

CALIFORNIA

A V E R



The Arroyo Tapiado Mud Caves INTRODUCTION

by Bob Richards



California's Anza-Borrego Desert State Park contains what may be the largest pseudokarst area in the United States. It also contains some of the most unusual caves in the state. Located in the Carrizo Badlands, an area of twisting mud hills abundant

with Pleistocene fossils, are numerous caves, some of which may be the largest and longest mud caves in the world.

History

In the 19th Century thousands of emigrants crossed the southern Anza-Borrego desert en route to the gold fields of California. They followed the only all-weather overland trail to California, the Emigrant Trail. This route was selected for the first mail and stage line linking California to the East. It was abandoned around the time of the Civil War with the completion of the rail line to California. No longer a major thoroughfare, it became virtually an unknown land. Even after the state park was formed the park system remained unaware of what the southern half of the Anza-Borrego region contains until the winter of 1952, when regular patrol of this area began. It was probably at this time that park rangers explored the arroyo and the Big Mud Caves (Cave Canyon) were found. Park rangers have discouraged visitors from exploring the caves due to fear of collapse or the possibility of someone falling into a sinkhole, although there is ample evidence that most of the visible caves are frequently entered and even used as campsites.

Pseudokarst Research

Although the existence of the caves had been known for some time, apparently no scientific investigation was done until Dwight Carey's research thesis on this area in 1975-76. He found that these pseudokarst caves were among the longest and largest yet reported. Carey noted that the subterranean streams were deeply buried (up to 180 feet) and

contain depositional and erosional features not yet described in other pseudokarst areas. According to Carey, the erosion rate appears to be low, indicating that the mature caves may be thousands of years old.

Carey located, explored and named most of the caves we know today. His thesis includes line plots of Big Mud Cave and Little Mud Cave and a map of Plunge Pool Cave.

Cavers Become Interested

The first organized caving group to visit this area was Bruce Rogers and SFBC members in December 1982. They explored Cave Canyon and Plunge Pool Cave and also mapped Chasm Cave. Unaware of the SFBC trip a couple months earlier, some Southern California Grotto members visited the area in March 1983. They explored Cave Canyon and Plunge Pool but missed the other caves.

In 1983 Phil Darling began caving at Arroyo Tapiado. Over the next four years he explored the mud hills, rediscovering Carey's caves and also finding new ones. In 1987 Phil met the Southern Cal Grotto and told the grotto of the many caves in the Anza-Borrego Desert. Also about this time, grotto member Scott Schmitz came across Carey's thesis and organized a trip in the fall of 1987. Since then, the Southern Cal Grotto has had several mapping trips to the caves, but several caves reported in Carey's thesis have yet to be surveyed and a little ridgewalking and digging is likely to reveal even more caves.

References

Carey, Dwight Lee, 1976. Forms and Processes in the Pseudokarst Topography of Arroyo Tapiado. Anza-Borrego Desert State Park, San Diego Co., CA.

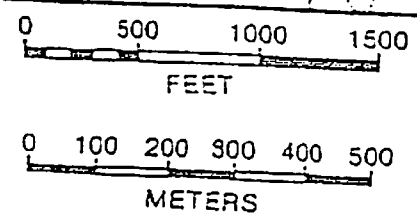
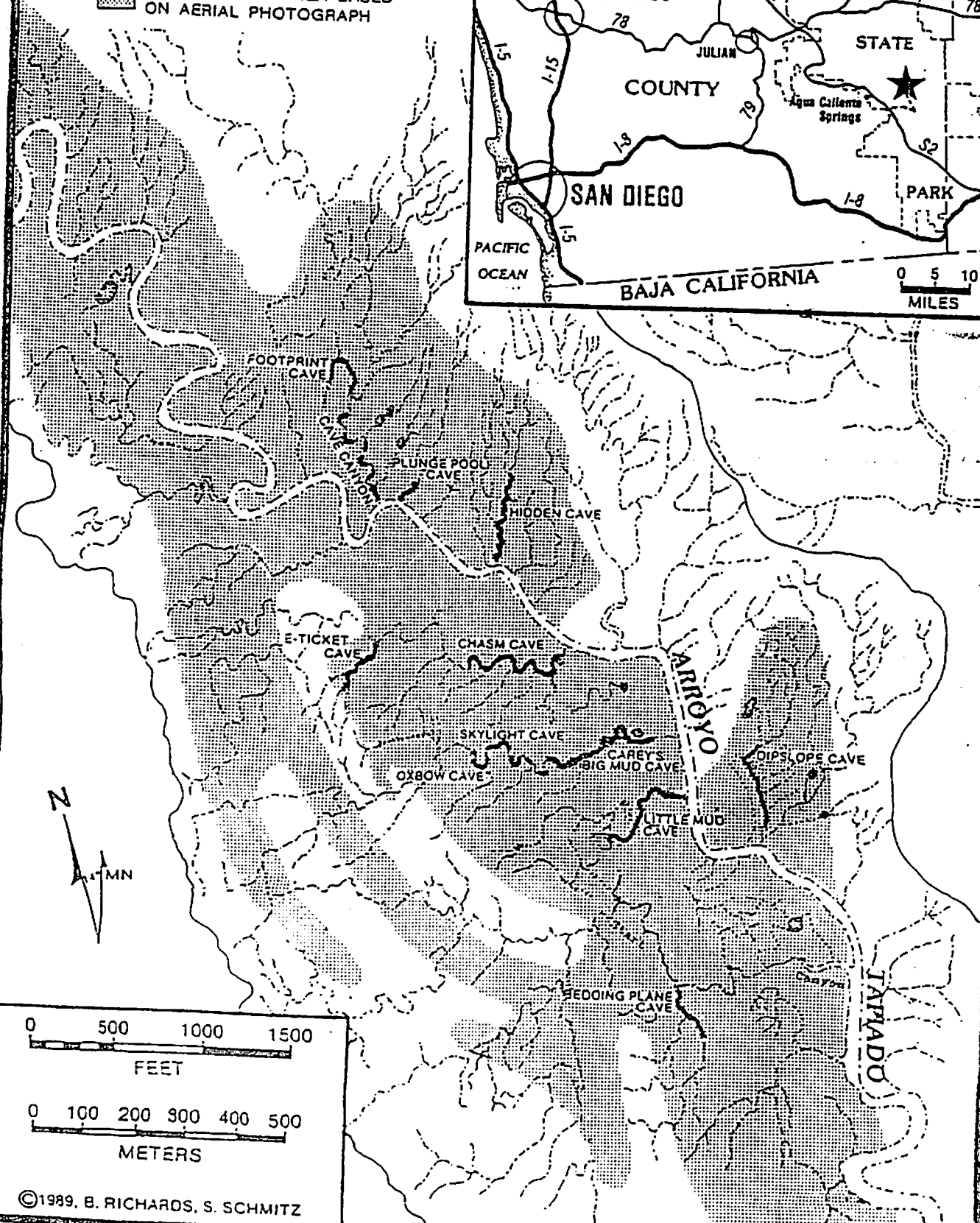
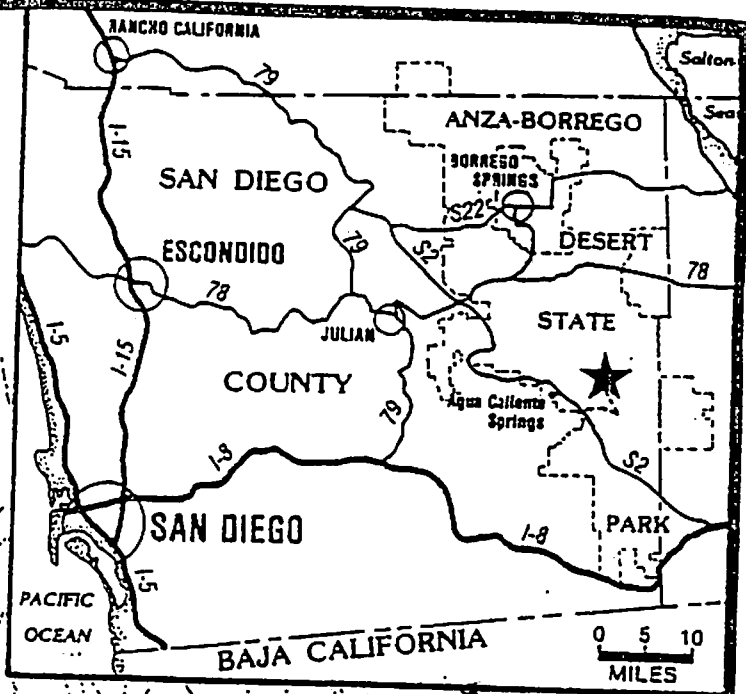
Lindsay, Lowell and Diana, 1978. Anza-Borrego Desert Region. p. 121-142.

Rogers, Bruce, 1983. Arroyo Tapiado Cave, Anza-Borrego Desert State Park. San Francisco Bay Chapter Newsletter, v. 26, no. 6, p. 16.

ARROYO TAPIADO PSEUDOKARST

ANZA-BORREGO DESERT
STATE PARK

 PSEUDOKARST AREA BASED
ON AERIAL PHOTOGRAPH



THE GEOLOGY

by Scott A. Schmitz

The Carrizo Badlands of California's Anza-Borrego Desert State Park contain what may be the largest pseudokarst area in the United States. The area is the site of numerous caves, some of them among the longest and largest mud caves to be found anywhere. The area may even be geologically unique in regards to the size and variety of its features.

Pseudokarst is a controversial term referring to karst-like terrain not formed in limestone. It is more properly used when described landforms made from insoluble material that mimic the morphology and hydrology of true karst. Arroyo Tapiado Canyon fits this description well, for along its tributaries can be found numerous blind valleys, sinkholes, pits and caves; evidence of extensive subsurface drainage through insoluble claystone.

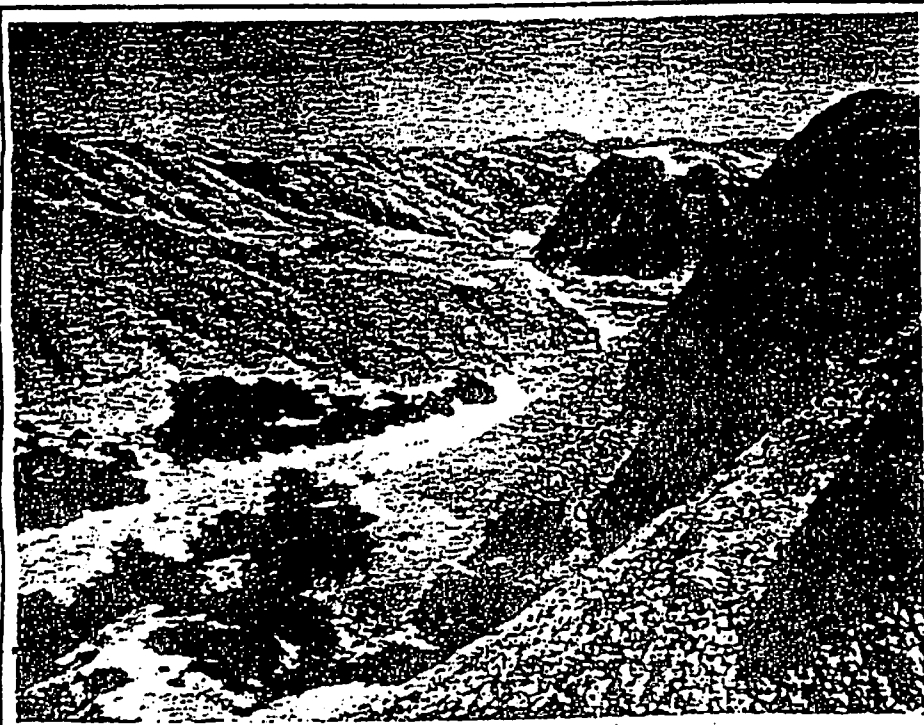
At least 16 caves in this area are enterable. The largest, Carey's Big Cave, is over 1300 feet long while Chasm Cave has 1010 feet of passage, with skylights being few and far between. Other notable

caves include Hidden Cave, Little Mud Cave, E-Ticket Cave and Plunge Pool Cave. All the caves are found in the narrow band of pseudokarst that begins about Mile 1.8 above the confluence of Arroyo Tapiado with Vallecito Wash. This band extends on either side of the arroyo to about Mile 4.6, covering a total area of approximately 0.54 square miles.

The area is primarily composed of a gypsiferous claystone known as mudstone. Its major characteristic is its ability to expand to nearly three times its original volume upon exposure to moisture. Weathered mudstone breaks down into a fluffy regolith composed of very fine particles that easily disperse in water. When wet, the regolith expands and can become quite mobile. When it is merely moist, the regolith is sticky and cohesive, and dried it forms a hard adobe crust. These characteristics are important for the formation of mud caves.

Initial Cave Formation

During infrequent periods of heavy rain, flash floods carve deep twisting and narrow slot canyons through the soft mudstone. Sharp stream meanders allow the rushing waters to undermine the mudstone walls. Eventually, the mudstone slumps over onto the streambed, but the stream continues to burrow under and through the debris. The swelling mudstone, sloughing off the steeper slopes, buries the landslide debris with a further layer of adobe. Being cohesive when moist, the mudstone bonds the debris together. Upon drying in the desert heat, this conglomerate forms a hard, thick brecciated roof. With each rain the stream carves its smooth, sinuous passage deeper while above the roof gets thicker until the stream approaches the level of the main arroyo.



The pseudokarst hills of Arroyo Tapiado. (photo by Scott Schmitz)

There are many small caves and arches all the way up the blind valley above Carey's Big Cave which illustrate this process. Most notable is Oxbow Cave where the stream has carved a great subterranean loop halfway through a hill using the process described above. Many of the smaller caves, particularly Hidden Cave and E-Ticket Cave, are still in the early stages of formation. The bonded debris that has roofed over the slots is very visible. In E-Ticket, which is still close to the surface, roof collapse has forced the stream to carve through lateral cracks, resulting in a mazy, multi-level structure. In many places in Hidden Cave the ceiling can no longer be seen from the bottom of the narrow, twisting passage.

Mature Cave Development

Once the stream has approached the level of the main arroyo, the cave enters a new stage in its evolution. With less of a gradient guiding floodwaters, the stream begins to meander more widely, carving out great rooms and chambers. As the cave grows laterally, large domed ceilings and underground natural bridges form when unsupported walls break loose and the ceiling grows upward through the collapse of succeeding layers. Surface water collected in sinks along the roof and by hanging tributary passages further degrade the ceiling and walls, enlarging sinks and covering the passage with a thin layer of cruststone.

Little Mud cave has recently entered this phase. Most of Little Mud Cave is like Hidden with most of its length being a tall, narrow passage, but it has become very sinuous and twisting as the floodwaters cut deeply into the heads of meander curves. Several chambers are forming, most notably Tudor Dome with its tall debris cone. Wall collapse at the Three Windows has led to a multilevel passage. Both Carey's Big Cave and Chasm Cave have large chambers formed by twisting meanders. Carey's has many upper level passages and underground bridges formed by collapse. In Chasm, one dome has broken through the bonded debris to form a spectacular skylight.

Water percolating into these caves from above is saturated with fine regolith particles. If the dripping waters slow for any reason, the particles sediment out, leaving behind a thin film of particles that dry into a fine crust. This cruststone mimics the action of limestone deposition in true karst caves. If a steady drip develops over an area, formations build up similar to drip castles built on the beach by sandcastle builders. The highlights of Little Mud Cave and, to a lesser extent, Carey's Cave and Chasm



Approaching the entrance to Big Mud Cave or Cave Canyon. (photo by Bob Richards)

Cave are the mud stalagmites and stalactites that are formed under the many dripholes and hanging tributaries. The water is also saturated with gypsum. In Chasm, gypsum flowers have formed in the Crystal Garden Room, and other caves have developed deposits of gypsum needles during times of moisture. The crystals quickly revert back to powder when the pools dry out and the humidity drops.

Eventually, the process of lateral development will bring down the ceiling, leaving only mudstone arches and bridges. The Big Mud Cave or Cave Canyon is the perfect example of this final stage of mud cave evolution. The collapsed remnant of an ancient cave, it is essentially just a long canyon with arches, although the more spectacular of the arches are enough to hint at the grandeur of the former cave.

Layering

Other processes also effect cave formation. Unlike other known pseudokarst areas, the mudstone unit is distinctly layered, the sediments having been evenly deposited at the bottom of ancestral Lake Cahuilla 500,000 years ago. For reasons of chang-

big salinity and climate, the mudstone layers are interrupted by several layers of harder siltstones and sandstones. Uplift began in the middle of the Pleistocene, creating a homoclinal deformation which dips about 25 degrees to the southwest. As streams encountered the harder layers, the cave passages were deflected and lateral enlargement was restricted. Both Dip Slope Cave and Bedding Plane Cave have tight, narrow passages whose dimensions are restricted by the harder rock.

When the stream manages to break through the hard layer into the softer layers below, the result is a dry subterranean waterfall. Away from the main arroyo, these falls are relatively small, such as the two-meter-high one found in Footprint Cave. But when the breakthrough occurs close to the main arroyo, the dry falls are spectacular indeed, as is the case in Bedding Plane Cave, Hidden Cave and Plunge Pool Cave. Plunge Pool Cave has a 15-meter-high dry waterfall plunging down from near a skylight entrance. It is customary to sit around at the bottom of the shaft until your eyes adjust to the darkness. You can then clearly see and admire the muted lines and shadows of this sculptured cave and the hard sandstone layer which composes its ceiling.

Earthquakes

Another factor in the evolution of the caves are the frequent earthquakes which strike the area. The epicenters of the two strong Superstition Hills Earthquakes of November 23-24, 1987, were a scant 20 miles east of the mud caves and were of magnitudes 6.0 and 6.4. The jolts dislodged large sections of the canyon wall, revealing the network of mud pipes that drain the upper plateau and sheets of calcite that had crystalized along the cracks in the mudstone. It is a testament to the relative stability of the caves to observe that, save for a few scree piles composed of debris dislodged from the tops of domes, no major damage was found on the inside. Only the unsupported outside walls, particularly tall cliffs standing perpendicular to the direction of the shock waves, showed signs of collapse. Earthquakes, while contributing a little to the lateral enlargement of the caves, may play a more major role in exposing fresh cracks to the effects of weathering, thus initiating a new cycle of cave development.

Considering the type of rock the caves are in, they are remarkably stable. However, extra caution must be applied when climbing in these caves due to the crumbly nature of the walls. Except for times of flood or earthquake, events which drastically alter the caves are rare. And rain is infre-

quent in this desert environment, so erosion rates are rather low. It is likely the caves have existed for as much as 15,000 years in the case of Cave Canyon. At present the most destructive events are the passage of cave explorers bumping the walls and formations, and compacting the regolith on the floors.

References

Carey, Dwight Lee, 1976. Forms and Processes in the Pseudokarst Topography of Arroyo Tapiado. Anza-Borrego Desert State Park, San Diego Co. CA.

Lindsay, Lowell & Diana, 1978. The Anza-Borrego desert Region.

Schad, Jerry, 1986. Afoot and Afield in San Diego County.

Road Log to Caves of the Arroyo Tapiado Region

Miles	
2.00 R	First Falls Cave
2.14 R	False Start Canyon
	a) False Start Cave
	b) Dead End Cave
2.24 R	Start Canyon
	a) The Squeeze Pit
	b) Start Canyon Cave
	c) Bedding Plane Cave
2.34 L	Bridge Canyon
	a) Dip Slope Cave
	b) Stairstep Pit
2.51 R	Little Mud Cave
2.56 R	Big Cave Wash
	a) Carey's Big Cave
	b) Slump Cave
	c) Skylight Cave
	d) Oxbow Cave
2.76 R	Chasm Wash
	a) Chasm Cave
	b) The Drainpit (too tight)
	c) E-Ticket Cave
2.91	Schad's Cave (buried entrance)
2.95 L	Hidden Cave
3.00 L	Plunge Pool Cave
3.05 L	Big Mud Wash
	a) Big Mud Cave (Cave Canyon)
	b) Corkscrew Cave (too tight)
	c) Footprint Cave
3.20	Falls Cave
3.52	Slot Canyon Cave
3.88	Meander Cave
4.00	Hard Rock Cave (too tight)

THE EXPLORATION

by Phil Darling

I'm a relatively new caver, having joined Southern California Grotto in November of 1987. Despite this, Carol Vesely asked me to write an article on the pseudo-karst area (mud caves) in Anza Borrego. I have frequented the area for over six years now. In fact, the mud caves are the first caves that I ever explored. I even "discovered" most of them. Now, before that last sentence gets you too disgusted, bear with me for a moment. My "discoveries" and my newness to caving are the reason Carol asked me to write this article. All of you had a "first" cave, whatever and wherever it was. Perhaps some of you prefer to forget your first cave, but, just as likely (perhaps more so), many of you will always remember your first cave, no matter how humble it seems compared to other caves you've seen. Although I'm not a sentimental person, the mud caves are special to me because they were my first. I found most of them on my own, some intentionally, most not.

Propane-lantern Caving

I first heard of Anza Borrego in 1983 when a couple of friends took me there. After exploring other areas we went to the mud hills in Arroyo Tapiado to visit the infamous Big Mud Cave. While the others were getting ready, I stuck my head in a big crack in the side of the wash that turned out to lead into a big passage. Not having a flashlight, I got my propane lantern and entered the cave. It wound a bit and required a little stooping at one point but eventually opened into a tremendous room with light coming in at the top from a horizontal opening. This being my first real honest-to-god cave, I spent quite a while being awed. The room was roughly circular, about 20 feet in diameter, and about 40 feet high. The lantern gave more than enough light to view the whole thing. After spending several minutes inside, just staring and staring, I ran back out to tell the others. None of the books that we had read stated that real caves existed in the area. Since we just had to have pictures and none of us had strobes, we used propane-lantern-light and a stopwatch. Surprisingly, the pictures turned out rather well. After we had had our fill of this cave (which by the way is Plunge Pool Cave), we headed back out to explore Big Mud Cave.

Nothing But a Bare Footprint

Big Mud Cave turned out to be a series of impressive arches that apparently were once part of a true cave. After passing through the arches, we entered a steep-walled wash with a narrower young wash at the bottom. Although none of us expected to find any more caves, I looked along the walls constantly. I got ahead of the others while they were taking pictures and found another crack in the side of the wash. Unfortunately, this crack was much smaller than the first one. However, I was able to get my head in to where I could see that a passage existed and that it widened out sufficiently for me (the largest of our group) to pass through. I then literally ran back past the others and grabbed my trusty propane lantern, matches, spare mantels and a hatchet and ran back to the crack.

After using the hatchet to clear away the sand burrs imbedded in the sides of the crack, I squeezed in and waited for the others. The passage seemed hundreds of meters long and seemed to take hours to traverse. Once inside, the walls were relatively close requiring us to turn sideways, and the passage twisted about and generally kept us bent over to follow the configuration of the cave. It was this configuration which kept the ceiling out of sight. The walls did not go straight up, but, although they kept reasonably parallel to each other, they tended to turn one way and then another. As a result, we didn't know what was above us or before us or whether the whole thing was going to come down on us in a choking cloud of dust. Naturally, we kept going. We had thought that we were the first to go through this cave, but our belief was destroyed when we came across a well-preserved child's bare footprint in the dust on a ledge. The magic and adventure were still there though!

After finding one side passage which dead ended, we came to an old collapse, which still had a small opening that we could climb up through. This dusty little climb forced us to live with that peculiar taste and smell of Mud Hills dust and with the way it finds its way into packs and onto cameras contained therein. We found ourselves crowded onto a narrow



Nancy Pistole climbs up to explore an upper level in Carey's Big Cave.(photo by Carol Vesely)

ledge, open to the sky, preceding an eight-foot drop followed by a ten-foot dry waterfall. The bedrock ledge was strong enough for us to use it to climb up. (In general, the walls of the cave are too crumbly for climbing). We left the sky behind and traversed a short passage which ended (started, actually) in a mini-wash almost at the top of the mud hills.

Bigger and Better Discoveries

Over the next four years, I explored the mud hills area blindly searching for more caves. In the process I "discovered" Carey's Big Cave, Chasm Cave, E-Ticket and a number of smaller caves that I have not been back to. Since joining the Grotto, I managed to "discover" Hidden Cave.

Probably the most exciting "discovery" for me was Chasm Cave. The entrance lies about 20 feet from the dirt road over a small embankment. It took me a surprisingly long time to find this cave, about two years. Once found, I fired up my trusty propane lantern and headed in. I had been suitably impressed and excited by Footprint Cave, but this was on an al-

together different scale. First, Chasm Cave is a walking-height cave requiring no crawling and only a few points where you must go sideways. Second, it has large chambers (to me they're large!). Chasm is also about a fifth of a mile in length. My first trip through seemed to take forever and even though it was obvious that others had been there, it still seemed as if I was the first. The dry stream channel meandered greatly revealing water-carved walls extending up to a ceiling composed of breccia. I remember noting the conveniently flat and easy to traverse path formed by the stream channel and how the walls generally sloped out rather than going straight up. Along the passage were a few chimneys, several of which I managed to squeeze into, only to find a tall round chamber that went nowhere. Too soon, I came to another entrance though the stream channel kept going in a very steep-walled wash. It was with high hopes that I continued along this wash in search of more caves. I was not disappointed, although it took another trip to find that out.

Worth an E-Ticket

As the wash that led into Chasm Cave was nearing its origin, I noticed a small hole in the left wall. I joyfully clambered in and found a moderately tight, but passable, passage (yes I had my propane lantern again). This passage required crawling most of the time with only a few places to stand. I crawled along on my hands and boot-toes pushing the lantern ahead in the sand, wondering if I was going to get stuck and thinking that, if I did, at least it was cool inside and the air was moving. Eventually I reached a round chimney that led to the surface about 20 feet above. Just beyond the chimney, the passage dead-ended and I thought that this was all there was to this cave.

Fortunately, on a subsequent trip I dragged the original friends who brought me to Anza Borrego into this cave and they, in turn, dragged their 14 year-old daughter with them. While we were resting and talking, the daughter innocently asked "where does this go?" while pointing down at a crack just past the bottom of the chimney, but well before the "dead-end". The passage we found was more fun than anything I'd been in previously. Much of it was very tight but definitely "went". At a couple of points I had a choice between upper and lower passages. The lower passages are all belly crawls while the upper passages are more interesting. The water which formed the passage was able to make a wide (i.e. about 1.5-2 feet) upper passage and a wide lower passage, but the area in between is only about six inches wide. When the lower passage got too tight, I ended up in a small upper passage desperately hoping that I would not drop anything (like my pack with my camera)

down into the inaccessible lower passage. At any rate, it was a very physical passage, but with the carved walls and the meanders and variety, it was incredibly fun. We climbing out a hole in the roof into a steep-sided sinkhole. I christened this cave E-Ticket and that name still stands although there have since been more than a few disparaging comments by some Grotto members who consider all the caves in the area to be just dusty holes rather than caves.

The Backdoor to Carey's Big Cave

After several more trips that turned up no new caves, I took some other friends through E-Ticket. After coming out, we decided to walk across the top of the mud hills to see what we could find. We ended up in a big wash to the south and followed it back to Arroyo Tapiado. Being in a new wash, I kept on the lookout for caves. I found several small in-feeding ones. Eventually we came to some arches, which became more and more like a ceiling. When it got to the point where we had to take off our sunglasses, I started getting excited! We eventually came to a 12-foot crawlway, where I just barely fit. This led into a tremendous (to me) cave with passages even larger than Chasm Cave. The ceiling was up to 80 feet high, and it was much wider. Also, there were arches indicating an old upper passage and possibly existing side passages. At a few points, we could turn out our lights and see dim bluish daylight penetrating the ceiling although we couldn't actually see the sky or reflected sunlight. When we eventually exited, it was through the lower of two entrances. I was quite surprised to find the exit barred by trees. After making our way to the road, I was even more surprised to find that we were only a few hundred yards away from Chasm Cave and very chagrined upon realizing that I had passed this entrance uncounted times without ever thinking to look behind the trees. Ah well! Since joining the Grotto, I have found that this is Carey's Big Cave.

Digging Open Hidden Cave

After another year or two I found out about the Grotto. I then met Scott Schmitz who told me about Dwight Carey's thesis. One Easter Vacation from law school, I went by myself to photograph some Indian pictographs in Anza Borrego and the mud caves of Arroyo Tapiado. As I was driving back from Plunge Pool Cave I noticed what was essentially a big ditch coming out through a raised portion of the wash. Having read Carey's thesis, especially the portions discussing the covering of cave entrances, I stopped to investigate. Armed with a

shovel, I followed the ditch to the wall of the wash and discovered a distressingly small hole at foot level. Upon peering inside, I discovered a forceful and very cool breeze blowing into my face. Before beginning what I thought would be an excavation of doubtful legality, I stood back and looked at the side of the wash to see if I could determine whether digging would even be worthwhile. The wall of the wash was easily over a hundred feet high and very steep. Just above the hole I could make out what looked like a depression that had been filled in by a mudslide. From Carey's thesis I recalled that the "clayey silt" which covered this whole area was very cohesive and viscous when wet. As it turned out my impression that a cave entrance was plugged by a viscous mudslide was essentially correct. I noted another hole about 20 feet up. This new hole was about as big as my helmet and really blowing cold air. Not relishing the thought of an extended dig, I reasoned that all I'd have to do was knock the dirt loose and it would fall into the cave instead of requiring my effort to remove it. This worked well except that the force of the wind blew geysers of dust into my face as I enlarged the hole. Fortunately, I only needed to remove



A So. Cal. Grotto group visits Chasm Cave.
(photo by Carol Vesely)

a thin rim around the edge rather than walls of the hole itself. Having created a sufficient opening, I donned my helmet and entered the cave. The initial drop was about 15 feet into a narrow slot that eventually widened sufficiently to allow me to walk normally. The passage meandered a great deal, almost turning back on itself. In many places where the passage turned, the passages were separated by a wall that was no more than a foot thick.

Eventually, I came to a dry waterfall about 30 feet high. I almost tried to climb it! I like to think that it was prudence which kept me from that climb. After all, it was a small hole that led into this cave and no one knew where I was, exactly. So, despite the layers of bedrock in the mud, which could have provided holds, I decided to wait for another day.

Return to Hidden Cave

About a week passed before I was back in Anza Borrego again. This time I wasn't alone. The Grotto had scheduled a trip as had, believe it or not, the scuba diving club I belong to. After showing everybody E-Ticket and the overland route to Carey's Big Cave, all the Grotto members were pretty well wiped out, so I grabbed two divers and assaulted this new cave I had "discovered". We had no difficulty getting to the base of the dry waterfall. Getting up it was interesting, however. At the top is what appears to be a big balanced block of bedrock. To get to the upper passage, you have to squeeze through a narrow notch just under the block. In addition, the layers of bedrock that the waterfall cut through do not provide particularly great holds. In short, the climb is a little tricky. Rick, the last of our party to climb up, had no less than four Radio Shack flashlights (the long kind they give away) stuffed into his shirt. Robert, second up the fall, hadn't wanted to be encumbered by carrying his lights. Eventually we all made it to the top.

The passage was no longer walking height. Nor was it easy to determine exactly which way to go as there appeared to be multiple passages. We passed under two large chimneys both of which turned so that we could not see the sky. After the second we came to what appeared to be an impasse... passages too narrow for yours truly to negotiate. The moment of decision came and we decided to have a go at one of the chimneys to exit the cave rather go all the way back which would have required a descent of the dryfalls (the most important consideration). For some reason, a 45-foot chimney climb seemed the safer alternative! Since I was the largest, I went first on the theory that if I could fit, so could the others. I made it out OK, but apparently just about



Exploring Chasm Cave. (photo by Carol Vesely)

buried the others with all the dried mud which broke off as I climbed. They were quite upset at being heavily dusted and thereby literally coated in sweaty mud. On a later trip, Dave Bunnell, Djuna Bewley and I surveyed from the top of the waterfall up past the chimney to the end of the cave. The passage was very tight in two places (my legs were just short enough for one S-passage) but contained some nice roomy chambers and ultimately led to almost the very top of the mud hills. Scott Schmitz has informed me that this cave is Hidden Cave, which Dwight Carey had excavated sometime around 1976.

I could add a lot more about the other caves which Scott Schmitz has shown me. In fact there are still a lot of interesting areas left that deserve closer investigation. At any rate I hope this gives you an idea of what the pseudokarst area in Anza Borrego is like, considering that it is coming from the standpoint of a new caver who used such silly things as a propane lantern, and others I won't mention, to explore the caves. As I hinted above, I'll always enjoy the mud caves, regardless of what other caves I visit in the future.

THE CAVES

by Bob Richards

Pseudokarst features along tributaries of Arroyo Tapiado include mud caves containing stream channels, sinkholes and blind valleys ending in swallow holes. The name mud caves is a bit of a misnomer, for although the caves are formed in mudstone they are actually dry and dusty most of the time. Three caves are over 1000 feet in length with rooms up to 80 feet high and 30 feet wide. Some caves are complex and have multiple levels. Others contain dry waterfalls up to 50 feet high. Certainly the most impressive pseudokarst features of the entire area are the caves upstream from the medium and large sized outlets. Beginning upstream and working down Arroyo Tapiado, the caves that we have visited are described.

Cave Canyon

Cave Canyon, known to the State Park as the Big Mud Cave, is not really a cave at all. It is essentially a long canyon of mudstone arches and bridges. The 30-foot-high entrance to Cave Canyon is the most visible entrance when driving up the wash. This canyon can be explored without any lights, due to its numerous skylights. The longest roof section is only about 100 feet. A small infeeding passage appears on the right after a couple hundred feet and can be followed for about 25 feet before becoming too tight.

Footprint Cave

A few hundred feet up Cave Canyon one finds a small, narrow slot on the left wall. This is Footprint Cave, named after the child's footprint Phil Darling noticed on his first trip back in 1983. This 334-foot-long cave has a nice ten-foot-high dry waterfall. When plotting this cave I discovered it made a giant loop, which I first thought might be a mistake in my field notes since most of the other caves go in one direction. I later checked with Scott Schmitz's aerial photograph of the pseudokarst, and the cave did indeed make a big semicircle.

Plunge Pool Cave

Next to the entrance to Cave Canyon is another slot visible from the arroyo, Plunge Pool Cave. The 20-foot-high by three-foot-wide entrance passage meanders for over 100 feet to the Plunge Pool Room.

The room has a spectacular 50-foot-high dry waterfall plunging down from near a skylight entrance. Just before the Plunge Pool Room is a tight side canyon along the right wall, which can be followed for at least 40 feet. Carey included a basic map of this cave in his thesis.

Hidden Cave

As we work our way from north to south downstream in Arroyo Tapiado we come to Hidden Cave, located in the east wall roughly 800 feet downstream from Plunge Pool. The main entrance, a two-foot-diameter hole about 20 feet up the arroyo wall, blows a cool steady breeze on a hot day. At the bottom of the stream bed is an even smaller entrance, which enlarges into a tight canyon passage that connects to the main entrance after about 30 feet. The stream bed then meanders tightly for a couple hundred feet. The cave ceiling is not visible in many places because of the passage's sinuous nature. The average passage width is only two to three feet with many tight meanders. Some are cut off from the main stream course at a higher level. These cutoff oxbows are evidence of the downcutting of the cave stream. Some 600 feet back in Hidden Cave is a 40-foot-high dry waterfall. Above this the passage branches and continues but with a lower ceiling. Both branches have skylights, some of which can be used to exit the cave. Hidden Cave has been only partially surveyed but the total passage length is at least 800 feet.

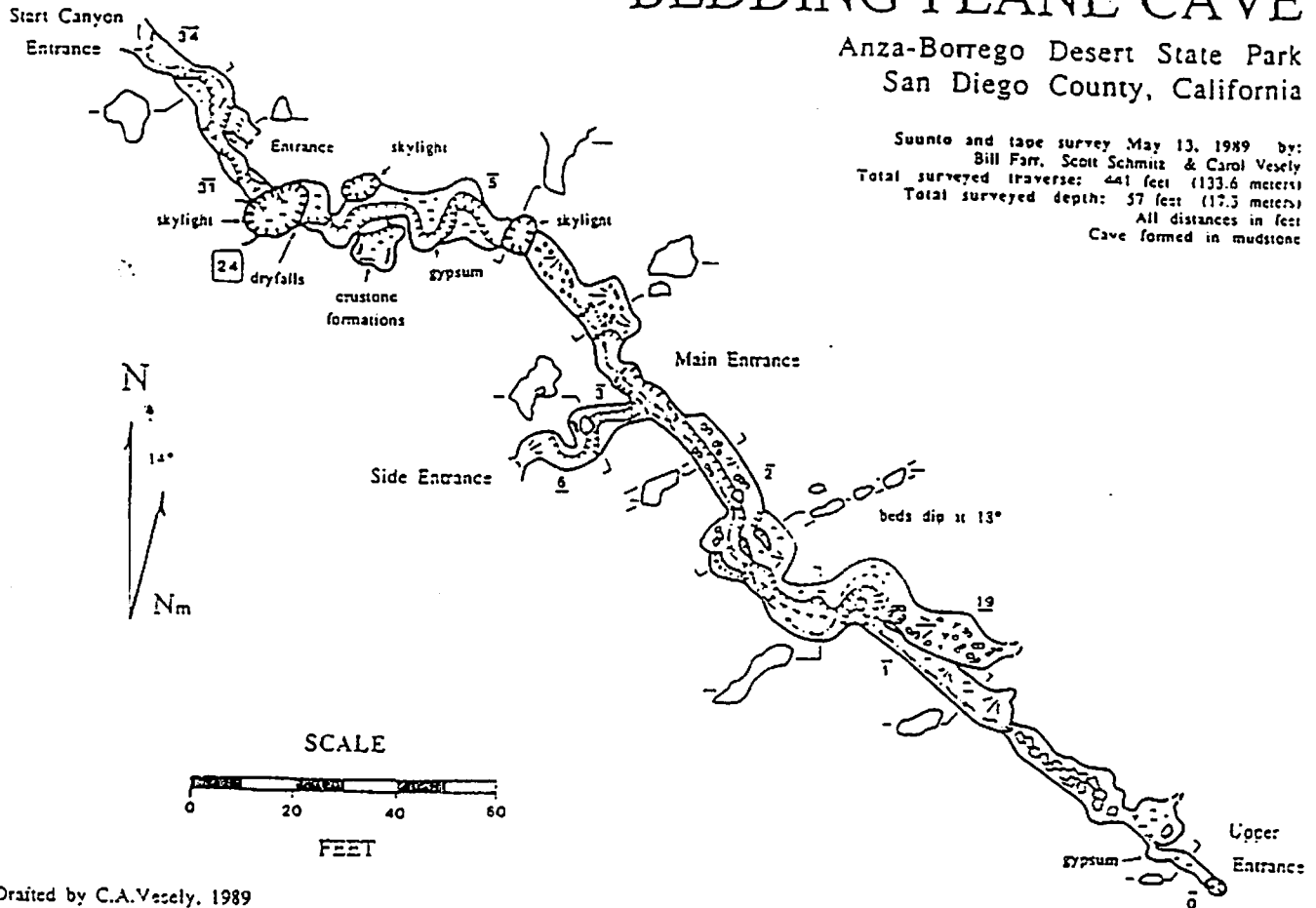
Chasm Cave

Moving down the arroyo another 700 feet one finds Chasm Cave coming from the west. The entrance is not visible from Arroyo Tapiado, for it is located some 50 feet back from the wash. Chasm can be traversed the entire 1010 feet without ducking or squeezing. This large volume passageway has one skylight halfway through. Past the skylight entrance is the Crystal Garden, where small gypsum flowers have formed during times of moisture. Farther on, the cave meanders more tightly and eventually makes a meander cutoff before coming to the swallow entrance. Past the swallow there is a 100-foot-deep blind valley.

BEDDING PLANE CAVE

Anza-Borrego Desert State Park
San Diego County, California

Suunto and tape survey May 13, 1989 by:
Bill Farr, Scott Schmitz & Carol Vesely
Total surveyed traverse: 441 feet (133.6 meters)
Total surveyed depth: 57 feet (17.3 meters)
All distances in feet
Cave formed in mudstone



Little Mud Cave

Little Mud Cave is just a few feet back from Arroyo Tapiado on the west wall several hundred feet farther downstream from Carey's Big Cave. Most of Little Mud is like Hidden, with its major length being a tall, narrow canyon passage. It is also very sinuous with tight meandering curves. After 604 feet we could not longer twist and turn our way through and had to return the way we came in.

Dip Slope Cave

Farther down the arroyo, on the east side, are Dip Slope Cave and Bridge Canyon, which have not yet been explored by members of our grotto. However, Dip Slope is mentioned in Carey's thesis. This area and Start Canyon both deserve more exploration.

Bedding Plane Cave

Still farther along the west side of Arroyo Tapiado is Start Canyon, about a half mile from Little

Mud Cave. About a thousand feet up Start Canyon on the left (south) wall is the canyon containing Bedding Plane Cave. At the beginning of this side canyon is a short section of passage leading to an impressive 27-foot-high dryfall with a large skylight above. The dryfall cannot be climbed. Instead, one must exit the cave and scale the mud hills to the left to gain access to the cave from above. At the top of the dryfall the passage continues intermittently, intersected by skylights and a section of collapse. Bedding Plane has 441 feet of passageways and the longest straight-line passage of any cave in the area. The dip of the beds is 18 degrees. The cave splits into an upper and lower level for a short distance. A small crawlway entrance at the back provides a through trip.

Summary

We have mapped 11 caves totaling more than a mile of passageways. With four other caves that we haven't visited yet this remote area of the Anza-Borrego Desert contains a pseudokarst playground attractive to both explorer and caver alike.

THE SURVEY

by Carol Vesely

In the fall of 1987 Southern California Grotto members began a project to locate, explore and survey the mud caves of Arroyo Tapiado Canyon. Several factors combined to generate interest in the survey of these caves. First, glowing reports of the passage size and extensiveness of the mud caves convinced grotto members Bob Richards and me that the area deserved a closer look. Second, the lure of Lechuguilla and the influx of many new people into the grotto prompted a surge in interest in learning to survey. The warm, dry, "friendly" nature of the caves coupled with their proximity to the L.A. area made them an ideal place to take beginners. Finally, because some of the entrances tend to be obscure and the first few feet of passage tight, there was the possibility of finding "virgin cave".

To date there have been five grotto trips to the area. The purposes of the trips have been two-fold: to map the caves and to teach people how to survey. With as many as 23 cavers on one trip we can field up to four survey teams. With so many caves in close proximity it is possible to send each team to a different cave with the objective being to complete the survey of that cave in one trip. This objective is harder to meet than anticipated, owing to the sinuous nature of the passages and the relative lack of experience of some of the survey personnel. Our plan has been to give those people who are totally new to surveying experience as tape or instrument persons and to provide experienced surveyors with an opportunity to sketch. Bob Richards has taught beginners the basics, while I have instructed the sketchers.

My first sketching class had three students: Nancy Pistole, Phil Darling and Susan Hammersmith. I instructed them in how to sketch to scale and provided each with a protractor and ruler. Cave Canyon turned out to be the ideal place for them to practice. It's all walking, dry, warm and best of all the numerous skylights make artificial lights unnecessary. The pace was very slow. The most difficult part for the new sketchers seemed to be drawing the area near the entrance. All three cavers produced excellent sketches, and it was interesting to compare their representations. On the next trip to Arroyo Tapiado, Nancy sketched E-Ticket Cave, which proved to be quite a challenge due to its meandering multiple levels. Nancy's excellent map of E-Ticket

and Scott Schmitz's fine maps of Little Mud Cave and the Caves of Big Canyon are their first cave maps.

For the second sketching class I chose to survey short, walking-height Plunge Pool Cave. This time the students were: Mark Tillman, Matt Oliphant and Phil Darling. The various ceiling meanders and ledges proved the most challenging for them to represent. For both courses I had a novice instrument reader along as well. In retrospect this is not a good idea. It would be best to have another experienced sketcher to help survey and answer questions. In one case the instrument person made two mistakes, causing the sketchers additional problems.

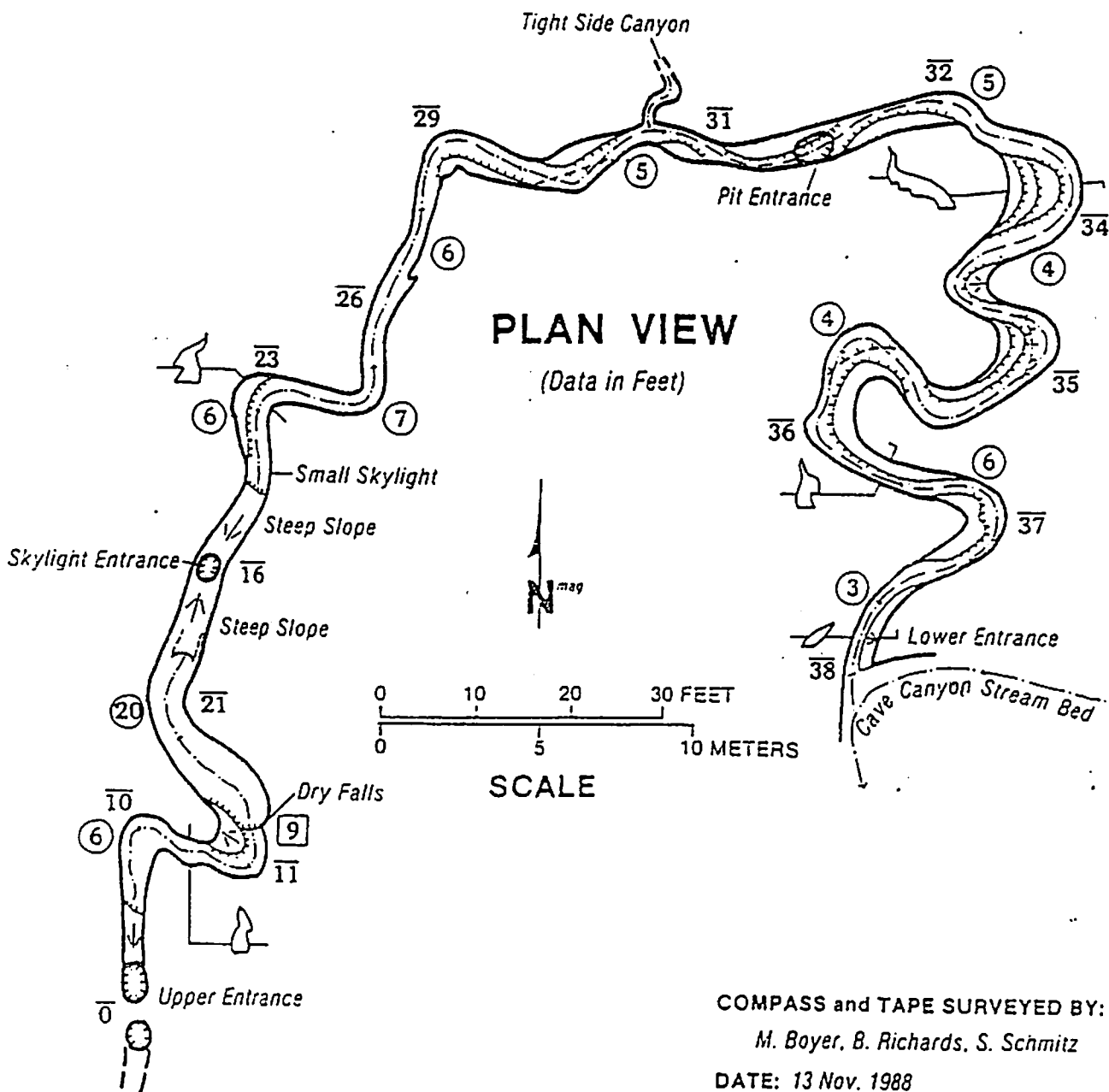
In sum, I think the survey courses have been informative for both the students and teachers alike.



Susan Hammersmith & Nancy Pistole learning to sketch in Cave Canyon. (photo by Carol Vesely)

FOOTPRINT CAVE

ANZA - BORREGO DESERT STATE PARK
SAN DIEGO COUNTY, CALIFORNIA



COMPASS and TAPE SURVEYED BY:

M. Boyer, B. Richards, S. Schmitz

DATE: 13 Nov. 1988

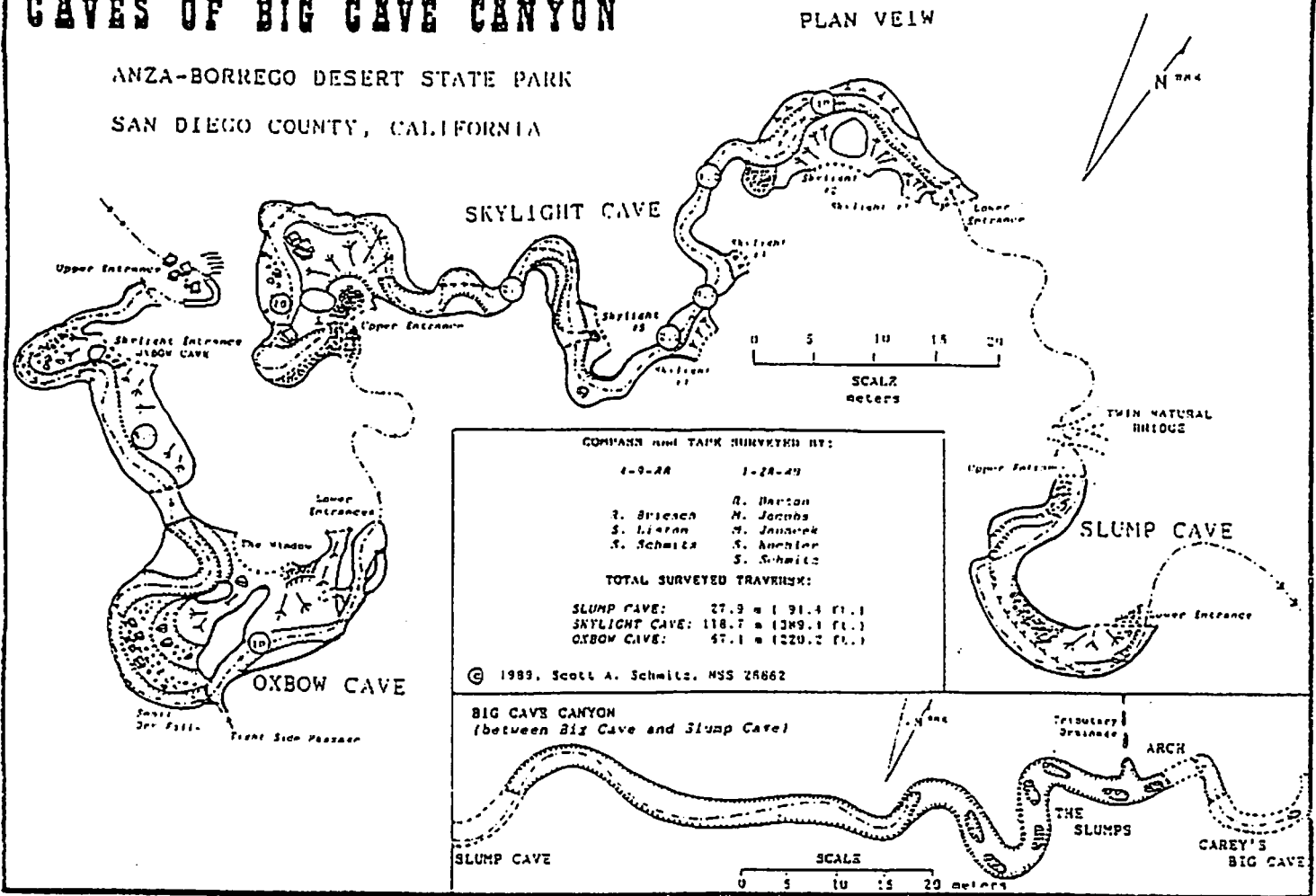
TOTAL SURVEYED TRAVERSE: 334 ft., 102 m

TOTAL DEPTH: 38 ft., 12 m

©1989, BOB RICHARDS, NSS 13720.

CAVES OF BIG CAVE CANYON

ANZA-BORREGO DESERT STATE PARK
SAN DIEGO COUNTY, CALIFORNIA



E-Ticket

Located on the left wall several hundred feet into Chasm's blind valley is E-Ticket Cave, the most complex mud cave yet discovered. This mazy cave is a series of crawls. Close to the surface, roof collapse has forced the stream to carve new passageways, resulting in a 583 foot-long multi-level crawl box. Eventually, it pops through to a higher blind valley, making E-Ticket another through trip cave.

Carey's Big Cave

Back in Arroyo Tapiado again we come to Carey's Big Cave, some 1000 feet downstream from Chasm. This is another cave not visible from the arroyo, set back nearly 200 feet. The double entrances, one above the other, are eight and four feet high respectively. The lower entrance is the most commonly used and both join after 30 feet inside. Carey's Big Cave is truly big, both in length and volume. About 1120 feet have been mapped, but that length could be nearly doubled if one could get into the upper levels of this cave. During one of the ear-

lier grotto trips, Don DeLucia made a tricky mud wall climb to one of the upper levels. He had some difficulty finding a way back down without taking part of the cave with him. Like Chasm, Carey's Big Mud Cave has twisting meanders that form large chambers farther into the cave. One area contains mud palisades with mud stalagmites and stalactites formed under a driphole from a hanging tributary.

Small Caves of Big Cave Canyon

One short crawl toward the back of the cave gets you to another large blind valley with many more small caves and arches, the most interesting being Oxbow Cave, which is 220 feet long. Slumping walls have buried the stream, which has since carved a great subterranean loop through the hill. Just down canyon from Oxbow Cave is Skylight Cave, which has five skylights and is 389 feet long. Farther downstream one passes a double natural bridge just before reaching 91-foot-long Slump Cave. In between Slump Cave and Carey's Big Cave is an area with more skylights and arches.

E-Ticket

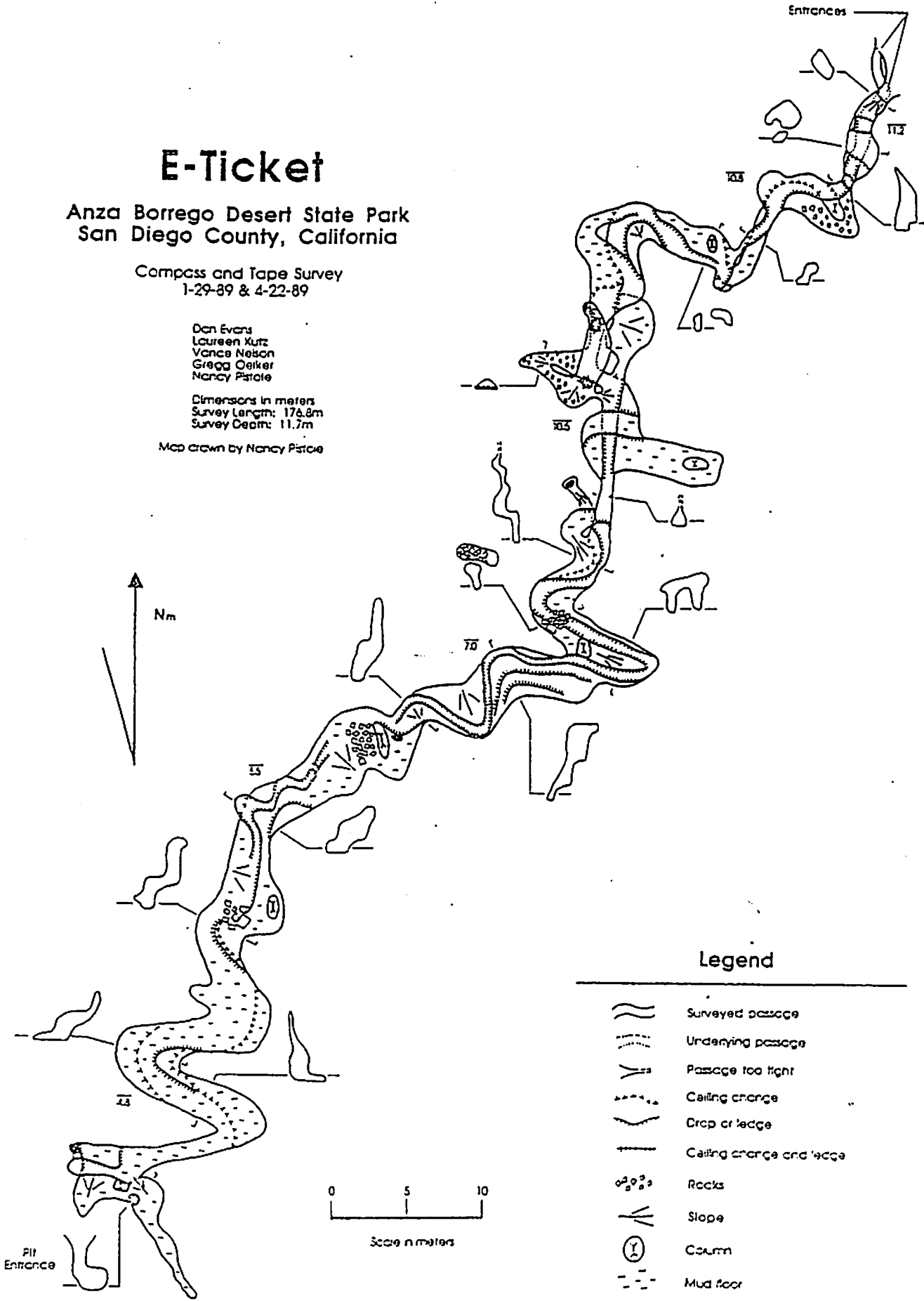
Anza Borrego Desert State Park
San Diego County, California

Compass and Tape Survey
1-29-89 & 4-22-89













Don Evans
Laureen Kutz
Vance Nelson
Gregg Oelker
Nancy Parole

Dimensions in meters
Survey Length: 176.8m
Survey Depth: 11.7m

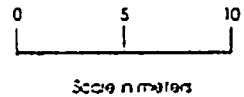
Map drawn by Nancy Parole



Legend

-  Surveyed passage
-  Underlying passage
-  Passage too tight
-  Ceiling change
-  Drop or ledge
-  Ceiling change and ledge
-  Rocks
-  Slope
-  Column
-  Mud floor
-  Skylight
-  Distance (m) below Pit Entrance

Pit Entrance



CAREY'S BIG MUD CAVE

ANZA - BORRERO DESERT STATE PARK
SAN DIEGO COUNTY, CALIFORNIA

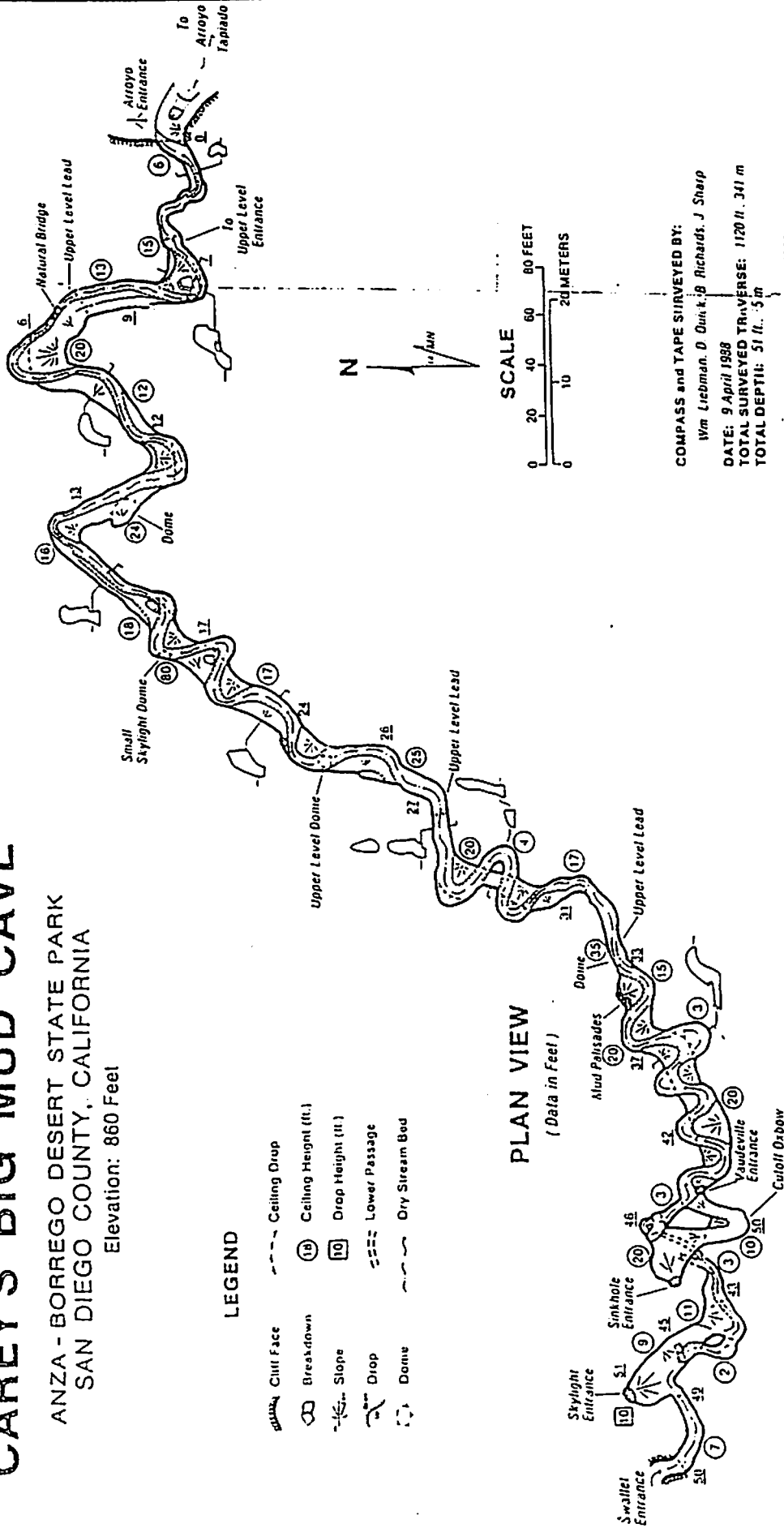
Elevation: 860 Feet

LEGEND

- Cliff Face
- Breakdown
- Slope
- Drop
- Dome
- Ceiling Drop
- Ceiling Height (ft.)
- Drop Height (ft.)
- Lower Passage
- Dry Stream Bed

PLAN VIEW

(Data in Feet)



COMPASS and TAPE SURVEYED BY:
Wm Liebman, D Quinn, J Richards, J Sharp
DATE: 9 April 1988
TOTAL SURVEYED TRAVERSE: 1120 ft. 341 m
TOTAL DEPTH: 51 ft. 15 m
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