Program

2020 NSS Virtual Convention

July 2020

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National Speleological Society
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Front cover: The photo is by Nikki Fox and was taken in Shoveleater Cave in Pendleton County, West Virginia. The photo is at the first drop climbing out of the E-series route, the trade route to Hellhole. Shoveleater is a highly technical cave with lots of ropework consisting of hanging rebelays, redirects, J-hangs and horizontal traverses. SEC visitation is managed by the Germany Valley Karst Survey.

Contents

Welcome to the 2020 NSS Virtual Convention!

Dear NSS Friends and Others,

We are so glad you are making time to join us in what is a first for the NSS. We hope you enjoy watching the session presentations and attending the live meetings.

We tried to replicate the schedule of the in-person convention. Each day, the videos for that day will go live at midnight-oh-one. You click on the title and it should take you to the video. Simple.

Simplicity was the name of the game when we started this big adventure. We tried to make it simple for presenters to offer their expertise and for you viewers who can pick and choose which videos to watch. The simple beauty of this virtual convention is that you don't have to choose between two (or more!) excellent presentations—you can watch them all at your leisure!

The schedule is online at nsscon2020.org, as well as in this virtual program.

We'd like to thank our staff—both for the in-person convention that got postponed and the virtual staff who helped make this virtual convention happen. We could not have done it without you!

And we'd like to thank YOU, who have supported and encouraged us with this big adventure.

Enjoy!

Rich Geisler and Meredith Hall Weberg

2020 NSS Virtual Convention Co-chairs

2020 NSS Convention Staff List

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Co-chair	Meredith Hall Weberg
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	Tony Canike
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Radio System Manager	Dave Field
Alternate Radio System Manager	Earl Suitor
"Help Line" Coordinator	TBD
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Cave Rescue Liaison	Bru Randall
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Facilities	Dave Field Bert Ashbrook
Signage	Jacque Harris
Geology Field Trip	George Dasher Rick Lambert
Guidebook	Meredith Hall Weberg
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Grounds	John Harris
Ice	Mike Oatney
Plumbing	Jim Forsythe
Roustabouts	Larry Harnatkiewicz
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Cave Trip Coordinator	TBD
Sign Out/In (at campground)	Mike Oatney
Decon Station	TBD
First Aid	Steve Mosberg
Howdy & Campground Parties	Sarah Mosberg Sarah Richards Judy Koon Kristen Matak Mary Ellen Smith Meredith Hall Weberg
Brew Crew	Scotty Baker
Satellite Registration	Dave Fricke Bobbi Seng Kat Crispin
Security	Grant "Patch"' Adams
Wild Side	Brian Cunningham
Volunteer in General	Susi Weston

Jim Justice

Governor of West Virginia

2020 National Speleological Society Convention

Dear NSS Attendees:

I am extremely happy and proud to hear that Elkins has been chosen as the destination for the 2020 National Speleological Society Convention. This is the third time this event has been held in Elkins and I am honored to have the opportunity to welcome you back to the great state of West Virginia!

As an avid outdoorsman myself, I am truly inspired by the breathtaking beauty of our great state every day. I've said for years that living in West Virginia is truly like living in paradise. We are blessed with natural resources that are as good as it gets anywhere in the country.

Please do not hesitate to reach out to my office if you need support during your visit. Whether this is your first time in West Virginia, or you're returning for another visit, please consider this your home among the mountains. Cathy and I hope that you enjoy your stay here in *Almost Heaven*.

For tips on things to and places to see during your stay, I encourage you to explore our tourism website at www.wvtourism.com.

Sincerely,

Jim Justice
Governor

State Capitol | 1900 Kanawha Blvd., East, Charleston, WV 25305 | (304) 558-2000

It is an honor and a privilege to welcome you to the 2020 National Speleological Society Convention on behalf of the City of Elkins. In case you have not been in Elkins recently, look for the many changes in our city! There are a lot of new businesses in the downtown area and a lot of the older businesses have made changes and grown. It is an exciting time in Elkins!

Our town has rich traditions and exciting entertainment for our visitors who come to Elkins, and I know I can speak for the Elkins Common Council and all Elkins residents when I say that we are so grateful for the hard work that makes this all possible.

We'd like to thank the citizens and business owners- not only for the effort they put into showcasing Elkins but also for the hospitality and friendliness they show to all visitors, throughout the year. We'd also like to thank the volunteers who show such dedication and pride as they work to transform Elkins into a place that's fun and inviting to everyone around us.

Finally, we'd especially like to thank our guests for visiting Elkins. I hope the National Speleological Convention will be a memorable event for you and that those memories will bring you back again and again, for our many other festivals, cultural events, and outdoor recreational opportunities. Our home is your home, and our door is always open to you.

Sincerely,

Van T. Broughton

Van T. Broughton
Mayor

Randolph County Commission

Commissioners

David L. Kesling **Chris See** **Mark D. Scott**

National Speleological Society

Dear NSS attendees:

We are excited and pleased that you have chosen our area in Randolph County West Virginia as your destination for your 2020 Speleological Society Convention site. Our County has many points of interest which we hope you will have time to explore and enjoy. We hope you have a safe and wonderful experience during your stay here.

If we can be of assistance in making your convention more enjoyable, please do not hesitate to reach out to us.

Best Regards,

David Kesling, President

Randolph County Commission

4 Randolph Avenue - Suite 102 - Elkins, West Virginia 26241 - Phone (304) 636-2057 - Fax (304) 630-1125
randolphcountycommissionwv.org

Elkins Depot Welcome Center CVB, Inc.

Elkins-Randolph County Tourism, CVB

315 Railroad Avenue, Elkins | West Virginia

(304) 635-7803 | elkinswelcomecenter@gmail.com
(304) 940- 2795 | elkinsrandolphtourism@gmail.com

WELCOME TO RANDOLPH COUNTY!

In June of 2019, we had the pleasure of meeting many of you at the Cookeville, Tennessee National Speleological Society (NSS) Convention. Back in 2018, we started talking about you coming to Elkins, West Virginia and we have been anxiously awaiting your arrival to Elkins and Randolph County. We hope that you are as excited about being here as we are to have you as our guests in our beautiful county.

For those of you that have not experienced the beauty that West Virginia has to offer, you are in for a real treat. These exquisite mountains are full of history and the arts that we love to share with visitors like you. The wide array of locally owned eateries, unique shops, and even a few micro-breweries are waiting to be explored. The Monongahela National Forest is at your doorstep with a wide variety of hiking and biking trails and fishing spots that you have to experience. On top of (or perhaps we should say below) all these exciting opportunities, Randolph County has over 500 caves, which many of you will get to explore.

Within the City of Elkins, you will find Thursday night music at the Rotary Amphitheatre in Town Square, classic cars by the Depot Welcome Center, excursions trains, the Gandy Dancer Theatre, plus several parks and walking trails. For additional information on any of Randolph County's communities, lodging, activities or restaurants, go to www.elkinsrandolphwv.com.

We hope that you have a delightful visit and make many memories that will entice you to return some day to this wonderful area we are lucky enough to call home.

Yours sincerely,

Anne F. Beardslee

Anne F. Beardslee
Executive Director

Taira Landavere

Taira Landavere
Director of Marketing

How to Attend the Virtual Convention

Viewing Recorded Presentations

When the Virtual Convention begins on July 27, 2020, the convention website [https://nsscon2020.org] will have presentations available each day. All you will need is your laptop, smart phone, or tablet. On the Web site you simply "click on" the title of a session or presentation, and it will take you to either a page with all that session's offerings or to the presentation itself.

There are also buttons on each page to help you navigate around the website. There are at least two ways to get somewhere.

All-Week Events

On Monday, July 27, all the available week-long events—Cave Ballad Kiosk, Graphic Arts Salon, and T shirt Salon—will go live. These would normally be available throughout the entire week of Convention.

Don't forget to vote for your favorite Symbolic Emblem, T-shirt, or Graphic Arts! Voting for the Cavers' Choice Awards will be done by email to SalonsCmete@caves.org and begin at 8:00 a. m. East Coast time on Monday when all the salon galleries open for viewing. Include your name, NSS number, and which Salon piece that you are voting for. The categories are Video, Graphic Arts (PPB: Posters, Postcards, Stickers, Brochures and Cover Arts: Photographic and Non-Photographic), T shirts, and Symbolic Emblems.

Note that for the Symbolic Emblems Caver's Choice Award, please submit your name, NSS number, and the number of the entry found in the lower right of the slide/image via email to dandjdecker@gmail.com.

The Cavers' Choice Award voting starts at 8:00 a.m. on Monday, July 27 and ends at noon East Coast time on Wednesday, July 29. View all the entries on the website.

Daily Schedules

Also on Monday morning, the sessions that would have taken place that day at the in-person Convention will go live as prerecorded videos. These are:

- Opening Ceremony
- Communications and Electronics Session
- Cultures of Caves, Cavers, and Caving
- Digging Session
- State Cave Surveys Session
- West Virginia Exploration

Later, the live events happen. The Communications and Electronics Section will hold its annual meeting from 4 to 6 p.m.

Again, you click on the title on the Web site and go to the meeting.

Live Events Using Zoom

Most live meetings will use Zoom. Be sure to have the most current version of Zoom installed on your laptop. Download the free Zoom Client for Meetings [https://zoom.us/download#client_4meeting]. You can also join a live meeting via the phone; all links, phone numbers, and meeting IDs will be embedded in the live meeting title on the Web site.

Event Times

For the global audience, remember that **all times listed are US East Coast time**. Also, we chose times that were later in the evening to allow for folks coming home from work in the east as well as to not be too early in the west.

This will be repeated for each day of the Virtual Convention. You still have to wait for the day the session would have happened, but the beauty of the Virtual is you don't have to miss a presentation because it's at the same time as another you also really want to see.

Later Viewing

All of the Virtual Convention presentations will be on the NSS's YouTube channel after the convention is over. For all time. Free. How cool is that?

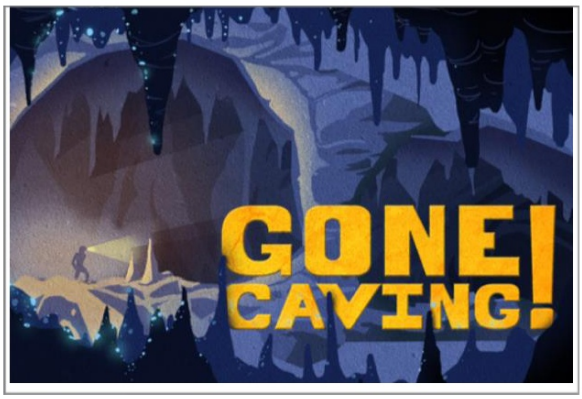
The Gone Caving! Card Game

The Gone Caving! card game will be played via a paid program called Tabletop Simulator available at [https://store.steampowered.com/app/286160/Tabletop_Simulator/], starting at 8:00 p.m. on Monday. (See the instructions for joining on the following page.) There will be three games with up to six people each, so join in early!

Gone Caving!

A Guide to Joining an Online Game via Tabletop Simulator

NSS Convention 2020!

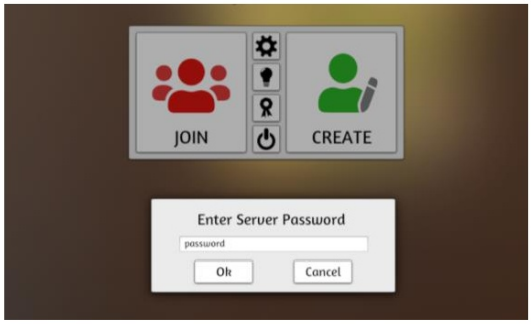


We are very excited to play Gone Caving with you. After installing Tabletop Simulator, you'll be able to search for a server and play online with the creators of the game, ask questions, and find out more about why we made this in the first place. Please join us and enjoy.

After Installing Tabletop Simulator

In order to join an existing server, you'll need to **search for "gonecaving"** and select from several numbered servers that are being hosted by members of the *Gone Caving!* development team. We are looking forward to seeing you.

After searching, select one of the servers with names like **"gonecaving_NSS_1"** and enter the password **"NSS2020"** to join a room. You'll see other folks in the room and they will help you if you have any questions.



If you are new to Tabletop Simulator, there are some things to familiarize yourself with (controls, etc.) but it's fairly intuitive and the interface is touch and click. Thank you for your patience and willingness to try this online. We hope to see you in person next year for a game.

Thank you!
The Gone Caving Team

Saturday, July 25

Note: All times are East Coast (U.S.) times

Board of Governors Meeting (open)

Live starting at 10:00 AM
Contact: Nathan Farrar

The Board of Governors sets policy for the management of the Society. This opening meeting consists mainly of reports from the officers and committees. The newly elected vice presidents for next year will be introduced. The agenda will continue with other items of business until noon.

The meeting is open to all members. Take the opportunity to observe the board members in action and learn some of the details of society business. Members may be allowed to speak on subjects of interest to them at the direction of the President or at the request of a Board member.

The morning meeting will be open and any NSS member is welcome to attend. Following lunch, the BOG's afternoon meeting will be a closed session that that will not be recorded.

Sunday, July 26

Board of Governors Meeting (open)

Live starting at 10:00 AM
Contact: Nathan Farrar

This open BOG meeting will be held only if there is business left over from Saturday's meeting.

Monday, July 27

Note: All times are East Coast (U.S.) times

Opening Ceremony

Recorded. Available for download at 12:00 AM
Master of Ceremonies: Rich Geisler

Join us for a brief welcoming ceremony to kick off the 2020 NSS Virtual Convention.

Gone Caving! A Card Game of Exploration and Discovery

Live, starting at 8 PM
Coordinator: Jared Embree

Gone Caving! is a card game for 2 to 6 people in which players of all ages explore a cave. Earn points for discovering passages, observing animals, and finding incredible geological formations. Overcome challenges by squeezing through tight passages or being prepared for an impending emergency. A hand of the game plays quickly, but the game is best played for several rounds.

Gone Caving! started off as a dream to introduce the world of caving to more people and what better way to do it than by spending time having fun with friends? We wanted to share parts of the beautiful underground world and the people who explore it with our friends in a fun and playful way.

The game has been designed, play-tested, and professionally illustrated, and we are shipping now! Our team has decades of caving experience and we are very excited to share *Gone Caving!* with the world. A portion of the proceeds from each deck sold go to the National Speleological Society (NSS) to support cave preservation and education and give back to protect caves for future generations.

For more information about *Gone Caving!*, visit www.gonecaving.com.

The game will be played via a paid program called Tabletop Simulator, which is not free, but it will be worth your time if you haven't already ordered a *Gone Caving!* card game, on Monday of the Virtual Convention from 8 to 10 p.m. (This software costs $19.99 unless you get it when it goes on sale, so watch for that!)

Communications and Electronics Session

Recorded. Available for download at 12:00 AM
Session Chair: John DeRoo

The Communications and Electronics Session covers all applications of electronics in caving, including surveying, photography, wired and wireless communications, lighting, data logging, and radiolocation. Amateur Ham radio may also be used in the pursuit of these goals. Informal talks and demonstrations will follow the formal presentations.

Data Transmission Through a Long Single Wire Phone Line

Brian Pease
(see abstract on page 23)

UHF Cave Data Communication Network for Fort Stanton Cave, NM

John T. M. Lyles
(see abstract on page 23)

Real Time Carbon Dioxide Monitoring System at Edgewood Caverns, NM

John T. M. Lyles
(see abstract on page 23)

Culture of Caves, Cavers and Caving

Recorded. Available for download at 12:00 AM
Session Chairs: John Wilson, Maria Perez

This session focuses on caving, including speleological research, as a cultural and historical activity. The session examines caving in the broader context of the history and culture of human-cave relations.

Caving and Caver Communities on a Hot Planet

John Wilson
(see abstract on page 26)

Introduction to Cultures of Caving: Broadening the Study of Humans and Caves
María Alejandra Pérez
(see abstract on page 26)

Safety Culture in College Caving Clubs
Riley Drake
(see abstract on page 27)

Post Kirkwood in Austin and San Antonio
Allan Cobb
(see abstract on page 27)

Environmental Education in Speleology: A Proposal for Elementary Education in Cuba
Dr. C. Jean Robaina Sánchez
(see abstract on page 27)

Digging Session
Recorded. Available for download at 12:00 AM
Session Chair: Benjamin Brown

The Dome 12 Dig Project
John Dunham
(see abstract on page 28)

Solving the Enigma of Engel Hill Inside Fort Stanton Cave, NM
John Lyles
(see abstract on page 28)

West Virginia Exploration
Recorded. Available for download at 12:00 AM
Session Chair: Nikki Fox

de Tour de West Virginia 2020
George Dasher
(see abstract on page 39)

The Survey of Cave Hollow Arbogast, Tucker County, West Virginia
Dave West and David Socky
(see abstract on page 39)

Germany Valley Bolt Climbs
Pete Johnson and Aaron Moses
(see abstract on page 40)

The Survey of Maxwelton Sink Cave, West Virginia
David Socky
(see abstract on page 40)

Communications and Electronics Section Meeting
Live starting at 4:00 PM
Meeting Chair: John DeRoo

The Communications and Electronics Section is for cavers interested in radio equipment and/or techniques and electronic gear specific to caving.

State Cave Surveys Session
Recorded. Available for download a 12:00 AM.
Session Chairs: Howard Kalnitz and Josh Brewer

The goal of the State Speleological and Cave Survey Roundtable is to share updates, best practices, and strategies, between the various State Cave Surveys throughout the NSS. Emphasis will be on the surveys themselves—state of the data, data collection, management and storage systems, and data access policies and procedures. Also important is sharing how to build relationships between surveys and governmental agencies who manage those resources.

The West Virginia Speleological Survey
George Dasher
(see abstract on page 33)

Caves of Minnesota
Nick Seaton
(see abstract on page 33)

Gerald Moni Uses QGIS
Jon Zetterberg
(see abstract on page 34)

Tuesday, July 28

Note: All times are East Coast (U.S.) times

Luminary Series I
"Reflections: Old Times, New Times, and Endless Adventure"
Philip C. Lucas (NSS 4820) (CM-CM-LB-FE)

Recorded. Available for download at 12:00 AM

Fortuitous poking around as a 7-year-old brought Phil Lucas into contact with a cave in his neighborhood. Then, at age 15, Phil was privileged to meet, and cave with, the legendary Oscar Estes. Oscar became a treasured mentor to Lucas and, along the way, introduced Phil to NSS founding president Bill Stephenson. Always on the lookout for new NSS members, Stephenson promptly got the young Phil Lucas signed up to the Society.

Phil Lucas' underground exploits are legion and include extensive poking, prodding, digging, excavating, exploring, and surveying in the Water Sinks area. This fascinating karst region is located in Highland County, Virginia; positioned at the north end of Burnsville Cove; the site of the Lucas retirement house; and the place where Phil first met his high school sweetheart, Charlotte. The Lucas-led initiative at Water Sinks resulted in many miles of fabulous cave being discovered, explored, and surveyed. In addition, a nature trail was developed in order to educate school groups and other members of the public about the value of caves as a resource. Deeming it appropriate to memorialize the vast amount of work done in the area, Phil Lucas published *Caves and Karst of the Water Sinks Area*, and he received a Certificate of Merit from the NSS for the result.

Phil is an accomplished and award-winning photographer and cartographer. Always curious about subterranean water flow routes, Lucas has performed dye traces—some of which have charted underground streams flowing beneath surface rivers. For instance, work published in 1977 demonstrated that the Blowing Cave stream passed under the Cowpasture River at several locations. Phil's associated interest in air currents spawned a unique method for measuring air flow between cave entrances. Working with collaborators Nevin Davis and Frank Marks, this procedure was published under the title "A Method for Detecting Cave Connections by Inducted Air Flow."

Phil has also had a long-term interest in the Culverson Creek area. Along the way, Lucas teamed with Roger Baroody to hook up Lower Fuller with Culverson Creek Cave. Believing that the earlier surveys could be improved, Lucas—along with Bill Royster and others—spent a decade pushing and mapping in the Culverson Creek complex. Putting miles of cave passage on paper, Phil became an expert on Culverson Creek and in the weather events that drive the water levels in this West Virginia river complex. When these cavers were done, Phil—in company with Bill Balfour and George Dasher—authored *The Caves and Karst of the Culverson Creek Basin*. This tome is populated with historic photographs, detailed maps, and a boatload of adventure.

Conservation and Management Session

Recorded. Available for download at 12:00 AM
Session Chairs: Jim Hildreth and Val Werker-Hildreth

The Conservation and Management Tuesday Talks include cave and karst conservation and management; minimum-impact, science-based decisions, stewardship; karst aquifer watershed protection; spelean habitat ecosystem findings; bat study updates; clean-caving ethics; WNS decon systems; as well as advancements in cave restoration, speleothem repair, and low-impact caving methods. Join us for lively speleological presentations and discussions exploring state-of-the art conservation solutions and current best practices.

Guads Caves: Restoration and Formation Repairs 2018–2020

Mike Mansur
(see abstract on page 23)

More Important Than Ever: Conservation Education During COVID-19
Dave Jackson
(see abstract on page 24)

Modeling Suitability for White-nose Syndrome Fungus in Texas and Mexican Karst Regions
Lilianna Wolf
(see abstract on page 24)

PULIAMO IL BUIO: Clean Up the Dark Conservation Initiative of the Italian Speleological Society
Ferdinando Didonna and Francesco Maurano
(see abstract on page 24)

Current Best Practices: Intro to Speleothem Repair
Val Hildreth-Werker and Jim Werker
(see abstract on page 25)

Who Will Be Dead After We Save the Bats?
Anastasia V. Pittis, Christopher I. Gallegos, Evan Lewis, Shane Johnson II, Kathleen L. Lavoie, Ivan S. Yates, Alice Chung-MacCoubrey, Eric Dinger, John Roth, Katrina Smith, Rickard Toomey, Jason Walz, and Diana E. Northup
(see abstract on page 25)

Kartchner Caverns State Park Lint Camp Management
Katherine Halter
(see abstract on page 26)

U.S. Exploration Session
Recorded. Available for download at 12:00 AM
Session Chair: Pat Kambesis

The U.S. Exploration Session presents exploration and survey conducted in caves and karst of the U.S.

Fantasyland: The West Edge of Wind Cave, South Dakota
Hazel Barton
(see abstract on page 35)

The Ouroboros Extension: Recent Bottom-up Exploration in Tumbling Rock, Alabama
Reilly Blackwell
(see abstract on page 35)

Aid Climbing and New Discoveries in Newberry-Banes Cave, Virginia
Reilly Blackwell
(see abstract on page 35)

A Sea Caving Voyage Around Santa Cruz Island, California, October 2019
Dave Bunnell
(see abstract on page 35)

The Mr. Toad Cave System
John Dunham
(see abstract on page 36)

Recent Exploration in the Otter Creek Watershed of Wayne County, Kentucky, USA
Lee J. Florea, Sarah Burgess, Chris Bauer, and Brian Devine
(see abstract on page 36)

Isla de Mona: Stepping New Paths to the North Cliff Caves
Tamara González Durán
(see abstract on page 36)

Scapegoat Cave System 2019
Daryl Greaser
(see abstract on page 37)

Turtles All the Way Down: Finding the Bottom of the US's Deepest Limestone Cave
Pete Johnson
(see abstract on page 37)

High Adventure in the Mystery Room of Carlsbad Caverns
Dwight Livingston and Mark Minton
(see abstract on page 37)

Exploration in Fort Stanton Cave, New Mexico—5.46 Additional Miles in 2019

John Lyles and Garett Jorgensen
(see abstract on page 37)

Project Update: CRF Mapping and Monitoring Project on the Buffalo National River

Kayla Sapkota
(see abstract on page 38)

The Best Cave Discovery in Texas in the Years of 2019–2020

Bill Steele
(see abstract on page 38)

End of The Line–Roppel Cave–Logsdon River

Mark Wenner, Jim Borden, and Pat Kambesis
(see abstract on page 38)

Studies Inside a New System of Glaciovolcanic Caves in the Crater of Mount St. Helens

Christian Stenner and Kathleen Graham
(see abstract on page 39)

Where the Dangers Are Double

Adam Weaver and Karl Emanuel
(see abstract on page 39)

Vertical Section Business Meeting

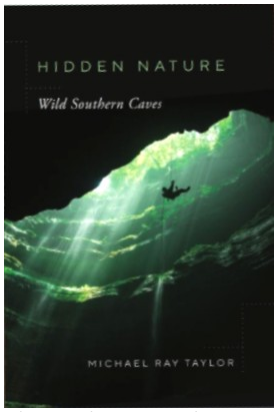
Live starting at 6:00 PM
Session Chairs: Gene Harrison, Mike Rusin

During the Annual Vertical Section Business Meeting, the membership will formally conduct the official business of the Vertical Section. This continues our 48-year Vertical Section tradition!

This meeting includes reports about the Section's financial posture, activities, new initiatives, and the annual election of Officers and Executive Committee Members.

Michael Taylor Book Signing

Live starting at 7:00 PM
Michael Taylor



Join caver, explorer, and author Bill Steele in conversation with Michael Ray Taylor about Taylor's new book, *Hidden Nature: Wild Southern Caves*. Beyond describing the majesty of the TAG region's wild caves and the concurrent joys and dangers of exploring them, Taylor examines their scientific importance, their relationship to clean water, and their uncertain future—and also the culture and personalities of TAG caving. This live event will be hosted by Speleobooks via Crowdcast, with special signed bookplates available and audience questions welcome. Check in early July for log-in details.

Lechuguilla Cartographers Meeting

Live starting at 8:15 PM
Meeting Chairs: Erin Lynch and Rod Horrocks

Lechuguilla Cave cartographers, expedition leaders, and other stakeholders are invited to attend the annual Lechuguilla Cave Cartographers Meeting hosted by Rod Horrocks and Erin Lynch. The meeting will be webcast for those unable to attend in person.

Wednesday, July 29

Note: All times are East Coast (U.S.) times

Luminary Series II
"Looking for Dye in All the Wrong Places"
William K. Jones (NSS 7934) (FE)

Recorded. Available for download at 12:00 AM

After graduation from high school in Fairmont, West Virginia, Bill Jones and a buddy set out on a much-anticipated road trip. The boys enjoyed a stop at Seneca Rocks and noticed a place on their map with the curious name Sinks of Gandy. They decided to check it out. Bill was mesmerized by a hillside that simply swallowed up a big surface stream. Two weeks later the guys were back with carbide lamp and helmet, and Jones began his career as a cave explorer.

Perhaps spawned by previous sightseeing at the Sinks of Gandy, Bill Jones became pretty jazzed about underground water very early on. The routes that water apparently pursued on its mysterious journeys seemed curious, unknown, and worthy of investigation. And, Jones was just the man for the job. Work at the West Virginia Geological Survey was followed by employment at the United States Geological Survey. Along the way, Bill did many water-tracing experiments in both Greenbrier and Monroe counties.

In 1984, Bill Jones edited a special issue of the *NSS Bulletin* (now *The Journal of Cave and Karst Studies*) devoted to water tracing. This followed his prior publication of numerous scientific papers, plus the 1973 monograph entitled *Hydrology of Limestone Karst in Greenbrier County, West Virginia.*

Although he sometimes thinks of himself as more of a hydrologist than a speleologist, Bill is no stranger to caves and hard caving. He discovered Sinks of the Run Cave, mapped Taylor Falls Cave, worked in Culverson Creek Cave and in Friars Hole Cave, and helped Bill Douty survey Bransford Cave. Along the way, Jones was a key player in three separate rescues in the wet, the vertical, and the dangerous place named Cass Cave.

As a proud West Virginian, Bill Jones believes that caving in his home state provides a classic feel in the birthplace of organized caving in America. The caves are great, the sinkhole plains are very much like those in Slovenia, and the scenery is unforgettable.

International Exploration

Recorded. Available for download at 12:00 AM
Session Chair: Pat Kambesis

The international exploration session features presentations on exploration, mapping, and studying caves outside of the U.S. Past presentations have featured caves from all over the world, including Central America, Asia, Europe, the Caribbean, South Pacific, and more! Emphasis is on current exploration projects.

Experiments in Autonomous Cave Exploration

Bill Stone

(see abstract on page 29)

From Conservation to Cave Mapping: A Scientific Expedition to Batu Katak, Northern Sumatra, Indonesia

Angel A. Acosta-Colón, Benny X. Bonet-Santiago, Joaquin Alonso Mont, Ruddy Anto Sinulingga, and Sedarta Sitepu

(see abstract on page 29)

The Invisible River

Sofia Oggioni

(see abstract on page 30)

Castleguard Cave: After 50 Years in Canada's Longest Cave, Exploration Continues

Christian Stenner and Kathleen Graham

(see abstract on page 30)

New Machine-learning Computer Program to Identify Unmapped and Obscure Tropical Cave Entrances Using Python, GIS and Lidar: Applying Geomorphometry to Automate Landscape Classification
Leila Donn, Tim Beach, Cody Schank, and Mike Mallner
(see abstract on page 30)

Into the Ice: Exploration and Science on the Greenland Ice Sheet
Matthew D. Covington, Jason D. Gulley, and David Ochel
(see abstract on page 31)

Mulu 2019 Expedition, Sarawak, Borneo
Derek Bristol and Hazel A. Barton
(see abstract on page 31)

Pink-eyed Cave Lobsters and Death by Dieffenbachia—Caving in Panama's Bocas del Toro Province
Joel Despain and Pat Kambesis
(see abstract on page 31)

More Rivers, Big Rooms and Grand Stal: The Fifth Expedition to Sultan Kudarat, Mindanao, Republic of the Philippines
Joel Despain and Philip Rykwalker
(see abstract on page 31)

Expedition With the Ukraine Speleological Society to Krubera Cave in the Arabika Massif, Abkhazia
Gilly Elor
(see abstract on page 31)

Caving in Cartel Country: The 2020 Cerro Rabon Expedition, Oaxaca, Mexico
Mike Frazier
(see abstract on page 31)

Easter Shan State, Myanmar 2019–2020: New Longest Cave
Mike and Andrea Futrell
(see abstract on page 32)

Going Under Down Under: Flank Margin Caves in Australia and New Zealand
Joan and John Mylroie
(see abstract on page 32)

Overview of the Caves of Taiwan
Nancy Pistole
(see abstract on page 33)

Proyecto Espeleologico Sistema Huautla (PESH) Update
Bill Steele
(see abstract on page 33)

Sistema Silvana—A new lava tube system in the Galapagos Islands, Ecuador
Aaron Addison
(see abstract on page 23)

Pottery Demonstrations

Recorded. Available for download at 12:00 AM
Peter Jones

Note: the video is in two parts.

Peter Jones has been a caver/cave photographer for 51 years and a potter for 49 years. He's been blending his two passions in life together for all those years. Many people have seen his finished work in Vendors Row at Conventions and Old Timers Reunions for many years, but very few have seen how his work is produced on the potter's wheel. Watch Peter perform alchemy and turn a lump of clay into a beautiful piece of functional artwork. Seeing the work being produced on the wheel is almost like seeing magic!!

The video created by Peter Jones begins with his passion of being a caver and potter at a young age. The video continues with Peter throwing pots on the wheel, explaining the how and why he throws his pots the way he does. Different decorative techniques are explained and exhibited throughout the remainder of the video at different times in the throwing, trimming and decorative stages.

Cave Conservancy Roundtable

Live starting at 3:00 PM
Roundtable Chair: Jeff Karr

Cave Conservancies are the future of private cave management. Should there be more cave conservancies or fewer through consolidation? Since many cave conservancies have become well-established institutions, what do we do now to expand these functions? Everyone interested in cave management is welcome to attend and share ideas so we can all learn from each other. Most of the active cave conservancies have at least one member at the Roundtable who provides a brief update on their conservancy's plans and activities. All interested Conservancy members are encouraged to attend and share knowledge and maybe gain insight from other conservancies that could benefit your organization. The NSS Nature Preserves should also participate.

NSS Nature Preserves Meeting

Live starting at 7:00 PM
Tom Griffin, Julie Schenck-Brown

Did you know you can access 19 NSS Preserves that are managed by a dedicated group of volunteers who serve as the public interface between the NSS and our caving community? This annual meeting of NSS Preserve Managers will include discussions related to our NSS Preserves with topics such as outreach, capital projects, research, developing a centralized permit system, and overall management. All NSS members are welcome to join us and learn about the daily operations and overall management of our NSS Preserves.

Thursday, July 30

Note: All times are East Coast (U.S.) times

Luminary Series III
"Holes are Fun"
William M. Balfour (NSS 10456) (CM-LB-FE)

Recorded. Available for viewing at 12:00 AM

While visiting relatives in Kentucky as a 13-year-old youngster, Bill Balfour—plus his dad and his uncle—drove over to Mammoth Cave. Balfour was particularly fascinated by the Rotunda and begged the adults for another commercial tour. But, having had enough fun for one day, Bill's father allowed his boy to go on another guided trip that same afternoon, while dad waited outside. Bill was entranced and soon bought each book about caves that he could find. He also lobbied for stops at any show caves that the family passed during their assorted travels.

During Spring Break in 1968, Bill Balfour and a friend did a productive trip to West Virginia, operating out of Bill's 1963 Volkswagen Beetle. They entered the Lipps Entrance to Organ Cave and climbed at Seneca Rocks. With topographic maps and a copy of William Davies' classic *Caverns of West Virginia* in hand, the team was also able to locate Cass, Culverson Creek, Schoolhouse, and other great caves.

West Virginia now firmly in his heart, Balfour began his long association with the West Virginia Association for Cave Studies (WVACS) and the West Virginia Speleological Survey (WVASS). A prominent figure in both WVACS and WVASS for decades, Bill has surveyed in several of the extensive contact caves in Greenbrier County; co-authored a pair of WVASS bulletins; computerized the West Virginia cave database; and has served as President, Chairman of the Board, and a Director of WVACS. In addition, Balfour has been the Executive Director and the Greenbrier County Director for WVASS.

As an aspiring architect at the initial explosion of his caving career, Bill could *draw*. As such, he became extremely interested in surveying and was only too glad to keep book, do the in-cave sketching, and draft the resulting map. His output is voluminous—several hundred maps of caves both large and small. Recalling the most productive part of his caving career, Bill Balfour estimates that perhaps 90 percent of his trips involved surveying.

One of Bill's favorite locations is the Culverson Creek Cave System. The historic entrance to this cavern is located near the tiny community of Unus, West Virginia. Balfour jokes that he became so enchanted with Unus that he *bought* the town. In fact, Bill does own a beautiful farm in the area and, each year, many cavers park on his property while visiting Culverson Creek. A short walk from his house is what is now known as the Balfour-Hinkle-Unus Entrance to the cave, and Bill owns that too. And, across the way is the Wild Cat Entrance to Culverson Creek.

Geology and Geography Session

Recorded. Available for viewing at 12:00 AM
Session Chair: Katherine Schmid

The Geology and Geography Session features talks about the latest research in the fields of geology, hydrology, speleogenesis and many other topics related to caves and karst.

Reverse Faults of the Williamsburg Anticline, Greenbrier County, West Virginia, and Their Effect on Speleogenesis

Sara H. Baldwin
(see abstract on page 28)

Geology Section Meeting

Live starting at 4:00 PM
Meeting Chair: Katherine Schmid

The Geology and Geography Section is a forum for the exchange of cave geoscience information and the interaction of karst geoscientists.

Awards Salon Program

Recorded. Available for viewing at 7:00 PM
Salon Committee Chairs: Blake Jordan and Dave Socky

The Awards Salon program presents the best of the Salon entries for the NSS Convention and includes the winners of each Salon—Honorable Mentions, Merit Awards, and Best of Show. The Salons included in the presentation are the Cartographic Salon, Graphic Arts Salon, Cave Ballad Salon, Symbolic Emblems Salon, T-Shirt Salon, Video Salon, and the Photo Salon. The pre-convention promos for the 2021, and 2022 NSS Conventions will also be available for viewing.

Friday, July 31

Note: All times are East Coast (U.S.) times

Survey and Cartography Session

Recorded. Available for viewing at 12:00 AM
Session Chair: Carol Vesely

Datums, Cave Lengths, Cave Depths, and Pit Depths

George Dasher
(see abstract on page 34)

Replacement for the DistoX2: A Project in Progress

Steve Reames
(see abstract on page 34)

Autonomous Cave Surveying With an Aerial Robot

Wennie Tabib, Kshitij Goel, John Yao, Curtis Boirum, and Nathan Michael
(see abstract on page 34)

NSS Awards Show

Recorded. Available for viewing at 7:00 PM
Coordinator: Mike Backe

The Society's 2020 Awards will be presented at this show.

Lightning Talks

Live 4:00 PM to 6:00 PM
Chair: Jim Washington

Put the Lightning Talks session on your schedule for Friday afternoon. You'll be glad you did. It's the session that's planned to be unplanned. It's cavers doing the thing they do best: showing off. Please, feel free to participate with a 5 minute (or so) presentation. Or just attend and enjoy. The atmosphere is casual and friendly.

A lightning talk can be about almost anything. Show us a cool thing you found. Tell us a little about a big project, or a lot about a little project. Regale us with a humble brag or an atrocious anecdote. It doesn't have to be really true, but we request that you keep it pretty short. You may be on the professional speaking tour, or this may be the first time you've talked at an NSS Convention. Awesome! Come on down! You've got 5 minutes (or so). No pre-registration necessary.

How to Give a Lightning Talk

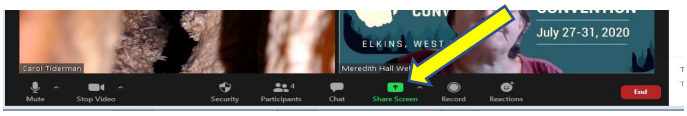
We will be doing this year's Lightning Talks via Zoom. Have your short [5 minutes (or so)] presentation ready to go on your laptop, tablet, or smartphone so when your name is called, you can share your screen (see screenshots below) and give your talk. If you don't have slides or photos to show, we'll be glad to just see your face.

Lightning Talks founder and emcee Jim Washington will give an intro to the Talks and then pick whoever first "signs up" in the chat box. Everyone is welcome. Contact Jim washington.jim@gmail.com if they have questions or have special concerns, or, for example, if they need to be first or last or not follow Bill Steele.

The Lightning Talks will start at 4 PM. on Friday, July 31 and run until 6 PM. That gives you enough time to grab a bit for dinner and get back to your device to watch the NSS Awards show when it goes live at 7 PM.

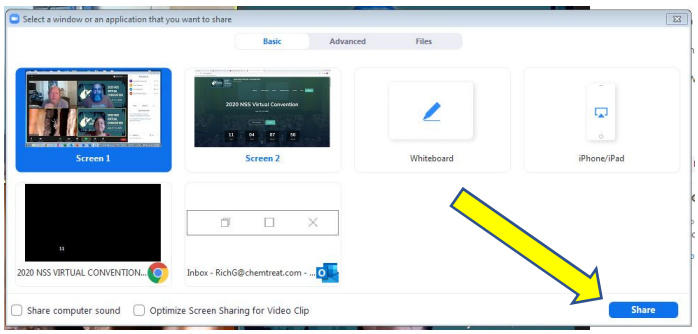
Sharing Your Lightning Talk Screen

Click on the green Share Screen button at the bottom of the Zoom window.



Click on the blue Share button at the bottom right of the Zoom window.

Because you'll already have your slides or photos ready on your device's screen, it should open up there and you are ready to give your Lightning Talk!



Saturday, August 1

Note: All times are East Coast (U.S.) times

Cartographic Salon Critique

Live starting at 9:00 AM
Coordinator: Dwight Livingston

This critique session will discuss and critique the cave maps that were submitted to the Cartographic Salon.

International Year of Caves and Karst Meeting

Live starting at 12:00 noon
Meeting Chairs: George Veni, Pat Kambesis

The world's first International Year of Caves and Karst (IYCK) will be held in 2021. It will be a global event to educate people about the importance of caves and karst. Dozens of organizations are involved, with national caving organizations taking the lead on the activities in their countries. The NSS is the lead organization in the US and is compiling a calendar of IYCK events for 2021. The purpose of this meeting is to provide an update on IYCK events and to solicit interest in hosting more.

ABSTRACTS

Communications and Electronics

Data Transmission Through a Long Single Wire Phone Line

Brian Pease
w1ir@arrl.net

Bill Stone uses single wire voice telephones (Michiephones) to coordinate between Base Camp and deep underground camps during his Mexican Cheve Expeditions. Each camp has one or more Android tablets used for surveying and sketching with TopoDroid software. On the last Expedition a successful experiment was run to send messages and survey data from Camp 1 to Basecamp using direct TTL [transistor-transistor logic] baseband signaling with UARTs [universal asynchronous receiver/transmitters]. Bill asked me for ways to improve the system to serve remote camps as far as 15 km away.

I created an approximate model of the single wire and the grounds used in the cave. The model will pass 2,400 baud data, likely less in the real world. Poor connections, poor grounding, and especially leakage to ground from bare spots may pull the 5V [volt] TTL signal below the 1.4V switching threshold. I looked into boosting the signal to ~12V with automatic transmit/receive switching.

Next I looked at creating my own modem using Exar FSK [frequency-shift keying] transmit and receive ICs [integrated circuits], which use sine waves on two audio frequencies and can be driven directly from the UARTs. This approach is fairly complex with initial analog adjustments and the need for an L-C [inductor-capacitor] bandpass filter to improve noise immunity.

UHF Cave Data Communication Network for Fort Stanton Cave, NM

John T. M. Lyles

The Fort Stanton Cave Study Project, in collaboration with the Roswell Field Office of the Bureau of Land Management, is developing a distributed communication network for data that will be tested in a small-scale prototype configuration in 2020. The ultimate goal is to establish a quasi-real time sensor network to measure air conditions such as temperature, movement, direction, and CO2 content, and measure similar water conditions in the intermittent Snowy River stream channel from the closest point at Turtle Junction back to the surface and to a nearby facility. This is through varying passage dimensions and numerous bends and crawls, for a total of about 2 miles. Data throughput is not high, as this system is intended to be extremely low power using numerous nodes to relay data similar to a mesh network. A plethora of hardware/software choices are commercially available in the Internet of Things marketplace. The challenge has been in selecting the best design for the uncommon attributes of cave environments. Non-licensed UHF [ultra high frequency] frequencies at ~915 MHz [megahertz] have been chosen based on range, antenna size, propagation characteristics of tunnels, and availability of nodes. A hardware variation of the Zigbee standard called Xbee is likely to be used, using DigiMesh protocol. It is optimized for battery life as nodes will remain asleep with little power consumption, waking up at predetermined times to pass traffic.

Real Time Carbon Dioxide Monitoring System at Edgewood Caverns, NM

John T. M. Lyles

Edgewood Caverns is a densely jointed cave in Santa Fe County that has a single 38 m deep entrance shaft, drilled and cased with a 0.5 m diameter steel pipe. The cave is in Pennsylvanian limestone and was phreatic in development with solution-enlarged joints. It is a substantial cave, having been mapped ~8.3 km (5.2 mi) as of 2019, and has barometric-driven winds at the entrance cap. A detailed talk on the history of the cave was given in the Conservation session at the 2018 NSS Convention. The Estancia basin in New Mexico is geologically known to source CO_2, measured in water wells and in the cave. Levels as high as 2% have been measured in the deepest passages during low-pressure weather events. The author, who owns the land overlying the entrance, has developed a system using a commercial CO_2 sensor that will be placed in the cave. It will use an adjacent abandoned water well for cables to bring the signals to the surface and also to power the sensor with a solar-charged battery. A commercial sensor gateway will be incorporated on the surface to upload regular updates to a server via LTE (cellular data service). With knowledge of the cave CO_2 conditions before descending the entrance shaft, and carrying portable gas meters, exploration of the cave will safely continue in the future.

Conservation and Management

Guads Caves: Restoration and Formation Repairs 2018–2020

Mike Mansur, NSS# 26393RL
Sandia Grotto Chair
mcmansur@zoho.com

Decades of human visitation into caves have caused moderate to severe impacts. We have been actively working on restoration and formation repairs in Carlsbad Caverns, and Lechuguilla, Cottonwood, Virgin, Hidden, Black, and Little Manhole Caves. I will be summarizing those efforts, as well as introducing some of my new inventions to facilitate formation repairs.

More Important Than Ever: Conservation Education During COVID-19

Dave Jackson, NSS#60740 FE RL
dave@cavesim.com

Around the world, COVID-19 has forced educational institutions of all kinds to close their doors and conduct their programs online. Conservation organizations are no exception, and CaveSim is stepping up to meet this challenge by providing a variety of distance learning programs to schools and other partner organizations. In this presentation, CaveSim inventor and lead educator Dave Jackson discusses several types of online programs that CaveSim has created to help students continue learning about conservation during the present pandemic. Examples of both live online classes and recorded lessons are shown, along with interesting challenges associated with each type of program. This presentation shows how conservation education can be integrated with traditional school subjects to create a program that meets the needs of teachers and students, with the added benefit of inspiring students to care about cave conservation. Additionally, this presentation features video footage of in-person programs conducted just prior to the pandemic, providing an inside view of the conservation education work done by CaveSim. Presentation attendees will see a wholistic approach that brings together conservation concepts, STEM lessons, fun, and inspirational messages that encourage students to love learning and love caves.

Modeling Suitability for White-nose Syndrome Fungus in Texas and Mexican Karst Regions

Lilianna Wolf
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White-nose syndrome (WNS) is a deadly introduced fungal disease that has led to deaths of millions of North American bats since it was first documented in 2006. Since this first documentation, the deadly disease has spread rapidly in all directions and has caused a precipitous decline in North American cavernicolous bat populations. This study aims to generate a predictive model to assess the potential spread of *P. destructans*, the fungal causal agent of WNS, through karst systems in Texas based on external features that correlate with suitable internal microclimates for fungal growth. An analysis of 43 cave microclimates across the state of Texas reveals a pattern of thermal suitability for *P. destructans* that correlates significantly with landscape (elevation, lithology) and external climate (mean surface temperature). Applications of this model show seasonally varying patterns of suitability for fungal growth in select regions of Texas karst systems. Similar work conducted in Mexico surveyed four caves in two areas of varying climate and elevation. Results from these surveys show that microclimates of Mexican caves are likely able to sustain the growth of *P. destructans* and could act as stepping stones for the fungus, allowing it to travel southward. The resulting work will inform Texas and Mexico researchers of areas of significant concern while monitoring the spread of WNS.

PULIAMO IL BUIO: Clean Up the Dark Conservation Initiative of the Italian Speleological Society

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www.puliamoilbuio.its

The use of natural and artificial hypogea as illegal landfills is unfortunately a widespread phenomenon. Damage

caused to the karst environment and to deep water resources is incalculable.

Puliamo il Buio (Clean Up the Dark) initiative of the Italian Speleological Society (SSI), now in its 15th edition, aims to bring a light into the dark and report risk situations in a timely, detailed manner to initiate possible solutions. Since 2005, SSI coordinates the events at the end of September throughout the Italian territory with the Italian Alpine Club (CAI) in collaboration with caving associations, companies, local authorities, and municipalities. Hundreds of cavers, speleologists, municipal administrators, and local residents participate.

The initiative, linked by collaboration with *Puliamo il Mundo* (Clean up the World) from *Legambiente-Italy*, aims to document natural as well as artificial caves while cleaning up the trash remaining from centuries of human use. The Census of Cavities at Environmental Risk is the fundamental node of *Puliamo il Buio* and provides a base for collaboration in protecting environmental and water resources, reducing waste, enhancing natural habitats, and fighting against illegal landfills.

Puliamo il Buio counts on a web platform with a register of caves. To date, 171 initiatives have been realized with 85,384 caver-hours donated by speleologists to safely extract waste materials such as plastic residues, glass, metal residues, cardboard, wood, chemicals, and other rubbish. A global sum of 162,680 kg (179 tons) of waste has been removed with an economic volunteer value up to $2,040,801.24 USD.

In addition to cave clean-up activities, educational and outreach events such as conferences, presentations, and round tables are held to disseminate our message and help prevent future cave and karst contamination.

Current Best Practices: Intro to Speleothem Repair

Val Hildreth-Werker and Jim C. Werker
NSS Conservation Division Joint Chiefs
valhildrethwerker@caves.org

This is the pilot for a series of online modules that explore current best practices in cave conservation and restoration. Expanding from the philosophies and techniques described in our peer-reviewed volume, *Cave Conservation and Restoration* (Hildreth-Werker and Werker, NSS 2006), each module teaches minimum-impact methods focused on specific tasks to mitigate anthropogenic impacts in caves. The pilot includes a short introduction to the possibilities for cave restoration, followed by an overview of important concepts in speleothem repair. Damaged speleothems can often be recovered or restored with cave-safe, minimum-impact materials, techniques, and protocols. We teach science-based speleothem repair methods to avoid contaminating cave habitats and provide long-term solutions that facilitate self-repair of active formations over time. In developing cave restoration and speleothem repair techniques, we are always guided by the principle: First do no harm—*Primum non nocere*.

Who Will Be Dead After We Save the Bats?

Pittis, Anastasia V.[1]; Gallegos, Christopher I.[1]; Lewis, Evan[1]; Johnson, Shane II[1]; Lavoie, Kathleen L.[2]; Yates, Ivan S.[3]; Chung-MacCoubrey, Alice[4]; Dinger, Eric[4]; Roth, John[3]; Smith, Katrina[5]; Toomey, Rickard[6]; Walz, Jason[3]; Northup, Diana E[1]

[1]Biology, University of New Mexico, Albuquerque, NM

[2]Biology Department, State University of New York College at Plattsburgh, NY

[3]Oregon Caves National Monument and Preserve, OR

[4]NPS Klamath I&M Network, Ashland, OR

[5]Lava Beds National Monument, CA

[6]Mammoth Cave National Park, KY

A proposed treatment for white-nose syndrome (WNS) involves the application of UV C light to cave surfaces to kill the causative agent of WNS, the fungus *Pseudogymnoascus destructans*. Our goal is to determine if such treatment will have detrimental effects on native cave bacteria due to its high energy level output. Partnering with the NPS, we cultured bacteria from caves in Lava Beds National Monument (California), Oregon Caves National Monument and Preserve, and Mammoth Cave National Park (Kentucky). Swabs of cave surfaces were inoculated onto ½ R2A, ½ R2A with Nystatin Antifungal, and AIA with powdered rock from each park. Forty-five cultures from each park were sub-cultured until pure to obtain 200 pure cultures from each park, from which DNA was extracted and sequenced. Culture DNA sequences from each park were compared using Bioedit and a MATLAB program to select the most unique and diverse 100 cultures. Selected cultures are being tested using a UV P crosslinker from Analytik Jena (Germany) to expose cultures and a control to UV C light for 5 and 20 seconds to mirror the UV-C irradiation used in the Palmer et al. 2018 study. Following UV C exposure, cultures are incubated in the dark at 8 oC for 6 days. To test if growth was impacted or not, ImageJ was used to measure surface area growth. Most of the initial 36

cultures tested showed extensive inhibition of growth from the UV C exposure in comparison to controls, which suggests UV C could kill some native cave bacteria. Our preliminary results suggest that extreme caution and further study should be conducted before considering the use of UV C treatments in caves.

Kartchner Caverns State Park Lint Camp Management

Katherine Halter
Cave Unit Park Ranger, Kartchner Caverns State Park
khalter@azstateparks.gov

Before tunnel and trail construction began at Kartchner Caverns State Park, a development team spent years monitoring the cave's natural microclimate and inhabitants, while also researching other tour caves. This research culminated in a careful development process, using baseline data and lessons learned from other tour caves to minimize impact. One aspect of this process was the future mitigation of lint build-up, both along tour trails and deeper in the cave. The development team put systems in place in order to prevent a large-scale lint problem: systems to prevent lint, to manage lint, and to clean up lint. After 20 years of tours, lint is not a large-scale problem. The natural resources team continues to host regular lint removal events that are open to the public, keeping certain restrictions and techniques in mind.

Culture of Caves, Cavers, and Caving

Caving and Caver Communities on a Hot Planet

John Wilson

Pandemics may be very disruptive to society and have a considerable impact on most of its institutions. While we focus most of our attention on the immediate health and economic concerns of the ongoing Covid-19 pandemic, we might consider what our response should be in the face of other crises. That is, global warming is already making our situation more precarious on Earth. The immediate impacts on humanity are temperature increases that cause the most vulnerable areas to experience agricultural failure. Sea level rise gets the press, but heat is the immediate threat that has resulted in millions of climate refugees, as land that once was productive can no longer sustain communities with available resources.

The Anthropocene is a unique, extreme, and rapid change epoch that is affecting all life and the supporting environment on Earth. Our world is the result of a very long series of actions and decisions. Each step may have seemed like the right thing to do at the time, at least for some. Humanity is short term clever but not long-term smart. People are both the victims and perpetrators of our precarious situation. Some of those most vulnerable have been the least implicated in creating this mess. We cannot blame an alien force, as climate change is of our doing. The difficulty we face in trying to stop global warming is a product of our biology and culture. Caving and speleology may suffer along with all human institutions. What is our plan for culture and organization in a future that may be far more traumatic, devastating, and cataclysmic than what humanity has ever known? How do we adjust as a species and as cavers, one small community within the vastness of the human condition? More interestingly, what role may we play to change the course of our trajectory towards an unlivable planet, not just for humans but all other critters on Earth?

Introduction to Cultures of Caving: Broadening the Study of Humans and Caves

María Alejandra Pérez, Geography Program at West Virginia University
maria.perez@mail.wvu.edu

Whenever "anthropology" and "caves" are mentioned together, it is usually in the context of archaeology. There is good reason for this, since caves have been and continue to be important sites to examine the past, not just of humans and their ancestors, but also of other living beings and even of the earth itself. Yet caves continue to be very active spaces of human cultural activity. We suggest that a focus on caving itself, including speleological research, be examined as a cultural activity, and that this examination be put in the broader context of the study of humans and caves (See Pérez's Chapter 26 of the 4th edition of *Caving Basics* for a more thorough exposition on this view).

Cavers explore, they discover. Most cavers survey and map while doing so. They also gather into groups, they tinker with and design their tools, and they establish certain rules (explicitly or implicitly) about who to share their information with and how. On this point, cavers sometimes fight with each other. The many ways cavers deal with territorial politics is a fascinating and complex area that is teeming with insights into how humans establish relationships among each other and with the earth. Caver ideas on conservation and cave modification are intriguing evidence of the complex ways humans behave culturally, shape the environment, and in turn, are shaped by it. In other words, cavers have culture, or, to be more precise, cavers cave *culturally*. Already in its 4th year, this Culture of Caves Session invites us to think of caving itself from diverse cultural and historical perspectives, and to examine what has changed and what has remained the same when it comes to humans exploring cave passages.

Safety Culture in College Caving Clubs

Riley Drake
riled@mit.edu

The caving community stewards a vast amount of experiential, technical, and institutional knowledge. For many cavers, the process of acquiring and passing on caving knowledge is a life-long endeavor. In college caving clubs, the process is accelerated—knowledge must be both acquired and passed-down in the 4 years before student cavers graduate. We used data gathered through a national survey of college caving clubs along with follow-up interviews to identify patterns in how these high-turnover groups impart individual and preserve institutional safety knowledge.

Post Kirkwood in Austin and San Antonio

Allan Cobb

The Kirkwood Community in Texas fell apart just a few years before I started caving. Following in the tradition of Kirkwood cavers looking for affordable group living with likeminded cavers, the tradition continued not with a block of houses on a street but in the individual houses of cavers. Many of the Kirkwood cavers moved to their own houses or pieces of property around Austin. They had space available for cavers to live inexpensively. I rented rooms or space from several cavers from that era while in Austin. I lived on a sofa in Blake Harrison's living room, and scored the back bedroom at Gill Ediger's house for 2 ½ years. These cheap accommodations allowed for many caving adventures and other adventures with cavers throughout the US and Mexico.

Upon moving to San Antonio, I lived at Linda Palit's house, which was a home to many wayward cavers for over 30 years. Linda's garage was used to house rescue gear and ropes with many area cavers having keys so they could gain access. Today, mine and Linda's house in San Antonio has given shelter to wayward or otherwise homeless cavers on several occasions.

Environmental Education in Speleology: A Proposal for Elementary Education in Cuba

Dr. C. Jean Robaina Sánchez (translated and presented by María Pérez)
jeanrobainasanchez@gmail.com

This presentation addresses a common challenge in most caving communities around the world: the fact that caver speleological and environmental knowledge vary immensely. Based on my Ph.D. work as an environmental educator and caver in Cuba, I suggest one way to address this challenge: by developing an environmental education program designed by and for cavers. Here I trace the theoretical and methodological elements of such a program, and examples of preliminary results. Given the importance of caves and karst in Cuba, where over 65% of the territory is karst, it is necessary for cavers to be better prepared to carry out research and environmental protection work of greater quality and effectiveness. But this program has an even bigger goal: attracting and preparing a new generation of cavers, a topic of concern beyond Cuba.

Digging

The Dome 12 Dig Project

John Dunham

Dome 12 is a sinkhole on the Northeastern Cave Conservancy's Merlins Cave Preserve and has been a Spring and Fall dig since 2016. Working after a sinkhole washout, the Berkshire Area Diggers Association has been excavating rocks and gravel in search of a way into presumed passage downstream of the main Merlins Cave, which has a few thousand feet of nice marble passages. With some stabilizing, creative engineering, and persistence, the crew got into some passage in Dome 12 at the end of 2019, which has ongoing digs in two downstream directions.

Solving the Enigma of Engel Hill Inside Fort Stanton Cave, NM

John Lyles

Starting in 1962 a dig in an airy dead-end passage continued on and off for 7 years, eventually opening Babb's Burrow into the Lincoln Caverns passage of Fort Stanton Cave. This was the most remote place in the cave. At the far end of a large decorated trunk, a massive breakdown collapse called Engel Hill terminated the trend while air continued. A dig in the 1970s continued upward using screwed-together steel pipes to probe overhead breakdown, but dire conditions killed enthusiasm. It wasn't until Snowy River (SR) was discovered in 2001 that the true nature of Fort Stanton Cave began to be realized in the south. In 2018 cavers pushed an upper level climb above SR into Gold Rush, a major breakout heading back towards the far side of Engel Hill but miles away. John Lyles led a reconnaissance trip in May 2019 with Ramon Armen and John Dunham to visit the old top dig and found it unworkable. They found a low crawl under a boulder, midway along the face of Engel Hill. They quickly advanced into Engel Hill 30 feet without even digging. Their new Midway dig began against a wall for a few hours. John returned in September with three local cavers and they progressed, reducing large boulders to rubble and advancing a body length. Returning to SR a month later, teams continued mapping the Gold Rush trend, breaking into extensive large passage (see the US Exploration talk) that they surveyed to add about 5.5 miles to the cave (now 40.1 miles). They even found the far side of the Engel Hill breakdown, after caving for 8.5 miles overnight. Capitan Gap is the remaining unopened distance through the breakdown. The dig remains important as it could provide an emergency route in case of flooding at SR.

Geology & Geography

Reverse Faults of the Williamsburg Anticline, Greenbrier County, West Virginia, and Their Effect on Speleogenesis

Sara H. Baldwin

The Williamsburg anticline is a large fold involving the Mississippian Greenbrier Group in western Greenbrier County, West Virginia. The Greenbrier Group is a series of limestones that are known for their karst development. Extensive reverse faults in these limestones have been identified recently by the author as a result of field mapping and lidar analysis. Some of these reverse faults extend as much as 18 miles and involve stratigraphic displacement of over 200 feet. Many, but certainly not all, of the major reverse faults can be traced by a distinct line of sinkholes along regional strike. This indicates that water flow is controlled by steeply dipping beds in the fault zone and/or along fractures associated with the fault surface. Caves were identified that were at or adjacent to faults. Culverson Creek and Taylor Falls Caves had entrances or passages near the faults but did not follow them. It is interesting to note that they also did not cross the faults. Piercy's Mill Cave, Bash Cave, Zicafoose Cave, and the Bag Cave System are all strongly influenced by the faults. In these cases the caves followed steeply dipping soluble layers of limestone, but they also did not cross the faults. In conclusion, it seems likely that ground water is strongly influenced to follow along the fault zones, but does not seem to cross them readily.

International Exploration

Experiments in Autonomous Cave Exploration

Bill Stone

We are living in an extraordinary era where machines have begun to replace humans, initially in highly structured settings such as manufacturing and now in more complicated real-world settings such as self-driving vehicles. This presentation goes beyond that—tracing the roots of fully autonomous exploration in 3D unstructured and ultimately completely unknown environments. Cavers have always known the special sensation of exploring completely unknown places. Would it actually be possible to replace a caver with a robot?

Our initial experiments dealt with a simpler problem: building a real-time 3D cave map. We achieved this in 1998 using an inertial guidance unit to track the position and orientation of a mapping instrument in the underwater tunnels of Wakulla Springs, Florida. A helical array of acoustic sensors acquired tunnel cross-section measurements as the vehicle was flown through the tunnels, guided by a cave diver. We later built on this concept by using the just-created 3D map as a navigation tool, a concept known as SLAM (simultaneous localization and mapping).

Over the course of the next 15 years these concepts were refined in a series of NASA-funded sub-ice vehicles designed to test life-search concepts for the exploration of sub-surface oceans of outer-planet icy moons, such as Europa and Enceladus. A person-portable version of these concepts, known as SUNFISH, was tested initially in Peacock Springs, Florida, in 2016. It used advanced behavior-based programming that emulated the way cave divers think. The ultimate test came in late 2019 when SUNFISH autonomously explored three of the world's deepest cave diving sites in northern Namibia, to depths of 265 m and distances of half a kilometer from the water surface—well beyond the limits reached by divers in these locations, despite the use of helium breathing mixtures, rebreathers, and propulsion vehicles. Dragon's Breath, Harasib Shaft, and Lake Guinas were all explored to their ends by SUNFISH.

A doorway has now been opened such that previously inaccessible cave diving sites—limited by human physiology, depth, length, visibility, or current—can now be explored. The same techniques employed in Namibia using an AUV (autonomous underwater vehicle) are laterally transferrable to aerial drones for performing the same maneuvers in air-filled caves. So far, neither of these approaches are suitable for crawling through breakdown, so, at least for a while, humans will remain the dominant cave explorers on Earth.

From Conservation to Cave Mapping: A Scientific Expedition to Batu Katak, Northern Sumatra, Indonesia

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The Batu Katak village in Northern Sumatra, Indonesia, is located in the Batumilmil formation, a paleokarst that consists of dark gray to reddish gray limestone. A group of scientists from the University of Puerto Rico and Harimau Conservation explored the neighboring karst forest and mapped five caves as a conservation action, to help protect the karst forest and its geological importance. As across the rest of Sumatra, this region is impacted by palm-oil farms, illegal deforestation, poaching, and mining. The goal of this study was to verify the safety of the cave environment and establish the cartography of the caves that surround the village: Water Cave (~901 m, 59.5M data points), Pupuk Mentar Cave (~121 m, 22.9M data points), Mbelin Cave (~100 m, 15.7M data points), Sibayak Cave (~36 m, 10.2M data points), and Jodoh Cave (~45 m, 6.8M data points). The maps were created using the Geoslam ZEB1 LiDAR. A total of 1.2 km of cave passage were surveyed, with 126.6 million data points collected. These cave maps are used for sustainable ecotourism and to understand the karst biodiversity including trogloxenes (bats, snakes, cave swallows, and many more) and the Sumatran tiger, a critically endangered species that, based on physical evidence during this study, used one of the caves as habitat.

The Invisible River

Sofia Oggioni

A documentary film directed by Colombian explorer and cinematographer Sofia Oggioni

Fellow Colombia explorers Dan Straley (USA) and Jesus Fernandez Auderset (Switzerland) open the presentation. The film begins with Jesus Fernandez Auderset re-enacting the past 11 years exploring throughout the Rosablanca formation in the Colombian Andes. He recounts his life and how he ended up in this magical landscape, all the while encountering gigantic cave passages, an ancient burial, and an unbelievable Megatherium (Giant Sloth) fossil locked in rock for thousands of years. We recommend you sit back and relax, but please remember to breathe! Enjoy.

Castleguard Cave: After 50 Years in Canada's Longest Cave, Exploration Continues

Christian Stenner and Kathleen Graham

Castleguard Cave has been featured in speleological writings since modern exploration began with Dr. Derek Ford and his team in the late 1960s. At 21 km in known length, it is Canada's longest. Although this length pales in comparison to many longer caves in the world, its alpine setting, unique formations, biology, and terminus underneath the Columbia Icefield combine for an extraordinary landmark. This presentation will cover highlights of the exploration history of Castleguard, the current exploration projects, and challenges.

One of the most challenging leads that may reveal a new system of passages is at Boon's Sump. British diver Martin Groves conducted a series of dives using a closed-circuit rebreather, cracked the sump, and emerged into an ongoing, dry passage. Martin had returned in 2012 with plans to continue exploration in the passage beyond the sump. After over 40 years of relative stability, we found the ice crawl located a few hundred meters into the entrance frozen shut. Since then, the ice crawl has been an intermittent problem that has prevented a return.

After the massive cave rescue operation in Thailand, Richard Harris and Craig Challen, key members of the response, as well as New Zealand caver Tom Crisp, opted to take on the Boon's Sump dive project. Additional leads and projects deep in the cave were also waiting for a return. Partnered with the Alberta Speleological Society, the Return to Castleguard took place over 2 weeks in March 2020, just before the country had started enacting drastic changes due to the crippling pandemic.

New Machine-learning Computer Program to Identify Unmapped and Obscure Tropical Cave Entrances Using Python, GIS and Lidar: Applying Geomorphometry to Automate Landscape Classification

Leila Donn, Tim Beach, Cody Schank, Mike Mallner
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Computer programs that can automatically identify landscape features are extremely useful for environmental study, conservation and resource management, and natural hazard identification. I am developing a machine-learning computer program to find unmapped cave entrances under forest canopy using Python, GIS, and LiDAR imagery. Such a method can be applied to any landscape feature with distinct morphologic characteristics, even features obscured by vegetation.

I trained the first version of this cave-finding program with a Python machine-learning library using a dataset that included a shapefile of known cave locations to which I added randomly selected locations where there are not caves. I then used LiDAR imagery and ArcGIS to generate values for the morphologic characteristics of these points, including slope, standard deviation of elevation as a measure of slope roughness, land surface curvature, distance from nearest stream, and fill difference. Next, I ran this trained program on LiDAR imagery from an area of northwestern Belize that is under dense tropical forest canopy, where there are no mapped caves. The program identified a number of potential cave entrance locations across 140 km^2, concentrated in four areas.

In June 2019, ground-truthing completed by me and a fellow caver confirmed the presence of a number of predicted unmapped caves, sinks, and cave-like features, including a 60 meter-long by 30 meter-wide by 35 meter-deep sink feature with a collapsed cave entrance at the bottom. Predication accuracy will be improved in the next version of the program by incorporating point cloud low points, local relief modeling, and canopy height modeling. I also plan to acquire a larger training dataset; run the re-trained program over imagery from Belize, Guatemala, and Mexico; and to ground-truth some of these areas next summer.

Into the Ice: Exploration and Science on the Greenland Ice Sheet

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Most of the meltwater on the surface of the Greenland Ice Sheet flows in rivers and streams that eventually end in moulins, which are giant holes in the ice that carry the water to the bottom of the glacier. Once meltwater is beneath the ice it can lubricate the bottom of the ice sheet, lift up the ice, and cause the ice to move faster. This may create a double effect, where future increases in melting of the ice during warmer climate may also cause faster sliding and more loss of ice into the sea. However, these processes are not well understood. During a 3 year project, we have conducted two summer field expeditions, where we measured meltwater and water levels inside of moulins. In the last 2 years of the project, we also conducted two fall expeditions, where we directly explored inside of moulins using a mix of caving and ice climbing techniques. During the presentation, we will share photos, videos, and stories from our adventures on the ice sheet, focusing particularly on our most recent expedition in fall of 2019, and provide a basic explanation of our initial scientific results.

Mulu 2019 Expedition, Sarawak, Borneo

Derek Bristol and Hazel A. Barton

The Mulu 19 Expedition continued the British exploration of the caves of Gunung Mulu National Park, Sarawak, Borneo. The expedition took place between April 18–May 12, 2019, with primary aims to connect caves within the Gunung Mulu massive, specifically within the southern peninsula of Gunung Api. Attempts were made to connect Cave of the Winds, Racer, and Easter Lagangs Caves into the already extensive Clearwater Cave System, which would have resulted in a new system >150 miles in length. Significant extensions were made in many of the explored caves; however, the much-needed connection requires a tight, technical cave dive, and was not completed. A new camp, Camp Golden Shower, was established in the northern region of Clearwater Cave, leading to significant discoveries within the Dune Series and Great Wall Chamber. Two significant discoveries were made, including Scientific Method and China Shop. This has opened up interesting leads to be examined by future expeditions in a blank area of the known cave.

Pink-eyed Cave Lobsters and Death by Dieffenbachia—Caving in Panama's Bocas del Toro Province

Joel Despain and Pat Kambesis

The first organized American effort to survey caves in Panama took place last December (2019). Building on the work of American caver Keith Christenson and British caver James Cobbett, our small team mapped about 2 kilometers of cave passages in the Bocas del Toro Archipelago on the country's Caribbean coast. It is a lovely area with lots of potential for more caves and caving.

More Rivers, Big Rooms and Grand Stal: The Fifth Expedition to Sultan Kudarat, Mindanao, Republic of the Philippines

Joel Despain and Philip Rykwalker

The fifth expedition to Sultan Kudarat, the Philippines, was another fun and productive trip to the island nation. More than 8 kilometers of new cave passages were mapped including several large rooms and passages. Most of the survey was in well-decorated river caves. The team has completed many maps of caves of the area, is working on a book project for the caves of the region, and looks forward to a sixth expedition in the future to return to the many leads. The expeditions take place in close cooperation with Philippine cavers and government organizations.

Expedition With the Ukraine Speleological Society to Krubera Cave in the Arabika Massif, Abkhazia

Gilly Elor

I will report on the results of the 2017 Ukrainian expedition to Krubera-Voronya, Western Caucasus Mountains, Abkhazia. I will focus on the camp to the bottom of the -1,710 meter branch of Krubera-Voronya, the trip I participated in, whose goal was to push leads at the limit of exploration at that level. I will emphasize my own experiences traveling to and caving in Krubera as a Westerner.

Caving in Cartel Country: The 2020 Cerro Rabon Expedition, Oaxaca, Mexico

Mike Frazier

The Cerro Rabon is a limestone uplift in excess of 2,000 meters in elevation. It is located in Oaxaca, Mexico, just west of the Presa Miguel Alleman near the city of Jalapa de Diaz. Working with Jalapa's Director of Tourism in 2019, the town provided us guided tours to cave locations as well as gas vouchers. We also received an invitation letter to explore and map caves in the area in 2020. This is virtually unheard of in the history of caving in Mexico. Unfortunately when something sounds too good to be true . . . . This is a tale of good intentions and high hopes. This is story of good men and of bad men, of ruthless criminals, and of fear. It is narrative of big borehole cave, deep friendships, and sad outcomes. It leaves to us to question the balance of our desire to explore caves and our involvement and effect on the local population.

Easter Shan State, Myanmar 2019–2020: New Longest Cave

Mike and Andrea Futrell

An international team of cavers from Myanmar, Germany, Britain, and America journeyed to East Shan State in Myanmar from late December 2019 to early January 2020. After 3 days arranging permissions and permits, the team met with great success by documenting the longest cave in the country. Som Hein Cave near Monghpyak is well known in the East Shan region for spiritual reasons. Cavers had only 9 days to survey and photograph the complicated cave system.

The first kilometer of large passage is an extension of the monastery and is regularly visited by pilgrims and meditating monks. It contains numerous Buddha images, stupas, and religious constructions. Many large and beautifully decorated side passages were surveyed. A smaller passage links the main trunk to a complex serious of seasonal stream passages that carry monsoon flow. One downstream trunk led to a boulder choke that yielded a small second entrance. The year-round active river that sinks nearby was not found and remains a mystery for future exploration. Som Hein was surveyed to 11.6 km, almost doubling the previous record for the longest cave in Myanmar.

Many passages and leads were left for Myanmar and international cavers to return to for further exploration. Myanmar caver Nyi Aung was an integral member of the team. He is a leader among the in-country caver and climber community and coordinator of the Myanmar Cave Documentation Project. We were also joined by Myoe Lwin, who is a fixture on Myanmar expeditions, and his van, providing transportation, translation, and untold logistical support behind the scenes. Without our in-country friends, the project would not have happened.

Going Under Down Under: Flank Margin Caves in Australia and New Zealand

Joan and John Mylroie
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Coastal carbonate rocks in Australia and New Zealand, with ages ranging from Oligocene to Pleistocene, contain numerous flank margin caves. In Australia, flank margin caves were found from near modern sea level up to elevations of 300 meters in eolianites of Pleistocene age and marine subtidal carbonates of Miocene age. Caves were explored in Victoria, southeastern Australia; Kangaroo Island, southern Australia; Rottnest Island, southwestern Australia; and Cape Range, northwestern Australia. The caves are small and entered primarily where cliff retreat has opened the cave chambers from the side. Because the caves form in the fresh-water lens at sea level, they have been used to determine past sea-level history as well as tectonic uplift rates and magnitudes. Some caves contain archeological items greater than 40,000 years in age.

In New Zealand, almost all known coastal outcrops of carbonate rocks were examined in the field on both North Island and South Island. The rocks ranged in age from Pliocene to Oligocene, all were marine subtidal carbonates that transitioned from eogenetic (porous and permeable rock masses) to teleogenetic (crystalline rock masses) in diagenetic maturity. The caves are small and on active coasts, with entrances formed by wave removal of rocky hillsides and cliffs. Some of the smaller caves in Napier, North Island, were uplifted and exposed by a 7.8 magnitude earthquake in 1931 that raised the coast 2.4 m. This vertical action pulled the caves up and out of the Holocene fresh-water lens, halting their growth and making them available for subaerial exploration. In Kaikoura and Punakaiki, South Island, the rocks are highly crystalline and altered by tectonics, the caves forming along closely spaced fractures and joints. Tide ranges in excess of 4 m on some coasts required careful planning to safely enter the caves.

Overview of the Caves of Taiwan

Nancy Pistole
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Five cavers from the USA, Netherlands, and Germany spent 3 weeks circumnavigating the island of Taiwan, documenting the caves. Forty-five caves were surveyed, for a total of 2.2 km. The presentation gives an overview of the caves that were visited.

Proyecto Espeleologico Sistema Huautla (PESH) Update

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Sistema Huautla is the deepest cave in the Western Hemisphere, tied to the meter with a cave in Austria as the world's ninth deepest cave, and is the 28th longest cave in the world as they are now known. It is 5,517 feet (1,560 m) deep, 55 miles (89 km) long, and has 29 entrances. The Proyecto Espeleologico Sistema Huautla (PESH) is an official project of the NSS.

NSS cavers first descended into a pit entrance to what is now a vast cave system in 1966. In the ensuing years there have been many expeditions with the participation of cavers and speleologists from several nations. Numerous articles have appeared in the *NSS News* and AMCS publications and in mainstream media such as *Outside* and *National Geographic*. Two books have been published about the caving: *Beyond the Deep* and *Huautla: Thirty Years in One of the World's Deepest Caves*.

PESH was organized in 2014 as project with goals to conduct annual month-long expeditions to the caves of the Huautla de Jimenez, Oaxaca, Mexico, area for a decade, to support Mexican cave scientists in their field research, to conduct research into all the scientific disciplines of speleology, to test and help develop caving gear, and publish.

As of 2020, six successful PESH expeditions have taken place, from 2014 to 2019. The 2020 expedition was canceled only 2 weeks before it was scheduled to begin due to the COVID-19 pandemic. Plans are to resume in 2021.

Sistema Silvana—A new lava tube system in the Galapagos Islands, Ecuador

Aaron Addison

As international teams of cavers enter the 10th year of documenting lava tubes and pit crater features in the Galapagos Islands, significant new discoveries are still being made. In August 2019, locals guided a small team to a new tube system that has now been surveyed over 4 km. Survey totals from the March 2020 expedition have now revealed that Sistema Silvana is now the longest known lava tube in South America.

State Cave Surveys

The West Virginia Speleological Survey

George Dasher

This talk will describe the West Virginia Speleological Survey, what the organization goals are, its history, what it has accomplished to date, and its plans for the future. The talk will also outline the weakness in the system, describe how cave length and depth is determined, and provide lists of the long and deep caves within the state.

Caves of Minnesota

Nick Seaton
Minnesota Speleological Survey

In my talk, I will discuss the geology of the cave-forming strata of Minnesota and how that affects the type of cave development we have here in Minnesota. The thinly bedded limestones are intermixed with layers of shale and this mostly leads to horizontal maze cave development with very little vertical development. The biggest pit in the state is only around 50 feet deep and is in the show cave, Niagara Cave. In contrast, the longest cave in the state is Mystery Cave in the Forrestville Mystery Cave State Park. It is 13 miles long but has very little vertical relief with most of the cave being contained in a single geological unit.

Gerald Moni Uses QGIS

Jon Zetterberg

Gerald Moni works diligently to keep the information of the Tennessee Cave Survey (TCS) as accurate as possible, and saw the potential to improve the dataset when statewide LiDAR was released for Tennessee. Over a few months, Gerald was able to generate a workflow utilizing GIS software and LiDAR data, both of which are free and available to the public. The correction work that is done helps to better the locational accuracy and elevation of the points stored in the TCS listings. The more accurate the location points are, the happier everyone is while trying to find caves in the field. This presentation will be given by Jon Zetterberg, but will be a walkthrough of Gerald's workflow.

Survey and Cartography

Datums, Cave Lengths, Cave Depths, and Pit Depths

George Dasher

There is an international standard regarding survey datums, cave length, cave depth, and pit depth, which this talk will describe.

Replacement for the DistoX2: A Project in Progress

Steve Reames, NSS 25533

The DistoX2 survey instrument has been key to accurate and efficient cave surveys. It was discontinued at the end of 2019; an electronics project was started to design a replacement. This ongoing project has investigated 19 digital compass MEMS sensors (Micro-Electro Mechanical System) and selected three devices to compare against the sensor used in the DistoX2. A turntable was designed to look into any non-linear behavior. This led to selecting a sensor for future development.

Autonomous Cave Surveying With an Aerial Robot

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This presentation details recent work in leveraging aerial systems for autonomous cave surveying. Traditional methods of cave surveying are labor-intensive and dangerous due to the risk of hypothermia when collecting data over extended periods of time in cold and damp environments, the risk of injury when operating in darkness in rocky or muddy environments, and the potential structural instability of the subterranean environment. The vision to which we aspire is to miniaturize the technology to such an extent that several portable aerial systems could be easily and reliably deployed to cooperatively build a map of the environment while avoiding obstacles. To this end, we present an aerial system that produces a map of a cave without guidance from a human operator. The approach is tested in Laurel Caverns.

U.S. Exploration

Fantasyland: The West Edge of Wind Cave, South Dakota

Hazel Barton

Wind Cave is the seventh longest cave in the world, with one of the longest exploration histories in the US. Exploration began in 1891, when Alvin McDonald explored almost 10 miles of cave using string and candles. In the 1960s and 1970, major new discoveries by Herb and Jan Conn, Dave Springhetti, and John Scheltens pushed the cave to 50 surveyed miles. In 1991, following the Rachel Cox rescue, the National Park invited the Colorado Grotto to establish the Wind Cave Project, which again accelerated discovery, resulting in 100 miles of known cave by 2001. Yet, even as Wind Cave reached 150 miles of surveyed passage in 2019, only the South Comfort extension (discovered by Paul Burger and Stan Allison in 1991) extended the cave beyond the 1 mile x 1 mile surface footprint of the 1970s.

In September 2019, cavers returned to push the Lunatic Fringe, which was discovered on the far west edge of the cave in 1994 and was thought to end at a distinct fault boundary. By pushing an internal lead, the team discovered over 1.5 miles of cave in three trips to an area now collectively termed "Fantasyland"; these trips have generated some of the largest single survey totals in the cave since the early 1990s. Fantasyland still contains a large number of leads and appears to be headed toward Persistence Cave, a small cave that airflow studies have suggested is part of the main Wind Cave system. Even though COVID 19 shut down exploration in March 2020, Fantasyland continues and has the potential to dramatically extend the length of the cave and add a new entrance into this enormous cave.

The Ouroboros Extension: Recent Bottom-up Exploration in Tumbling Rock, Alabama

Reilly Blackwell
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Since 2018 Tumbling Rock Blowing Cave, a "horizontal" cave with an aid climbing history, has been the center of one of TAG's larger aid climbing projects, led initially by Lee White. This presentation will cover the climbs and the passages accessed, as well as show photos of two of Alabama's new climbed domes.

Aid Climbing and New Discoveries in Newberry-Banes Cave, Virginia

Reilly Blackwell
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Newberry-Banes is a cave with a long and storied history, having been initially explored with the help of Bill Cuddington, at the forefront of American vertical technique. Modern vertical techniques, namely aid climbing, have facilitated the discovery of a large new pit and virgin passage, and revived work towards a connection with another significant Virginia cave. Reilly Blackwell will talk about her project with Phillip Moneyhun to push the new area of this well-known cave.

A Sea Caving Voyage Around Santa Cruz Island, California, October 2019

Dave Bunnell

Photos by Dave Bunnell with additional contributions by Carolyn Fusinato

In 1988 I published *Sea Caves of Santa Cruz Island*, with descriptions of 113 caves of which over 100 had been mapped by members of the California Sea Cave Survey. They were of impressive length and the combined surveys totaled over 5 miles of cave! Some were never completed due to their orientation towards the most prevailing swell conditions and some we had simply missed. Over the last 32 years, I have now made only five trips back that have resulted in about 16 new caves and determined that there are perhaps as many more caves missed on the original trips.

On our most recent trip after a lapse of 4 years, I was joined by Phyllis Boneau, Carolyn Fusinato, Matt Oliphant, Nancy Pistole, and Charley Savvas. We rented a 45 foot catamaran for a week and brought kayaks for accessing the caves. Our objectives were basically scattered around the island, so our sailing plan was to circumnavigate the entire island, which is some 25 miles long. As usual we picked a week with good low tides, which is crucial to accessing the maximum amount of cave passage. The fall months are historically some of the calmest in the Channel Islands.

As usual, results were mixed. We surveyed four new caves—Bashed Kayak (532 feet), Pelican Rock (129 feet),

Gurgling Tidepool (179 feet), and the premiere discovery of the trip, Fraser Point Cave (530 feet). The latter was a spacious multi-entrance cave with copious tidepool life including purple urchins, starfish, and sponges in various hues of yellow, orange, and red.

Some of our hoped-for leads again proved elusive due to a large western swell. But we were able to accomplish some further photo-documentation in previously mapped caves including Painted Cave, the longest on the island and second longest sea cave in the USA.

Currently I am working on a revised second edition on the island's sea caves with the new materials gathered in the past 3 decades.

We are grateful to the NSS for supporting the expedition with a Sara Corrie grant.

The Mr. Toad Cave System

John Dunham

Recently the Berkshire Area Diggers' Association (B.A.D.Ass.) connected Mr. Toad's Wild Ride Cave with an adjacent shorter cave (both new discoveries in the past decade) to form the Mr. Toad Cave System—now the longest cave in Vermont with over a kilometer of mapped passage. The Mr. Toad Cave System is a multi-level stream cave in marble, with numerous domes, waterfalls, crawlways, climbs, and pits. The known cave is over 200 feet deep with the cave spring a further 800 feet lower. In 2017, a fall and rescue in this cave led to limited access, but the owners have this year allowed us to resume exploration and complete the connection. Multiple leads remain with digging or climbing work at multiple levels and in three different downstream passages. The cave complexity arises because most major passages are formed along fault-related joints in the marble, while minor passages cross between joints following old phreatic tubes on less soluble beds. Normal faults are visible in multiple locations, most notably in the 80 foot-high Window Dome on the cave's southwest edge. Pre-glacial development, notable for the area, is visible in the 120 foot-high Funhouse Pit Room, which is the highest recorded ceiling in a Vermont cave. These features, along with strong airflow from three downstream passages and the depth of the cave spring, lead us to believe that much more passage is waiting to be found.

Recent Exploration in the Otter Creek Watershed of Wayne County, Kentucky, USA

Lee J. Florea[1], Sarah Burgess[1], Chris Bauer[2], Brian Devine[3]

[1] Indiana Geological and Water Survey, Indiana University

[2] Central Ohio Grotto

[3] Greater Cincinnati Grotto

A decade of intensive exploration in Wayne County, Kentucky, presented in US Exploration sessions of the National Speleological Society Conventions in 2015 and 2019, focused on what became the Sulphur Mountain System, comprising both Bowman's Pit and Skert Well. At present, that system remains the longest cave in Wayne County at 8.6 miles on five levels expressive of the paleo-hydrology of Beaver Creek. The connection between those two caves is a vertical miasma of canyons and shafts, and cave of similar character encompasses many remaining leads.

The experiences in Sulphur Mountain provided suitable training for the new exploration focus in Edwards Mountain in the Otter Creek watershed to the south. At Edwards Mountain, the Sunnybrook Anticline, with an amplitude of 150 feet, enhances the potential depth of caves, and this anticline has produced the deepest pits in Kentucky. Petroleum seeps identified in streams and caves along this anticline suggest the potential for hypogene speleogenesis through the cycling of sulfur.

Spelungers Cave on Edwards Mountain was an entrance blasted into the Bangor Limestone in 2007 with shafts that lead to a current depth of 322 feet. Recent project invigoration has extended Spelungers to 2.8 miles, including significant upstream and downstream leads on multiple levels. Downstream, the suspected resurgence includes a nearby lead with massive air, the focus of digging and blasting. Upstream, along the anticline flank, a series of pits, all with significant airflow, are of keen interest and recent exploration. If connections are successful, the vertical potential is approximately 510 feet.

Isla de Mona: Stepping New Paths to the North Cliff Caves

Tamara González Durán, NSS 68872

Situated in the Caribbean Sea, Isla de Mona presents an opportunity in perseverance in the exploration efforts of the cavers who step on the island. Locating caves in the

north cliff of Isla de Mona requires constant planification. Each corner of the island embodies its particularity and adaptation is a must for the cavers exploring it. Here, we will be addressing the initiative, achievements, and the learning experiences of our cave exploration team on the north cliff of Mona since 2016. Considering that Mona is a remote island, any arrangements toward searching for caves to survey need to include the environmental conditions where the island is situated. Caves have been located, explored, and surveyed in the north cliff with each one being a story of its own on how it was found. Caves show evidence of past human activities that can be imaginarily recreated while we survey and wonder what might be ahead at the next station. The growing experiences have defined the will of the workgroup when the exploration expeditions have been more of learning than achieving the goal. This just makes the cavers ponder how they can keep going further to explore the north cliff caves of Isla de Mona.

Scapegoat Cave System 2019

Daryl Greaser
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In the early 1970s, *Caves of Montana* author Newell Campbell began exploration of the caves of Green Fork and the 6 square mile alpine karst plateau. Forty-eight years later, exploration is ongoing and new discoveries are made on every trip. The 2019 "Spacegoat" Expedition pushed water leads in The Abyss of Kathy's Icebox, completed the re-survey of the Northwest Passage in Green Fork, completed the survey between the two entrances comprising the Scapegoat System, accessed the cliff-side Campbell's Cave, bottomed Arm Pit, and more. Fourteen cavers attended the expedition, representing three NSS grottos and contributing to the Caves of Montana Project. Objectives for 2020 include continued downstream survey in Kathy's Icebox, checking NW Passage leads, and exploring Campbell's Cave.

Turtles All the Way Down: Finding the Bottom of the US's Deepest Limestone Cave

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Since 2005 cavers have been returning to the Bob Marshall Wilderness in Montana to try and find the bottom of Tears of the Turtle Cave, currently the deepest limestone cave in the US. A tight, difficult, alpine fissure cave, Tears has so far resisted those efforts. This presentation covers the 2019 25 person, 2 week expedition. Come find out how deep they made it.

High Adventure in the Mystery Room of Carlsbad Caverns

Dwight Livingston and Mark Minton

During a 2019 survey expedition in the Mystery Room section of Carlsbad Caverns, a team noted a couple of technical leads above the Mabels Room drop, measured nearby ceiling windows topping out well over a hundred feet high, and figured these might all connect. In March 2020, an expedition pushed these leads; made the hoped-for connections; surveyed nearly 900 feet of ledges, domes, and passages; and reached 192 feet above their starting point on the Mystery Room floor. Using Olympus TG and Zebralight photography, the team captured the sights along Calla Lily Ledge, up Saints Garden, out High Adventure, and into the Sharps Container, all of them decorated in the abundance one expects in Carlsbad.

Exploration in Fort Stanton Cave, New Mexico—5.46 Additional Miles in 2019

John Lyles and Garrett Jorgensen

Through most of 2019, as typical of recent years, Snowy River (SR) was flooded, preventing exploration due to closed sumps. By late summer it began drying out to produce a refreshed hard calcite floor and October was deemed the optimal time for exploration. A year earlier, a climb above SR had broken out into a new upper passage, Gold Rush. The first October 2019 expedition continued at one of the significant unexplored leads at Tetlin Junction. Survey continued heading northwest, then gradually turning northeast. The passage developed into interlaced upper and lower levels, both large walking passages. The team spent 2 days in the cave, sleeping to allow for a productive second day. They added 12,400 feet of significant passage, and named it Capitan Caverns [1]. The next weekend a team pushed Capitan Caverns for another 4,777 feet in a very decorated upper level passage that paralleled the earlier work.

In another 2 day expedition, cavers definitively established that they had reached the far side of the breakdown blockage at Engel Hill, in the historic Lincoln Caverns part of the cave. Their final point was 8.5 miles from the entrance, but only about 2 miles direct distance, if Engel Hill wasn't blocked. The third weekend was planned for a 2 day mop up of side passages including

completion of a massive upper level trunk overlying Capitan Caverns. They were not disappointed with the leads remaining, and surveyed another 11,700 feet in some of the largest decorated passage in the cave. These three weekend trips added 5.46 miles of amazing new passage to Fort Stanton Cave, now at 40.15 miles in length.

[1] A. Weaver, G. Jorgensen, D. Wolfe, The Discovery of Capitan Caverns, *NSS News*, May 2020, pp. 18–25.

Project Update: CRF Mapping and Monitoring Project on the Buffalo National River

Kayla Sapkota

For several decades, the Cave Research Foundation has worked with the National Park Service (NPS) on the Buffalo National River in northern Arkansas to document, monitor, and map its over 750 cave and karst features. The Buffalo National River, established in 1972, is popular for camping, hiking, and floating along its 135 miles of unrestricted waterways with picturesque bluff lines. This presentation serves as a 5 year update of this project since the 2015 NSS Convention presentation, discussing progress, data and training, educational activities, and developed efficiencies

The Best Cave Discovery in Texas in the Years of 2019–2020

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In 1960, cavers checked out a small cave on a ranch near San Antonio, Texas. Other cavers had been there before, but they pushed harder, and made the discovery of some of the largest, best decorated cave passages in Texas. A few years later it opened as a show cave and is well known and very popular. No new passages had been discovered in the cave since the late 1960s.

In October 2018, Bill Steele arranged with one of the original explorers of the cave, Orion Knox, now in his late 70s, to join and narrate a special tour of the cave for members of the Texas Chapter of The Explorers Club. At the visitors' center after this tour, standing at a map of the cave on the wall, Orion was asked if any leads remain in the cave. He smiled and pointed to the Dome Pit, a 100+ foot-high dome with a possible passage at the top. It was thought to not be climbable due to the limestone being too soft, so it had never been attempted.

Steele said that the best cave wall climber in the USA, Lee White of Georgia, would be with him following the 2019 Huautla expedition. In May 2019, White climbed the wall and the passage at the top led to an extension of the cave with pits; well-decorated chambers; experiments with flying drones underground, netting much media attention; and now a planned new shaft entrance into the new discoveries.

End of The Line–Roppel Cave–Logsdon River

Mark Wenner, Karst Terrain Explorations; Jim Borden, Central Kentucky Karst Coalition; Pat Kambesis, Cave Research Foundation

Project cavers know, after years of mapping any cave system, it develops a life and mind of its own. A small group called Karst Terrain Explorations (KTE) has spent decades pushing the Roppel Cave–Logsdon River dive lead, following up on the ground work provided by our predecessors—our goal being to gather volumes of data and then systematically pass it forward to the next group involved. With continued support from the Central Kentucky Karst Coalition (CKKC) and Cave Research Foundation (CRF), KTE have religiously set up operations at CRF's Hamilton Valley's field station, just outside of Cave City.

With a spirited team of players, support in place, patience, dedication, and blind luck, KTE's work was once again rewarded last September. Divers Matt Vinzant and Mike Young traversed underwater passage through Sump 1 (~700 feet); hiked 1,000 feet between the two sumps portaging gear; and then pushing underwater again, surfaced from the furthest reaches of Sump 2 (2,794 feet) in walking trunk passage. It has been 35 years since divers Ron Simmons and Wes Skiles penetrated Sump 1 for the first time, to survey the dry passage beyond. Their original challenge and efforts became our exploration's starting point, each dive team tying into the previous divers' final station. Every minute the divers are exposed to these elements, they're closer to a place, where mindful is just another word, even more difficult for them to return. Those of us left on surface watch can only imagine, wondering what's going on below.

This is the culmination of KTE's efforts to date, and the hope is to provide a cross section of our results. Maps, photos, accurate geo referencing using the latest in underwater radio location tools, etc. With each expedition we continue to compile the latest rendition of a very complex puzzle, with everyone's safety our priority.

Studies Inside a New System of Glaciovolcanic Caves in the Crater of Mount St. Helens

Christian Stenner and Kathleen Graham

It has been 40 years since the destruction of May 18, 1980. In the years since, a natural laboratory has sprung forth from the devastation and Mount St. Helens is now one of the most intensively studied volcanoes on Earth. Episodic unrest in the crater between 1980 and 1986 brought forth a new series of lava domes that grew to 350 meters tall. Another period of unrest started in September 2004, when a second lava-dome-building eruption initiated in the crater. These domes ultimately grew 455 meters high. Within the crater, the glacier officially called "Crater Glacier," is the newest and one of the last expanding glaciers in the Cascade Volcanic Arc.

Volcanic steam and gas rising from around the 2008 lava dome has carved an intricate network of cave tunnels within the ice mass. Expeditions from 2014 to 2019 were successful in exploring and mapping 2.3 km of new glaciovolcanic cave passages in the Crater Glacier. The 10 distinct caves are named mostly after classical Godzilla monsters. A reference starting with the Godzilla Hole, a gaping chasm in the Crater Glacier was the first cave entered behind the 2008 lava dome.

These explorations have enabled integrated studies by the team that included sampling cave soils for astrobiology research and to search for antibacterial agents effective against resistant pathogenic bacteria and fungi. Climatology work was conducted to understand the formation of the caves. It was in Mothra Cave, the largest we have discovered so far within the Crater Glacier, that the conditions were right for testing the world's first ice climbing robot. Dubbed IceWorm, it was created by researchers at NASA's Jet Propulsion Lab as a way to move about on icy bodies of the solar systems and collect samples.

Where the Dangers Are Double

Adam Weaver and Karl Emanuel

A special introduction to the gypsum karst landscapes of the Black Hills of South Dakota. This presentation highlights a recent set of trips into a couple gypsum sinkholes that were discovered when a neighborhood in Black Hawk, SD, started to fall into some rapidly forming karstic collapses. The presentation details the work of the Paha Sapa Grotto to explore and then map the sinkholes and caverns in this neighborhood. It also delves into the recent work that has been done in the Black Hills to discover, catalogue, and explore more than 2,000 sinkholes in the region. This work, using lidar and old-fashioned field visits, is giving us a new understanding of the karst within the gypsum region of the Black Hills. It has also shown itself to be a great source of new cave discovery. This presentation is great for those who enjoy a bit of the absurd and have an interest in geospatial karst science in action!

West Virginia Exploration

de Tour de West Virginia 2020

George Dasher

This talk will discuss the four karst- and cave-forming limestones within West Virginia, as well as the different types of karst. The talk will also describe the karst and hydrology within the various counties and river basins, starting in southern West Virginia and working north, and it will provide a limited description of some of the caves within the state.

The Survey of Cave Hollow Arbogast, Tucker County, West Virginia

Dave West and David Socky

The Cave Hollow-Arbogast Cave system is a roughly 5-mile cave in Tucker County, West Virginia. The system was known to locals for many years and was visited frequently by organized cavers starting in the 1960s. A rather slow-moving survey project was gaining momentum in the late 1970s and early 1980s when access to the cave was halted by the U.S. Forest Service. Since 2007 Dave West has been working with the Forest Service to get approval for the Cave Research Foundation (CRF) to produce an accurate and detailed map of the cave. Finally, in 2017, approval was obtained, and the new

survey of Cave Hollow-Arbogast began. This is a CRF project, but it is open to any serious caver who wishes to participate in this resurvey project, as long as the rules worked out between the CRF and the Forest Service are followed.

Since 2017 there have been about seven to eight trips a year. The goal has been for monthly trips, but ice, snow, and flooding have canceled a number of trips. So far, the project has resurveyed a little over half of the cave and stands now at 3.4 miles. When the project started, the cave trips were pretty easy, surveying nice large trunk passages and breakdown rooms. However, most of the easy cave has been done, and we are now focusing on some of the more challenging sections. There are a number of water crawls that need to be done, and there are sections of the cave where "small persons" are required. But it's not all hard. There is still some nice passage that needs to be done, but it's just not within 10 minutes of the entrance. There is still a couple of years' worth of work left to do.

Germany Valley Bolt Climbs

Pete Johnson and Aaron Moses

Aaron Moses and Pete Johnson discuss 1,500 feet of aid climbing across four dome climbs in Germany Valley, West Virginia. The four climbs discussed are Lubyanka Dome (213 feet), The Flying Dutchman (303 feet), Perseverance Dome (526 feet), and Philosopher's Dome (387 feet).

The Survey of Maxwelton Sink Cave, West Virginia

David Socky

In the mid-60s Maxwelton Sink Cave was dug open and then explored and surveyed by the Pittsburgh, Boston, and Philly Grottos of the NSS. The entrance was notorious for silting shut, so the whole 10 miles of cave was surveyed in just a few years before it was totally silted shut from Hurricane Camille in 1969. Maxwelton Sink Cave, in Greenbrier County, West Virginia, is a large contact cave and belongs to the group that includes such caves as McClungs (which it is now connected to), The Hole, Ludingtons, and Culverson Creek.

A new entrance was dug open and the resurvey of Maxwelton Sink Cave commenced in February 2004. In the early stages of the project, most of the work being done was resurvey, but as the map began to fill out, it became obvious that there was a lot of potential for new cave. It wasn't until later in the project that more and more new passage was found. In addition to the large extension of Sweetwater (to be covered in detail in another presentation), there were a number of finds in such places as Thunder Dome, Consent Canyon, and Classic Canyon. Plus, there were numerous other small extensions that added to the overall length of the cave. Over 4 miles of new cave have been added to the "historic" section of Maxwelton Sink Cave, plus 10 miles have been added via the Sweetwater extension, which makes Maxwelton Sink Cave 24.1 miles long. Of course, Maxwelton Sink Cave is now just a part of the Great Savannah Cave System, which is 42.3 miles long. But better yet, in addition to the Sweetwater extension, the classic section Maxwelton Sink cave is still growing—new cave is being found. Who knows what the future will bring?

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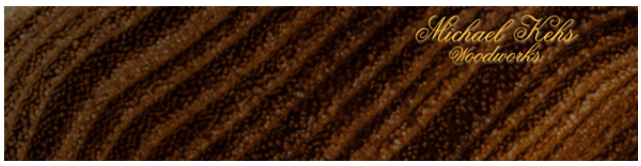

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