. D. Lynch

Records.—Little Sand Cave, McKittrick Cave.

Comment.—This is a common entrance area toad in Central and West Texas (Reddell, 1967). Late Pleistocene or Recent fossils of this toad have been reported from Dry Cave (Holman, 1970).

Class Mammalia

Order Chiroptera

Family Vespertilionidae

+*Myotis velifer incautus* (Allen) – Mexican Brown Bat

Records.—McKittrick Cave.

Comment.—One specimen was collected on 13 April 1924. It was active while some nearby individuals of *Plecotus townsendi* were torpid. The species is also reported from Late Pleistocene deposits in Dry Cave (Harris, 1970).

Bibliography.—Bailey (1928).

+*Plecotus townsendi pallescens* (Miller) – Western Big-eared Bat

Records.—Dry Cave, McKittrick Cave.

Comment.—Flying bats observed by the author in the Gypsum Room, Endless Cave, on 26 May 1975, may be of this species. Late Pleistocene fossils, probably of this species, were reported from Dry Cave by Harris (1970), who also captured one living specimen there. The McKittrick Cave specimens were collected on 15 April 1924, while they were still hibernating. During hibernation, this species curls its long ears around its head.

Order Rodentia

Family Cricetidae

+*Peromyscus pectoralis* Osgood – Encinal Mouse – det. A. H. Harris

Records.—Dry Cave.

Comment.—Several individuals were collected from the lowest level beneath the entrance fissure by A. H. Harris. Harris also reported this species as Late Pleistocene or Recent fossils from the same cave. This species has also been reported from caves in Burnet, Uvalde, and Val Verde Counties, Texas (Reddell, 1967).

Family Erethizontidae

+*Erithizon dorsatum* (Linnaeus) – Porcupine

Records.–McKittrick Cave.

Comment.–Two porcupines were seen in different parts of the cave by two survey teams on 10 March 1973. One was seen by the author near its nest, several hundred feet from the entrance. This species has also been reported from two caves in Culberson Co., Texas (Reddell, 1967).

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BIBLIOGRAPHY

The following, somewhat unorthodox, bibliography for the caves of McKittrick Hill makes no pretense of completeness. It does, however, contain all of the primary references from the speleological literature which could be located in a reasonable amount of time. These have been arranged into sections by publication and briefly annotated so that those with specific interests and/or regionally oriented library facilities may more easily search the literature available. Separate bibliographies accompany several sections of the text; these generally cite literature specific to the topic covered in that particular section.

Abbreviations used: BLM—Bureau of Land Management; CEK—Carl E. Kunath; MH—McKittrick Hill; re—regarding; SWR—Southwestern Region; TR—Trip Report; TSA—Texas Speleological Association.

Miscellaneous

ARIZONA CAVER

Volume I (1964)
(1) 5 (April) — Article: Endless as example of network cave
Volume II (1965)
(1) 4 (Jan.-Feb.) — TR: Temperatures. Endless 65°F; McKittrick 63°F
(5) 83 (Sept.-Oct.) — Note: Endless on "shield" list

SPELEO-DIGEST

1965 1-56 — Endless, Dry (Reprint from *The Texas Caver*)
1965 1-59 — McKittrick (Reprint from *The Texas Caver*)
1965 1-60 — Sand (Reprint from *The Texas Caver*)

WESTERN CAVE QUARTERLY

Volume I
(2) 42 (fall 1966) — Project report

NSS News

Volume XI (1953)
(4) 1, 3 — Report of visit to McKittrick Hill by Colorado Grotto
Volume XXIII (1965)
(11) 161 — Comparative photos of Endless Cave 1934/1962
Volume XXIV (1966)
(9) 197, 198 — Photo: Sand Cave
(9) 201, 202 — Publicity re 1966 TSA project
Volume XXV (1967)
(4) 78, 79 — Results of 1966 project w/photos
Volume XXVII (1969)
(1) 4 — SWR roundup at McKittrick Hill in December 1968
Volume XXVIII (1970)
(7) 93 — Announcement of 1970 project at McKittrick Hill
(8) 105 — New discoveries in Dry; publicity re 1970 project

(10) 150	Publicity re 1970 project
(11) 161	Publicity re 1970 project
(12) 178	Summary of 1970 project
Volume XXXIII (1975)	
(8) 122	Announcement: SWR Labor Day Regional at MH
(11) 182	Note re forthcoming MH publication
Volume XXXIV (1976)	
(2) 31	Note: Work continues on MH publication/mapping

Southwestern Cavers

Volume I (1962)	
(2) 1	Reference to Endless vandalism
(4) 25	TR: McKittrick, Endless
Volume II (1963)	
(1) 3	TR: Endless, McKittrick, Sand, "Little Spider"
(3) 10	Notice of coming Regional at Endless
(4) 1	Cover cartoon re Endless
(4) 5	Notice of coming Regional at Endless
Volume III (1964)	
(2) 12, 15	Report of Regional at Endless
(7) 50-51	TR: Endless, Boyd's, McKittrick, Sand, Little Sand, "Cave near Sand"
(9) 66-67	TR: Humorous trip to Endless
Volume IV (1965)	
(3) 40	TR: Endless, McKittrick
(3) 41	TR: Endless, Sand
(6) 71-72	Reference to discovery at Dry
(6) 75	TR: Dry
(6) 76	TR: Dry
(6): 78-79	TR: Endless
(7) 87	Reference to snakes at Sand
(8) 103	Reference to snakes near Dry
(8) 107	TR: Dry
(8) 109	TR: Dry
(10) 127-128	Article: McKittrick Hill System
(10) 130	Note: Attic and other recent discoveries in Dry
(10) 131	Note: Biota of Dry
Volume V (1966)	
(1) 1	Editorial comment re Endless and CEK
(1) 13	TR: Dry
(1) 14	TR: Endless
(2) 43-44	TR: Dry
(3) 5	TR: Dry
(7) 101-102	Pre-Project article
(8) 112	Bibliography of McKittrick Hill
(8) 112-113	Reference to Endless
(8) 114	TR: Project
(8) 120-123	Poem on Endless
(10) 141	Project notes

Volume VI (1967)	
(3) 32	Reference to Dry mapping
(3) 37-38	TR: Dry and small shelter near Dry
(4) 47	Reference to Dry gate
Volume VII (1968)	
(4) 59	Notice of Regional at McKittrick Hill
(4) 67	Note re length of Endless and Dry
(4) 77	TR: Endless (vandal seen)
[1969-1970 Unavailable and may not exist]	
Volume X (1971)	
(3) 36	Poem about Endless
(5) 77	TR: Dry, Sand, McKittrick
Volume XII (1974-1975)	
(6) not paged	TR: BLM officials visit Endless

Texas Caver

Volume VI (1961)	
(6) 69, 70, 74	TR: McKittrick Hill (aborted)
Volume VII (1962)	
(2) 17	TR: McKittrick
(8) 106	Grotto News: Endless
Volume X (1965)	
(5) 90, 91	Article: Endless (first mapping)
(6) 107-109	Article: First exploration of Dry
(6) 110-112	Article: Dry
(6) 111-112	Article: Origin of Dry
(6) 122	Grotto News: Dry
(7) 139, 145	Article: Endless
(8) 151, 152	Comment: Dry and Endless
(8) 154	Comment: McKittrick
(8) 155	Comment: Sand
(11) 207, 208	Cover Photo: Dry
Volume XI (1966)	
(1) 5	Article: Endless
(2) 24	Article: Endless proposed as project site
(3) 38	Article: Endless, Sand, and McKittrick
(4) 45, 46	Comment: TSA convention talk on Dry
(6) 81	Grotto News: McKittrick
(6) 81	Note: SWR accepts bi-regional project proposal
(7) 85, 91	Article: Pre 1966 project information
(8) 101	Article: Pre 1966 project information
(9) 115	Article: Early arrivals at 1966 project
(10) 119-121, 125, 126, 128	Article: Report on 1966 project
(10) 122	Article: Unsafe anchor in Dry
(12) 150, 151	Article: Endless, Dry, McKittrick, and Sand

Volume XII (1967)	
(1) 9	Comment: Review of TSA projects
(4) 58	Note: McKittrick Hill progress
Volume XIII (1968)	
(12) 150	TR: Endless and Dry
Volume XIV (1969)	
(2) 19	Comment: Review of TSA projects
Volume XV (1970)	
(4) 76	TR: Dry and Endless
(5) 88, 89	Article: Pre 1970 project information (Little Sand w/map)
(5) 94	TR: Endless, McKittrick, and Little Sand
(6) 103-106	Article: Pre 1970 project information (location map, Sand w/map, and McKittrick w/map)
(7) 121, 122	Photo: Endless
(7) 123-126	Article: Pre 1970 project information (Endless and Dry w/maps and photos)
(8) 154	TR: Dry
(9) 161	Photos: 1970 project
(9) 170-172	Registration list: 1970 project
(10) 197	TR: 1970 project
(10) 198	TR: 1970 project (two reports)
(10) 199	Grotto News: 1970 project trip report
(12) 240	TR: Endless and Dry (two reports)
Volume XVI (1971)	
(3) 55	TR: Endless, Little Sand, and McKittrick
(3) 57	TR: 1970 project
(4) 71	Note: SWR regional at McKittrick Hill (before)
(4) 81	Note: SWR regional at McKittrick Hill (after)
(7) 141	Article: Dry (struck by lightning)
(7) 144	TR: Dry
Volume XVII (1972)	
(4) 76	TR: Endless
Volume XVIII (1973)	
(5) 157	TR: Endless and McKittrick (first mapping)
Volume XIX (1974)	
(3) 46	TR: Endless, Sand, and McKittrick
(4) 62	Article: Comments re McKittrick publication
(5) 81	Article: Cosmic Consciousness re McKittrick trip
Volume XX (1975)	
(8) 114, 115	Photo: Endless
(8) 117	Article: Comments re McKittrick publication
Volume XXI (1976)	
(1) 14	TR: Sand, Endless
(2) 34	Two TR: McKittrick and Sand; Sand
(3) 54	TR: Sand, Endless
(4) 75	TR: Sand, Endless, Little Sand