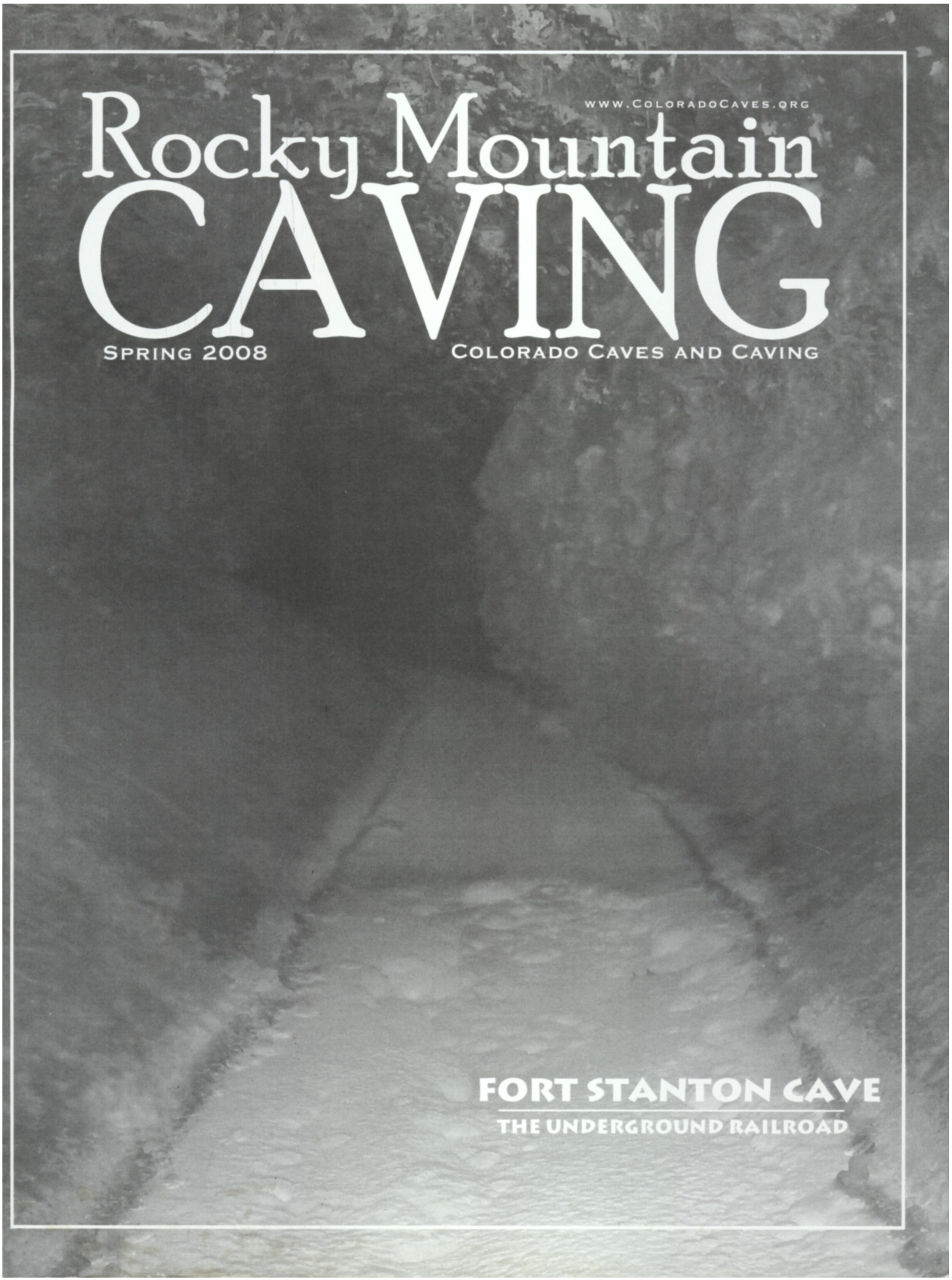


www.ColoradoCaves.org

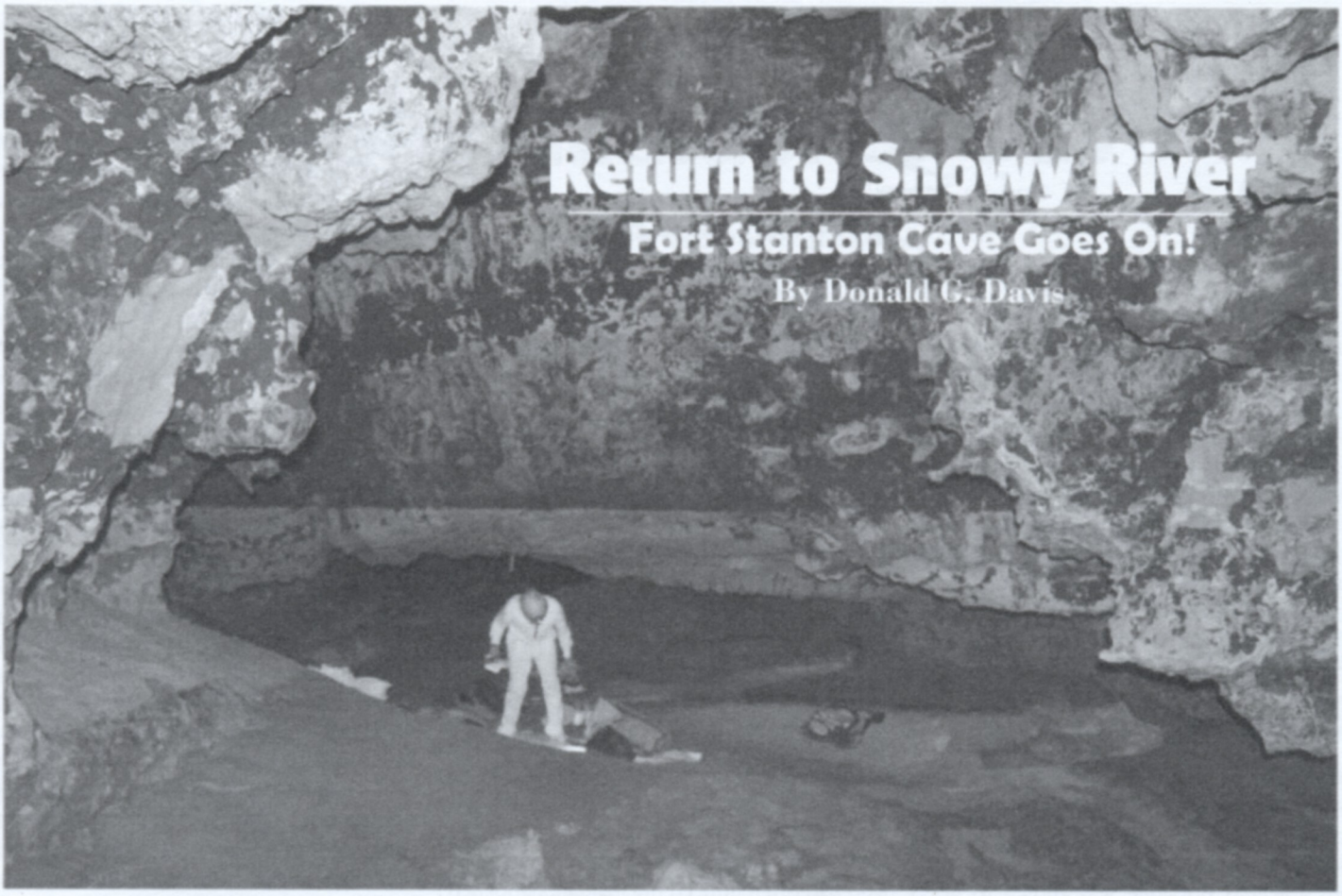
Rocky Mountain CAVING

Spring 2008

Colorado Caves and Caving

Fort Stanton Cave

The Underground Railroad



Return to Snowy River

Fort Stanton Cave Goes On!

By Donald G. Davis

"Deep into that darkness peering, long I stood there, wondering, fearing

Doubting, dreaming dreams no mortal ever dared to dream before..."

—Edgar Allan Poe, *The Raven* (1845)

The Fort Stanton Cave Study Group expedition of April 25—May 4, 2008 was finally able to get teams back to resume the survey of Snowy River South from station SRS108, the final point reached in October 2003. The results were very gratifying.

Some background for readers unfamiliar with the Fort Stanton project: Fort Stanton Cave, in south-central New Mexico, is the third-longest cave in the state, with more than 11 miles surveyed. Unlike other caves in the western U.S., it has long, sinuous galleries of the river-system type, resembling a simplified version of Mammoth Cave, Kentucky. Its recorded history dates back to 1855. The original cave was expanded by intermittent discoveries through the 20th century, mostly via digging through breakdown and mud chokes. The cave has been managed by the Bureau of Land Management from the latter 20th century to the present time, with most exploration and survey being conducted, under BLM agreement, by the Fort Stanton Cave Study Project led by John Corcoran.

The most rewarding excavation was the Priority 7 breakdown dig in the northern part of the cave, which broke through in 2001 to an intersection with a gallery having a unique floor channel lined with a strange bed of nodular white calcite. Exploration was delayed for two years while BLM prepared a management plan. Then in 2003, teams proceeded to explore. Unusual techniques were involved to minimize damage. It was impossible to walk far along the mud banks above the white channel without having to get off onto the continuous calcite. Plastic-sheeting changing stations were devised to switch between dirty and clean clothing and gear so that the channel itself could be walked on. Strips of plastic were cut, and as Snowy River was traversed, they were laid as walkways where there were problems keeping mud off the calcite.

The left branch, Snowy River North, led northeast toward the surface valley of the Rio Bonito; exploration stopped where a subterranean spring, Crystal Creek, came in (to protect native microbiology, BLM had forbidden walking through cave water). The right branch, Snowy River South, trended south-southwest farther underneath the ridges and canyons in the Permian San Andres limestone. Three survey trips in 2003 (documented in *Rocky Mountain Caving*, winter 2004) mapped this corridor more than a mile south to SRS108. The entire Snowy River complex—including a large phreatic tube, the Metro, and a tributary, Mud Turtle—had added more than three miles of surveyed passage to the eight previously known in FSC.

SRS108 was the best remaining lead; the passage continued two feet high but 25 feet wide, with strong airflow. We had anticipated resuming survey there in the spring of 2004,

Photo:

John McLean near SRS125. Note old waterline below which manganese has been removed.

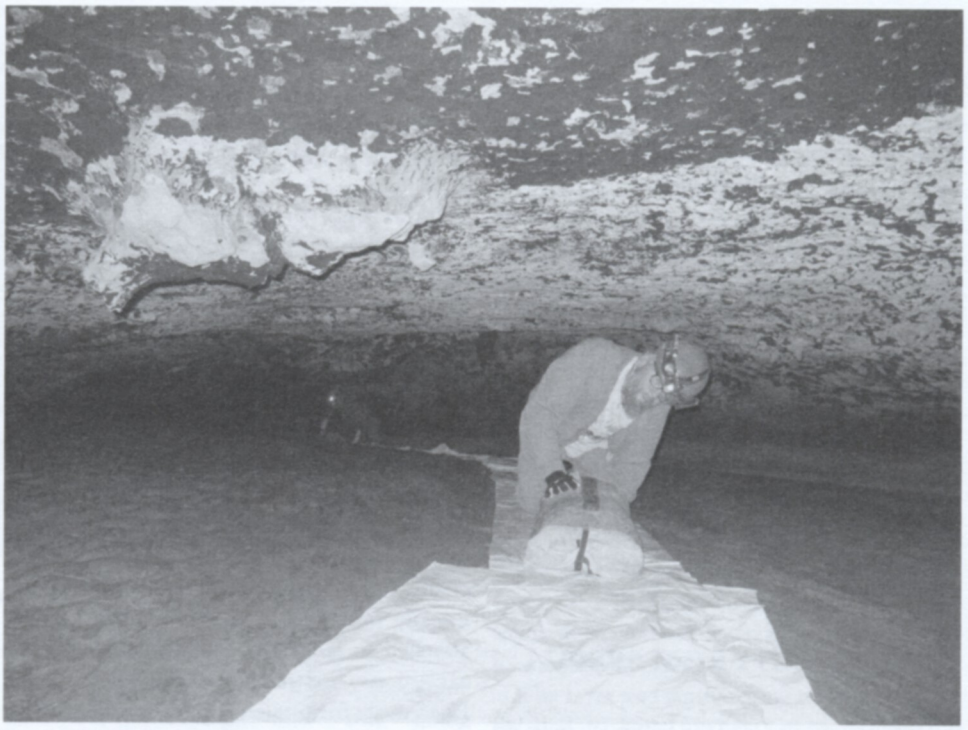
Photograph by Wayne Walker.

when the seasonal bat-hibernation closure of the cave was lifted. But in the meantime, BLM decided that the Priority 7 route was too dangerous to keep using, and closed Snowy River to exploration. However, survey had shown that the Mud Turtle passage ended beneath the breakdown of Don Sawyer Memorial Hall, in the old cave. A plan was devised to sink a hand-dug shortcut shaft between the two. The FSC cavers focused their energies from 2004 through 2007 on this challenging project.

Meanwhile, we had been thinking about the nature of the cryptic Snowy River calcite. Unlike most cave pool deposits, it had no shelfstone or rimstone margins, and thickened from the upper limit downward. (Recent cores reveal that the deposit is thickest on shallow shelf areas between deeper pools, and thinner, with more mud interbeds, in the deepest pools—see below.) The best explanation seemed to be that the channel had flooded intermittently with calcium-rich water, with deposition peaking as influx ended and the water level receded due to evaporation and seepage. We had no clear idea how long ago such flooding had last happened, though Dr. Victor Polyak obtained a date of about 150 years on a sample of the topmost calcite, a very young age for an apparently inactive speleothem. In a paper with Dr. Lewis Land, for the New Mexico Geological Society's 57th Annual Field Conferernce guidebook, I predicted in 2006 that "...the Snowy River calcite-deposition process is not extinct; the channel is probably only temporarily dry and could refill during the next sufficiently wet climatic period."

During this time, recognition of Snowy River's uniqueness had been growing. New Mexico Senator Pete Domenici's office had introduced a bill in Congress to make Fort Stanton Cave a National Conservation Area, with proposed boundaries encompassing an area somewhat larger than the cave as currently mapped.

After about 15 years of drought, the year 2007 in the Fort Stanton area proved to be unusually wet, with frequent heavy storms. In April 2007, the first group who entered the cave that year found water flowing through the northern part of the Main Corridor. The July FSC expedition found the water still higher—close to two feet deep at the Sewer Pipe/Skyscraper Domes junction—making for harder work getting to the Sawyer Hall dig. But the work continued, and during that expedition, after more than 40 feet of digging, the shaft broke through into Mud Turtle.



Donald Davis pushing pack along plastic path in crawl section of Snowy River South.

Photograph by John T.M. Lyles.

Project leader John Corcoran had secured BLM permission to resume Snowy River exploration if the July 2007 digging broke through. After it did, a reconnaissance team headed down Mud Turtle to check conditions. Would Snowy River also have reflooded, along with the Main Corridor? We had hoped that it might take much longer for Snowy River to respond to precipitation. But when our team reached the junction, we were greeted by a sight that no humans had ever before witnessed: the Snowy River channel was full, with clear water flowing silently and serenely northward, and little swirls casting shadows on the bottom from our lights. The keener-eared people could hear the faintest sound of tiny riffles up and down the passage. It was a charming, almost magical scene, but its implications dashed our hopes for exploration, and many expletives echoed along the passage from the mouths of frustrated cavers.

In less sensitive stream caves, explorers simply dress in protective clothing and plunge ahead through the water. For Snowy River, this was not an option. Aside from the prohibition of microbial contamination, it was evident that wading through the water would make waves (a phenomenon which the calm Snowy River had never experienced) that would slosh up onto the adjoining silt banks and tend to wash staining dirt down into the calcite channel. We also knew that the low sections in Snowy River South must be near-sumps, miserable to survey through in any case. We reluctantly resigned ourselves to wait until the passage dried out once more—which, for all we knew, might be years ahead.

However, after July, the rains around Fort Stanton began to decline. The next expedition, in early October, 2007, found the water in the Main Corridor starting to drop. More unexpectedly, Snowy River seemed to have been turned off. Water was still in the channel, but it was not flowing, and the level had dropped about two inches. A post-expedition recon crew to Turtle Junction in late October was even more surprised. Where the channel had still held up to a foot of standing water three weeks earlier, it was entirely empty! We hoped for a dry winter.

This time our wishes were fulfilled; there was little winter snow or rain in the area, and as the April 2008 expedition date neared, we anticipated that we might finally be able to try to extend Snowy River farther. In truth, we were better prepared than we had been in 2007, having had the winter to think about proper techniques, including more efficient clean/dirty gear switching. Project leaders also cut, in advance, many more plastic-sheeting strips to bridge vulnerable floor sections and speed travel through the

passage explored in 2003, as well as problem spots yet undiscovered.

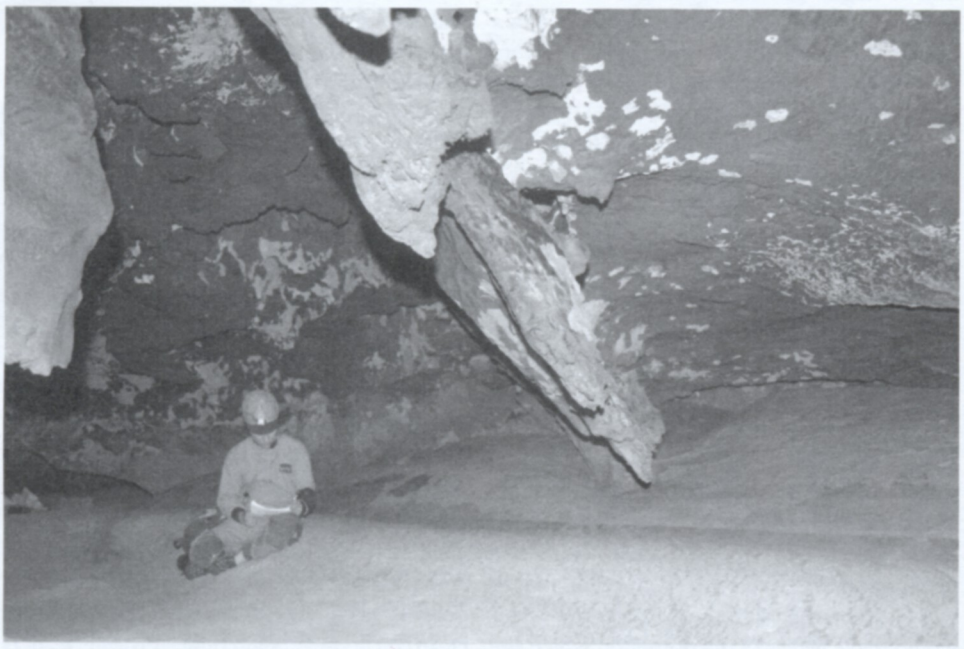
We had worn clean clothing and had taken mostly survey-gear rucksacks into the final length of crawly passage mapped in 2003, but now, we knew that we should take larger packs in the event that we broke into passage where we might need to change back to dirty gear. Some of us opted to keep our main packs clean through the Main Corridor and Mud Turtle by making shells of 3-mil contractor's trash bags with slits for the pack straps. Others took two switchable packs, or got ballistic-nylon shells or large nylon stuff bags. We all had boots for dirt, and non-scuff boat shoes or other rubbery shoes for clean wear, with either rubber over-slippers or spare shoes for places where only footgear needed to be changed.

ONWARD FROM SRS108

I was assigned to lead the first push team on Saturday, April 26, including Chris Andrews, John McLean, Henry Schneiker, Lloyd Swartz and Wayne Walker. After driving from the field house near Fort Stanton, we entered the cave at 10 a.m. The water had drained completely from the Main Corridor over winter; it was easier to see where we were stepping, but the deep mud was still wet and even stickier than when underwater, making high rubbers and hiking poles still desirable. Otherwise, we reached Turtle Junction uneventfully. There was a slight delay while John Lyles's preceding Snowy River North team was dressing on the changing sheet (other sheets were added later in the expedition). We were soon ready to walk south on Snowy River for the first time in 4½ years.

We were all wondering what changes might have happened along Snowy River during the flow surge in 2007. In 2003, not expecting flooding in the immediate future, we had marked a few vulnerable features in the channel with loops of plastic flagging tape. We soon found that some of these tapes had been washed downstream and snagged around calcite mounds. The blue survey station flags for SRS31 and 45 were also encountered on the floor. Station 45 was one of the few that had been set on a knob in the channel; 31 must have fallen from a ledge. Luckily, nearly all of the other stations were attached to ledges or ceilings, and with few exceptions, had remained intact since 2003. Even more fortunately, a proposed plan to lay a continuous flagging trail throughout all of Snowy River had not been implemented; the flood would have reduced it to a nightmare tangle of snagged debris.

We also tried to guess what might have happened to two- and three-foot-wide plastic strips that had been laid across silt banks, but whose ends dipped into the channel. These, it turned out, had all stayed in place, the only change being that the upflow corners of strip ends that dipped into the stream were typically folded under quite neatly.



Chris Andrews below sandstone (?) joint filling near SRS119.

Photograph by Wayne Walker.

As we proceeded along the gallery, we began to realize that Snowy River has unusual self-healing capacity. Along the four-foot-high ceiling section about a hundred yards before Independence Hall, I remembered that we had in 2003 knocked many bits of manganese coating onto the floor, not all of which had been possible to clean up from hollows between the floor knobs. All of these black spots had disappeared, as if by magic; it seemed that they had disaggregated in the 2007 flow and dispersed imperceptibly downstream, or been encapsulated in calcite.

After changing to dirty footgear and crossing the muddy Independence Hall breakdown, we approached the SRS60-64 zone where about four plastic strips had been laid *across* Snowy River to allow crossing with muddy shoes. We expected that these might not have stayed put so well. Indeed, we found that all of them had been washed away and snagged on knobs, but none here, apparently, traveled more than a few yards. We were able to recover and re-use these. The mud lumps that had been on their upper surfaces had, like the manganese chunks, melted away, and left no obvious stains downstream. This, I suppose, is not very surprising, since the tiny volume of such mud, distributed into millions of gallons of water, is negligible in comparison to the extensive calcite surface downstream from these locations.

Equally interesting was the transfiguration of bits of Tyvek cloth fibers that had gotten stuck on rough floor knobs. In 2003, white Tyvek suits had been tried experimentally as Snowy River clean garments, but proved too fragile; pieces readily wore off onto the floor, and not all were picked up. Now we saw that a number of these fiber tufts had gotten visibly encrusted with calcite, making them look like little tangled bristly speleothems. All submerged plastic, not only Tyvek, had accumulated calcite crust during the flood, in some cases thickly enough to form opaque white flakes stiff enough to peel off intact. The extent of new calcite deposition surprised all of us. Presumably a fresh layer was also applied to all of the natural floor.

We continued from SRS64 along the walking passage, laying additional plastic strips along silt floors where it had formerly been necessary to change to dirty footgear or crawl around low meanders. We snacked at SRS98, beyond which the route ducks to the right through a crawl around a pillar, and most of the ceiling lowers to heights requiring hands-and-knees crawling for several hundred feet. Travel here required more

"Mud Lizard" clay mound.

Photograph by John T.M. Lyles.

work; large packs had to be removed. They could be jerked along by hand, but the fabric was being sawed through by the sandpaper-like calcite floor. We found that rolling packs, though perhaps a little slower, was more efficient and less damaging. Some of the team even tried rolling through themselves, an odd mode of locomotion that I personally found impractical.

About 5 p.m., seven hours into the cave, we reached the legendary station SRS108—the end of survey in 2003, and the most remote known place in Fort Stanton Cave. We rested briefly and prepared to begin surveying. This was the moment of truth. The ceiling beyond here lowered to two feet. We had spent 4½ years with uneasy thoughts. After another shot or two, would the space pinch down to six inches high? If it didn't quite become impassable, would we need to lay hundreds of feet of plastic to keep dirt rubbed off the ceiling from staining the floor? On the positive side, we had at least not encountered any inconvenient left-over pools of floodwater anywhere along Snowy River South. And the cave wind was blowing enticingly.

Shaking off these musings, I took the survey tape and began crawling in to set SRS109. Ahead it looked as if the ceiling was getting lower, but as I went on, it never really did; it was just that I could see so far forward that there was an illusion of lowering. It was easy to avoid rubbing the ceiling, which was in any case mostly clean rock, with manganese only in higher pockets. By and by I was suddenly halted by the tape running out at 100 feet, still well within sight of station 108; I had to back up to 99.8 feet. The next shot was 88.6 feet. I began to feel that things were going to be all right.

As it happened, these first two shots encompassed the lowest section of crawlway we would encounter. Beyond, the roof gradually rose until the travel was again mostly on hands and knees, with occasional short bits of crouching and even walking, and still going south-southwest. Most of the shot lengths continued between 50 and 100 feet. At SRS117, the direction turned more nearly west, but within a few more shots it curved back to the original trend.

At about SRS124, the ceiling suddenly rose higher, and small domes and crevices appeared in it—even possible ceiling leads. Locally, fins of insoluble siltstone protruded from ceiling joints, separating the space into chambers. Several feet up the walls was a distinct "bathtub ring," below which much of the manganese coating had been washed off. In a little hollow on the floor were several old, encrusted calcite rafts, up to five inches across, embedded edgewise—the largest we had seen in all of Snowy River. We had already been noticing a subtle change in the floor: the Snowy River calcite was slowly becoming less white as we went upstream, and streamers of fine silt began to appear on parts of it. It seemed that some significant change was taking place.

At SRS126, the passage widened to about 30 feet, and something startling happened. The calcite channel abruptly split in two and turned left, with both forks coming from sub-crawlway-sized holes at the foot of the left wall. Someone in the team immediately dubbed these the "Snowy River springs," though I had a feeling that we had not yet found the end of Snowy River. The walking passage continued with a 45° turn to the right. At the beginning, this had a narrow calcite-lined floor channel about 20 feet long, probably a backwater from the Snowy River spring outlets; inflow from beyond had eroded a deeper, wider trench beside this channel, leaving its right side perched as "inverted terrain." This spacious passage went on south about 200 feet, with signs of flowing water on the floor, but no more calcite. Then at station 129, the horizontal passage ended where a pile of massive breakdown sloped down at a 40° descent from the left. At the junction was a peculiar bedrock speleogen resembling a giant rock lobster claw.

The hour was approaching midnight, so we decided to limit further survey, putting on dirty footgear and taking one more shot to station 130, 45 feet up the breakdown into an enlarging room. Henry and I walked another 50 feet up a gentle rise to the top of the breakdown mound, where we could see most of the chamber. It was about 50 feet wide, but the ceiling was not far overhead. The main trend went south, with the breakdown canted into a large void slanting down to the left (east). To west and north, the room was bounded (after a fashion) by open bedding planes. This was the first large collapse feature we had seen since Independence Hall, and I thought of the name Two-Way Hill (after Three-Way Hill in the original cave). The air

"Rock Lobster" speleogen.

Photograph by Roger Harris.

was moving into it. Whether we could find a way onward was not yet clear.

We had surveyed more than 1,300 feet of virgin cave, and began the tedious pack-rolling return journey toward the entrance. The slowest of us took nearly seven hours to get outside, stumbling with fatigue through the main corridor, and having spent 21 hours in the cave.

I took two temperature readings with my Taylor alcohol thermometer in the new passage segment; both were about 56.5° F. This conflicts with a 58° reading I had obtained in 2003 before SRS108 with the same instrument; other thermometers should be brought on the next visit.

We learned at the field house that John Lyles's climbing lead in Lincoln's Bathtub, near the end of Snowy River North, had gone nowhere, but they did find a walkup slope that led into a 498-foot-long segment of big borehole above the northeast part of Snowy River North, with windows down into Snowy River—perhaps an extension of the Metro phreatic tube farther southwest. They called this the Tulip Garden, because it had many large calcified splash cups around which the soil had been eroded, creating features resembling giant fossilized tulips. Contrary to the situation in SRS, the team found in SRN a number of pools of water left over from the summer flood, some of which were difficult to get past. They also found more numerous tangles of transported, calcite-encrusted flagging tape, some of which may have been used nearby, but some also perhaps washed long distances from Snowy River South.

ONWARD FROM SRS130

On the optimistic assumption that the April 26 trip would end in going cave, John Corcoran had scheduled the next trip for Tuesday, April 29, with me as leader again. Having lately turned 70 years old, I needed the intervening day and a half to recover and clean my gear, but was then ready to go again. Our sketcher from the first trip, Chris Andrews, had suffered bad back pain and didn't feel up to going back in. To replace him we recruited John Lyles, who had made a special drive back from Los Alamos to attend the Tuesday trip. The team was filled out by Roger Harris, Henry Schneiker, and Lloyd Swartz. We now knew that we had to take full dirty-caving gear to proceed through the Two-Way Hill breakdown, so our packs were even larger this time.

We got a little earlier start into the cave, at about 9:15. I was surprised that we reached the end of survey in only five hours this time, probably mostly because the additional plastic we had laid made the trip substantially faster and easier, as well as our being more accustomed to the route. At SRS126, we reached a changing sheet we had set up on Saturday, added more sheeting to it, and got back into dirty clothes. We proceeded to extend the survey across Two-Way Hill, with a right-hand side shot into an open bedding plane, and angled down into the large left-hand void that was the most obvious direction to map. This required walking along a somewhat exposed breakdown ledge, below which the slope went down into a slippery mud funnel that Lloyd likened to an ant-lion trap, with a three-foot-wide, triangular hole opening to the south from the bottom. Henry cut some mud steps to descend safely, and we approached this possible gateway.

A few yards upslope from this opening, I had noticed what seemed to be a calcite-coated spillover point from the funnel into rubble at the edge of the breakdown. This suggested that we might be returning to the Snowy River watercourse. On looking into the triangular orifice, I saw that it immediately opened into an ongoing, undulating south-trending bedrock tube, about six feet wide by four high, with a very wet floor of cracked mud. On a wet rock projection just above the opening, on the outward side, was a tiny hollow holding a shallow mini-pool about 1½ inches wide by 2 long—the first water we had seen in all of Snowy River South. I set SRS136 in the orifice, and the party moved into the tube. On the floor not far inside was an elongated bulge, covered with scale-like mud plates, that Henry dubbed the Mud Lizard—which name we then started to apply to the passage. There was strong airflow from it.

Soda straws and manganese coating near SRS181.

Photograph by Jim Cox.

We did not realize it at the time, but as we passed into the Mud Lizard crawl, we were breaking a historical record. Since 1969, the southern limit of Fort Stanton Cave had been the southernmost point in the Lincoln Caverns extension of the original cave. Now Snowy River was going farther south.

It seemed that we had indeed returned to the Snowy River conduit upstream from the "Snowy River springs," but with a very different aspect from any segment we had

seen before. This section must have been a sump during the flood, filled to a level about 15 feet below the spillover. We surveyed about 140 feet of relatively short shots through it. The past presence of Snowy River water was indicated by sparse calcite knobs and crust on the walls and floor. The floor mud showed wide shrinkage cracks, partly infilled by newer mud which in turn had dried enough to crack slightly. This suggested repeated fillings and emptyings. Toward the far end, its height lowered to about 14 inches below a flat, curving ceiling that looked to me like a thin bedrock plate of blackish chert. I slid on my back underneath without touching it. Others contacted it, however, and found that it was not a rock surface at all, but a sheet of soft, wet manganese mineral that slimed them with black smears.

Above station 142, the passage suddenly turned up a steep slope of clean-washed breakdown, opening into a second breakdown chamber more than 50 feet long—still much smaller than Two-Way Hill. There was a two-inch-wide calcite "bathtub ring" in it at about the level of the spillover on the Two-Way Hill end of Mud Lizard. We shot up a rubble slope to hang SRS144 on the ceiling near the inner end of the room. The only apparent way out was a downslope under an overhang west of 144. The air was blowing from there, and a few yards downslope was what appeared to be the beginning of another section of Snowy River calcite floor, back above the sump level. Henry removed clothes and went down to check. A left-hand branch appeared to go into the breakdown, and was probably where the water had gone toward the Mud Lizard sump. To the right, a bedrock passage three or four feet high and several feet wide went upstream, southwest away from the breakdown chamber.

Because of this, a team member suggested that the the breakdown room be called "Return to Snowy River." After the expedition, however, I found that in 2003, that name had already been applied by Kevin Glover to the part of SRS just upstream from Independence Hall (though few cavers knew or used the name). As I write, the final name for the new room has not yet been settled.

This room had some oddities. Much of the floor looked pitted and water-washed, even well above the Snowy River level. Above those areas, the ceiling some 30 feet overhead was also clean-looking and riddled with solution tubes and crevices, below which there were many small heaps of sand on the floor. It appeared that intermittent water influx had been splashing from the ceiling openings. This led me to surmise that this room might be where the cave was crossing beneath Cave Canyon. Water runs down Cave Canyon only during storm runoff, when aggressive leakage could seep into the chamber below, though probably not enough to be a substantial contribution to the Snowy River flow. (This sub-canyon location was later confirmed when the survey was plotted.)

The Underground Railroad in Fort Stanton Cave.

Photograph by Roger Harris.

We set station SRS146 as far down the slope as we could get without muddying the calcite below, but we had not brought much clean gear from the other side of Two-Way Hill, and were not prepared to deal quickly with getting back onto the Snowy River surface. We would also need plastic to create another changing sheet in the rather constrained quarters where the calcite floor resumed. We therefore decided to end the survey with 548 feet, leaving the ongoing passage for the next trip. We went back to SRS126, changed again to clean mode, and left the cave at 5 a.m. On this trip the total time in cave was about 19 hours.

ONWARD FROM SRS146

The third SRS trip was scheduled for Thursday, May 1. I was not on it; I wasn't sufficiently rested or logistically reorganized to return so soon. That trip was led by John McLean, also acting as sketcher, and accompanied by Jim Cox, Paul Dunlap, Roger Harris, Rick Reynolds, and Allen Wright. Roger was the only one from the Tuesday trip who was ready to go back by Thursday. (Much of this section was contributed by John McLean.)

The team managed, with some difficulty, to lay out a suitable changing station. Once in clean outfits, they found that the passage kept going. It began as a wide but low duckwalk alternating with a hands-and-knees crawl trending generally southwest for the first 300 feet. The passage consisted of the Snowy River calcite from 4 to 8 feet wide meandering between bedrock walls and steeply-sloping mud banks. A low, muddy crawl trending due west was passed near station SRS157 where the main passage jogged abruptly to the northeast. It appeared that south Snowy River had intersected an older passage, as it became a "double-barrel" passage for about 70 feet, with a lower calcite-lined crawlway and a upper mud-floored walking passage adjacent to the south. The team laid strips of plastic over the mud to bypass the crawl without a change in footwear. At the end of this section the passage again made a right-angle bend and continued to the southeast to SRS164 where it turned east. Several east to northeast survey sights culminated in a bearing of 045 between SRS169 and 169. They were headed northeast!

The passage became a series of low pools floored with cemented calcite rafts and containing many mud-covered ceiling

pendants which had to be avoided. Finally, at station SRS172, the passage returned to a south trend and after a few more pools became a duckwalk. The passage size continued to increase to the south, changing into a 15-foot-high canyon. This is a straight gallery with two parallel dark lines running along the sides, along steep segments of mud bank at each edge of the channel, separating the lower part of the Snowy River deposit from an upper, smoother zone of rafts and calcite.

When I saw Roger's photo of this displayed in the field house, I exclaimed "That's the Underground Railroad!" Steve Peerman had exactly the same name strike him as we both viewed the picture. That name seems to have caught on, and may become its formal designation.

The Underground Railroad also sported some patches of Fort Stanton "velvet" consisting of small stalactites and draperies up to a foot long, the best-developed decorations of that type yet seen in Snowy River. Also, near the end of the survey, some silt has flowed onto the calcite from a small opening near the ceiling, too small to be considered an explorable lead. Dripping water has washed deltas of mud from the mud slopes onto the Snowy River deposit in several places, where it darkens the calcite for several feet downstream.

The team kept mapping until station SRS181, when midnight had passed, and they decided to turn back. At that point, they gathered at the last survey station, and stared hungrily into virgin walking passage where their combined lights showed only more blackness in the distance, and the wind was still with them. They had mapped more than 1,500 feet of new cave—the most productive trip of the expedition. They returned to the surface 22 hours after entering.

...AND ONWARD FROM SRS181?

The total survey from the three SRS trips was 3,414 feet, essentially all in a single passage. Viewed in profile, the last Snowy River segment aligns perfectly with the level of the section before SRS126, despite the interruption by the two breakdown chambers and the sump passage connecting them. Several possible side leads were passed at various places along the survey line, but none looks exciting, and their investigation will involve a clothing change for most of them; the main trend should still have top priority.

All three trips made inventories and took scores of digital photos.

A fourth trip for Saturday, May 3, had originally been scheduled, but was canceled. A qualified sketcher was lacking, and there was also a shortage of other participants who were capable of making the trip, not committed to other tasks, and who didn't need to be rested to drive home Sunday. The survey is to be resumed on the July expedition, but probably only three trips, each three days apart, will be scheduled. This may be the most that will be practical as the expeditions are presently organized.

The end of survey is now more than 1,000 feet farther south than the Engel Hill breakdown blocking Lincoln Caverns, the previous southernmost end of Fort Stanton Cave. The Underground Railroad, as far as it has yet been explored, is running parallel to the adjacent section of Cave Canyon's bed, not far to the west of it. If this marks a structural preference, it could continue for most of a mile in that direction, beyond which we can't predict with any confidence what will happen, though a turn toward the southwest looks most probable in relation to faults and potential past and present surface water sources. In any case, given the airflow volume, some kind of intersection with a system of larger passages still seems very feasible. A cross-connection to a continuation of Lincoln Caverns beyond its blowing breakdown is one scenario that is quite possible (although Lincoln Caverns is about 50 feet higher than Snowy River, and looks much older).

We have now seen much more of the Snowy River deposit, and observed previously-unknown aspects of it, but still have no evidence as to the ultimate source of the Snowy River stream, except for the geomorphic indications that the water comes from that general direction, and its source is not yet close.

However that may be, Snowy River has only gotten farther back under the hills, with the turnaround more remote with every trip, and there is no sign of any end impending. The present extension would have been difficult to reach had it not been for the Mud Turtle shaft eliminating the need to approach via Priority 7. As it is, a few more increments may be feasible with the present strategy, but beyond that, endurance will again become a serious consideration. Other strategies may become necessary, such as camping (which is problematic because no water source has been found).

THE SNOWY RIVER CORE SAMPLES

During the expedition, several other activities occurred, including more work on the bottom of the DSMH-Mud Turtle dig shaft; a visit by engineering students planning for the proposed drilled shaft nearby; some microbiological sampling by Diana Northup and colleagues; geological examination by Dr. Victor Polyak and Paula Provencio; and planning for a scheduled visit by Congressional aides and BLM state staff in July.

One special activity merits additional comment. Dr. Lewis Land (NMBGMR / NCKRI) had applied to take core samples of the Snowy River deposit several years ago, but political complexities at the time stalled action on this project. It was finally approved by BLM this year. Dr. Land successfully drilled out four one-inch-wide cores in Snowy River April 29, and another five on May 3, over a distance of about 2,900 feet along the passage. These are very interesting. He showed them in the field house; the following remarks are my impressions. They range from about 1½ to 3½ inches long, and all but one

Cores drilled from Snowy River calcite deposit by Dr. Lewis Land.

Photograph by Wayne Walker.

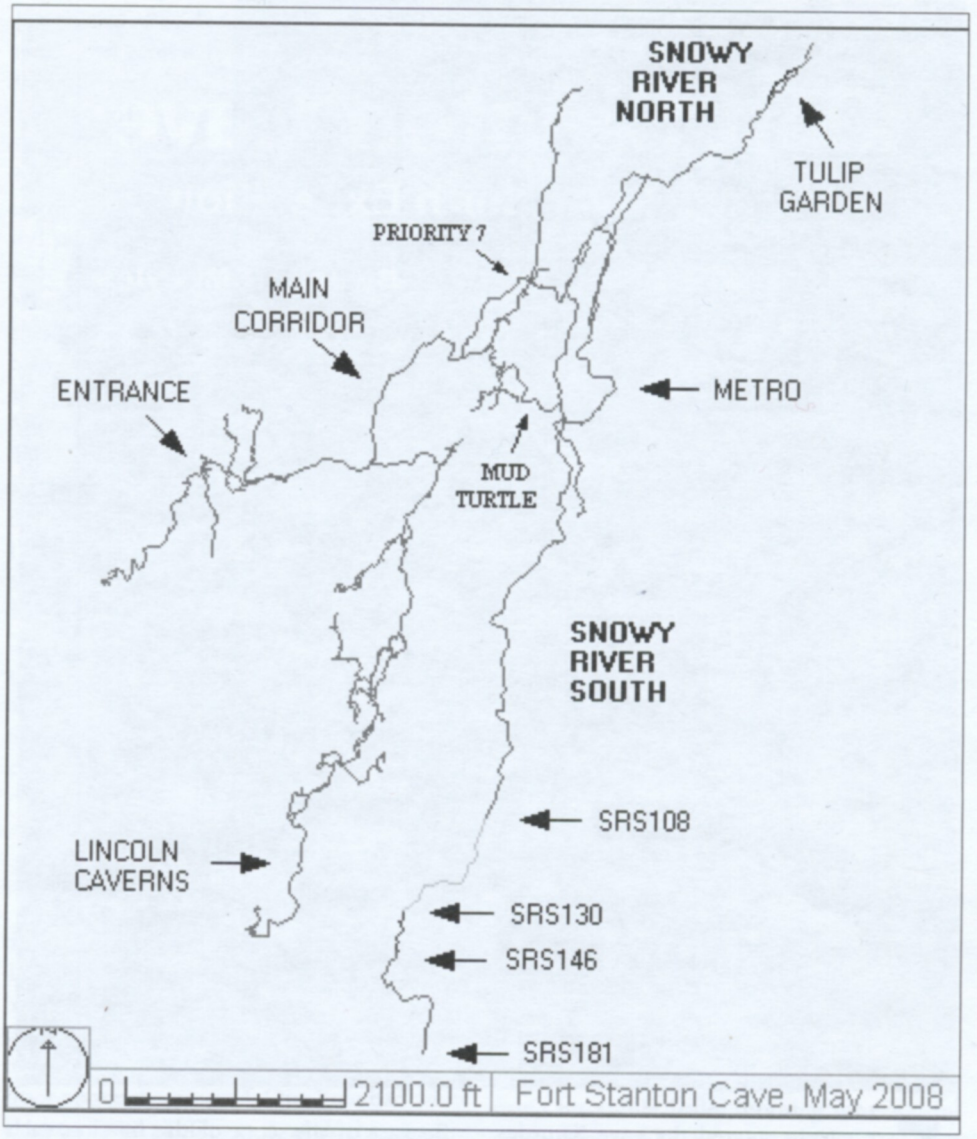
pierced the entire thickness of the deposit, which is not as thick as I had guessed.

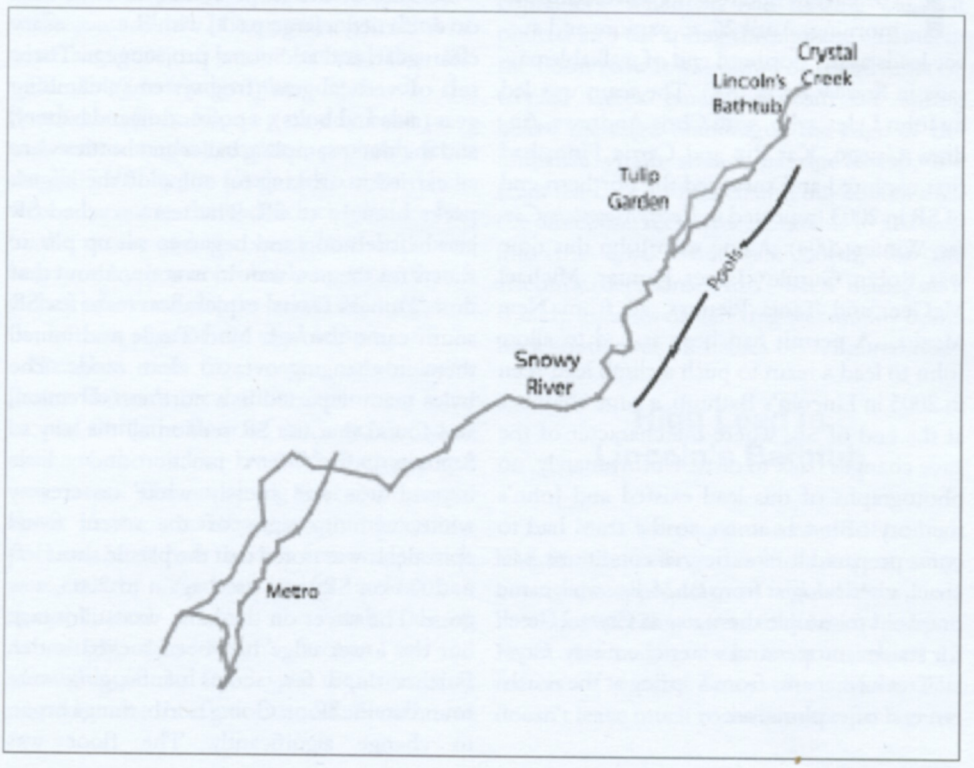
The cores show banding with differing colors and compositions, and the sequence is recognizably the same in all of them. In the shorter cores, which evidently represent slower deposition, the banding is compressed, but no major band is missing from any. One prominent marker is a thin, dense yellow non-calcite band about ¼ of the way down in the deposit. Another, nearly halfway down, is a thick, dark layer, composed of mud-stained calcite in the most dense core, but mud and gritty sand in less dense ones, two of which parted at this layer during drilling. This muddy layer could mark some one-time event such as breaching of a sinkhole pond into the source passage feeding Snowy River. Some of the cores are friable and full of cavities between clusters of radiating crystals that grew primarily upward. Water on these porous sections would readily seep into the sediment below, which is no doubt one reason why water does not stand long in most of Snowy River after influx ceases.

Most of the layers are darker than the one at the top; indeed, it seems that we are now seeing Snowy River at the cleanest time in its history (the basal layer being the next-whitest). Dr. Land (e-mail communication) is applying for funding for the following tests on the cores, for dating and paleoclimatic data:

- Stable isotope analysis (carbon-13 and oxygen-18) of individual laminae.
- Radiometric dating of individual laminae.
- Thin section analysis of individual cores.
- Paleomagnetic dating of the underlying mud.
- General chemistry of the cores, including measurement of total organic carbon.

Given the rapid calcite accumulation in the summer 2007 flood, the entire sequence may not represent a great length of geologic time (unless there were long hiatuses between periods of growth). ■





Maps:

Line plots of Fort Stanton Cave.

Plots courtesy Donald G. Davis.