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J. Michael Queen (1948 – 2019): A Memorial

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Dr. James Michael Queen of Carlsbad, New Mexico, passed away on August 20, 2019, from pancreatic cancer, at his family's home in Oak Hill, New York. He devoted most of his life to the innermost processes of speleogenesis. His other interests ranged widely, starting from a foundation in geology and paleontology and branching in many directions through the fine arts and humanities.

On the day of his death, he dictated these last few words to his family: ***Dear Friends, if you are reading this it means that the time on my ticket has expired and I have shuffled on. I don't know about the when or how of the return trip. As a bat perhaps, or a cephalopod? Or a new biothem [a speleothem built around organic filaments]? Watch for me soon!*** A close friend, Ron Kerbo (retired Cave Specialist at Carlsbad Caverns National Park), wrote a eulogy that concluded with: ***He showed us that to be rich is to never stop wondering....*** Ron and I collaborated on a remembrance of Michael for the November 2019 NSS News (National Speleological Society, USA). Here I focus on some of his more important work in the field.

Born in California in 1948, Michael grew up in New York State and obtained B.A., M.A., and Ph.D. degrees at the State University of New York at Stony Brook, with concentrations in biology and geology. Employment never ranked high among his priorities. He held many part-time jobs throughout the USA, mainly in college teaching and petroleum geology, which gave him the flexibility to pursue geology at his own pace.

In 1971 he interrupted his university studies to work for Shell Oil Company, near the cavernous Guadalupe Mountains of New Mexico. On his first caving trips there, he noticed that much of the limestone in the cave walls had been replaced by gypsum, which preserved the textures of the original limestone. This idea launched him on a 40-year study of Guadalupe caves, particularly Carlsbad Cavern. His first interpretation of the interaction between limestone and gypsum was presented at the 1973 NSS Convention and won an award for best scientific paper by a young student.

At roughly the same time, the concept of speleogenesis by sulfuric acid was proposed by Stephen Egemeier, also a graduate of State University of New York (New Paltz), from observations in the still-active Kane Caves

of Wyoming for his PhD studies at Stanford University. His work was published in 1981 and helped to steer Guadalupe researchers in the same direction. Michael and one or two fellow researchers (e.g., Donald Davis of Colorado) also considered sulfuric acid to be a factor in late-stage modification of the Guadalupe caves; but further observations convinced him that, in fact, most of the cave enlargement was the work of sulfuric acid.

Michael wrote few technical papers, but they described speleogenetic processes with unusual clarity. His interpretations tend to follow paths independent from other researchers. For example, he stressed the importance of cave enlargement by sulfuric acid **above** the water table long before the concept became well accepted. He was not the first to conceive of some of these concepts, but he expanded on them independently and helped to explain them to others.

A prominent feature in Carlsbad Cavern is a sponge-like zone of bedrock called the Boneyard, which was long considered an iconic example of phreatic dissolution. On the basis of morphology, air patterns,

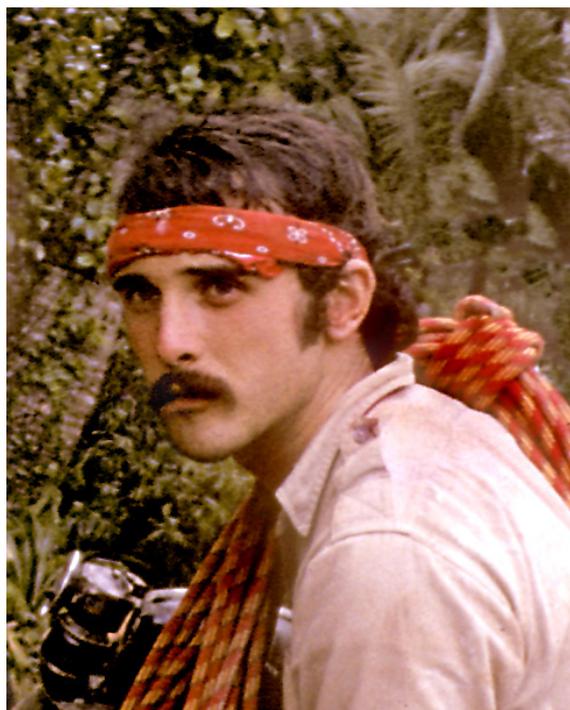


Fig. 1. Michael Queen working in the field, Bermuda 1974. Photo by Art Palmer.

and relation to other cave features, Michael claimed that this and similar dissolution features were instead vadose in origin. Specifically, they were formed by sulfide-rich water rising from depth and releasing H_2S into the cave air. The H_2S is absorbed by thin moisture films on the cave walls, where it is readily oxidized to sulfuric acid, the main driver of local cave enlargement. One corollary is that the air movement needs to be cyclic, passing from, and to, other parts of the cave. In fact, the Boneyard was found not to be a local feature, but instead a connection between the Big Room level and lower cave levels. This idea came from Michael's standard procedure of following trails of air movement, using diagnostic clues, such as distinct levels of dissolution and flared "ears" of corroded bedrock. The validity of this process has recently been documented experimentally elsewhere. Michael warned that caves that are still rapidly enlarging by these processes can be dangerous to one's health upon lengthy exposure without protective gas masks.

He accepted that H_2S oxidation could also play a role in **phreatic** speleogenesis, but only in a minor way because of the limited availability of dissolved oxygen and the fact that highly acidic water cannot be sustained in a carbonate aquifer. In the mid-1970s Michael also promoted the concept of speleothems produced by microbial activity (later named "biothems" by biospeleologists). This topic has flourished in recent decades.

Michael had an unusually clear memory for small geologic details in the caves he studied. Very few are shown on cave maps, but when asked for directions to any of them, he could usually sketch from memory their exact location and how to traverse the area without causing damage. His sketches started as crude lines that seemed to have little relation to each other, but which grew together like ice crystals on a pond, revealing ever-clearer details, and always in correct proportion, as in a jigsaw puzzle.

Most of Michael's publications were short summaries in conference proceedings, which did not draw the attention they deserved. His interpretation of Guadalupe speleogenesis was summarized in the proceedings of the 1994 Karst Waters Institute meeting in Colorado Springs, Colorado; the 2006 meeting of the New Mexico Geological Society in Carlsbad; and the 2009 International Congress of Speleology in Kerrville, Texas. He was reluctant to publish in high-profile journals with widespread readership, because he was still learning and exploring.

What was it like to go caving with Michael? He was a skilled and careful climber, with a gentle touch, and very protective of cave features. He wore any kind of clothes that were handy – tennis shoes, etc. – as long as they were clean and not abrasive. He became close friends with many Guadalupe cavers, particularly Ron Kerbo at Carlsbad Caverns. Their most memorable feats were climbs far above the cave floor. Along the main tour route they saw holes high above them lined with evaporative speleothems, which suggested strong air flow. They used helium-filled balloons to lift loops of parachute cord, maneuvered them over projections near the ceiling, and then pulled up a climbing rope.

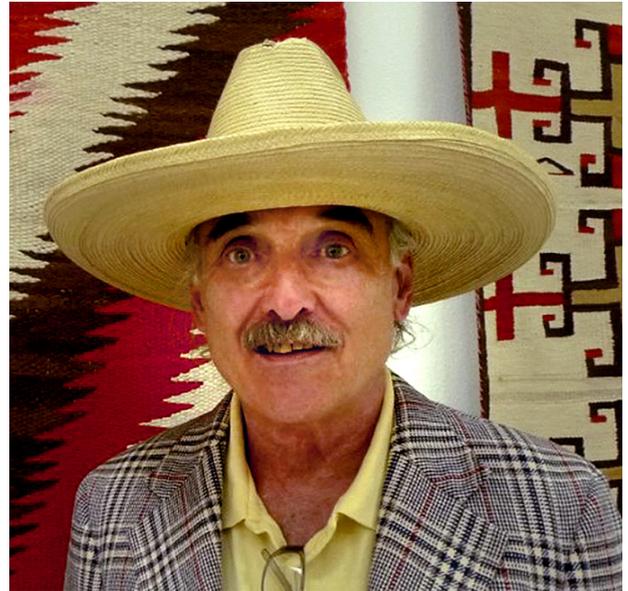


Fig. 2. Michael Queen at a photo lecture in Carlsbad, NM, 2011. Photo by Gosia Allison-Kosior.

Their greatest success was in the highest ceiling in Carlsbad's Big Room, nearly 80 m above the floor, which led to a major upper chamber. The rope is still in place along the main tour route, and although inaccessible, it is considered an attraction by visitors.

Meanwhile Michael became the founding member of a group of photographers that concentrated on large-format prints of caves and karst, which they called "Karst Features" (www.karstfeatures.com). He also wrote two geologic guides to the tours in Carlsbad Cavern that illustrate the many details that can be seen on a leisurely trip. The latest is listed below (Queen and Hose, 2006). His other publications were mainly short summaries in conference proceedings and guidebooks, which did not gain the attention they deserved.

A couple of decades ago Michael acquired an old house at the foot of the Guadalupe Mountains in Carlsbad, New Mexico – "the Hacienda" – which he used for storing his antiques and art treasures, and as a home for entertaining friends and visiting geologists. He was a welcoming host and superb cook. His health began to decline rapidly in the past few years, but he continued to help with caving and karst events. He made his last public appearance at the June 2019 National Speleological Society Convention in Tennessee. A gathering of friends was held on November 8 to cheer his final journey, as ashes, down a remote canyon in the Guadalupe Mountains. We regret his death but treasure his memory and the life he shared with us.

Significant recent publications by J. Michael Queen:

Few of Michael's publications are easily available, but some can be accessed through repositories on the Web, e.g., Karst Information Portal. A few of his recent and most accessible papers are listed below.

Queen J.M., 1994a - *Influence of thermal atmospheric convection on the nature and distribution of microbiota in cave environments*. In: Sasowsky I. & Palmer M.V. (Eds.), *Breakthroughs in Karst Geomicrobiology and*

- Redox Geochemistry*. Karst Waters Institute, Charles Town, VA, Special Publication, **1 (1)**: 62-63.
- Queen J.M., 1994b - Speleo-genesis in the Guadalupe: The unsettled question of the role of mixing: phreatic or vadose sulfide oxidation? In: Sasowsky I. & Palmer M.V. (Eds.), *Breakthroughs in Karst Geomicrobiology and Redox Geochemistry*. Karst Waters Institute, Charles Town, VA, Special Publication, **1 (1)**: 64-65.
- Queen J.M., 1994c - A conceptual model for mixing-zone diagenesis based on the hydrogeology of Bermuda. In: Sasowsky I. & Palmer M.V. (Eds.), *Breakthroughs in Karst Geomicrobiology and Redox Geochemistry*. Karst Waters Institute, Charles Town, VA, Special Publication **1 (1)**: 65-66.
- Queen J.M., Hose L., 2006 - *Trail guide to, and discussion of, the geology of Carlsbad Cavern: Main Corridor and Big Room*. Caves and karst of Southeastern New Mexico, New Mexico Geological Society, 57th Annual Field Conference, Socorro, p. 151-160.
- Queen J.M., Melim L.A., 2006 - *Biothems: biologically influenced speleothems in caves of the Guadalupe Mountains*. Caves and karst of Southeastern New Mexico, New Mexico Geological Society, 57th Annual Field Conference, Socorro, p. 167-173.
- Queen J.M., 2009a - Geologic setting, structure, tectonic history, and paleokarst as factors in speleogenesis in the Guadalupe Mountains, New Mexico and Texas, USA. In: White W.B. (Ed.), *Proceedings of 15th International Congress of Speleology*, Kerrville, TX, **2**: 952-957.
- Queen J.M., 2009b - Pre-drainage development of the caves of the Guadalupe Mountains. In: White W.B. (Ed.), *Proceedings of 15th International Congress of Speleology*, Kerrville, TX, **2**: 958-963.
- Queen J.M., 2009c - Post-drainage evolution of the caves of the Guadalupe Mountains. In: White W.B. (Ed.), *Proceedings of 15th International Congress of Speleology*, Kerrville, TX, **2**: 964-970.
- Queen J.M., 2009d - The Lost City: Hot springs, mixing, and a possible model for folia development. In: White W.B. (Ed.), *Proceedings of 15th International Congress of Speleology*, Kerrville, TX, **3**: 1650-1656.
- Queen J.M., 2009e - *Brine mixing as an initial stage of speleogenesis*. In: Palmer A.N. & Palmer M.V. (Eds.), *Caves and karst of the USA*. National Speleological Society, Huntsville, AL, p. 280-282.
- DuChene H.R., Palmer A.N., Palmer M.V., **Queen J.M.**, Polyak V.J., Decker D.D., Hill C.A., Spilde M., Burger P.A., Kirkland D.W. & Boston P., 2017 - *Hypogene speleogenesis in the Guadalupe Mountains, New Mexico and Texas, USA*. In: Klimchouk A., Palmer A.N., De Waele J., Auler A.S. & Audra P. (Eds.), *Hypogene karst regions and caves of the world*. Springer International Publishing, Cham, p. 511-530.
- https://doi.org/10.1007/978-3-319-53348-3_31