

AMCS

ACTIVITIES

NEWSLETTER

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The *AMCS Activities Newsletter* is published by the Association for Mexican Cave Studies, with assistance from William Russell. This issue was edited by Bill Mixon, with help from Katie Arens, Oscar Berrones, Susie Lasko, Mark Minton, Gary Napper, Terry Raines, and Peter Sprouse.

The *Activities Newsletter* seeks articles and news items on all significant exploration and research activities in the caves of Mexico. Photographs suitable for the covers and other full-page applications are also sought. They need not relate to an article in the issue, but the original slide or negative must be available on request for printing full-page photos. All material may be sent to the AMCS address. Those planning an article may contact the AMCS for the name of the editor and the schedule for the next issue. Better yet, just send it now.

The Association for Mexican Cave Studies is an informal, nonprofit organization dedicated to the exploration, study, and conservation of the caves of Mexico. All previous issues of the *Activities Newsletter* are available, as are various other publications on caves and cave life in Mexico. Write for a list of publications.

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Front cover

Francie Tucker is about 500 meters into Sac Actún, Quintana Roo, from the Ho Tul Cenote entrance.
Photo by Bill Tucker.

Back cover

Cyndi Walk watches Dawn Reed climb in Sótano de la Cuchilla, Tamaulipas.
Photo by Susie Lasko.

Frontispiece

Formations in Gruta del Palmito, Bustamante, Nuevo León.
Photo by Bill Mixon.

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Cueva de la Forje II, Nuevo León.
Photo by Susie Lasko.

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MEXICO NEWS

Compiled by William Russell

CHIAPAS

An Italian expedition took place in 1993, centered around Las Margaritas near the Guatemala border. **Cueva Pierluís Fiordel mundo** is a short, multi-level vertical cave 80 meters deep. **Cueva Loregito Zappaluerto** contains a single inclined passage that was incompletely explored due to high levels of CO₂ encountered at -110 meters. *Source: Speleologia 29, 1993.*

On April 6, 1995, a party of rafters was fired upon by bandits on the Guatemalan side of the Usumacinta River, which forms the border between Chiapas and Guatemala, and forced to shore. Three cavers well known for their work in Mexico, Ursi Sommer of Switzerland and Karlin Meyers and Gill Ediger of the United States, were wounded. The bandits were frightened back into the jungle by the chance appearance of a Mexican Army helicopter, and the rafters hastily fled down-river through the night in their now leaky rafts. Twenty parties of rafters had descended the river in the previous several months unmolested, despite the well known unrest in the area, and the trip was regarded as safe. *Source: Gill Ediger.*

COAHUILA

Texas cavers explored a remote pit in northwestern Coahuila at Rancho la Pirámide. **Pozo de la Peña** had a 61-meter entrance drop into a large borehole floored with dust-covered breakdown. This ended after 100 meters at a depth of 83 meters. *Source: Peter Sprouse.*

Mark Minton and Peter Sprouse helped gather information for this feature.

NUEVO LEÓN

In November 1994, cavers of the Proyecto Espeleológico Purificación continued prospecting for caves around Cerro el Viejo, Zaragoza. Fourteen new caves were mapped around La Escondida and Agua del Toro. The deepest of these was **Pozo de Más Cable**, which went down a series of drops to end at a depth of 154 meters. A multi-day effort was required to reach a cave high on the east face of El Viejo. **Cueva del Machete Volando** was reached via lead-climbing and turned out to be a dry gallery several hundred meters long. *Source: Peter Sprouse.*

OAXACA

The Chilchotla '94 expedition, fourth Australian expedition to the Zongolica-Chilchotla area, lasted only five weeks and turned out to be their least productive. They began by looking for new caves where they wanted them to be, higher up the hill in a series of monster dolines filled with nasty spiky bushes and stinging insects, but no caves.

Two weeks into the trip they began to rig in **Sonconga**, the second-deepest cave in the area. It had a nice-looking sump at the bottom that they hoped might have drained enough during this dry season to be passed. A swim by Greg Tunnock, with Steve Carrick in support, showed the sump still closed, but less muddy because of lower flow. Greg thought a dive with a small bottle might be worthwhile, but wasn't enthusiastic about trying a free dive. The strong air flow just before the sump was not pursued; trying to follow it remains a possibility. The swim must have increased the depth of the cave by all of

a meter, to 947 meters. Derigging was even slower and more laborious than the usual epic, as several were out of action with ailments ranging from a broken ankle to turistas and others weren't willing to go below -400 meters.

About a week before the end of the trip, a short burst of enthusiasm got a group going into **Nia Quien Nita** (Dead Dog Cave). Unlike most other deep caves around Zongolica, Dead Dog hits some major horizontal passages at about -500 meters, and these are intersected by several streams. In 1987 one of these went to -750 meters. Shane Wilcox and Steve Carrick found another intersection this trip, but with so little time and equipment available, it was left for next time, the end of 1995. *Source: Alan Warild.*

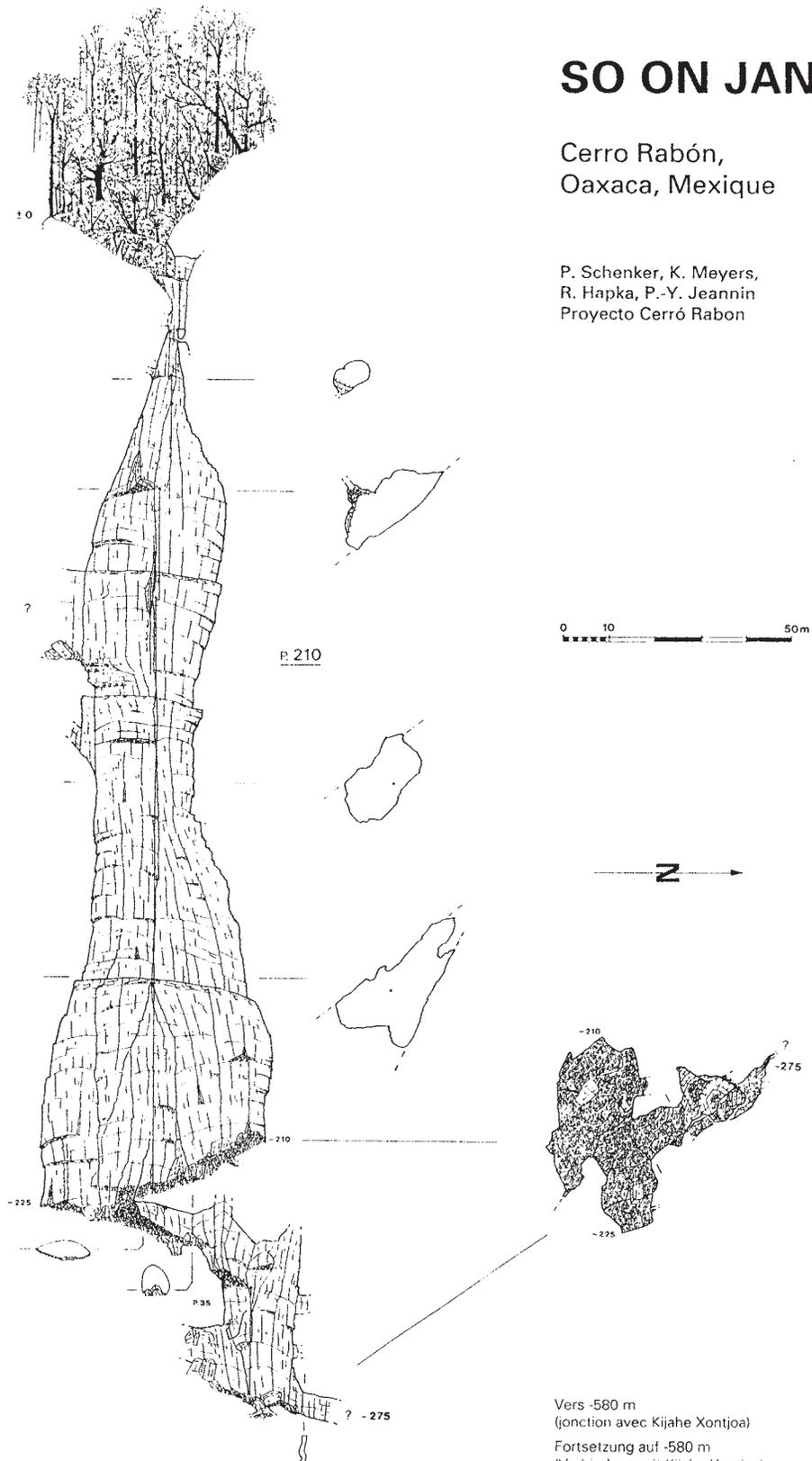
Cruz Roja-Oaxaca cavers and two cavers from Colorado continued their alliance in the summer of 1994, exploring caves in the Sierra Mixteca west of the city of Oaxaca. [See also the article in this issue on the Sierra Mixteca Alta.] The only commercial cave in the state, **Las Grutas** in the town of San Sebastian de las Grutas, was the focus of most of their attention. They mapped about 1300 meters, but declined to finish surveying the river passage during the height of the rainy season. They hope to continue during a drier time of year. The group also started a map of a remote, quasi-commercial cave in the village of San Pedro Totomacapan. A one-day trip yielded 409 meters of mapped stream passage, about half the known cave.

The most exciting exploration occurred in the village of San Andrés Chicahuaxtla in a cave with the

SO ON JAN

Cerro Rabón,
Oaxaca, Mexique

P. Schenker, K. Meyers,
R. Hapka, P.-Y. Jeannin
Proyecto Cerró Rabon



Vers -580 m
(jonction avec Kijahe Xontjoa)
Fortsetzung auf -580 m
(Verbindung mit Kijahe Xontjoa)

Spanish name **Pozo del Viento**. The Cruz Roja team had recovered a body from three pitches down two and a half years before. We learned from the locals during our visit that she had been the fourth woman in memory to "fall" into the hole on the edge of a corn field near town. Despite a death threat issued by a *borracho* to the team when the only female started her rappel, the group of three Oaxaqueños and two Coloradoans safely descended and mapped down six pitches. Their retreat was forced when they encountered a seven-second (with one bounce) pit for which they did not have enough rope. They intend to return soon. The November 1994 issue of *National Geographic* mentions the village and its "well." *Source*: Louise Hose.

The deep pits of the Cerro Rabón area just east of Huautla are described in an extensive article in *Stalactite* by Roman Hapka. The article is in both French ("Les grandes puits du Cerro Rabón") and German ("Die großen Schachte des Cerro Rabón") and describes more than just the pits of the Cerro Rabón. It also discusses the history of the exploration of the deep pits of Mexico, from the first trips by Texans to the Sierra de El Abra and Sótano de Huitzmolotitla to the explorations of Sótano de Golondrinas and El Sótano de El Barro. The history of exploration in the Cerro Rabón includes a detailed description of **So On Jan**, the deepest pit in the Cerro Rabón at 210 meters. In 1993, this pit was pushed to a connection with Kijahe Xontjoa at a depth of 550 meters. *Source*: *Stalactite*, vol. 43, no. 2, 1993.

The 1995 Cueva Cheve expedition made progress in an unusual direction—straight up. About twenty cavers camped in the llano near the entrance in March. The group included cavers from the United States, Switzerland, Britain, and even a Russian. The main effort was a twelve-day push from Camp 3, 1006 meters below the main entrance and near the present end of the cave. The cavers followed the air up a 5-meter-diameter breakdown-filled shaft. With the judicious use of Kinepak, they were able to work their way up through

massive breakdown for 100 meters to a room about 50 by 25 meters and 5 meters high. From this room, they continued upward through breakdown to a formation room and then up through more breakdown to a hole just too small to pass with good air flow and an apparent room beyond. They were out of time; a return trip is planned in three years. *Source*: Charlie Savvas.

PUEBLA

The 1994 Cuetzalan Expedition, a joint venture of the Northern Caving Club from England and the Sociedad Mexicana de Exploraciones Subterráneas, involved seventeen British and seven Mexican cavers. Between March 22 and April 21, 11 kilometers of cave were surveyed, bringing the total surveyed passage in the area to 79.1 kilometers. The expedition made the connection between the **Chichicasapan** part of the **Cuetzalan System** to **Atepolihuit de San Miguel**, producing a cave 34.4 kilometers long and 650 meters deep. The expedition was severely impacted by floods that trapped five cavers deep in the system for twenty-four hours, but all survived.

British cavers returned to the Cuetzalan area for three and a half weeks in January 1995. They pushed the **Alpazat** resurgence to 11,903 meters in length, now only 200 meters from the San Miguel section of Sistema Cuetzalan. Sistema Cuetzalan itself grew slightly to 34,345 meters. A new cave east of **Sistema San Andrés**, **Sima Talcómitl**, was surveyed for 5.58 kilometers. This may turn out to be part of the San Andrés system.

Caves in the Cuetzalan area over 2 kilometers long are:

Cuetzalan System	34.3
Cueva de Alpazat	11.9
Atepolihuit de San Andrés	10.7
Zoquiapan System	6.5
Sima Talcómitl	5.0
Tasalopan	2.9
Sima Grande de Cuauhtamazalco	2.8
Tacomitl	2.1

Source: *Descent*, no. 120, October-November 1994; *International Caver* 12, 1994; Ramón Espinasa.

QUERÉTARO

Since the preparation of the article on page 93 of *AMCS Activities Newsletter* 20, cavers from the southeastern United States, led by Gerald Moni, have continued their search for caves south of Highway 120 near Xilitla, SLP. The total number of caves now on their list is 169. Most of the added caves are in Querétaro, but some are in Hidalgo. See also the articles on **Sótano Brillante** and **Sótano de Alfredo** in this issue. Starting with a trip in January 1995, they have turned their attention to the Tamapatz, SLP, area. *Source*: Gerald Moni.

SAN LUIS POTOSÍ

A new type of speleothem resembling subaqueous helictites has been identified in **Cueva de la Puente**. These unusual formations, dubbed larvites, grow by precipitation of calcite around the mucous tubes of fly larvae attached to travertine dams. These tubes are quite delicate and are frequently destroyed by floods, but they grow back easily, reaching 10 to 15 centimeters in length and up to 1 centimeter in diameter within a few months.

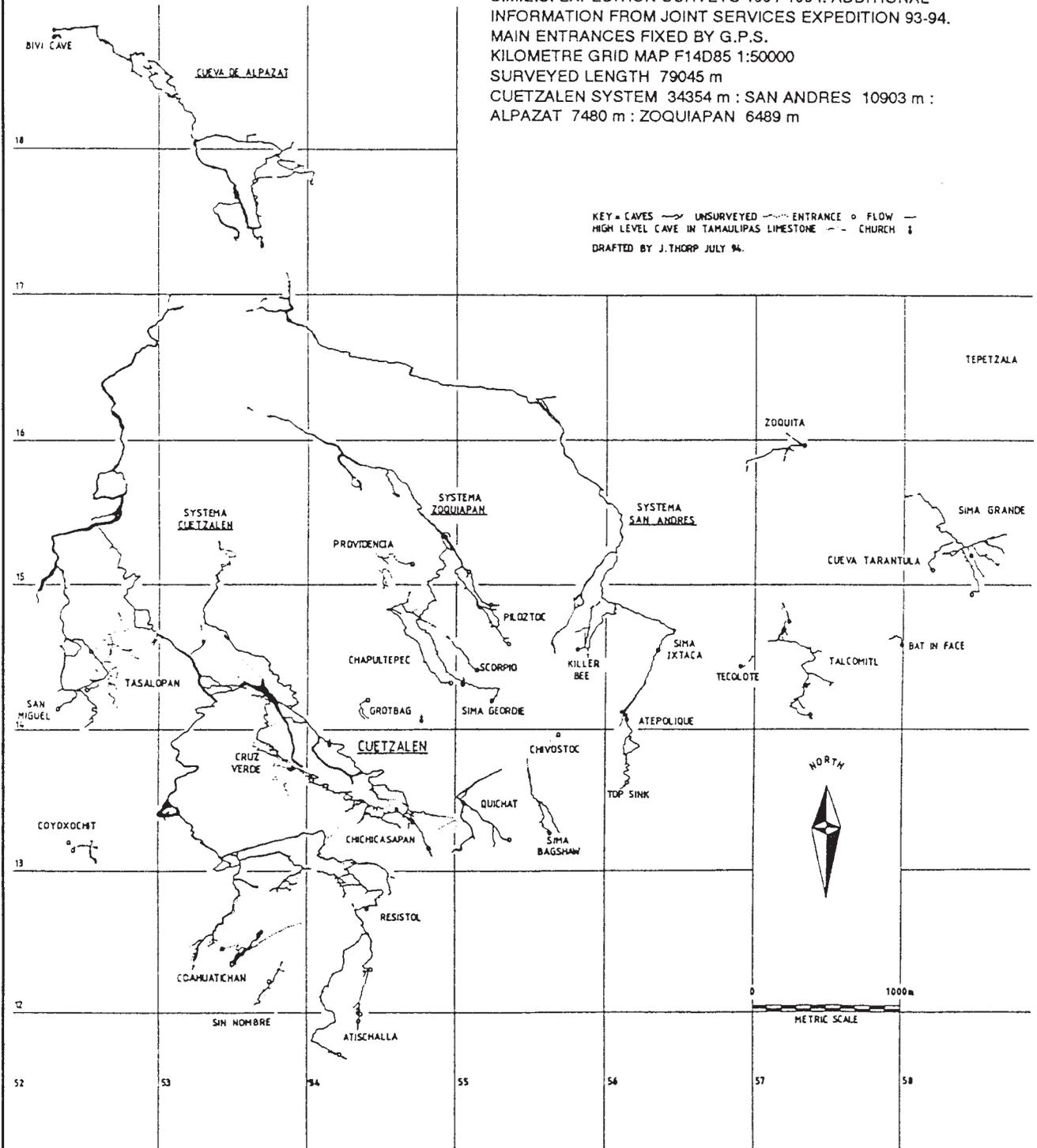
In March 1995, Mike Warton found the road to Cueva de la Puente blocked by a gate with a "private property" sign. A massive stone wall extended in both directions. *Source*: *GEO*², vol. 18, no. 2, fall 1991, and Mike Warton.

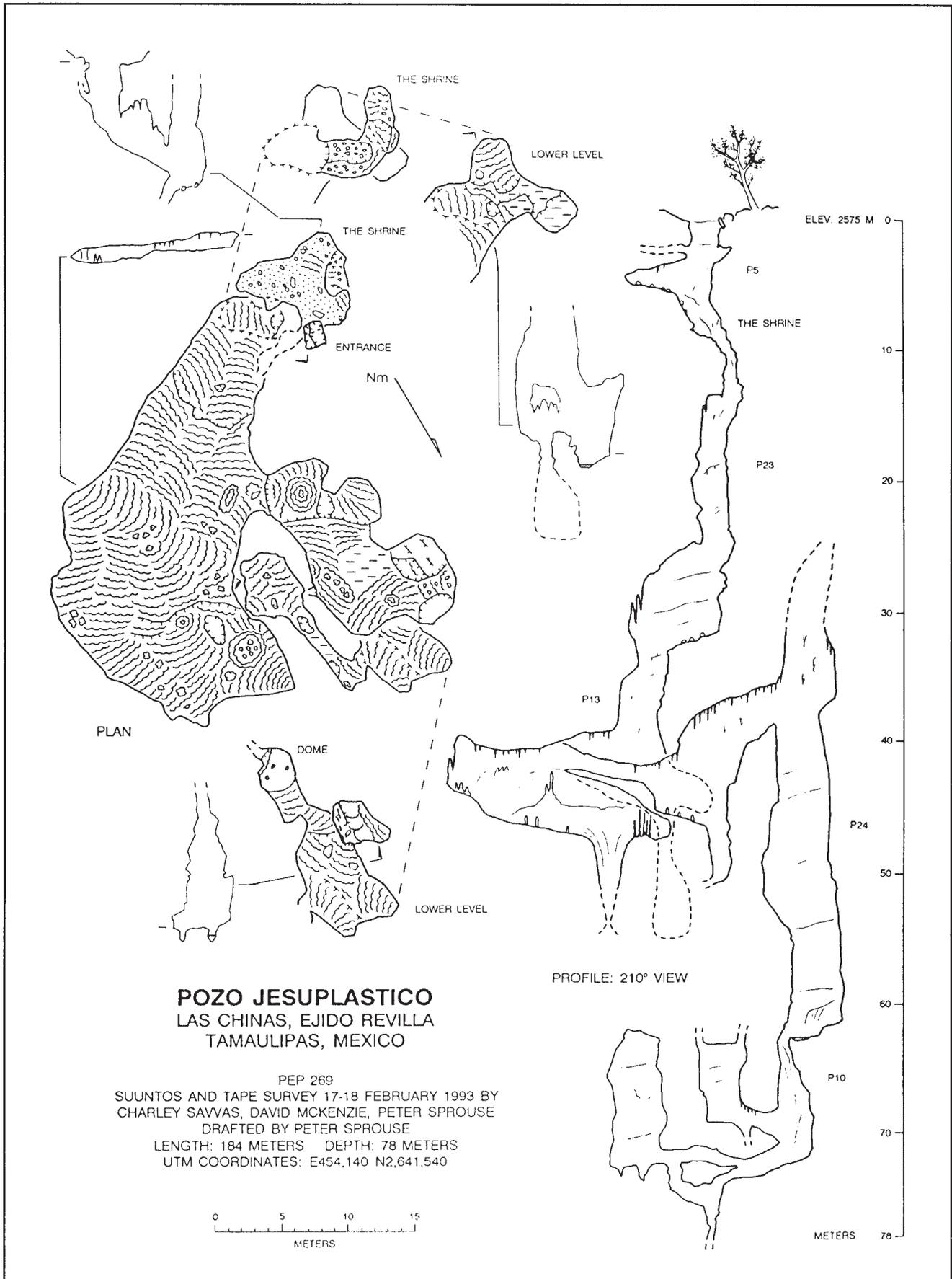
Sótano de Trueno, a 146-meter shaft located near San Francisco (see *AMCS Activities Newsletter* 14) is being filled with rubble from a nearby limestone quarry. Unexplored leads near the bottom have been filled, and blasting caps and other explosive materials were seen in the debris. This once-fine pit is now extremely dangerous and should be avoided. *Source*: George Veni.

The Asociación Potosina de Montañismo y Espeleología has published a location map and brief descriptions of forty-three caves found by their Sierra de Alvarez project in the vicinity of the town of San Francisco and the Valle de los Fantasma. The deepest is **Sótano de San Francisco** at 214 meters; second is **Sótano de Puertos**

CUETZALEN AREA PUEBLA, MEXICO

CAVE SYSTEMS OF CUETZALEN COMPILED FROM N.C.C. AND S.M.E.S. EXPEDITION SURVEYS 1991-1994. ADDITIONAL INFORMATION FROM JOINT SERVICES EXPEDITION 93-94. MAIN ENTRANCES FIXED BY G.P.S. KILOMETRE GRID MAP F14D85 1:50000 SURVEYED LENGTH 79045 m
 CUETZALEN SYSTEM 34354 m : SAN ANDRES 10903 m : ALPAZAT 7480 m : ZOQUIAPAN 6489 m

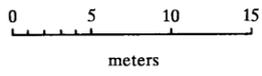




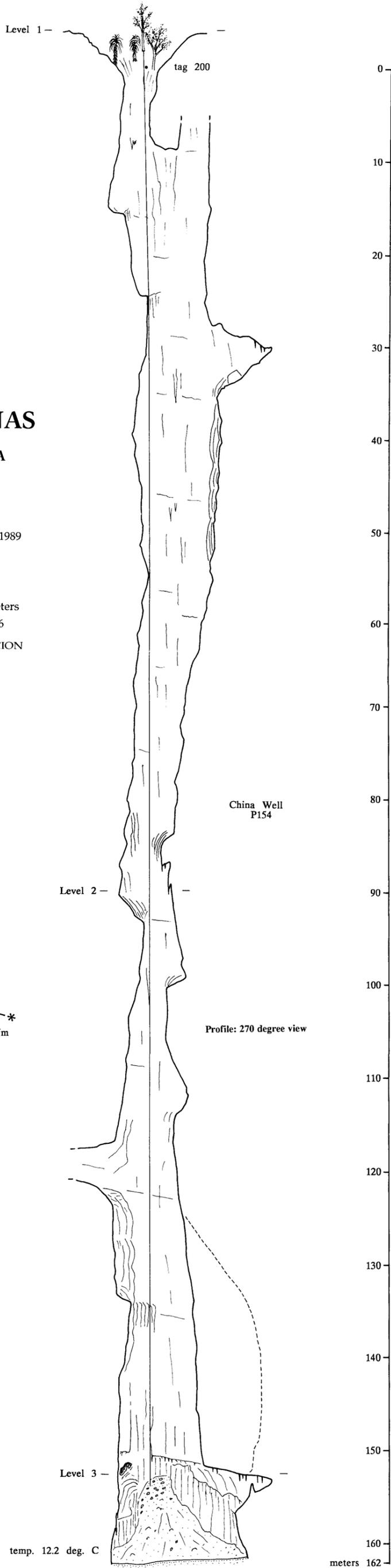
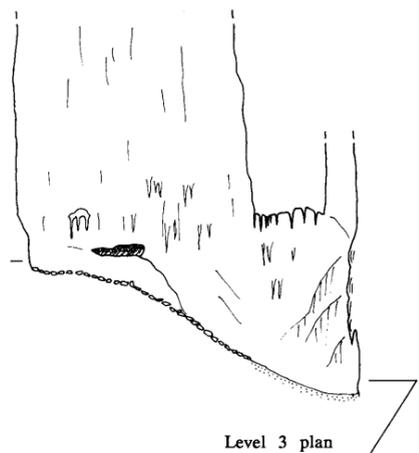
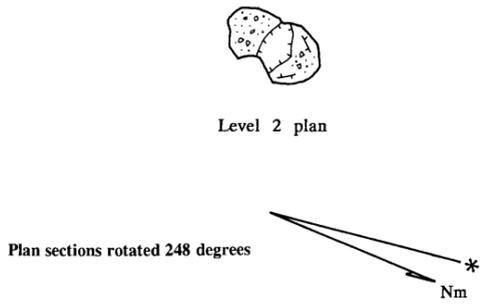
POZO DE LAS CHINAS

LAS CHINAS, EJIDO REVILLA TAMAULIPAS, MEXICO

PEP 200
 Suuntos and tape survey 2 September 1989
 Val Ellis, John Fogarty,
 Susie Lasko, Peter Sprouse
 Drafted by Peter Sprouse
 Length: 190 meters Depth: 162 meters
 UTM coordinates E:454,650 N:2,638,276
 PROYECTO ESPELEOLOGICO PURIFICACION



PEP standard cave map symbols



de los Lobos, 202 meters. *Source: Tsaval 3*, July 1993.

In February 1990, a group of cavers from the Asociación de Excursionismo del Instituto Politécnico Nacional visited **Sótano de Soyate**, a deep pit just north of Cd. Valles that leads to a large lake room. Several cavers had feared that Soyate was lost in the jungle and would be difficult to relocate, even though it is just off the road to **Cueva Pinta**. If cavers visit the sótano every few years, the locals will remember the location. *Source: Excursionismo Politécnico, época 4*, no. 3, August 1993.

TAMAULIPAS

Appropriately named **Bee Cave**, a 74-meter pit near Gómez Farías, contains an extensive bee population. The local people construct scaffolds within the pit in order to collect honey from the hives. TAG (southeastern United States) cavers had visited the pit in the past without incident by rigging a free drop well away from the walls and making the descent at night. However, on a return visit over Thanksgiving of 1994, cavers were attacked by the bees, both on rope as well as on the surface near the lip, even at night with the same rigging point. This raises the specter of Africanized "killer" bees and indicates that extreme caution should be observed whenever bees are seen around cave entrances. *Source: Alan Cressler.*

A full report on the 1993 expeditions to **Cueva de Tecolote** and **Cueva del Paraíso Difícil** (see Mexico News, *AMCS Activities Newsletter 20*) has been published in the third Proyecto Espeleológico Purificación newslet-

ter. Also included are a list of the invertebrate fauna of **Cueva del Tecolote**, trip reports, and descriptions of several area caves, including **Pozo de las Chinas**, with a 154-meter entrance shaft, longest in the area, 78-meter-deep **Pozo Jesuplástico**, and 110-meter-deep **Pozo de Rancho Viejo**. *Source: Death Coral Caver 3*, October 1993.

VERACRUZ

In March 1995, a large international expedition investigated new karst areas southeast of Tequila, near Orizaba. About thirty cavers from Mexico, the United States, Britain, and Germany participated. They explored fifty new caves around Tlaquilpa and Atlahuilco. The deepest of these was **Sótano del Hombre Miedoso**, which went down a number of pitches to a depth of 218 meters. It was at this cave that four cavers had their rope sabotaged by some hostile locals, resulting in a 7-hour entrapment until fellow cavers came to investigate. Other expedition finds included two entrance pitches in the 100-meter range. *Source: Peter Sprouse.*

YUCATÁN

A group of U.S. cavers continued mapping efforts in **Cueva de Kaua** in December 1994, after a 20-year hiatus in activity there. Over half of the encircled North Maze was surveyed in ninety stations. In all, 746 meters of passage were mapped, making the cave 7446 meters long. Plenty of maze remains unmapped and unexplored. *Source: Peter Sprouse.*

BIOLOGY

The cricket fauna of caves in southern Mexico from Oaxaca and Chiapas through the Yucatán Peninsula is de-

scribed and analyzed in a long article by Laure Desutter-Grandcolas of the Museum National d'Histoire Naturelle, Laboratoire d'Entomologie, in Paris. (These are true crickets, not the "cave crickets" of the United States.) Six new genera are defined, and twenty-three of the twenty-six species considered are new species described in the article. A fundamental problem of cave biology is whether removal of the ancestral surface population is necessary before a relict population in the cave can adapt to the cave environment. The cave crickets of southern Mexico indicate that removal of the surface population is not necessary. *Source: International Journal of Speleology*, vol. 22, pp. 1-82, 1993.

NOTE ON SOUTHERN MEXICO

See the article on the Sierra Mixteca Alta in Oaxaca in this issue for an example where government permission and even the presence of a government representative did not suffice for local permission to cave. In the high karst near Tequila, southern Veracruz (see Veracruz, above), Peter Sprouse and others were denied local permission despite having a letter from the presidente of the municipio, a PRI official. If you plan a cave trip to the populated areas of southern Mexico, particularly the Indian areas, expect local problems and have a backup destination. The instability of the PRI and the fighting in Chiapas make things even more confusing than usual, but then some of the first caving trips to Mexico, almost thirty years ago, had similar problems. *William Russell.*

LONG CAVES OF MEXICO

Peter Sprouse
 April 1995
 Length in meters

1	Sistema Purificación	Tamaulipas	81950
2	Sistema Huautla	Oaxaca	55953
3	Nohoch Nah Chich	Quintana Roo	39624
4	Sistema Cuetzalan	Puebla	34345
5	Cueva del Tecolote	Tamaulipas	32031
6	Sistema Cheve	Oaxaca	23300
7	Coyalatl	Puebla	19000
8	Kihaje Xontjoa	Oaxaca	18500
9	Sistema Naranjal (Najaron-Maya Blue)	Quintana Roo	18472
10	Sistema Ojos (Ojos, Palmas,Tic-Te-Ha)	Quintana Roo	12073
11	Cueva del Alpazat	Puebla	11903
12	Atlixicalla	Puebla	11700
13	Sistema San Andrés	Puebla	10903
14	Grutas de Rancho Nuevo (San Cristóbal)	Chiapas	10218
15	El Chorro Grande	Chiapas	9650
16	Sistema Pondazul	Quintana Roo	9254
17	Cueva del Arroyo Grande	Chiapas	9154
18	Cueva Quebrada	Quintana Roo	9000
19	Sistema de Niebla	Puebla	8511
20	Sistema de Angel (Ehocoklh)	Puebla	8000
21	Sumidero Santa Elena	Puebla	7884
22	Cueva Yohualapa	Puebla	7820
23	Cueva de la Peña Colorada	Oaxaca	7793
24	Cueva de Comalapa	Veracruz	7750
25	Sótano de Las Calenturas	Tamaulipas	7730
26	Actún Kaua	Yucatán	7446
27	Sótano del Arroyo	San Luis Potosí	7200
28	Cueva del Mano	Oaxaca	6798
29	Xongo Dwi Ñi	Oaxaca	6500
30	Sistema Zoquiapan	Puebla	6412
31	Sumidero de Jonotla	Puebla	6381
32	Gruta del Río Chontalcoatlán	Guerrero	5827
33	Sistema H31-H32-H35	Puebla	5745
34	Gruta del Río San Jerónimo	Guerrero	5600
35	Los Bordos	Chiapas	5211
36	Cueva de Agua Blanca	Tabasco	5200
37	Grutas de Juxtlahuaca	Guerrero	5098
38	Sima Talcómitl	Puebla	5058
39	Sac Actún	Quintana Roo	5013
40	Veshtucoc	Chiapas	4930
41	Sistema Ocotempa	Puebla	4720
42	Sistema Huayateno	Puebla	4710
43	Cenote Zapote	Quintana Roo	4604
44	Cueva del Nac. del Río San Antonio	Oaxaca	4570
45	Sistema Atlalaquia	Veracruz	4530
46	Sótano de la Tinaja	San Luis Potosí	4502
47	Sótano de Japones	San Luis Potosí	4500
48	Cueva Escalera	Oaxaca	4500
49	Sótano de Agua de Carrizo	Oaxaca	4477
50	Sumidero de Pecho Blanco No. 2	Chiapas	4435

Peter Sprouse
 April 1995
 Depth in meters

DEEP CAVES OF MEXICO

1	Sistema Huautla	Oaxaca	1475
2	Sistema Cheve	Oaxaca	1386
3	Akemati	Puebla	1200
4	Kijahe Xontjoa	Oaxaca	1185
5	Sistema Ocotempa	Puebla	1070
6	Akemabis	Puebla	1015
7	Sistema Purificación	Tamaulipas	955
8	Sonconga	Oaxaca	947
9	Guizani Ndia Guinjao	Oaxaca	940
10	Nita Cho	Oaxaca	894
11	Sótano de Agua de Carrizo	Oaxaca	843
12	Sótano de El Berro	Veracruz	838
13	Sótano de Trinidad	San Luis Potosí	834
14	X'oy Tixa	Oaxaca	813
15	Sistema de Niebla	Puebla	778
16	Nia Quien Nita	Oaxaca	767
17	Nita Ka	Oaxaca	760
18	Sistema H31-H32-H35	Puebla	753
19	Sonyance	Oaxaca	745
20	Nita Xonga	Oaxaca	740
21	Yu Nita	Oaxaca	704
22	Aztotempa	Puebla	700
23	Sótano de los Planos	Puebla	694
24	Resumidero el Borbollón	San Luis Potosí	678
25	Sótano de Alfredo	Querétaro	673
26	Sistema Cuetzalan	Puebla	658
27	Sótano de Tilaco	Querétaro	649
28	Nita Nashí	Oaxaca	641
29	Sistema Atlalaquía	Veracruz	623
30	Cueva de Diamante	Tamaulipas	621
31	R'ja Man Kijao	Oaxaca	613
32	Nita He	Oaxaca	594
33	CH54 (Meandre-Qui-Traverse)	Puebla	588
34	Sótano de las Coyotas	Guanajuato	581
35	Sótano Arriba Suyo	San Luis Potosí	563
36	Sistema de Angel (Ehecoklh)	Puebla	533
37	Sótano del Río Iglesia	Oaxaca	531
38	Sótano de Nogal	Querétaro	529
39	Grutas de Rancho Nuevo	Chiapas	520
40	Sótano de Ahuihuitzcapa	Veracruz	515
41	Sótano de las Golondrinas	San Luis Potosí	512
42	Hoya de las Conchas	Querétaro	508
43	Sótano del Buque	Querétaro	506
44	Sótano de Tepetlaxtli No. 1	Puebla	502
45	Pozo de Montemayor	Nuevo León	501
46	Nita Chaki	Oaxaca	493
47	Hoya de las Guaguas	San Luis Potosí	478
48	Sistema San Andrés	Puebla	474
49	Cueva de la Canoa	San Luis Potosí	466
50	Cueva de San Agustín	Oaxaca	461

DEEP PITS OF MEXICO

Peter Sprouse
 April 1995
 Depth in meters

1	Sótano de El Barro (El Sótano)	entrance drop	Querétaro	410
2	Sótano de las Golondrinas	entrance drop	San Luis Potosí	376
3	Sótano de Tomasa Kiahua	entrance drop	Veracruz	330
4	Sótano de Alhuastle	P'tit Quebec	Puebla	329
5	Zacatón	entrance drop	Tamaulipas	329
6	Nita Xonga	Psycho Killer	Oaxaca	310
7	Sotanito de Ahuacatlán	second drop	Querétaro	288
8	Sótano del Arroyo Grande	entrance drop	Chiapas	283
9	Sima Don Juan	entrance drop	Chiapas	278
10	Resumidero del Pozo Blanco	entrance drop	Jalisco	233
11	Sótano del Aire	entrance drop	San Luis Potosí	233
12	Sistema Ocotempa	Pozo Verde	Puebla	221
13	Sótano de los Planos	second drop	Puebla	220
14	Sótano de Eladio Martínez	entrance drop	Veracruz	220
15	Sótano de Coatimundi	entrance drop	San Luis Potosí	219
16	Sótano de Sendero	entrance drop	San Luis Potosí	217
17	Resumidero el Borbollon	first drop	San Luis Potosí	217
18	Sima del Chikinibal	entrance drop	Chiapas	214
19	Cueva del Tizar	third drop	San Luis Potosí	212
20	Kijahe Xontjoa	Son On Jon	Oaxaca	210
21	Nacimiento del Río Mante	Macho Pit	Tamaulipas	206
22	Hoya de las Guaguas	entrance drop	San Luis Potosí	202
23	Sistema de la Lucha	entrance drop	Chiapas	200
24	Sistema H3-H4		Puebla	200
25	Kijahe Xontjoa	Lajao Se	Oaxaca	199
26	Sima La Funda	entrance drop	Chiapas	198
27	Sótano de Soyate	entrance drop	San Luis Potosí	195
28	Sótano de Alpupuluca	entrance drop	Veracruz	190
29	Cuaubtempa	Pozo con Carne	Puebla	190
30	Sótano de Tepetlaxtli #1	entrance drop	Puebla	190
31	Sótano de Puerto de los Lobos	entrance drop	San Luis Potosí	189
32	Sótano de Hermanos Peligrosos	second drop	Veracruz	186
33	Hoya de la Luz	entrance drop	San Luis Potosí	180
34	Ahuihuitzcapa	entrance drop	Veracruz	180
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ARTICLES



HISTORY OF EXPLORATION IN SISTEMA HUAUTLA

Bill Stone

Until the early 1980s, Mexico was known to the speleological world chiefly for its spectacular open-air pits, Sótano de las Golondrinas in San Luis Potosí, considered by many to be the world's most awesome pit, with its 333-meter free low-side drop, and the gigantic El Sótano del Barro in Querétaro, with its 410-meter drop. These pits were discovered by cavers in 1968 and 1972, respectively. They attracted primarily curiosity seekers, not explorers. An event in the spring of 1980 changed the world's view of Mexican caves. Li Nita (Mazatec for Flashlight Cave) and the Sótano de San Agustín on the Huautla Plateau in Oaxaca were linked to form Sistema Huautla, the first cave in the Western Hemisphere to break the one-kilometer depth barrier. News of this discovery spread not only through the country of Mexico, where a small but growing number of exploration groups were developing, but around the world.

Thereafter, increasing numbers of speleological expeditions visited Mexico, each intending to go deeper beneath the surface. For instance, in the spring of 1991, during the dry season from February through May, more than a dozen major expeditions were being fielded in widely scattered regions throughout the country. The growth of caving in Mexico is shown by the increase in known deep caves that surpass the world-class five-hundred-meter mark. In 1968 there were only two such caves, Sótano de San Agustín (612 meters deep) and Sótano del Río Iglesia (535 meters). By the spring of 1991, there were thirty-four caves deeper than

five hundred meters; five of these were deeper than one thousand meters. Today, Mexico is recognized as one of the premier sites in the world for deep cave exploration, and there are many who believe that the world's first 1700-meter-deep cave will be explored in the southern Sierra Madre Oriental within the next ten years. One cave that could achieve this depth is Sistema Huautla, located in the Sierra Mazateca in the northeast corner of the state of Oaxaca.

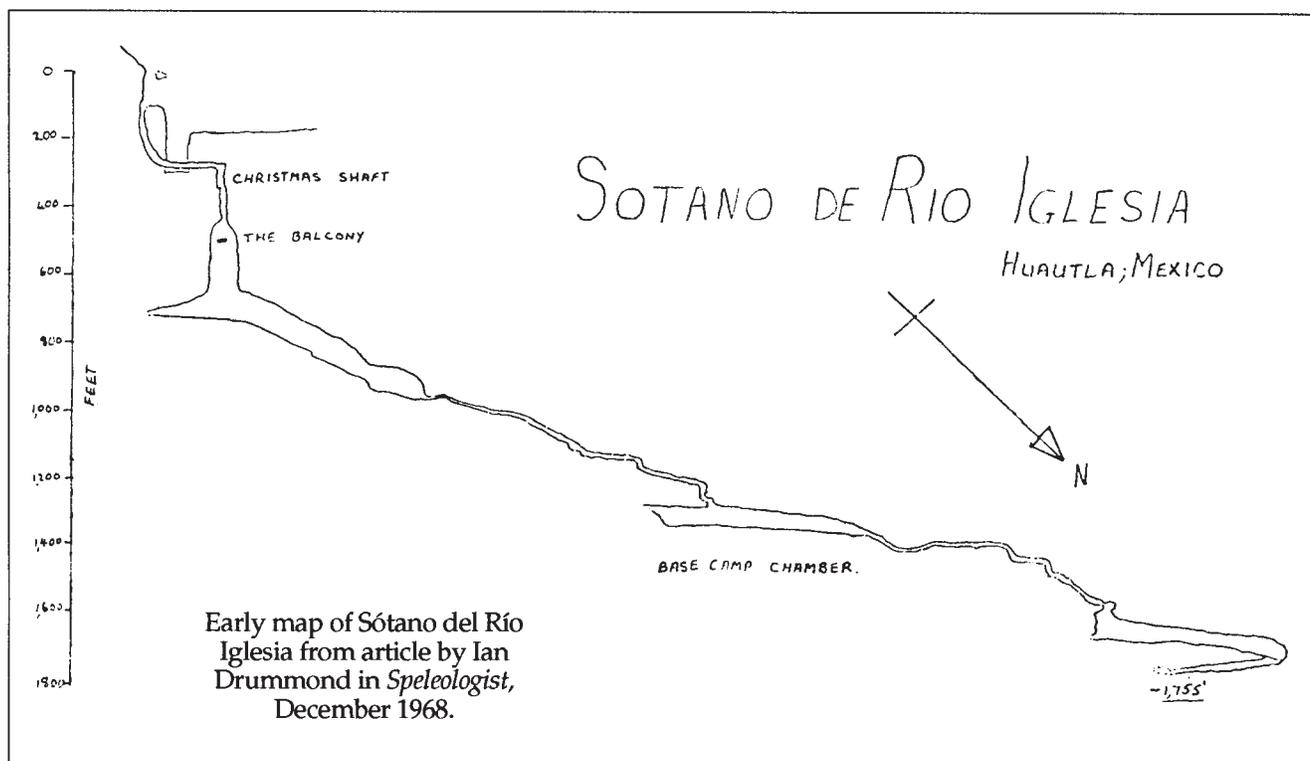
In the early 1960s, a group of speleologists, largely from Texas, began investigating the deep caves of the Sierra Madre Oriental of Mexico. Initially, these were reconnaissance trips that found excitement in descending the entrance shafts of what in some cases proved to be very large cave systems. Given the startling depths of these entrance pits, up to 200 meters in some cases, in 1964 William Russell began an extensive search of topographic maps at the University of Texas at Austin for locations in Mexico where water was shown sinking at high elevations and emerging from springs at much lower altitude. The specific intent of this effort was to locate a potential site for the world's deepest cave. Russell concluded, conservatively, that the potential existed for a thousand-meter-deep cave in the vicinity of Huautla de Jiménez, Oaxaca. In July 1965, he and two others set out for Huautla, but turned north at the Puente Fiero at the suggestion of local Mazatecs, who said that large caves existed on the road to Santa María Chilchotla. Although they discovered several large horizontal caves, they concluded that the deep caves must lie somewhere to the east.

In June 1966, Ed Alexander, Bob Burnett, John Fish, John Kreidler, Charlie Jennings, Tommy McGarrigle, and Bill Russell proceeded east from Huautla de Jiménez toward the limestone region where the topographic maps indicated the presence of immense sinkholes. What followed was one of the greatest speleological discoveries of all time. In one afternoon, they located the entrances to Sótano del Río Iglesia, Sótano de San Agustín, Cueva de San Agustín, and Cueva de Agua Carlota. The exploration of the caves discovered that afternoon will almost certainly continue well into the twenty-first century.

On June 6, Burnett, Jennings, Alexander, and McGarrigle visited Sótano de San Agustín. They explored the two entrance drops into the Sala Grande, a chamber at -114 meters measuring 50 meters wide, 25 meters tall, and 200 meters long, and continued down a series of small drops. Alexander acquired the distinction of being the first person to descend into Sótano de San Agustín.

Then, during the last days of 1966, Alexander and McGarrigle, accompanied by Tom Tracy and Terry Raines, returned to San Agustín and began the survey, reaching a depth of 281 meters at the top of a deep shaft taking water. It is of some historical interest to note that at the same time T. R. Evans, Charles Borland, and Ronald Stearns were pushing into a new area north of Xilitla and west of Aquismón, San Luis Potosí, and were led to the entrances to Sótano de las Golondrinas and Hoya de las Guaguas.

The stage was set for the first two large-scale cave-exploration expeditions to Mexico, with destinations



Sótanos de San Agustín and de las Golondrinas. Both trips were in the first days of April 1967. The twelve members of the San Agustín team quickly rigged down to the end of previous exploration and found water levels too high to continue. The cave was derigged, and they went home. In contrast, the team of twelve cavers led by T. R. Evans had great success in rigging Golondrinas and putting the first people on the floor of the cave. The drop was measured to be 333 meters, and during the course of the expedition eight cavers descended and returned to the surface. To this day, Sótano de las Golondrinas is considered by many the most magnificent pit on the planet.

During Christmas of 1967, Canadian cavers joined forces with the Texans in the Huautla area, pushing deeper into San Agustín and Sótano del Río Iglesia, which until this time had remained unentered. Río Iglesia was surveyed to a depth of 535 meters, making it the deepest cave in the Americas and the first Mexican cave to surpass five hundred meters in depth. This team, led by Ian Drummond and Peter Thompson, established a subterranean camp for nearly a week at a depth of 400 meters

during their efforts to reach the bottom.

In December of 1968, a three-week expedition was directed at Sótano de San Agustín. Unlike previous efforts, this one was highly organized; it was a joint Canadian-American effort under the leadership of John Fish. Nearly six months of planning went into the effort, which was unheard-of in those days. They used wetsuits, electric miner's lamps, and a combination of British wire ladders and American single-rope techniques. A subterranean camp, Camp 1, was set in San Agustín at a depth of 250 meters, at the top of a 300-meter series of shafts that had halted earlier exploration. They eventually reached a depth of 606 meters at a sump, for a new Western Hemisphere depth record.

Following the 1968 joint Canadian-American expedition to Sótano de San Agustín, political relations on the Huautla Plateau began to deteriorate. This had nothing to do with caving. The ancient Mazatec Indian custom of using psilocybin mushrooms in curing ceremonies had been, shortly before Russell's discovery of Huautla on the topographic map, discovered by the American Timothy

Leary, whose hippie movement brought hoards of counter-culture types to Huautla to partake in the drug. By the late 1960s, resentment of these individuals by the local Indians grew to the point where all *extranjeros* were viewed as hippies. A particularly notorious incident occurred near the end of the 1968 expedition, when a small scouting team was conducting the initial exploration of a cave named La Grieta, which had been discovered by T. R. Evans some 4 kilometers north of San Agustín near the village of Plan Carlota. The team left one of its members, Don Broussard, at the entrance to guard the rope, as the 60-meter entrance pit was within sight of a nearby trail. Ten friendly Mazatecs joined Broussard, and eventually three arrogant ones appeared. Shortly thereafter, when Broussard was distracted checking on Meri Fish, wife of expedition leader John Fish, who was ascending the rope and was more than 50 meters off the floor, just above a small ledge, the rope was cut, and all the Indians fled through the fields. Sure that a murder had just been committed, Broussard scrambled to the edge of the pit to find, to his utter amazement, that Fish had managed to stop her fall on the small ledge.

With a replacement rope and reinforcements from expedition base camp, the team was rescued from La Grieta.

By the end of 1970, when Cueva (not Sótano) de San Agustín was bot-tomed at -461 meters and Cueva de Santa Cruz, west of San Andres Hidalgo, was explored to -320 meters, several exploration teams returning after dark had rocks thrown at them, and in one case near the village of San Miguel Huautepec, locals had rolled boulders down a shaft while the cavers were inside. Military road-blocks were also beginning to appear on the main four-wheel-drive road to Huautla. These had specific instructions to stem the flow of *norteamericanos* to Huautla, regardless of their missions. Similar instructions were issued to all agencies in the Sierra Mazateca. The actual source of these orders has been disputed, but they appear to have resulted from an agreement between the Mexican government and the Nixon administration's Drug Enforcement Agency.

After 1970, an unofficial moratorium on cave exploration in Huautla went into effect, and with each passing year the stories of what had occurred there became more the substance of legend.

Richard Schreiber, the discoverer of Ellison's Cave in the state of Georgia with its 190-meter Fantastic Pit, had been one of a three-member team, with Mike Lemon and Julian Coward, that reached the end of Route '68, a kilometer-long horizontal gallery at the -540-meter level, during the 1968 expedition to San Agustín. They had been stopped at a vertical wall, but there was a substantial wind flowing down the passage. Since this was not the deepest

passage in the cave and their supply lines had been stretched thin in reaching the -606-meter sump, further efforts to explore Route '68 had not been made then. Following the return of that expedition, Schreiber enlisted in the Air Force, a measure forced upon many young Americans in that era, when the alternative was being drafted by the Army and sent to Viet Nam. Schreiber spent four years in Minot, North Dakota, far from any caving area. Eight years later, however, memories of San Agustín were still haunting him, and rumors had recently spread that a French-Canadian team had toured the upper part of San Agustín and that the political climate appeared to be improving. Furthermore, equipment and techniques had improved significantly.

In July 1976, Schreiber quietly began preparing for a return to Sótano de San Agustín. A dual assault was planned for early December. First, Schreiber, along with Mark Stock and Jim Smith, bypassed the climb that had stopped Schreiber in 1968, and the three reached a new Western Hemisphere depth record of 628 meters. Then Schreiber's team was replaced by one led by Bill Stone of Texas, which included Frank Binney and Roy Jameson, with support from Alexia Cochran, Patty Mothes, and Jeff Horowitz. This new group, along with Jim Smith, who had stayed on to serve as a guide, established Camp 2 at -536 meters and pushed on for four days to -745 meters before being stopped by high water. During this same expedition, La Grieta was revisited, and exploration there was

extended to -410 meters, despite a near repeat of the 1968 rope-chopping incident.

One of the most significant technical expeditions of 1977 was the return to Sumidero Yochib, in the southern state of Chiapas. This magnificent river swallet, near the city of San Cristóbal de las Casas, had been discovered in January of 1974 by Canadians Joan Beckett and Mike Boon, although numerous groups had heard of its existence up to three years earlier. Yochib's principal distinguishing feature is the amount of water, more than a cubic meter per second, that thunders down its sinuous passages. By 1977, the stories of endless "bolt ladders" traversing the smooth canyon walls, hundreds of meters of canal lines, and noise so loud that it was nearly impossible to communicate had drawn the attention of Bill Steele, Blake Harrison, Mike Van Note, and Jim Smith, among others, who joined Boon in his mad scheme to bottom Yochib. Ultimately, Yochib was pushed to a 60-meter-diameter chamber where the river disappeared into a sump at a depth of 206 meters. More than a kilometer of rope had been rigged to reach this depth, making Yochib meter-for-meter one of the most technical caves in the world. The resurgence to Yochib is presumed to lie at Cruz Pilal, some 2 kilometers distant and 100 meters vertically lower than the sump. The complete traverse of the Yochib system lies in wait for ambitious cave divers.

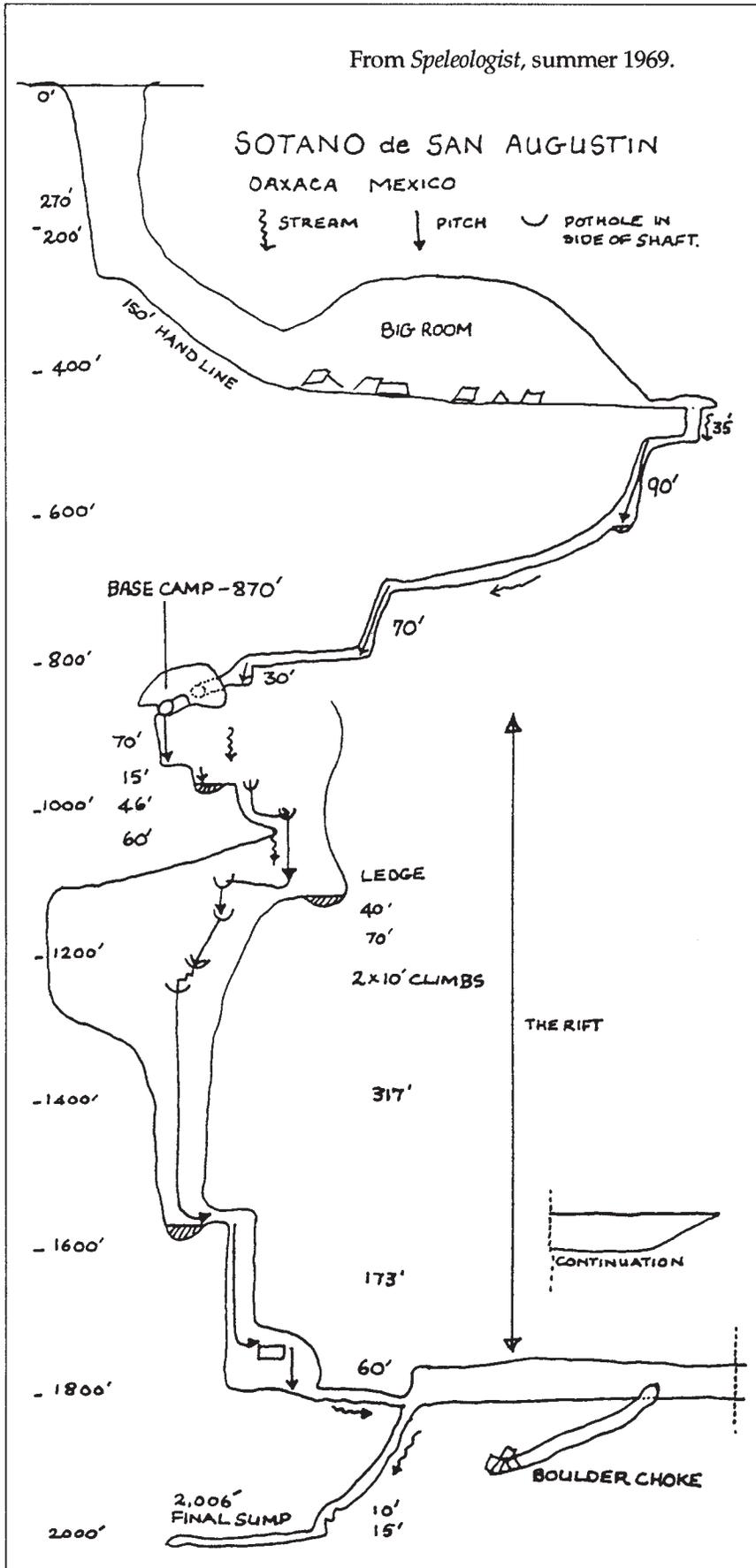
In March 1977, after the triumph at Yochib, most members of the expedition drove north to Huautla to join

Participants in the April 1967 expedition to Sótano de San Agustín. From left, standing:

Dave Brison, John Fish, Robert Thren, Runi Burnett, Ed Alexander, Orion Knox.

Seated: Terry Raines, Laurie Cameron, Tom Tracy, Bill Bell, Jonathan Davis, Tommy McGarrigle. Terry Raines.





Richard Schreiber for a return push at San Agustín. This group quickly rigged to the limit of exploration and, working from new Camp 2A, near Camp 2 at -536 meters, bottomed the river passage at a sump at -790 meters. One member of the team, Warren Heller, left for the surface ahead of the others so that he could take time to attach his duffel to the bottom of the ropes and hoist it up each pitch. After each such maneuver, Heller tossed the rope back down the shaft. Others on the team were accustomed to tethering their duffels on a 2-meter length of webbing as they ascended. The substantial wisdom of this latter technique was about to be demonstrated. On the longest shaft then known in San Agustín, The 318 (a 97-meter pit), Heller's rope toss never made it to the bottom; the end of the rope was hung on the wall in a giant loop some 50 meters off the floor. Heller continued out, unaware of his error. Those below soon realized they were trapped, a condition that was not resolved until five days later, when Joe Lieberz, a member of the surface team, entered to ascertain why the others had not left the cave. Following their rescue, the Camp 2A team was joined by reinforcements who convinced them to stay on for another push at the bottom. They soon discovered, in a chamber named the Sala Grande de la Sierra Mazateca, 50 meters wide, 250 meters long, and 60 meters high, a bypass to the sump at -790 meters. A multi-drop canyon with water flow nearly equal to Yochib led from one end of the room. Ultimately, Steele, Smith, Jean Jancewicz, Steve Zeman, and Dino Lowrey reached another sump at -840 meters, the bottom of Sótano de San Agustín. (This was known as the -861 sump, before calculating new loop closures reduced the depth. Figures in this article reflect the current best numbers.)

Less than six weeks after the return of the Yochib-San Agustín expedition, most of the same team, with the addition of Bill Stone and Tracy Johnson, returned to the Huautla area to push La Grieta. Sufficient public-relations work had been done to alleviate the problems there. A camp was set at the -300-meter level for a period of ten days, during which nearly

Steve Zeman (left), Tracy Johnson, Bill Stone, Gary Stiles, Bill Steele, and Ernie Garza leaving for camp in La Grieta, May 1977. *Jeff Horowitz.*



6 kilometers of passage was mapped, reaching a depth of 665 meters. The cave was heading south, for San Agustín. By this time, the rainy season was imminent, and the team retreated.

Six months later, in December 1977, an international team including Australians Julia James, Alan Warild, and Neil Hickson and most of the May 1977 Association for Mexican Cave Studies expedition members returned to set Camp 2 in La Grieta at -500 meters. During this twelve-day underground camp, a terminal collapse was reached at a depth of 720 meters, about 7 kilometers from the entrance. During the later part of the expedition, Warild and Hickson discovered a new cave on the ridge separating La Grieta and San Agustín. The new find was named Sótano de Agua de Carrizo. A series of surface-based trips quickly descended the near-vertical system to a depth of 778 meters before running out of rope and time. This mark stood for more than seven years as the deepest any expedition had descended into a cave on its discovery push. The exploration of two systems more than seven hundred meters deep on one expedition signaled a new level of technical competence, and the beginning of a team that became known as the Proyecto Espeleológico Huautla, the Huautla Project.

When Sótano de Agua de Carrizo was bottomed some four months later by many of the same team (Steele, Smith, Stone, Zeman, Schreiber, et al.) at -848 meters, with a completely independent route to -844 meters, it was felt that Huautla had little competition in the Western Hemisphere for deep cave exploration. But this was proved incorrect most dramatically when Peter Sprouse and crew connected Cueva del Brinco and Cueva de Infiernillo in northern Tamaulipas to form Sistema Purificación, 894 meters deep. In this cave system, remarkably, only two shafts required the use of rope, in contrast

to the kilometer of rope typically required to rig one of the deep routes in Huautla. There was now a race between these two groups to discover the first thousand-meter-deep cave in Mexico.

Prompted by the success of Sprouse's long-duration expedition to Sistema Purificación in 1978, a three-month expedition to Sótano de San Agustín was planned for the spring of 1979 in an effort to bring the depth record back to Huautla. The expedition almost never came to be, for while driving to Huautla, the five-person lead team of Steve Zeman, Tommy Shifflett, Hal Lloyd, Dino Lowrey, and Bill Stone had a close brush with death when their truck was forced off the road by a passing tractor-trailer. The heavily loaded pickup rolled and skidded upside down for 80 meters before coming to a stop. Miraculously, no one was hurt, and, after a week of repairs, the expedition carried on to Huautla, where they spent a phenomenal thirty-nine days camped at or below Camp 2A (-536 meters) during the following three months. The longest continuous underground stay was seventeen days, when Camp 3 was set at a depth of 745 meters in the Sala Grande de la Sierra Mazateca. During this push, Anthodite Hall, the largest chamber in Huautla, 400 meters long, 140 meters wide, and 60 meters high, was discovered, and the sump at -840 meters was dived using small scuba

tanks, a fruitless effort that only verified that the sump, unfortunately, was long and deep. During later pushes from the Camp 2A level, with the additional help of Richard Schreiber, Jim Smith, and Jill Dorman, more than 8 kilometers of horizontal galleries were discovered. The most significant of these was Kinepak Canyon, which led 2 kilometers north and came to within 20 meters of the bottoms of both La Grieta and Sótano de Agua de Carrizo, a connection to which would have signaled the first kilometer-deep cave outside of Europe. Despite the closeness of these connections, fourteen days of effort did not bring success, and the expedition was forced to retreat by the onset of the rainy season.

One of the distinguishing aspects of Mexican speleology over the years has been the open nature of the exchange of information on project areas. This is largely based on a simple principle of gentlemen's ethics: one does not attempt to steal another's project area. In the spring of 1980, a notorious breach of this unspoken compact among explorers occurred. Guided by AMCS reports, a Polish expedition under the leadership of Marcej Kuczinski arrived a month ahead of the American expedition organized by Stone and Steele with the specific objective of achieving the San Agustín-Carrizo connection first. After touring to the -840 sump and pounding in a brass plaque to



Jim Smith (left) and Bill Stone ready to dive the sump at -1030 meters in Li Nita, 1980. *Ron Simmons.*

commemorate the event, they retreated to begin work in Kinepak Canyon, at the -600-meter level. Two serious accidents subsequently occurred. Jerzy Musiol broke his leg while traversing a canyon some two kilometers from Camp 2 while en route to the La Grieta collapse area. While Joseph Cuber was heading to assist with the rescue of Musiol, a rope broke at the 25-meter shaft at the end of Route '68, halfway to Musiol. In the resulting fall, Cuber's spinal column was severed. An international rescue soon ensued. First to reach the scene was a Belgian and American team from Cuetzalan, in addition to nearly fifty Mexican Cruz Roja personnel. The Belgian doctor Etienne Degrave saved Cuber's life at -620 meters. By the time they had reached the -350-meter level, the Huautla Project expedition had arrived, hastened by news of the rescue, and they completed the operation. Both Musiol and Cuber were safely out of the cave within seven days of the accident, but Cuber remains paralyzed as a result of his injuries.

While the Poles packed their base camp, explorations were begun in a cave that had been discovered in 1979 by Steele, Zeman, and Lowrey named Li Nita, Mazatec for Flashlight Cave, on a high ridge 2 kilometers north of

San Andres Hidalgo, at an elevation 361 meters higher than San Agustín. During the next three months, Li Nita was pushed without significant difficulty to -1020 meters, becoming the first kilometer-deep cave in Mexico. A major effort, involving a total of twenty-seven days camped at the -620-meter level of Li Nita, was subsequently launched to achieve a connection with San Agustín. Field reduction of the survey data had shown that the bottom of Li Nita was within 100 meters of an upstream passage discovered from Camp 3 in San Agustín during the spring of 1979. Both ended in sumps. The 1020-meter sump in Li Nita was

dived by Stone and Jim Smith, using lightweight scuba. It continued beyond the range of their tanks. An airy climb up a 60-meter overhanging dome by climber Bob Jefferys led to the discovery of an even deeper sump at the -1030-meter level, this one only 60 meters from San Agustín. On May 9, with food and carbide supplies stretched to their limits, a concerted effort was made to put one diver in the -1030 sump as a last effort at the connection. After penetrating three short, shallow sumps, Stone, the lead diver, later wrote, "I consulted the primary pressure gauge—1350 psi—still plenty of air for shallow dives like this. So I decided to at least run out the line before throwing in the towel; there were barely ten meters left as it was. Following a brief descent to clear the roof, I was back into the black gulf below . . . still no visible bottom and the walls stretched a good six meters apart. At eight meters into the dive, I was having some difficulty with the spool and happened to glance up to see the reflection of another airbell, or so it seemed. As with the previous three sumps, my first action upon surfacing was to tie off the line. This was timely, for there were but two meters left on the spool at this point. In my preoccupation with this procedure, it took some time—wetsuit hoods tend to block

sound—before I became aware that something was rumbling behind me. I turned around, and suddenly it hit me. This was no airbell. It was East Redball Canyon in Sótano de San Agustín. I stood there stunned. We had just linked up the world's third-deepest cave!" At this time, Sistema Huautla grew to 23 kilometers in length and 1222 meters in depth.

As the 1980 Huautla expedition was winding down, two more significant caves were discovered. Nita He (Mazatec for Deep Cave) began with a 130-meter entrance shaft and was ultimately bottomed at a sump at -595 meters. Its entrance was found by Dino Lowrey, Janet Steele, and Jill Dorman at the southern base of a karst knoll, one of the highest points in the Agua de Cerros area, a kilometer north of Li Nita. Some 105 meters even higher on the knoll and on the northern side was Nita Nanta (Cave by the Spring). It was ironic that the discoverer of this cave was Mark Minton, the chief architect of the exploration of Cueva de Diamante in northern Mexico, for the caves were distressingly similar in character, exceedingly tight and jagged. Zeman, Steele, and Smith ultimately reached a depth of 445 meters in Nanta before the expedition packed up after 123 days in Huautla. From the tattered state of their attire when they returned to base camp, it was not apparent who had won, cave or explorers.

When the data for Nita Nanta was entered into the computer, it became immediately evident that it was heading toward Li Nita in Sistema Huautla. That extra 105 meters of depth would, if Nanta could be connected, put the overall system only 65 meters short of the Réseau Jean Bernard in France, the world's deepest cave, which was 1402 meters deep in 1980. Stone soon proposed that the extra depth could be achieved by means of a deep dive in the San Agustín sump, and plans were soon drawn up for a two-pronged assault in the spring of 1981. During the months of February and March, some fifteen days were spent working from the cramped quarters of Camp 1 at a depth of 410 meters in Nanta. This happened to be the only place in what was otherwise an inclined

rift averaging 40 centimeters wide that was large enough to place hammocks for sleeping. From this base, Zeman, Stone, Shifflett, Chris Kerr, Bob Jefferys, and Neil Hickson pushed relentlessly to a depth of 927 meters, where the crack narrowed to 2 centimeters wide. This was only 100 meters from Li Nita, unfortunately through solid rock. Meanwhile, Mark Minton, Alan Warild, and companions pushed from -50 meters in an obscure side passage near the entrance of Li Nita to a phenomenal -906 meters down the White Room route, completely independent of the route explored in 1980. Unfortunately, no connection was made with Nanta, and both caves were derigged. Within 50 meters of the entrance to Nita Nanta, however, Minton discovered another descending rift, soon to become known as the Naranja Passage for its abundant orange flowstone. In the course of five pushes, Minton, Zeman, Steele, Jefferys, Shifflett, and Stone reached a depth of 734 meters, where the route appeared to end in a giant chamber known as the Football Stadium.

While the 1981 work in Nanta was winding down, eight members of the team, including two trained cave divers, Shifflett and Stone, began transporting diving equipment to Camp 3 in San Agustín for an attempt to crack the sump at -840 meters. For this particular effort, Stone had worked with NASA and several aerospace companies to build the first diving apparatus making full use of composite tanks, which were made of fiberglass-reinforced aluminum, had an operating pressure of 4500 psi, nearly double that of normal scuba, and weighed only a third as much as a standard aluminum tank. Five tanks in all were transported to the sump, four filled with compressed

air and a fifth filled with pure oxygen for decompression. In the course of two dives, the second of which expended the gas limits in all four air tanks, Stone reached a point 285 meters into the sump at a depth of 28 meters, and still the underwater canyon continued. A breakthrough into an air-filled passage was not forthcoming, and after ten days underground the team left the cave, and San Agustín was derigged. As a result of this dive, the depth of Sistema Huautla increased to 1248 meters.

At the end of the 1981 expedition, Bill Stone and Pat Wiedeman conducted a reconnaissance of the springs at the bottom of the Santo Domingo Canyon. They discovered a 30-meter-wide arroyo that led off from the Santo Domingo and through a deep, narrow gorge in the plateau, heading north toward San Agustín. The arroyo ended at the base of a 300-meter cliff known as the Peña Colorada, and leading off into the mountain was a 30-meter-wide, 10-meter high tunnel, from which the water that had created the arroyo obviously originated. A short distance inside, the tunnel sumped. This discovery, which Stone believed to be the fossil resurgence to Sistema Huautla, combined with personality

conflicts among the strongest players on the team over a number of issues, including finances, the allocation of limited rigging resources (although some would call four kilometers of rope unlimited, it was all in use at once on many occasions), need or lack thereof of sponsors, and the composition of the team, led to a split in the core team of the Huautla Project. Steele, Minton, Smith, and others would ultimately press on with the exploration of the main system and the goal of connecting Nita Nanta. Stone, Wiedeman, and Jefferys went on to assemble a completely new team consisting entirely of cave divers for the exploration of the Peña Colorada. Others, like the stalwart Steve Zeman, whose wry sense of humor had calmed many disputes, and the ebullient, athletic Dino Lowrey, who had been the first American woman to reach -1000 meters, vanished from the Mexican expedition circuit.

Spring of 1982 marked the first time in which separate United States teams were fielded to Huautla. A ten-person team, led by Minton and Steele, targeted Nita Nanta for a three-week period during which a seven-day underground camp was set in

Over 1000 meters deep in Nita Nanta, December 1983. Alan Warild (left), Mike Doe, Mark Minton, Doug Powell, Scott Davis, Frank Bogle, Hans Bodenheimer (seated). The Explorers Club was a sponsor of several Huautla expeditions.
Jim Smith.



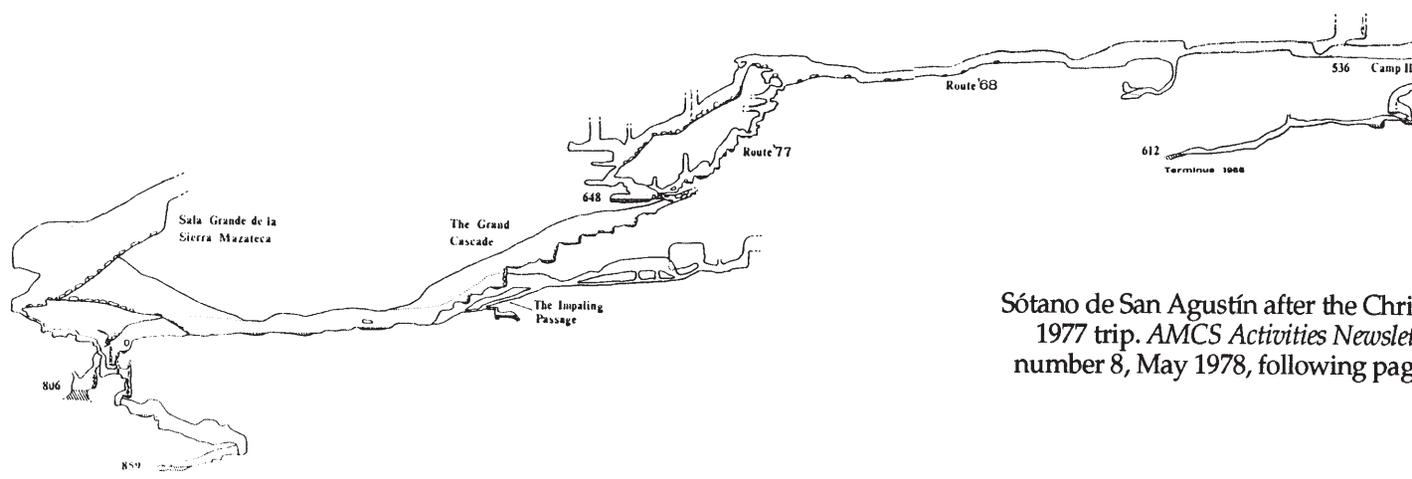
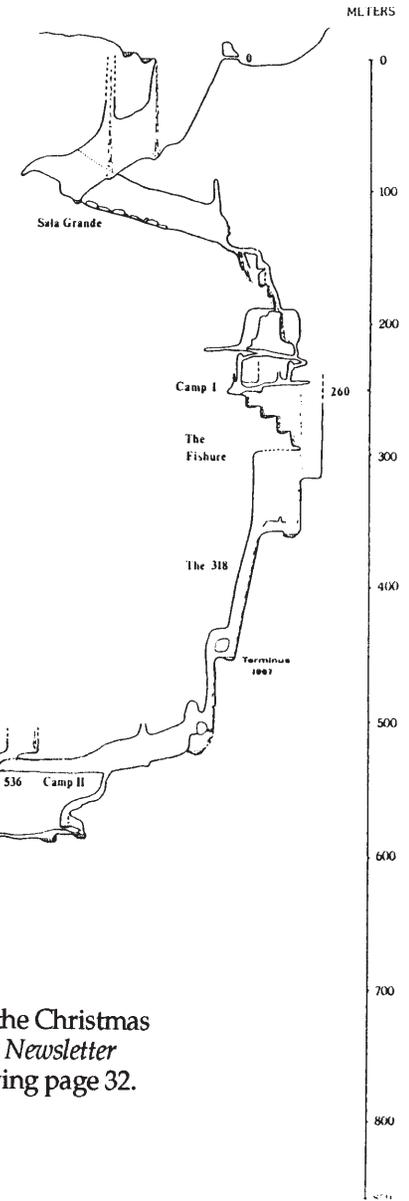
SÓTANO DE SAN AGUSTÍN

San Agustín Zaragoza, Municipio de Huautla de Jimenez
Oaxaca, México

Total traverse length : 5900m
 Total Depth : 859 m
 Data reduction and plotting by Ellipbg
 Sauntos, Brunton and tape survey conducted by
 the AMCS and MUCCC 1966, 67, 68, 76, and 77.
 Sketch to -612m adapted from original map which
 was published in Canadian Caver Vol. 1 no.1
 Sketch from Route 68 to -859m by R. Schreiber
 and B. Stone
 A full list of participants in the 1976-77 survey
 can be found on p.27 AMCS Activities Letter no.6
 Drafted by Bill Stone January - April 1978

ASSOCIATION FOR MEXICAN CAVE STUDIES

Projected Profile



Sótano de San Agustín after the Christmas
1977 trip. AMCS Activities Newsletter
number 8, May 1978, following page 32.

the Football Stadium at -640 meters in the Naranja Passage. Despite a methodical survey, they were unable to surpass the previous depth of 734 meters in loose breakdown, before beginning the laborious ascent with duffel bags up forty-eight pitches through the narrow fissure. Meanwhile, a second part of the team set another week-long underground camp in a new cave, Nita Nashi, one kilometer east of Nanta. This cave was ultimately bottomed at -641 meters.

Meanwhile, Stone had not forgotten the Cueva de la Peña Colorada. By April 1982, he had assembled a team of three cave divers, including Pat Wiedeman and John Zumrick, and made a preliminary reconnaissance at the sump there. Equipped with four pairs of composite scuba tanks and a compressor, the three successfully cracked Sump 1, a 524-meter dive at 20 meters depth, and emerged to discover a 15-meter-diameter borehole heading north towards San Agustín. They followed this for nearly a kilometer before being stopped by Sump 2. Between there and the San Agustín sump lay 9 kilometers of the unexplored heart of the Huautla Plateau.

Progress in Nita Nanta was considerably better in January 1983. In April 1982, working from Camp 2 in the Football Stadium, Doug "Kaliman" Powell had scaled a 30-meter sheer face on the west wall of the giant chamber to reach an obscure and impenetrable fissure. Now blasted open, this fissure led downward through several extremely tight squeezes before intersecting a stair-stepping series of shafts. On the last push of the expedition, Smith, Minton, Ron Simmons, Dave Black, Jeb Blakely, and Ed Holladay found that the final shaft dropped into a 10-meter-diameter streamway at a depth of 970 meters that went both up- and downstream. Minton later described the euphoria of the moment: "We found ourselves dropping rapidly in clean-polished, horizontally bedded black limestone. After two more pitches, there were telltale signs of the shaly layer. We practically ran down 500 meters of Nanta Gorge to a confluence with an even larger

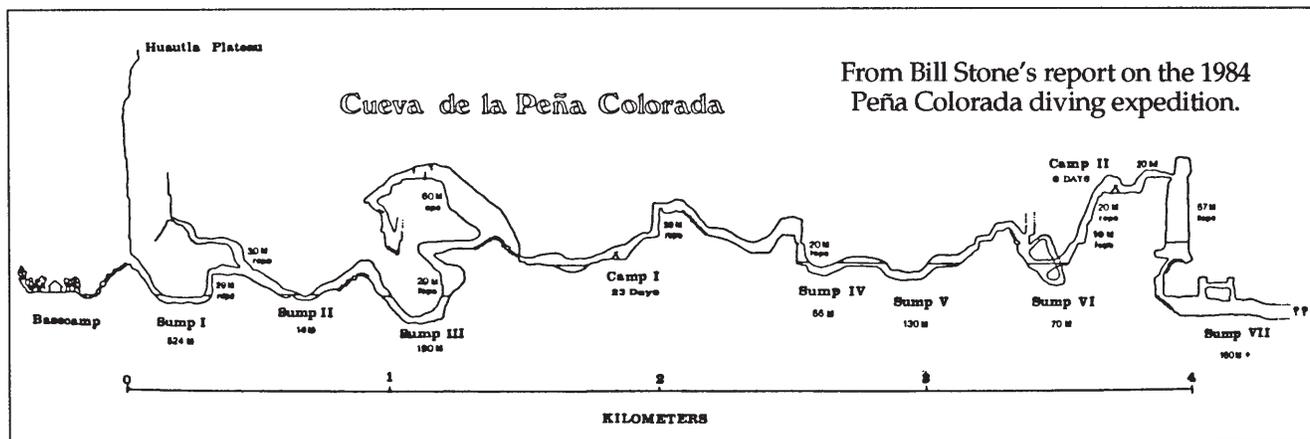
stream. It was unbelievable. After all these years, Nanta had finally opened up." They left with considerably more leads than they had started with and Mexico's second thousand-meter-deep cave. But the link to Sistema Huautla was still elusive.

By December 1983, an unusual twist had been added to the Nanta story. An entrance, named Nita Zan, was rediscovered in an overgrown sink just 100 meters from Li Nita. It had earlier been written off as a sure connection to Li Nita, but exploration proved otherwise. At one point it came with 15 meters of Li Nita, then dipped underneath, and it ultimately intersected another cave discovered that year, Nita Sa, which itself connected to Nita Nanta through a hole in the ceiling of the Football Stadium, at a depth of 510 meters. Although not significantly larger than the sinuous Naranja Passage, this new cave shortened the travel time by a factor of two and quickly became the standard route to Camp 2 in Nanta. The downstream river passage at the -1000-meter level was rapidly extended for nearly a kilometer to the southeast, to where a sump was encountered. Nanta reached a length of 10.7 kilometers, an amazing size for a cave so much of which is less than a meter wide. When the survey data was reduced and plotted, it became apparent that the Nanta sump was within 50 meters of the giant collapse known as Quadrant 18 that marked the terminus of not only Sótano de San Agustín, but also Agua de Carrizo and La Grieta. A giant rubble pile was blocking the grand four-way junction. It was maddening.

While the December 1983 push on Nanta was underway, the Australian explorer Alan Warild visited the area and carried out a maneuver that was to make him a legend in the vertical-caving community, the first solo descent of a thousand-meter-deep cave that was not already rigged. The site chosen was Li Nita, largely because Warild was familiar with the route, having been to its -1020 sump in the spring of 1981 during a forty-hour through trip from Li Nita to San Agustín carried out that year by Stone, Shifflett, and Belgian caver Etienne Degrave. Although many of the deepest routes in Huautla were

"stage derigged," that is, the main tackle was pulled to the top of each shaft and left there for future pushes, all rope had been removed from the historic route in Li Nita in 1981 to provide tackle for Nanta. Warild thus used the "cordelete" technique of descending each shaft with a 50-meter length of rope and then pulling it through a carefully placed sling or chock with a length of 2-millimeter parachute cord, which was left in place to reverse the operation on the ascent. During the course of a 42-hour marathon, Warild reached the -1020-meter sump and ascended safely, derigging as he went, in what must be considered one of the boldest operations in speleological history. It need scarcely be said what the consequences of a single fouled re-rig on the ascent would have been.

During the two years following the reconnaissance dives in Cueva de la Peña Colorada, Stone and co-leader Bob Jefferys assembled an eleven-person international team for what was to be one of the most technically complex speleological expeditions ever fielded, a four-month attempt to dive through the sumps of the Peña Colorada and ultimately reach the San Agustín Sump from below. The team included Rob Parker from Britain, Sergio Zambrano and Angel Soto from Mexico, and Pat Wiedeman, Gary Storrick, John Zumrick, John Evans, Clark Pitcairn, and Noel Sloan from the United States. The team rehearsed cave-diving drills for forty days during the eighteen months prior to the expedition in the clear-water springs of north Florida. Special techniques were developed for setting long-duration underground camps beyond sumps, something that had never been done before. In addition to being cave divers, all expedition members were skilled in vertical caving. Parker and Jefferys, whose forte was rock climbing underground, had been specifically selected to scale any vertical shafts encountered on the way up through the mountain. The scale of the expedition was evident from its logistics. Most of the healthy men (197) and burros (60) within hiking distance of San Miguel Huautepéc were hired for the three days needed



to transport eight tons of diving and other equipment from the top of the Huautla Plateau to the base camp at the Peña Colorada canyon, all under the security of a platoon of Mexican infantry. An additional 39 men cleared a 50-by-100-meter swath of jungle, in which two 5-by-10-meter main tents and a dozen personal tents were erected. Finally, generators, dive-light recharging stations, compressors, seventy-two composite tanks, and piles of other gear provided by forty-three corporate sponsors were set up and ready. Technical advances had been made that enabled the tanks and regulators to be operated at 5500 psi. This gave a diver 3000 liters (104 cubic feet) of gas in a cylinder weighing only 12 kilograms fully charged.

With this momentum, the dive at Sump 2 was anticlimactic. Storrick and Pitcairn found it to be only 14 meters long before it emerged into 15-meter-diameter borehole. This new discovery led only 250 meters before hitting Sump 3, a more serious 220-meter dive reaching 20 meters depth. When Parker and Stone first surfaced on the far side of Sump 3 into a lake chamber 60 meters in diameter, there appeared to be no way on. Parker subsequently free-climbed a sheer 20-meter wall, with the safety net of water beneath, to reach the continuation of the main trunk, which he followed 500 meters to a "whacking great chamber." Pushes from the surface, as expected, soon extended beyond 24 hours duration, and Camp 1 was set a kilometer beyond Sump 3. During the first 10-day push from Camp 1, the team literally ran through two kilometers of 20-meter-diameter borehole before the strata began to

signal another dip. A 20-meter shaft at the end led down to Sump 4. This 55-meter sump and the 130-meter Sump 5 that was found just 100 meters beyond were explored solo by Pitcairn in order to reduce the logistics of transporting compressed air to that point. Pitcairn, while one of the best cave divers on the expedition, was not very proficient at rock climbing and was soon stopped at a vertical climb. Jefferys and Parker subsequently explored an additional kilometer, scaling four 20-meter pitches in the process, before coming to a pit going down. Sixty meters below was Sump 7, and there was no dry land, only sheer walls entering the water. (Sump 6 turned out to be an alternate route that is bypassed by the dry passage between Sumps 5 and 7.)

A second push was fielded from Camp 1 specifically for the purpose of investigating Sump 7. Stone later wrote: "Two days after reaching Camp 1, Jefferys and I, assisted by Zumrick and Wiedeman, set off for what was to be a nineteen-hour trip to Sump 7. I prepared my diving equipment at the top of the 60-meter shaft and rappelled in with the tanks slung from a 2-meter tether attached to my harness. Jefferys helped with the final adjustments in the water. In the course of two dives, I worked down through a series of boulders that were wedged between the walls of the shaft. At a depth of 40 meters, the passage took off as a large horizontal tunnel measuring 10 meters by 13 meters. It was the strangest geological quirk I had ever seen: a 100-meter-deep vertical cylinder, half filled with water, connecting two hori-

zontal passages."

Several weeks later a final ten-day underground push was made in the Peña Colorada. The plan had been worked out in minute detail. This time Camp 2, set at the top of the shaft leading to Sump 7, was used in order to allow Zumrick and Pitcairn, the team's best divers, to be fully rested before setting off. Sloan and Jefferys would serve as the primary sherpas beyond Sump 5. If a line was successfully laid to airspace beyond, Stone and Parker would then follow for a 40-hour bivouac on the upstream side to push the limits as far as possible. On the fourth day in the cave, Zumrick and Pitcairn did the dive, reaching a penetration of 125 meters beyond the end of Stone's line at a depth of 55 meters. Pitcairn said he was suffering from nitrogen narcosis, and he dropped the spool in the process of tying off the line. It plummeted to the floor and still remains there. They spent 1.5 hours underwater and still had not reached a point where the tunnel began to ascend to air-filled passage. Zumrick and Pitcairn were replaced at Camp 2 by Stone and Parker, and they, with Sloan and Jefferys, spent the better part of a week scaling domes looking for a bypass above Sump 7. None was ever found.

A total of forty-five scuba tanks had been expended, and 1,360 kilograms of diving hardware, including 340 kilograms of lead ballast, had been used in the push from Camp 2. A return push in Sump 7 with stage bottles would have required more tanks than were available in base camp. Derigging operations were begun. The Peña Colorada had

reached a length of 9 kilometers, 2.16 kilometers of which was under water. The gap to San Agustín had been reduced to 6.5 kilometers. It was clear, however, that new life-support technology, with significantly greater range than high-pressure composite scuba, would be required to close this gap.

By the spring of 1985, little had changed regarding the linking of Huautla's "supersystem" in the five years since the Li Nita-San Agustín connection. When one considers that no fewer than seventeen of Mexico's deepest known vertical routes had been explored within a 4-by-2-kilometer rectangle centered around the Sótano de San Agustín, it seemed almost impossible that they should all come so close and never touch. Just 40 meters separated four of the deepest routes, and yet none had been connected, despite intense effort. The Loggerhead Hall area at the end of Kinepak Canyon at -600 meters in San Agustín had seen no less than six weeks of underground camping missions, all based out of Camp 2A at -536 meters, trying to crack the riddle. Intent on altering this stalemate, an eighteen-person team headed by Steele, Minton, and Smith set up base camp in the village of San Agustín Zaragoza in late March of 1985 for what was to be a two-month effort to link Nita Nanta to the Sótano de San Agustín. Since there was an uncommonly large compliment of personnel and a massive supply of climbing equipment, a two-pronged assault was launched.

Nita Nanta was rigged through the new Nita Zan entrance, which connects quickly to Nita Sa and the fast route, and Camp 2 was reestablished in the Football Stadium. Meanwhile, Sótano de San Agustín was rigged to Camp 2A. Steele, Holladay, Blakely, Schreiber, Simmons, Jim Smith, Marion Smith, and Scott Davis moved into the Nanta camp, from which they surveyed to -1085 meters, near the sump discovered in 1983. A sustained push, however, netted no bypass. Furthermore, what appeared to be a fresh breakdown blocked access to the actual sump pool, thus barring a scuba dive at this point. The decision was made to derig the

route. However, at the -900-meter level, a parallel shaft was found leading off in the direction of Agua de Carrizo. They followed this until running out of rope at a shaft taking a strong wind. Shortly after their return to Camp 2, they were stunned to hear a thunderous crash. Suddenly the wind picked up, and spray was whipped into the air from the waterfall more than 100 meters away that poured into the center of the Football Stadium from the Nita Zan entrance. A flash flood on the surface had swollen the otherwise quiet 70-meter falls to nearly 2 cubic meters per second, and the team soberly pondered what would have happened had they been in the narrow confines of the lower cave. They sat out the high water for two days before it was safe to ascend.

Four kilometers away, in San Agustín, a team led by Minton had attempted to reach Loggerhead Hall from the surface and possibly succeed in a voice connection through the breakdown. Due to excessively heavy bivouac packs, they only made it half way out Kinepak Canyon before aborting for the surface, only to be met by a wall of water. Three of the team were trapped near the Camp 1 level (-250 meters) for nine hours before it was safe to continue up and out.

Determined to push the new lead across the Corkscrew Shaft at -900 meters in Nanta, most of the camping crew decided to attempt one last push from the surface. In the course of a thirty-nine-hour marathon, they discovered to their dismay that the new route connected to a point upstream in the Confluence Passage at -1030 meters.

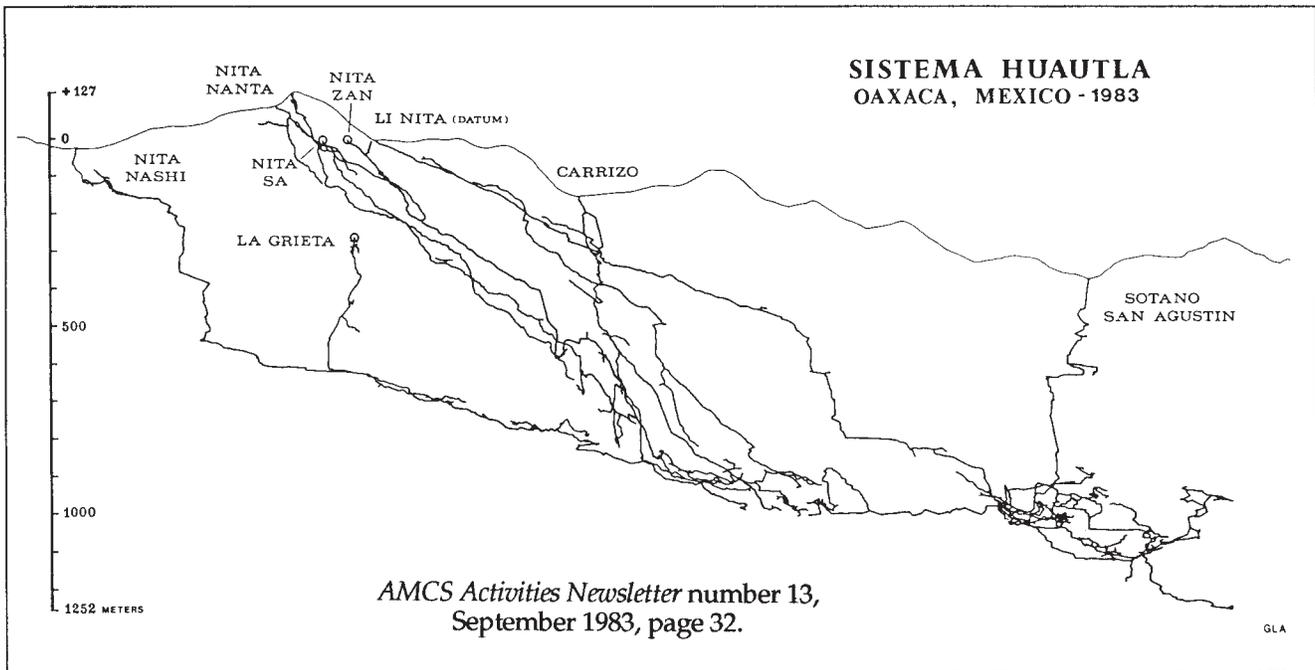
Several weeks later, a team led by Smith that included Holladay, Blakely, Andy Grubbs, Paul Wojtkowski, Keith Goggin, and Lisa Wilk set up operations at Camp 2A in San Agustín. Minton later wrote: "The next day the camp crew was in Loggerhead Hall probing the ubiquitous breakdown. Following the best draft, Jim and Paul crawled into a short

section of the open Scimitar Passage, but it ended in a terminal-looking breakdown. Jim let out a hoot, and received a resounding echo! With renewed vigor, they dug open a small hole and looked out into big passage. Jim immediately recognized where he was: not Nita Nanta, but the Fracture of the Deep in La Grieta! On April 24, 1985, cavers were triumphantly running down passages not seen since the first days of 1978." The connection of La Grieta added 9 kilometers of length to Sistema Huautla, but no depth. Nanta was needed for that, and it remained as elusive as ever. Despite an additional week's effort from both sides of the Loggerhead Hall breakdown, no connection was forthcoming.

During the following two years, Smith corresponded frequently with Stone regarding new plans for a connection to Nanta. In 1979, during the final nine-day push from Camp 2A, Stone had discovered an upstream sump at the end of a 6-meter crawl along the west wall of Loggerhead Hall. Even though they had scuba tanks at Camp 2A, the site was not considered a high priority at the time. Now, eight years later, with the realization that Nanta also ended in a sump only 10 meters away, and with all other leads exhausted, Smith was looking for advice and light-weight diving hardware. Stone and Zumrick prepared four of the composite scuba sets used in the Peña Colorada for

American and Swiss cavers celebrate in San Agustín's Camp 4 after the connection with Nita Nanta in 1987. *Jim Smith.*





Smith's use in San Agustín. In March 1987, Smith, Steele, Doug Powell, and most of the 1985 La Grieta connection crew set Camp 4 in Loggerhead Hall, preparing for a ten-day push. Minton's log describes what followed: "The day after arriving in camp, they carried the dive gear through the crawl to the nearby sump, and Jim suited up. It was 8 P.M., 26 March 1987, when all was ready, and Jim disappeared beneath the water. He surfaced less than a minute later, only 10 meters away in the terminal sump chamber of Nita Nanta, 1098 meters below its entrance. It took a moment to recognize, but that was it: the connection we had worked so hard for ever since the discovery of Nanta back in 1980. It was the connection of a lifetime and the first-ever joining of two caves each over one thousand meters deep." A survey was subsequently conducted, during which it was discovered that there was, in fact, no new breakdown collapse on the Nanta side. The 1985 survey crew had been overextended and had missed the route.

One might think that the remainder of this expedition would have been anticlimactic, but yet another surprise was waiting. Within sight of the San Agustín entrance, Minton and Steele discovered a small crawlway taking a tremendous amount of air.

When this was enlarged, they found, to their amazement, a completely independent route in San Agustín. Over the next month, more than a kilometer of rope was rigged down the Fool's Day Extension to where it ultimately connected back into lower San Agustín at the head of the Gorge at -620 meters. The significance to future explorers was that the travel time to Camp 3, the camp nearest the -840-meter sump, was cut in half by the new route.

More than 7.5 kilometers of new surveys were conducted during this expedition, including 2 kilometers of true vertical traverse. Sistema Huautla, with seventeen entrances, reached a depth of 1353 meters and a length of 52.7 kilometers. The system had more independent deep routes than any other cave system in the world: two over 1000 meters deep, two over 900 meters, two over 800 meters, one over 700 meters, and two over 600 meters. As Minton later pointed out, a spectacular through trip could be made, 1225 meters down from Nita Nanta's highest entrance, through the best of San Agustín, and 1100 meters back up Li Nita, without ever retracing a step. (It would require diving two sumps at the deepest parts of the traverse.) At this time, Sistema Huautla was the fourth deepest cave in the world.

In January of 1988, the nature of Huautla caving changed dramatically when Jim Smith began what was to be a five-month continuous stay on the plateau in pursuit of hydrology studies for a master's thesis on the Sierra Mazateca. By the end of this expedition, Smith had logged a lifetime total of ninety-nine trips from the surface to depths exceeding five hundred meters. Only a man of Smith's drive and physique could have accomplished the extensive internal dye-tracing net that ultimately provided clues to many of the missing pieces of the Huautla puzzle. It was through this effort that a positive dye trace was finally made to the Huautla Resurgence, located at the confluence of the Peña Colorada and Santo Domingo canyons. During this same time, Smith and Holladay also explored Nita Ka, on the Agua de Carrizo ridge, to -760 meters.

Jim Smith, Laura Campbell, and Bill Storage returned a year later to revisit Cueva de Agua Carlota, which Canadians had "bottomed" in 1969 at -152 meters. An obscure continuation was discovered that led 5 kilometers to the southwest from the entrance and to a depth of 510 meters, where the cave ended in breakdown. This was the nineteenth route in the Huautla karst drainage area to surpass five hundred meters in depth. No further work was done

in the Huautla area until the arrival of the 1994 San Agustín expedition, the principal objective of which was to pass through the San Agustín sump and explore air-filled galleries believed to exist beyond in the direction of Cueva de la Peña Colorada. An article on that expedition appears elsewhere in this issue.

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Historia del Sistema Huautla

Esta es la historia del Sistema Huautla anterior a la expedición de 1994. Los primeros cueveros visitaron el área en 1966. Para 1968, dos cuevas profundas fueron conocidas: Sótano de San Agustín con 612 metros y Sótano del Río Iglesia con 535 metros de profundidad. Para finales de los 80's, muchas entradas han sido conectadas dentro del sistema de 1353 metros de profundidad y 52.7 kilómetros de longitud, con mas independientes y profundos caminos que cualquier otra cueva en el mundo: dos de ellos arriba de los 1000 metros, dos mas sobre los 900 metros, otros dos sobre los 800 metros, uno sobre los 700 metros, y dos sobre los 600 metros de profundidad. Otras de las cuevas profundas en el area incluyen Nita Ka (-760 metros) y Cueva de Agua Carlota (-510 metros). En 1984, buzos exploran de la Cueva de la Peña Colorada, una resurgencia localizada en el Cañon de Santo Domingo. Esta cueva con una longitud total de 9 kilómetros (de los cuales dos de ellos son inundados) es una resurgencia para las cuevas localizadas en la meseta.

PEÑA DE SALAZAR

EXPLORATION OF CUEVA DE LA CANOA AND A NEW AREA IN THE MUNICIPIO DE CERRITOS, SAN LUIS POTOSÍ

Oscar Berrones and Raúl Puente

On the morning of January 9, 1993, Miguel A. Jones, Víctor Nungaray, Teresa Williams, and Raúl Puente, members of the Asociación Potosina de Montañismo y Espeleología, arrived at the village of Peña de Salazar after wandering around Cerritos lost, thanks to erroneous directions received from Antonio Ramírez (Toño), the only APME member who had visited the area before. Upon arrival in Peña de Salazar, we made the acquaintance of several residents, who showed us to some of the known caves. We visited the entrances of Cueva de la Canoa, where we climbed down the first two drops, and of Sótano de Rosa de Castilla. We then decided to return to the village to prepare our equipment and wait for the other team members. Around 4:00 that afternoon, Oscar Berrones, Juan Vargas, Silvia Vela, Martha González, Claudio Espinoza, Guillermo Martínez, Aureliano Tenorio, Jesús Arias, and Sergio Sánchez-Armass arrived.

Once we were all reunited, we arranged for four more burros, in addition to the one we already had, to carry our equipment to the entrance of Cueva de la Canoa, the most interesting cave, based on reports from Toño and our observation of the initial passages. Just as we were about to begin our walk to the cave, Bardomiano Rodríguez, assistant judge, and José Rodríguez arrived and demanded our permit to enter the cave. Since we didn't have a per-

mit and, as we learned, these two men represented the authorities in the village, we explained to them the purpose of our visit and our plans for exploration. In response, they agreed to allow us to explore the cave, but insisted that for subsequent visits we would need a permit from the *presidente* of the Municipio de Cerritos.

The entrance to Cueva de la Canoa is at an elevation of 2105 meters, about 30 minutes' walk along the hillside northeast of the village. Two steep climbs along the way make transport of equipment by burros convenient. The most interesting thing about the entrance is that it takes the drainage from three small, intermittent arroyos, which presented the exciting possibility of finding a large cave. At the entrance, we readied our equipment and decided that Juan, Víctor, and Oscar would form the lead group. They then entered the cave with fourteen ropes for the first drops. About an hour later, Aureliano, Claudio, and Jesús entered the cave with nine more ropes to continue the rigging. A third group, the surveying team of Teresa, Miguel, Raúl, Sergio, and Guillermo followed, after allowing some time for rigging.

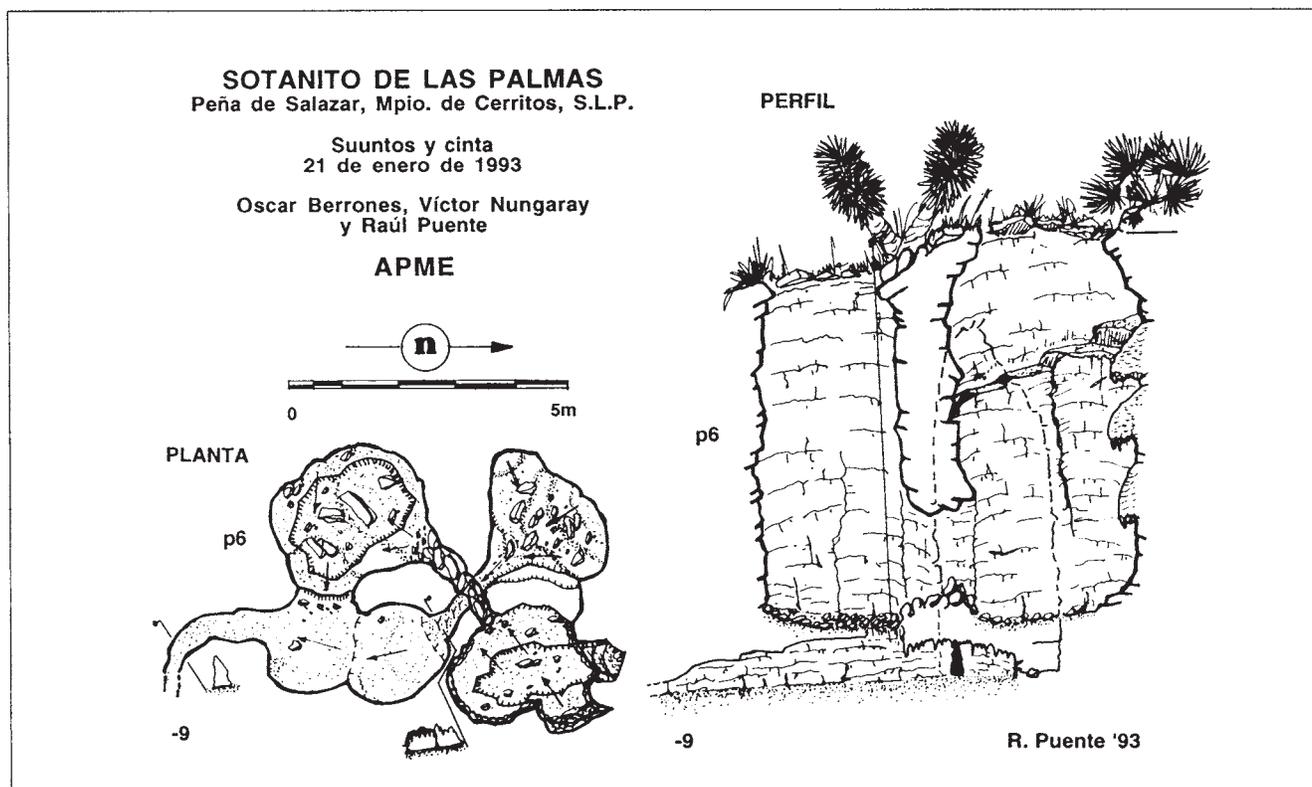
The lead group decided to save rope by free-climbing the first two drops, of 4 and 5 meters, respectively. The 4-meter third drop couldn't be free-climbed, and it was followed immediately by a 40-meter drop, which was named Tiro de los Troncos after several tree trunks that had been washed part way down the pit by water from the three arroyos. From here, the passage continues past a constriction formed by a great stalac-

tite at least 20 meters long. Below another drop, of 10 meters, the passage splits. A difficult free-climb through a crack leads to a lower passage with a low, wet duck through ponded water, while an upper passage leads to the Salón de Sergio, a room decorated with stalagmites and some aragonite crystals. This room connects to the lower passage by a 10-meter drop.

While the survey party mapped in a side passage near the entrance, Guillermo climbed down a passage that connected with the main passage and then continued through a series of pitches and arrived at the Salón del Bloquonón, a room almost completely filled by a single block of stone 8 meters long, 5 meters wide, and 3 meters high. A climbing lead on the west wall of this room was left unexplored. A little later, the survey party met the members of the second rigging party, who had had some light problems that caused them to turn back, leaving several ropes further into the cave.

After a short while, the first rigging team ran out of ropes, which halted their advance, and they decided to wait for the second team, which was to bring more ropes. When they didn't show up, the first team decided to start out, leaving the cave rigged for continued exploration later. On their return, they were surprised to find that the rope on a 4-meter pitch was wedged between two large rocks, blocking the climb. After a good bit of struggling by the three people present, including forming a three-person pyramid, Oscar was able to climb past the blockage and change the rigging so that the rest of the

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group could climb up. A little further along, they met Sergio Sánchez, who had come to tell them that the second rigging team had turned back. A little while later, they met the mapping team, and since approximately twenty-four hours had now passed since they'd entered the cave, it was agreed to leave the cave rigged with the fourteen ropes and return later.

The next morning, Guillermo Martínez, Raúl Puente, and Teresa Williams mapped Sótano de Rosa de Castilla, which is located in the Rosa de Castilla pasture, south of Cueva de la Canoa. The irregularly shaped 3-by-5-meter entrance at 2177 meters elevation opens onto a 25-meter free drop. The cave is developed along a north-south fault. At the bottom of the drop, the floor is covered with a large number of rocks and breakdown blocks. Twelve meters up the south wall is an opening into an ascending passage. To the north, the floor descends until it reaches a 5-meter drop, and the cave ends at an impassable 20-centimeter opening in flowstone. Twenty-five meters southwest of the main entrance is a small hole blowing air and heading in the direction of the cave.

Although it's small and impassable, it almost certainly connects.

After completing the mapping of this cave, the group returned to camp and departed for San Luis Potosí.

On Thursday afternoon, January 21, we returned to Peña de Salazar. Our objective was to finish the exploration and mapping of Cueva de la Canoa, and we allowed ourselves a period of four days to accomplish it. This time, Oscar Berrones, Víctor Nungaray, and Raúl Puente, in Oscar's car, made many stops along the way to look at some sinkholes that were marked on our map in El Durazno and in the contact zone between the rhyolitic rocks and the limestone on which the village of Peña de Salazar is located. When we arrived, we went to the store and tried to find the *comisariado ejidal* to ask permission to explore caves. We were informed that he wasn't in the village and that he worked in the city of San Luis Potosí. Hearing this, we began to talk with several of the residents, showing them copies of the map of Sótano de Rosa de Castilla and the topographic map of the area. Several of them agreed to show us some entrances to nearby caves.

In the village, we met don Ciro, a local resident, and in talking with us he mentioned the existence of a very well known hole, often visited by people from the region. "It's called Three Mouths, because it has exactly three mouths," don Ciro told us. We decided to ask him to take us to the place, and he readily agreed. Two of the community school teachers decided to come along as well. It was about 8:30 p.m. when we started walking, and though we experienced a little difficulty, we managed to find the sótano after about two hours. Don Ciro showed us one of the entrances, where many people had gone in using pulleys, and we promptly rigged a 30-meter rope. Cueva de las Tres Bocas consists of a dome accessed by three vertical entrances, the shortest of which, 14 meters, we had rigged. No passage leads off from the bottom, and there are only a few signs of where the water sinks. Due to the cave's location on a hillside, all the entrance drops have different lengths, the longest being about 30 meters. The cave is circular in shape, with a diameter of about 50 meters and a sloping floor of gravel and large breakdown blocks. Numerous formations cover the walls and ceiling. We

began mapping, but since the cave was much larger than we had been led to believe and the hour was quite late, almost midnight, we decided to leave and return later. As a result, only a rough map was produced. We left the cave to find don Ciro and the teachers shivering from the cold. We set off at once in the direction of the other nearby caves.

Don Ciro showed us two more sotanitos located next to the road to Tres Bocas, though the lateness of the hour and the dense vegetation made finding them a little difficult. Finally, we located Sotanito de las Palmas and El Hoyo de don Ciro. The first of these consists of a vertical chamber with two 1-meter-diameter entrances and two 7-meter climbable drops connected by a 30-centimeter-wide fissure. From one of the entrances, a 2-meter climb down leads to a room 3 meters in diameter, from which a low passage 4 meters long ends in a for-now impassable constriction. Some *Brahea dulcis* palms around the entrance give the cave its name and also serve as a reference for finding the entrance. The cave was entered and mapped with Suunto and tape by Oscar Berrones, Víctor Gómez, and Raúl Puente.

We baptized the second sotanito El Hoyo de Don Ciro, which provoked an attack of laughter from our guide. We didn't even enter the cave because of the lateness of the hour and the 2.5-kilometer walk back to the village that was still ahead of us. We only stopped to throw several rocks into the pit, from which we estimated its depth to be some 12 meters. It's not known whether it had been previously explored, and we are contemplating a return some day to explore it.

We returned to the village, and the teachers who had accompanied us invited us to sleep in one of the school's classrooms, which we accepted without hesitation.

On the morning of January 23, the three of us, Oscar Berrones, Víctor Gómez, and Raúl Puente, began our preparations to return to Cueva de la Canoa, and with the help of don Ciro and his burro we carried our equipment to the cave entrance. We were a single team for both rigging and map-

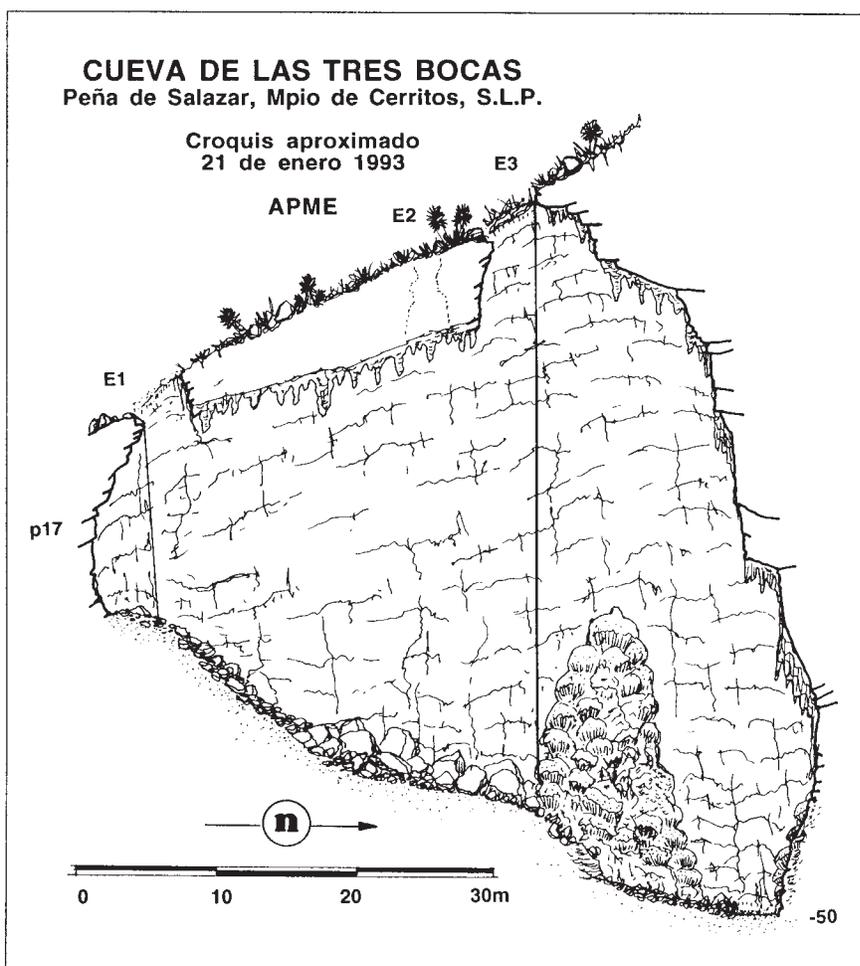
ping, and we carried a large number of ropes for descending the remaining pits. An additional support group was expected to join us later.

We reached the point where the mapping had stopped on the previous visit, past the Salón del Bloquón, and continued descending and mapping the pits that were already rigged. The majority of the mapping was through spacious passage averaging 5 meters wide that crossed some pools with low ceilings. Oscar and Raúl went to great lengths to skillfully cross these without getting wet, hugging the walls or crossing with one leg in the water and the other against the wall, while Víctor didn't think twice about plunging right through the cold water. The easiest part of the mapping was the APME Passage, which is 5 to 10 meters wide and runs north-south along a fault for 120 meters. After this, we stopped to explore a passage we discovered on the right wall. Oscar climbed up to it and found that it

ended in a sump among flowstone and microgours. This is probably a perched sump, but since we'd just started exploring, no one wanted to get soaked checking it, and we decided to let it wait for a subsequent trip.

After mapping this side passage, we continued descending through narrow, meandering passage, and shortly we heard behind us the voices of Sergio Sánchez-Armass, Toñito Ramírez, and Javier Zermeño, who were coming to help us. At this point Javier said that he had to go back because "you all told me it was just a little cave," which prompted us to name this passage Adios de Javier. From the end of this passage, a sinuous phreatic passage and an 18-meter drop lead to the Salón del Secreto. Two muddy passages leading from this room were left unexplored and unmapped.

Now that the others had joined us, we had two people to explore ahead, rig, and help with the packs, so as to



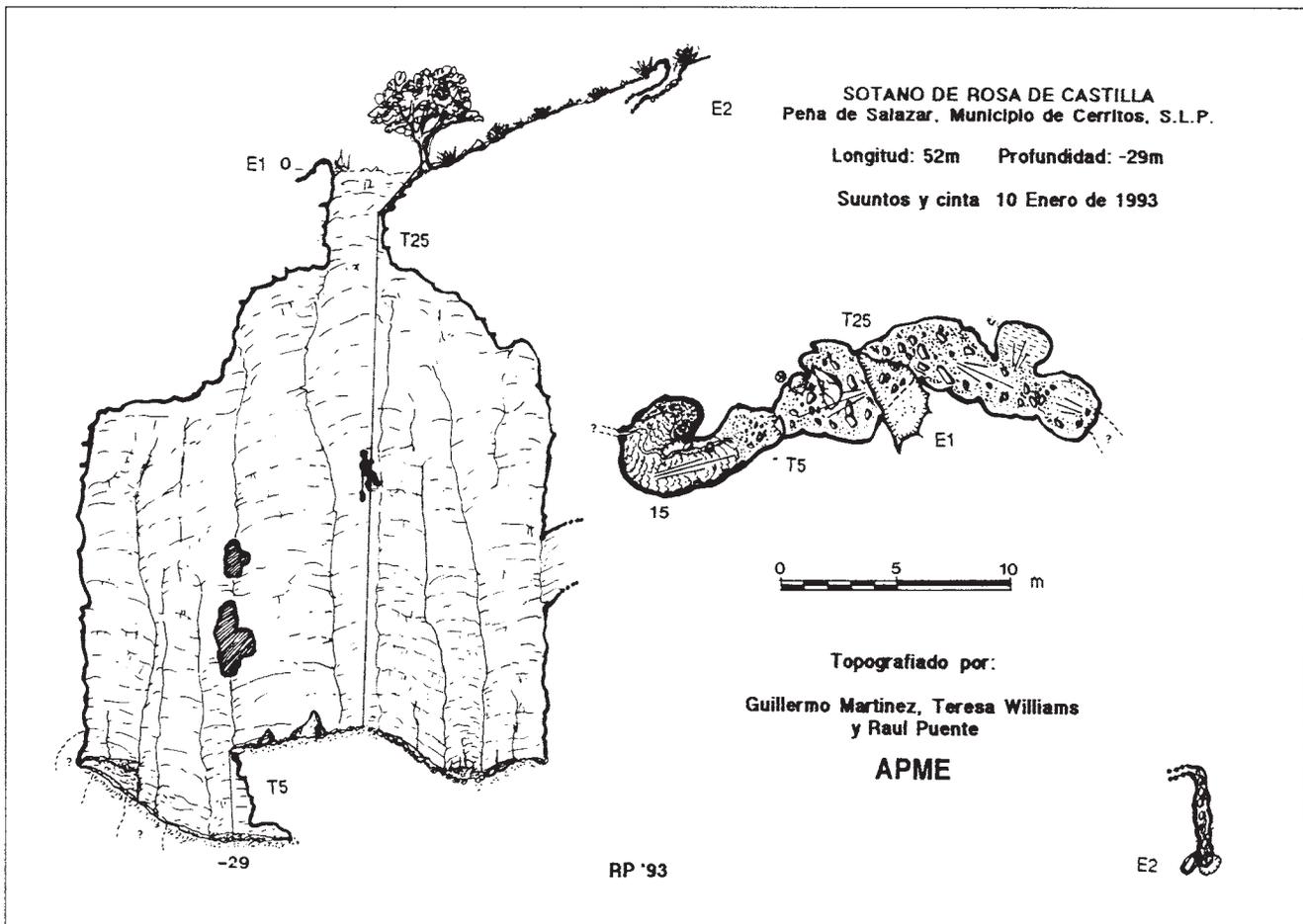
speed up the mapping. In spite of this, we soon realized that the mapping was taking an inordinate amount of time, and we decided to send Víctor ahead to catch up with the lead party and tell them to leave the mappers' packs, since we'd be needing them to rest in the cave. When we saw Víctor again, he told us that he had told them and that the packs were just ahead. We were surprised, however, to find only Raúl's and Víctor's. They had most likely taken Oscar's ahead to make his mapping progress a little easier, since there were many very narrow passages in the area. In fact, they had caused him one of the most "unforgettable" bivouacs of his caving career, trying to sleep on the bare, rocky floor.

After our brief four-hour rest, we continued mapping. Several climbs and short rope drops led us to the Sala de las Peñas, a room notable for its large number of economy-size breakdown blocks, where we observed an area of fan-shaped mycelium growing on some decomposing

tree trunks. Beyond this room, we reached the Arrastradero del Comisario, a 30-centimeter-high crawlway with a gravel floor that is not much fun to traverse. Raúl pushed an equally low side passage that leads off from the right side of this crawlway for about 5 meters, beyond which it continues unexplored. A few meters beyond the *arrastradero* is the Salón de Derrumbe, a 30-meter-long room 25 meters wide and over 30 meters high with a 10-meter-wide horizontal passage leading off to the north. High, wide, and inviting as that passage was, we nevertheless left it unexplored in our determination to follow the general downward trend of the cave. We plan to return to it.

Another series of rope drops took us to the Regadera, a large room with a waterfall coming from a dome and some impressive formations. After a few more climb-downs and rope drops, we caught up with Sergio and Toñito, who told us that the cave was all rigged and that it ended in two

sumps. This raised our spirits, which had dropped somewhat, as we thought we had just used up the last page of our sketch book. Fortunately this was just teasing on Raúl's part, since he had anticipated the need and had another "extra thick" book with him, with which we continued our mapping. Toward the end, the main passage is canyon-shaped and 5 meters wide, with a ceiling that is out of sight. It divides into two muddy passages, each of which leads to a sump . . . the end of the cave. We looked for a way around the sumps, but only found a window on the wall of the passage behind us that would require bolts and technical climbing to reach. Since our exploration had now reached the forty-eight-hour mark, we decided to turn back and begin the saddest part of all explorations, derigging and carrying out the gear. Although we were a little disappointed that the cave had ended, our hunger, tiredness, and lack of sleep did make us glad to be at the end. After a horrible gringo military



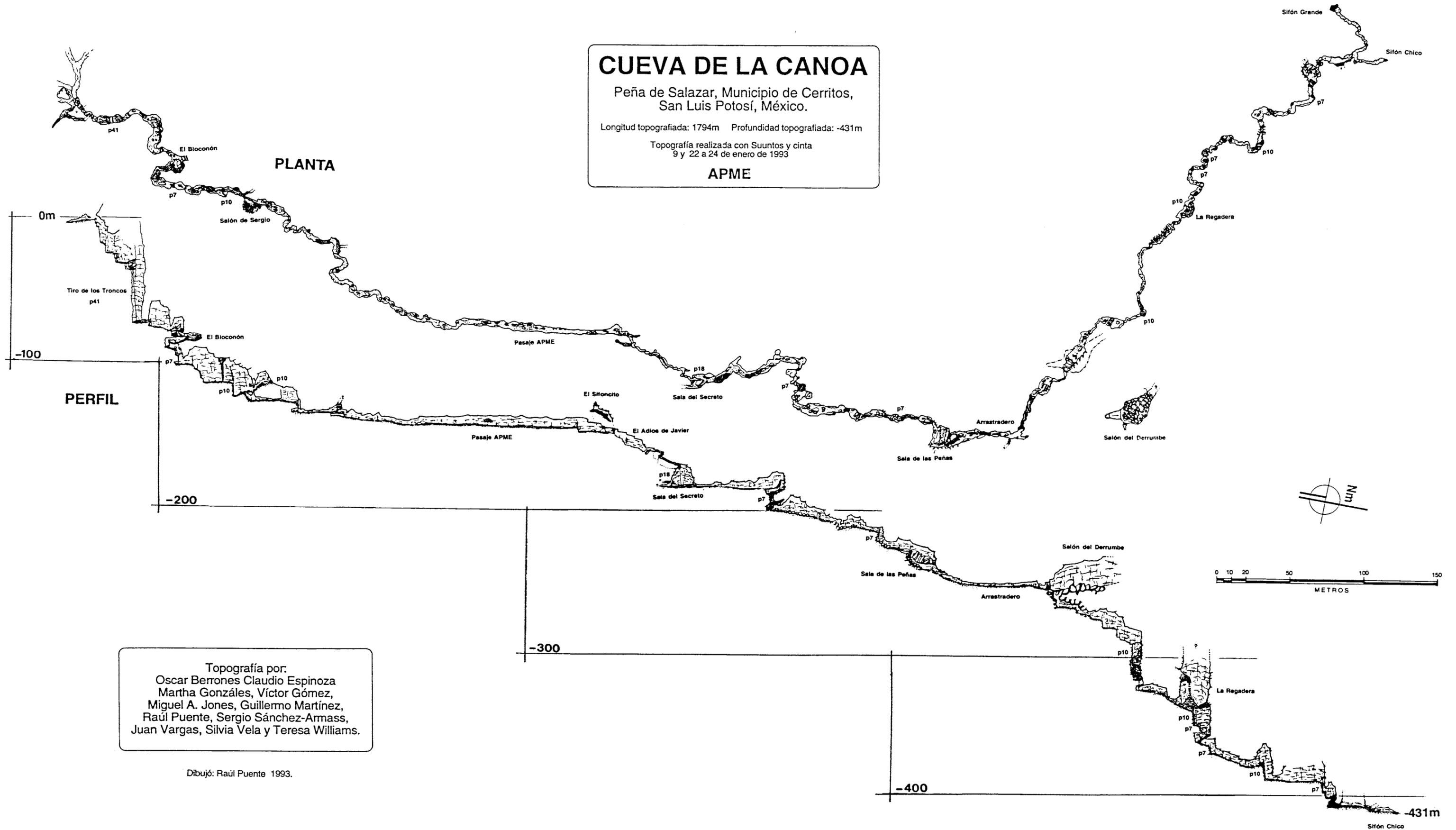
CUEVA DE LA CANOA

Peña de Salazar, Municipio de Cerritos,
San Luis Potosí, México.

Longitud topografiada: 1794m Profundidad topografiada: -431m

Topografía realizada con Suuntos y cinta
9 y 22 a 24 de enero de 1993

APME



Topografía por:
Oscar Berrones Claudio Espinoza
Martha González, Víctor Gómez,
Miguel A. Jones, Guillermo Martínez,
Raúl Puente, Sergio Sánchez-Armass,
Juan Vargas, Silvia Vela y Teresa Williams.

Dibujó: Raúl Puente 1993.

meal (MRE) of dubious origins and unknown expiration date, we got started on the derigging.

The derigging was accomplished with no problems other than an incipient case of hypothermia on Sergio's part, which was alleviated by a change into drier clothes, and almost poisoning ourselves through Oscar's idea of burning the garbage so we'd have less weight to carry out and. Almost back at the entrance, at the bottom of the 40-meter drop, we met up with Alejandro "El Pollo," Silvia Vela, and Guillermo Martínez,

who helped us carry the rest of the ropes from the cave.

At last we were on the surface after a fifty-six-hour excursion, during which we had slept four hours and mapped 1500 meters of passage to a total depth of 431 meters and a total length of the cave of 1794 meters. The cave has twenty-six drops that require ropes to descend and a great number of climb-downs. Some of the drops can be rigged to natural rigging points, but the majority require artificial anchors, 6- or 8-millimeter *barrenanclas*

bolts. Much use was also made of chocks and stoppers. We can generalize and say that the cave is technically rather easy, though it requires the efforts of a large team to move all the equipment. It's also necessary to add that, in spite of this, the exploration of the cave is far from finished. Twelve leads remain to be checked, including horizontal passages, climbs, and a sump that can likely be drained. Also, reports of other entrances above the Canoa entrance promise a truly interesting cave.

Peña de Salazar, San Luis Potosí

Miembros de la Asociación Potosina de Montañismo y Espeleología, han estado explorando cuevas cerca de el area de Peña de Salazar, SLP. La Cueva de Canoas tiene 26 tiros, alcanzando una profundidad total de 431 metros y una longitud de 1794 metros. Este articulo es reimpreso de la revista *Tsaval* No. 4.

ZACATÓN

Ann Kristovich and Jim Bowden

Zacatón is the deepest of five cenotes located on a large ranch, El Rancho Asufrosa, in northeastern Mexico. Members of the Proyecto de Buceo Espeleológico México y America Central first visited it on a reconnaissance trip made at the end of two weeks of exploration diving and surveying in the Nacimiento Santa Clara, a cave system at the base of the El Abra near the Nacimiento del Río Mante. There, the team led by Jim Bowden had laid more than 1400 feet of line, but had stopped at that point because of the depths encountered in the far reaches of the cave. Beyond 1100 feet back, depths exceeded 250 feet. At that time, in 1989, the team was not routinely employing mixed-gas techniques in Mexico, and the door further into the Santa Clara was thus temporarily closed to them. Jim had studied geological and topographical maps that revealed the possibility of inland cenotes in the karst terrain found at the southern end of the Sierra de Tamaulipas. On a ranch near the small town of Aldama, Tamaulipas, five cenotes were located. Exclusive permission to visit and dive was granted by the owner, and in late April 1990 exploration began. The cenotes proved to be extremely unusual. They are aligned generally east to west within a radius of approximately two miles. They are highly sulfurous in odor. In one

This material appeared in slightly different form in the August and November 1994 issues of the *IANTD Journal* (vol. 94, nos. 3 and 4). An analysis of Sheck Exley's last dive appears in the November 1994 and January 1995 issues of *Pressure* (vol. 23 no. 6 and vol. 24 no. 1); no definite cause of the accident was discovered.

named Poza Asufrosa, the sulfur precipitates and floats on the surface in raft-like formations. The waters tarnish metals and seem to leach the surface of galvanized tanks. The systems are surprisingly warm: 93 degrees Fahrenheit in Poza La Pilita, 87 degrees in Zacatón, 86 degrees in Poza Caracol, 87 degrees in Poza Asufrosa, and a cooler 83 degrees in the huge oasis-like Poza Verde. The waters in Poza Verde, unlike the others, are layered in thermoclines, and they behave more like a lake during times of flood and drought, apparently responding less to changes in the water table.

The first systematic exploration concentrated on Poza La Pilita, the warmest of the five. The walls surrounding the 68-by-120-foot water surface have tufa formations like those often seen at warm springs. Underwater, the walls are coated with dense algae that hang like curious stalactites. Measurements made using the Scubapro personal sonar device revealed that the pit enlarges significantly with increasing depth. At 150 feet, La Pilita is about 396 feet from north to south and 239 feet from east to west. The team initiated a search for a connection to the cenotes located immediately to the east or west, but no going passage was found in these early explorations. The depth of La Pilita was plumbed to 360 feet, and dives were made to 250 feet.

On May 2, 1990, divers Jim Bowden and Gary Walten entered El Nacimiento at the western boundary of the ranch. A typical boil was noted on the surface of the water near a limestone outcrop. Pursuing this current, the divers located a small cave and followed it northeast until they had exhausted the line on their reel.

With passage obviously continuing, they turned the dive, obtained an additional exploration reel, returned to their tie-off, and resumed laying line. Now in the lead, Gary soon noticed a bottle-green glow ahead. He covered his light and verified that the light was natural, which could only mean that they had made a connection to the surface. The exuberant divers emerged into Zacatón at a depth of 26 feet and surfaced in the beautiful cenote, which takes its name from the islands of tall *zacate* (grass) that float across its surface. The succeeding days were spent surveying the nearly 600 feet of passage, named Pasaje de Tortuga Muerte for the frequent turtle skeletons, connecting the nacimiento to Zacatón, the water from which forms the river. The water surface in Zacatón is approximately 70 feet below the surrounding land. It is 380 feet in diameter and roughly circular. Its walls undulate vertically, and the dimensions increase with increasing depth. A rough survey by personal sonar from the center of the cenote has been completed to 175 feet of depth. The project hopes that side-scanning sonar techniques can be applied in the future to study the full extent of this great pit. Divers Gary Walton and Ann Kristovich plumbed the pit to 250 feet.

Exploration continued in August 1990 with dives by Karen Hohle and Ann Kristovich in Poza Verde. This tropical oasis is more than 600 feet across, somewhat cooler than the other cenotes, and surprisingly shallow, a mere 140 feet by our measurements in the four quarters of the area. Also, Bowden and Walten pushed a passage in Poza Asufrosa with sidemounts, but the tight passage choked after 30 feet.

Caracol, like its immediate neighbor Zacatón, sits beneath cliffs. A large tunnel goes off beneath the cliff on an azimuth that would lead to Zacatón. In 1990, Bowden's dive reached a depth of 72 feet; the maximum depth is not known, because the passage leads back under the roof and could not be adequately plumbed. Subsequently, a penetration of 300 feet to a depth of 218 feet has been made.

After these exciting early trips, members of the Proyecto de Buceo Espeleológico México y America Central spent the next two and a half years exploring cave systems associated with the inland Blue Hole of Belize.

The project resumed the exploration of the five cenotes on the ranch in April 1993, fully equipped with mixed-gas capabilities to allow the safer exploration of the deeper systems. Sheck Exley joined the team for a week and dove with Bowden the previously unexplored depths. La

Pilita revealed a going passage to the southwest at a depth of 358 feet. Zacatón, however, provided the greatest surprise. Air dives to 258 feet by Bowden and 407 feet by Exley failed to find a bottom. The divers dove beyond the ledge that had captured the measuring line in 1990. The following day, Bowden, Exley, and Kristovich returned to Zacatón to attempt a more accurate plumb. The line spun off the reel, past 500 feet, past 800 feet, past 1000 feet! The line finally stopped after some 1080 feet had run out. The line was secured to the north wall of the cenote, and the divers completed plans to make a deep mixed-gas dive the following day. In April 1993, Bowden dove to 504 feet of fresh-water depth, and Exley to 721 feet. Tables for both dives were prepared using Exley's Dr. X software. Neither diver experienced performance difficulties or physiological complications during or after the dives. These two would be the first of seven dives to deeper than

500 feet made in Zacatón in a twelve-month period. As the week of diving came to an end, Exley and Bowden agreed to return together to Zacatón and, like Hillary and Norgay, pursue the exploration of this upside-down Everest. The perfect site for an open-circuit dive to 1000 feet and beyond had at least been found. It was warm, there was no perceptible current, the natives were friendly, and access to the system was uncomplicated. Bowden and Exley declared the goal of reaching the bottom of Zacatón within the year.

Members of the project made six trips to Mexico during the following twelve months. With each return to the cenote, Bowden dove deeper, in order to prepare himself for the 1000-foot attempt. Exley meanwhile pursued the exploration of a huge underwater cave at Bushmansgat, South Africa, diving to 863 feet in this system. During this dive, Sheck experienced visual, somatic, and neurological symptoms of high-

Zacatón. The cliffs completely surround the cenote. Wind blows the floating islands of grass across the surface. *Ann Kristovich.*



pressure nervous syndrome. The symptoms resolved during his ascent to his first decompression stop at 400 feet, and there were no persistent effects. In September, Bowden dove to 774 feet. Team member Kristovich dove to 554 feet (169 meters), setting a new women's depth record with this effort. On December 2, 1993, Bowden made a dive to below 800 feet. The exact depth of the dive could not be documented, because all three of the digital depth gauges he was wearing ceased to function at various depths ranging from 684 to 756 feet. Bowden, however, had visually noted the 825-foot marker on the descent line before reversing the direction of his dive. Bowden experienced multiple-joint decompression illness upon the completion of his decompression obligation. Symptoms resolved following aggressive rehydration, oxygen therapy, and in-water recompression. There were no persistent symptoms.

The 1000-foot attempt had been slated for December 25, but it was the consensus of the team in early December that the conditions imposed by the unusually wet rainy season were unfavorable for such an effort. The current in the Pasaje de Tortuga Muerte was fierce and imposed a heavy exertion, very unfavorable prior to any deep dive. It was necessary to traverse this cave passage, nearly 600 feet long, prior to any dive in Zacatón. For the safety of the divers, the dive was rescheduled for April 1994.

In April, the Proyecto, including Exley and Mary Ellen Eckhoff, assembled on the Rancho Asufrosa. Two days were spent staging the required decompression bottles at their required depths in Zacatón and in the nacimiento, where the shallow decompression stops would be made. The dive would be accomplished on independent descent lines, a condition both divers favored to avoid contact and potential interference during the very rapid descent. Each effort would be solo, by necessity. Exley would use heliair 6 (air diluted with helium to give 6 percent oxygen); Bowden would use heliair 6.4. Their decompression tables were similar and had been formulated using the Dr. X program. Both divers carried an assortment of tables, since the bottom time and the maximum depth of the dive were not known. Both Bowden and Exley made multiple deep air dives for acclimation to prepare themselves for the 1000-foot attempt.

Early in the morning of April 6, 1994, all was felt to be ready, and the divers and their support team assembled on the banks of El Nacimiento. Bowden and Exley geared up and swam together through El Pasaje and into Zacatón. The pre-dive mood was positive and optimistic. The men began their descent at approximately 9:50 A.M. U.S. central standard time. Bowden dove to 925 feet (282 meters) and would spend over nine hours decompressing. Exley, for reasons we will probably

never know, failed to return from his dive. His computer, recovered unexpectedly when his body came up with his dive line when it was pulled days later, showed a maximum depth of 906 feet.

During the twelve months spent in training and preparation for the deep dives, the following dives were made by members of the Proyecto de Buceo Espeleológico México y America Central: 50 to 100 feet in depth, one hundred ninety-seven; 101 to 200 feet, twenty-two; 201 to 300 feet, thirty-nine; 301 to 400 feet, forty-eight; 401 to 500 feet, three; and over 500 feet, seven. It is significant that these 316 dives were accomplished in only fifty-one diving days. Bowden made more than one hundred of these dives, including four of the dives to below 500 feet and a dive on air to 411 feet (125 meters, fresh water).

The project will continue its efforts in Mexico after a brief pause for the rainy season. Bowden feels certain, after his dive to 925 feet, that a dive to 1000 feet fresh water is possible, and he will pursue his plans to see the bottom of Zacatón. With the use of heliair, the survey of the long passage in the Nacimiento Santa Clara will be resumed. The team also plans to aggressively explore the magnificent deep caves of the Sierra Madre Oriental, including the Río Choy, Río Frío, Río Sabinas, Nacimiento del Río Mante, Nacimiento del Río Huichihuayan, and many others.

—Ann Kristovich



After days of cool mornings and evenings and pleasantly warm middays, I awoke to blustery winds swirling around the doline that was our camp site. The weather seemed charged with the same excitement I felt as I began my last preparations for an attempt to dive below 1000 feet of fresh water in Zacatón, perhaps the world's deepest water-filled pit. This was it. All I had worked for over the past year came down to this day, April 6, 1994. I had already made three dives to below 500 feet in this system. The first, to 504 feet, was

Jim Bowden displays the equipment needed for a deep dive. *Ann Kristovich.*



Jim Bowden preparing for a deep dive in one of the cenotes.
Ann Kristovich.

made in April 1993 while diving with my friend Sheck Exley. We discovered then that we had the possibility of an upside-down Everest in Zacatón. It was also at this time that Sheck suggested we make the attempt for the bottom, plumbed at 1080 feet, together, as he put it, like Hillary and Norgay did Everest.

In 1993, I was just returning to deep diving. For the previous two years, exploration in Belize had involved big river caves and sumps seldom deeper than 60 feet. Prior to that, my project in the Río Santa Clara had provided me with the most time that could be considered deep, 250 feet or so. That system and isolated excursions below 250 feet elsewhere were the extent of my deep diving. The idea of diving to 1000 feet and beyond in Zacatón intrigued me. After all, it was precisely this system that had motivated me to seek the training in mixed-gas diving from Sheck in early 1989. Our plans to dive this system had been put on hold because of a year of illness on Sheck's part and two years of Belize project on mine. Finally it was coming together. I was, of course, sobered by my lack of deep experience compared to Sheck. My deepest dives in the previous ten years, to some 250 feet, although deep by some standards, certainly did not put me in the extreme depth group. Sheck, however, believed in me, and, after all, with mixed gas a diver calculates his acceptable air-equivalent narcosis depth and partial pressure of oxy-

gen. The main thing was that I did feel that I had more experience in wild cave diving than most. I've been knocking around Central America and Mexico for almost a decade and a half, and I have arranged my life so that I can spend months of each year diving virgin systems. If a disciplined head and the experience of those years make a difference, it was worth a shot. I set about an effort to work up to the target depth and create a deep-diving equipment set that was as much a part of me as my exploratory set and my side-mounts had become. My 1993 dive to 504 feet filled me with pride at being one of only six individuals at that time to have made an open-circuit scuba dive below 500 feet, and in a cave, no less. However, it is a long way from 504 feet to 1080 feet, so my efforts were directed to diving deeper in a series of at least two more dives. The first, on September 2, 1993, went to 744 feet. My confidence increased, and I planned for one more dive below 500 feet before the big attempt, which was scheduled for the end of 1993.

My next dive was made with the intention of diving as deep as my comfort level allowed. My mix was the same one I planned to use later to dive to the bottom. In other words, I wanted to break Sheck's existing record or get as close as I could. In late November 1993, I returned to Mexico and, with the help of Karen Hohle, Ann Kristovich, and Allan Jackson, staged my decompression

bottles. Then I got sick. Good old-fashioned cold or flu. I extended our stay another week and shivered and sneezed in my tent, hoping to recover enough to get my dive in. Eventually, I decided to make the attempt in spite of my compromised health. As a result, I suffered a severe decompression-sickness incident upon surfacing. The dive went well otherwise. I dove to 800 feet plus. I passed the 800-foot mark on a measured line, but my gauges stopped reading after 756 feet. I'm not sure to this day why I turned the dive. Perhaps confusion over the gauges' cratering or just that little voice that has kept me alive all these years. At a depth between 750 and 800 feet, I had experienced some high-pressure nervous syndrome, but not to the extent that Sheck did in Bushmansgat. My symptoms manifested themselves as tightness or slight tremor of the latissimus dorsi or paraspinal muscles. At no time did I feel impaired. Although it was foolish of me to dive when I was sick, in spite of the DCS hit I convinced myself that a dive to the bottom could be done and that I was ready to do it. Because of the DCS hit, we did postpone the big dive until April 1994, when there would be less flow in the access tunnel. Exertion there before the deep dive might have contributed to my decompression problem.

The time until April passed rapidly, with preparations and planning consuming every day and night. In addition to three dives below 500 feet, I had made over thirty dives below 300 feet. Some were done on air to acclimate and build up my narcosis tolerance. Many of these dives included skills testing at depth, primarily problem solving or tasks posed by Dr. Kristovich, who was on mix while I was on air. This provided at least one clear head to deal with problems that might arise. Frankly, I became very confident of my skills and less worried, because of my disciplined avoidance of any carbon-dioxide buildup, about oxygen toxicity and narcosis blackout. I became the ultimate "easy diver," a term

coined by Lou Fead in his book by the same title. It was essential that I be comfortable with an equivalent narcosis depth of 330 feet, as my planned bottom mix of heliair 6.4 (69.5 percent helium, 24.1 percent nitrogen, and 6.4 percent oxygen) produced an END of 300 feet at 1000 feet true depth. The bottom would demand that and more. I made one dive to 411 feet on air, a possible record on air in a cave, but it was soon eclipsed by Sheck, with his dive to 420 feet on April 4, two days before our attempt for the bottom.

All of this history came rushing back to me on this day, the day of the dive. "Addressing our fears," as Sheck put it, was a constant companion morning, noon, and night over the last year. I am sure the intensity of my commitment to this dive was difficult on all those around me. I was obsessed, driven, and sensitive as hell. I can't think of ever wanting anything more than this. Now was the time to fish or cut bait. The final preparations were made, and the first support team left camp to put down the decompression oxygen and Divecomm full-face mask that I planned to switch to at 20 feet. Shortly thereafter, we all left for the spring. Our team that day consisted of Sheck, me, Mary Ellen Eckhoff, Karen Hohle, Ann Kristovich, and Marcos Gary. Also present were a writer and photographer from *Sports Illustrated*, a photographer from *Destination Discovery*, a television crew from Channel 7 in Tampico, the land-owner and his family, and the local residents of the area.

Sheck and I geared up and swam through the 600-foot cave passage, El Pasaje de Tortuga Muerte, to reach our dive site. Surfacing in Zacatón, we swam slowly over to our descent lines. We commented on the beautiful day and wished each other luck. We separated at that time and went to our respective down-lines. Time passed in silence as we calmed our breathing and focused our minds for

Sheck Exley (left) and Jim Bowden in El Nacimiento at the start of their deep dive, April 6, 1994. *Ann Kristovich.*

what was ahead.

After a time, I felt all was right and glanced over at Sheck. He seemed to sense my glance and nodded affirmation. I submerged and hesitated at 10 feet for a minute or so and then went into free fall. I had planned a descent rate of one hundred feet per minute to 300 feet on air, then the same rate to 600 feet breathing heliair 10.5, then switching to my bottom mix, heliair 6.4. I planned to slow my descent around 750 to 800 feet, where I had first noticed HPNS symptoms on my previous dive. All went according to plan. As I passed the 800-foot mark, I was conscious of very little tremor; I felt even better than on my previous dive. But at 900 feet, I was shocked to find that I had already used my bottom mix down to a pressure only slightly greater than 1000 psi. At that depth, a regulator will not deliver if the pressure in a tank is much less than 500 psi, as the ambient pressure is so great. I inflated my wings and managed to stop my descent at the 925-foot mark. My Aladdin Pro gauges read 915 feet and 924 feet. I switched to the 80-cubic-foot tank of bottom mix under my right arm and breathed that and then my 10.5 travel mix to my first decompression stop at 450 feet. By the time I reached my first stage bottle of heliair 10.5 at 350 feet, both bottles were essentially consumed. To my horror, the regulator on my deep deco bottle free-flowed violently when I turned it on. It seemed to take a lifetime to shut it off again. I went back to my back-mounted doubles while I tried to remedy the problem. Unfortunately, the

regulator would not stop free-flowing. The only solution was to open and close the tank valve for each breath. I had eight minutes of stops between 350 and 300 feet, where my next stage bottle (heliair 14) was located. I decided to omit the deeper stops in that range and hang longer at 310 feet, just below my stage bottle. After successfully reaching this next stage, I began finally to relax my concern for the extreme depth exposure, but now would come the long decompression and the worry about oxygen toxicity and decompression sickness.

I switched to air for the stops between 260 and 130 feet, where I switched to air enriched to 30 percent oxygen. Here I could clearly see the line that Sheck used on descent. All of his stage bottles were still neatly packaged and unused. The sinking feeling in my heart was overcome by my confidence that he had gone deeper than I had and had not yet reached the same decompression level. Ann checked on me around 230 feet, but said nothing to me about what she and Karen already knew. It wasn't until I reached my next gas switch at 60 feet, to 50 percent oxygen, that Karen told me we had lost Sheck. I was stunned. The remainder of the dive was mechanical, as I tried to insure my safe exit from the water. I switched to argon mixed with 50 percent oxygen at 40 feet for fifty-two minutes, air enriched to 70 percent oxygen at 30 feet for sixty-one minutes, and argon-oxygen 40 percent through the cave passage and to my 20-foot stop, where I switched



to pure oxygen delivered by the full-face mask. We had constructed a ball-valve system that allowed me to switch from oxygen back to air for five-minute air breaks every twenty-five minutes. At least one of my support divers was with me during the four hours I spent at 20 to 10 feet. They were prepared to assist me should I convulse or to manage my air breaks should I forget.

I surfaced after almost ten hours of decompression to a DCS hit in my left shoulder. I passed my neurological survey and had stable vital signs, so we managed my hit on site. I have no noticeable impaired function. I awoke the next morning with a record I never thought I'd possess and the loss of my friend and teacher.

—Jim Bowden

Zacatón

Hay cinco cenotes profundos en rancho Azufrosa, cerca de Aldama, Tamaulipas. El agua es templada y sulfurosa. El más profundo es Zacatón, llamado así por las islas de "zacatón" que flotan en la superficie. Há sido sondeado hasta 330 metros de profundidad. En Abril de 1994, espeleobuzos intentaron alcanzar el fondo. Jim Bowden fué forzado a regresar a la profundidad de 280 metros. Este es el récord mundial en profundidad para espeleobuceo. Sheck Exley murió despues de haber alcanzado la profundidad de 275 metros.

THE 1994 SAN AGUSTÍN EXPEDITION

Bill Stone and Barbara am Ende

This is a narrative of the expedition in the spring of 1994 to dive the sump at the bottom of Sistema Huautla, which, before the trip, was the second-deepest cave in Mexico and twelfth in the world. An accompanying article in this newsletter tells the thirty-year history of the exploration of this system and the motivation for seeking passage beyond the sump. The development of the rebreather diving apparatus employed is described in an article in *AMCS Activities Newsletter* number 20.

Final expedition organization began on January 15, 1994, in Gaithersburg, Maryland. During the next four weeks, nine MK4 rebreather units were assembled and tested. This was necessary because substantial changes to the apparatus had been made in response to requests by team members during the 1993 training exercises. On February 15, the team moved to Ginnie Springs, Florida, for a week on in-water testing, during which the apparatus and onboard software were put through controlled maneuvers. The final assembly of the team took place in San Antonio, Texas, February 24 and 25. We left Texas on Saturday, February 26. The team consisted of Jim Brown, Bill Farr, Barbara am Ende, Kenny Broad, Noel Sloan, Steve Porter, James York, Don

Broussard, Ian Rolland, and Bill Stone in a five-truck caravan. It took three days to drive to Huautla de Jiménez. Along the way, potholes in the east-coast road broke springs on two of the trucks. While these two plus a backup truck were delayed by repairs in Poza Rica, near Tuxpan, Sloan, Porter, Stone, am Ende, and Angel Soto, who joined the team in Tehuacán, went on in the remaining two trucks to gain permission from the authorities in Huautla. By March 2, we had arranged for local permission in the village of San Agustín Zaragoza as well. Four houses were rented from the villagers, two for sleeping, one for equipment maintenance, and one for cooking and team meetings. Within two days of our arrival, we had base camp organized in the rented buildings, and we began rigging Sótano de San Agustín. It took another week to reach the -620-meter level. More than a kilometer of rope was rigged on fifty pitches in this section alone.

The entrance to Sótano de San Agustín is a gigantic funnel in the jungle that descends 120 meters vertically by means of two sloping 90-meter shafts. Verdant ferns and native begonias line the walls of the first shaft. A 40-meter climb at the base of the second pitch leads up and to the west to an impressive balcony overlooking both the Sala Grande, a large hall at the base of the second shaft, and the entrance pitch. At the southwestern edge of this balcony begins the Fool's Day Extension, a passage discovered on April 1, 1987. This is an obscure route at first, requiring passing through two tight places and a 100-meter-long sand crawl. Beyond the long crawl, a se-

ries of twenty-three short drops connected by large walking passages leads to the -325-meter level.

From this point there are six large shafts, some deeper than 100 meters and walled with smooth, tan-colored travertine and knobby popcorn, down which the cave stream flows. The total descent in this section is 305 meters. Fortunately, the stream flowing through this passage is not the one seen at the entrance, and the route remains passable even in high-water conditions. Still, one can expect to get totally soaked to the waist, and there is a substantial wind through the connecting fissures between the vertical shafts.

By March 10, a number of support personnel had arrived, and the equipment for the first reconnaissance dive at the bottom of the cave was rapidly being moved further in. Soon, seven hundred kilograms of sleeping, diving, and cooking equipment had been transported to a depot at the -620-meter level. The depot was located at the base of a 77-meter shaft in the middle of a large tunnel 15 meters wide and 50 meters tall known as Tommy's Borehole. Camp 3 is another 90 meters deeper and more than a kilometer distant from the 620 depot. From Camp 3, it is another 130 meters vertically to the San Agustín sump, along a kilometer of the most technical passage in the cave system, due to its high volume of water. Two rebreathers, five 368-liter oxygen bottles, five 850-liter bottles of 86/14 heliox diluent gas, three 2950-liter bailout bottles of the same mix, and one emergency 1700-liter oxygen bottle were staged at the -620-meter depot, in addition to more traditional caving and camping equipment. The rebreathers were broken down into

©1994 William C. Stone and Barbara Ann am Ende. This expedition narrative has been extracted and revised, with the help of the authors, from the longer expedition report prepared for the Mexican government. The majority of the material in italics is copied, lightly edited, from logs written during the expedition.

components for transport on the ropes; the heaviest component was the core electronics and gas-processing module, which weighed 19.5 kilograms. Eight other covers from around the world (as far away as Germany) supported this phase of the operation, in addition to the eleven members of the dive team.

On March 16, six of us rigged to Camp 3 at the -710-meter level. It would be sixteen days before we saw the surface again. We then carried equipment down to Camp 3. About half of this material was sleeping bags, foam pads, freeze-dried food, cooking stoves, fuel, and calcium carbide for our lamps. The remainder was diving gear. On March 19, we began rigging the final 130 vertical meters down to the sump.

Over the next three days, we assembled a lightweight platform of aluminum poles and nylon fabric. This 4-by-12-foot deck was Camp 5, the dive base. Hammocks, rigged to rock bolts in the walls, allowed up to three individuals to sleep at Camp 5. Another deck, 4 feet square, was constructed at the water level for departing and returning divers. Otherwise, there was no dry land down there. The water-level never changed during our initial stay in March.

At Camp 5, we reassembled one of the rebreathers that had been brought down in pieces. The three lead divers, Ian Rolland, Noel Sloan, and Steve Porter, then began the exploration of the underwater tunnel, while the remaining members of the team at Camp 3, Bill Stone, Kenny Broad, and Barbara am Ende, continued to haul supplies, mostly small diving tanks, from the -620-meter level to Camp 5.

The first diving push was on March 23, the day after Sloan, Porter, and Rolland reached Camp 5. Rolland was the first person to dive. Following the roof, he surfaced into a large airbell at approximately 60 meters penetration, hoping to find a dry bypass to the remainder of the sump. There was no continuation in that direction, unfortunately. Further progress was hampered by silt stirred up in the vicinity of the airbell when he broke the surface; this significantly reduced visibility. So Rolland returned to Camp 5, and later that morning Sloan made a dive. He fol-

lowed Ian's line to its final tie-off point, clipped on a new reel, and spooled out. Soon the passage widened into what apparently was a large breakdown chamber. The visibility was poor to begin with, but became worse when Sloan had to struggle to disentangle one of his fins from the line. Porter made the third dive of the day, but again poor visibility made him call the dive before he could make significant progress.

The next day Rolland followed the line to where Porter had left his reel. He tried to follow the passage upwards. Ultimately he surfaced in a small airbell in a narrow fissure, but the passage ended. Exploration under water was again difficult due to extremely limited visibility, and Ian called his dive. Porter and Sloan also dove that day, but had little luck in finding the way on in the breakdown chamber. The limit of exploration was now 230 meters from dive base at a water depth of 20 meters.

On March 25, Rolland once again returned to the end of the line and picked up Porter's reel. Unfortunately, soon after he began exploring, his breathing became labored, and he developed a headache. He aborted the mission and safely returned to dive base on closed-circuit rebreather by periodically purging the system with heliox, still much more efficient than switching to open circuit. Apparently, after six hours of diving the CO₂ absorbent, anhydrous lithium hydroxide, in the rig was spent. This was somewhat unexpected, since we usually got seven to eight hours for each charge during our Florida training missions. By now, the enthusiasm of these explorers had been taxed. The dives were technically difficult. Worst of all were the conditions at Camp 5. The constant loud roar of a nearby waterfall, the inconvenience of the toilet facilities (a trash bag), the lack of immediate success, and all the other stress-creating factors, including the awareness of their location at the bottom of three kilometers of rope, convinced the three to return to Camp 3 to unwind and to discuss the situation with the other members of the team. The next day, after a more comfortable night at Camp 3, they talked about the configuration of the flooded tunnel, and

Stone drew a map based on the reports of all the divers and his own recollections from diving there thirteen years before.

That morning, Rolland and Kenny Broad left Camp 3 for Camp 5. The mission plan was for Broad to make an exploration dive in the hopes of finding the southern continuation that apparently had been lost in the large breakdown chamber. Noel Sloan and Steve Porter headed for the surface to get more supplies and to rest. They gave a message to three British visitors, Paul Whybro, Rick Stanton, and Mike Madden, to bring Stone's diving kit and drysuit clothes to Camp 3. These three arrived the following afternoon. Stone intended to descend to Camp 5 the following morning and make the next exploratory dive after Broad.

On March 26, after recharging the CO₂ absorbent canister, Broad laid 85 meters of line on a due south bearing. The meeting at Camp 3 must have helped, because Broad felt he had going passage, estimated to be 10 to 15 meters wide, with a height of 14 meters and a floor depth of 34 meters. The following morning, emboldened by Broad's significant advance, Ian continued on where Kenny had tied off and laid another 85 meters of line. The floor of the tunnel was now rising, and Rolland had tied off at a depth of only 10 meters. He was certain a breakthrough was imminent. Broad dove again early in the afternoon, and after a little more than an additional 40 meters, he surfaced in a large air-filled passage. In his log, Broad wrote: *Ceiling sloped upwards for about 40 meters until it broke into open water, and the mercury-like reflection of the surface sent a shiver down my already shivering spine. While underwater, I disabled the oxygen injector (in software), shut off the manual control box valve, and surfaced. I removed the regulator and sat on my knees in the mud, breathed the warm humid air, and was in awe. The passage was 12 to 15 meters wide, 12 meters high. Several low (0.3 to 1.0 meters) sandbars broke the still surface. There was no perceptible water or air movement, and I heard no noise.*

Because he wasn't as experienced at dry caving, Broad returned to base,

and Rolland went to check out the new tunnel. Unfortunately, Rolland never returned. According to a pre-arranged plan, Broad left the sump to "call out the cavalry" at 10 P.M. Stone subsequently wrote in his log: At 11:49 P.M., we were awakened by a familiar clanking of vertical gear. I awoke to see a light over near Ian's bed, then heard Kenny's voice say, "Where's Bill. Is Bill here?" I figured he was coming over to tell us they had cracked the sump, since Don Broussard had returned around 4 P.M. to say that they had run out two line reels and it looked like they were heading up. Kenny came over to our campsite, and Barb and I sat up. Kenny had surfaced in a 15-meter-wide by 12-meter-high tunnel with sand bars . . . apparently in a huge airbell. At 4 P.M., Ian had gone back in (full tanks, about three hours cumulative use on the scrubber). They had staged an oxygen bottle at 120 meters in, and a heliox bottle at 230 meters in. Before leaving to explore the new air-filled tunnel, Ian had told Kenny, "If I'm not back by 10 P.M., call out the cavalry." At 10 P.M., Ian had not returned. Punctual, and extremely concerned, Kenny geared up and climbed to Camp 3. At my bedside he was hyper and wanted to organize a return dive immediately. Don Broussard had now joined the gathering, along with Brown; Kenny had awakened both on the way to camp. I was still fuzzy from only two hours sleep. Kenny's concern was that Ian might be beyond the sump with insulin shock. (Rolland had, some eighteen months prior to the expedition, been diagnosed with diabetes. This had been openly discussed with the team, and it was felt that Ian would be able to manage this in the face of the tasks he would be required to do on the expedition.) According to Don, this would occur if Ian had not eaten enough in the face of heavy exertion. The symptoms were lightheadedness, followed by convulsions or unconsciousness or both. Don felt sure Ian would be aware of such a situation and, if on the far side of the sump, sit patiently for someone to bring in food. Kenny was concerned over the two high-carbohydrate PowerBars Ian had taken in this belt pouch. Had he eaten them? We went through many scenarios and concluded, largely based on Broussard's knowledge of diabetes, that the rescue could wait till 5 A.M. while we all got some needed sleep. I did not sleep well.

At 5 A.M. Rick Stanton left for the 620-meter depot to retrieve the first-aid kit, an extensive trauma kit prepared by Noel that filled an entire 40-liter dry bag and would presumably have injectable glucagon. Broussard's recommendation was to use this as the most effective tool for overcoming insulin shock. Barb and Don stayed in camp, awaiting word whether to make a run to the surface to inform Noel and Steve. (An earlier effort to rig a fiber-optic communication link from surface basecamp to Camp 3 had failed, apparently because an irate Mazatec chopped the surface portion of the link several times. Thus messengers had to be used.) Mark, Paul, Jim, and I headed for the sump with enough gear to build up the second rebreather. We arrived around 7 A.M. It took till 11 A.M. to have it together and checked out.

By this time, Kenny had arrived with Rick and was laying flat on the upper deck trying to compose himself for the dive. After completely calibrating the rig, I let Jim have an independent double-check of the plumbing. During this time I spoke to Kenny about the dive plan. He had one of the waterproof CO₂-canister carriers filled with candy bars, carbide, a cap lamp, injectable glucagon (found in Ian's kit at Camp 3), and a space-blanket sleeping bag. After a 10-minute pre-breathe to check the canister I had repacked and an in-water leak check, he gave me the "OK" circle with his light and disappeared. It was 12:15 P.M.

I started a ten-hour countdown timer on my watch. Jim went to sleep. The rest of us stood with a solitary carbide lamp—almost a vigil—made some bullion broth, sucked on Jolly Rogers hard candy, but in general said little. At one point we talked about incidents of sump divers stranded beyond dives. At 1:45 P.M. Paul saw lights returning, 90 minutes out. Kenny had said it would be a 35- to 40-minute dive each way. I immediately said, "This is not good." Brown was down on the lower deck. I saw the unmistakable words, "Ian drowned," formed on Kenny's lips, but could not hear him saying it due to the roar of the falls. My heart sank. I had been steeling myself all day for this, but it still made me dizzy. The first thought was, "Oh hell, Ian, not Ian. How could this have happened?" And the second was, "And now what are we going to do about it?" This went in a vicious circle until it was apparent that Kenny needed

assistance.

After helping him onto the platform, I silently put my hand on his shoulder. He grabbed it and held it. Of all those on the expedition, he was the closest to Ian. Ian had taken him under his wing, made him his apprentice. They were so matched as a pair that I often slipped and called Kenny "Ian." By this time Whybro and Stanton were getting cold. We made a decision to send them to Camp 3, while Brown, Kenny, and I spent the night at the sump. We were all too wired to dive at this point, but it was painfully obvious to me that we had to bring Ian's body out. It was also clear that Kenny should not be the person doing that. Brown was still having ear problems, so that left me. I figured it would take two dives at least. After the others left, we got into camp clothes and strung the hammocks. Kenny and I talked for what seemed hours about the whole thing. Both of us were numb. Both dazed.

That evening am Ende and Madden left Camp 3 to alert members of the team on the surface that a recovery effort was on and to inform the authorities. Sloan, Porter, and Madden made plans to descend the following afternoon.

Rolland's body was transported through the San Agustín sump on the morning of March 29 by Bill Stone. That same day Paul Whybro, Rick Stanton, and Kenny Broad joined the recovery effort, and by late evening the four had reached Camp 3 with the body. They were then joined by Mark Madden, Noel Sloan, Steve Porter, and Alex Wade. This team, over the course of the following three days, transported the body to the -250-meter level, three pitches above the 110 Meter Shaft. During the next two days, a relief team from Britain, consisting of John Palmer, John Thorpe, Dick Ballantine, Pete Ward, and Pete Hall, continued the operation to the entrance. In the meantime, Rob Parker, Tony Finnegan, Barbara am Ende, Sergio Zambrano, and Angel Soto worked with authorities on the surface.

When the team reached the surface with the body on April 1, a wave of emotion swept over everyone. Nearly two hundred villagers lined the path from the entrance. The women bore flowers and burned incense. The men, who had come to

help bring Ian up the final hill and over to the church for a memorial service in Mazatec, had dug scores of steps in the steep trail out of the entrance. He was then taken by the Oaxacan authorities and ultimately by the RAF to Scotland. Rob Parker accompanied the body back to Great Britain. He and two of the British support-team members, Paul Whybro and Rick Stanton, who were with us during the recovery, represented the team at the memorial service. Bill Stone wrote a eulogy for Parker to read on behalf of the team.

Ian Rolland had been found in open water in the large passage beyond the sump. Investigation at the time and after the return of the expedition, including examining the data logged by the rebreather unit he had been using, led to the conclusion that Rolland had drowned for some medical reason not related to the equipment in use during the dive. A blackout due to diabetes-related hypoglycemia is regarded as the most likely medical explanation, although there is no evidence bearing directly on this question. Circumstances did not, of course, permit a prompt and thorough autopsy. [A detailed accident analysis by Kenny Broad and Bill

Ian Rolland working on a MK4 rebreather in Maryland, January 20, 1994. Bill Stone.



Stone appears in the January-February 1995 issue of *Underwater Speleology*.]

There was a group meeting on Easter Sunday, and, based on the preponderance of evidence that the fatality was medically related, the decision was made to continue the expedition. After the meeting, some of the team members left the area for a few days of rest and relaxation. Several individuals stayed on, however, including the photographic team from *National Geographic* magazine, Wes Skiles, Tom Morris, and Paul Smith. They were slowly acclimatizing themselves to the elevation and the rigors of ropework by making successively deeper trips into the cave.

On Wednesday, April 6, Barbara am Ende and Bill Stone descended to Camp 3 with equipment for a reconnaissance dive beyond the sump. On Thursday, April 7, they continued down to Camp 5 at the sump and prepared one of the rebreathers for use the following day. On Friday morning, April 8, they got up at 6 A.M. and had a breakfast of freeze-dried food and powdered potatoes. Stone was ready to dive by 9 A.M.

Although much has been written about the mechanics of establishing Camp 5, little has been said about its ambience. Most individuals who have been there describe it as spooky. It was suspended 3 meters above the sump pool, and there is a waterfall less than 20 meters away that makes a continuous loud roar. One has to shout to be heard. Ear plugs will not abate the noise. It is a low-frequency pulse that vibrates the walls of the tunnel.

Initially we had used drysuits for the exploratory dives. Our duration underwater during those first dives was a complete unknown at the start of any mission, and cold water was anticipated. The presence of the fixed

guide line and a known traverse distance of 430 meters to the airbell at the end of Sump 1 now enabled us to estimate a maximum transit time of forty minutes. For these conditions, wetsuits are sufficient, provided you keep moving underwater. The use of wetsuits also permitted us to eliminate an extra tank of gas, as we had been using argon to inflate the drysuits.

After leaving the dive platform, Stone submerged and swam 100 meters into the sump, where he heard strange gurgling sounds. He aborted the dive and returned to Camp 5, since rebreathers are not supposed to make any sounds. There he and am Ende spent an hour examining the rig, without finding any leaks or problems. So at 10:30 A.M., Stone set off on a second attempt. This time he got 150 meters into the sump before hearing more of the irregular gurgling noise. He sat there underwater for a few minutes trying to determine the origin of the sound and then aborted again to dive base. Stone and am Ende took the rig apart and ultimately found a small leak in the buoyancy-compensator jacket. It took three hours to repair this, and by 3 P.M. Stone was back in the water.

This time everything went well, and Stone dove 430 meters through the sump, reaching a maximum depth of 25 meters. The sump was mostly a canyon passage measuring approximately 14 meters high and 6 to 8 meters wide, but in most places one could not see the floor or the east wall. A bluish-white haze, created by suspended calcium carbonate in the water, reduced the visibility to approximately 1.5 meters in most places. In a few places the visibility reached a maximum of 5 meters. The white diving guideline had been tied to small solution-holes near the roof of the tunnel to minimize the depth of the dives. This is why one usually could not see the floor. The temperature of the water was 17°C (63°F), fairly cold water. Along the way, Stone placed white arrows, numbered to indicate the distance back to base, on the line. These line arrows are a useful reference on the way out, similar to mile markers on the interstate. After thirty minutes, Stone surfaced into the air-filled chamber that we have

now named Rolland Airbell, in memory of our colleague. This chamber measures 100 meters long, 15 meters wide, and 12 meters tall. Except for two small sandbars in the middle of the room, the entire floor is beneath a large lake.

Stone swam to the end of the lake and picked up the line reel that had been dropped by Rolland. There he submerged to find a large underwater tunnel leading downward and to the east. It looked like a long way down, but the visibility was not great. Stone tried to maintain a southerly bearing and to stay on the roof. He had good luck, for the roof never dipped below 10 meters. He connected a second spool of line midway through the sump. By this time it was apparent that the tunnel was rising. At 170 meters into the dive, Stone surfaced into a large tunnel measuring 20 meters wide and around 10 meters tall. There was a gravel beach in the distance, and he could hear the sound of a powerful waterfall.

Stone's writes: *This is what we had been working ten years to achieve: To find an air-filled continuation of the main river passage beyond the San Agustín sump. It took a while for that to register, given where I was and the amount of gear I was embedded in. I raised by hands in silent prayer. By God, we had done it!*

I took off the backpack and climbed out of the water. The gravel beach quickly led into a field of polished breakdown with the stream running along the west wall. I had started down this in my wetsuit booties with a backup dive light, but soon got a grip on myself and returned to retrieve a carbide cap lamp from my daypack, along with a pair of boots. I followed the big tunnel 100 meters to where it split. The larger, eastern branch continued 100 meters until it began to descend to the west. Within what seemed a very short distance, I found a large lake, with the river pouring into it. Apparently this was Sump 3. I continued around its edge and followed the incoming tunnel to the north and east to where it joined the main passage coming from Sump 2. I returned to the dive gear, thinking that this was it. Then I thought better of it and began to carefully follow the east wall again. This time, with the aid of a dive light, I saw a blackness at the top of a boulder slope just before the descent to

Sump 3. I climbed up this and found myself in 25-meter-wide by 15-meter-tall borehole.

The new tunnel led 100 meters to where it split. The main passage continued south up a steeply inclined breakdown slope. However, to the west, shortly beyond the beginning of the slope, was a 3-by-5-meter water-scoured canyon. I chose to follow this in hopes of bypassing Sump 3. The canyon quickly opened up to the west and into a descending sand slope, 200 meters from where I had entered it. There I connected back into the river passage. In the upstream direction there were several long lakes leading off that presumably continued to the downstream side of Sump 3. I never did go up there. To the south, however, there was again a large lake, 20 meters long by 10 meters wide, leading into Sump 4. Route-finding became difficult. A steep climb to the southeast led into an ascending fissure. There were deep potholes in the floor, and it appeared to be an infeasible. I stopped at a place that would have required an exposed traverse of a 6-meter-deep pothole.

Back at Sump 4 I noticed a black alcove directly above the sump. I could not get a clear view of it due to the steam I was generating. I had, in my excitement, never bothered to take off my wetsuit top or hood and was now overheating. I looked at the blackness up there for some time, trying to scope out a climbing route. Reason then got the better of me, and I decided that this was no place to be conducting exposed climbs without a partner. I retreated to Sump 2. I had been on the far side of the sumps for two hours now and had seen roughly 500 meters of virgin tunnel. With three leads heading south in air-filled passage, I felt there was sufficient reason to return with a survey party and rope.

It took close to an hour to get back into the rebreather and check out all the systems. Stone then surveyed both Sump 2 and Sump 1 on the dive out and arrived safely back at dive base at 8 P.M. By 10 P.M., he and Am Ende had things packed up, and they ascended to Camp 3, where they found Tom Morris, Paul Smith, Neal Messler, Jim Brown, and Kenny Broad. These five, with Broad serving as guide, had made a reconnaissance of the cave to Camp 3 for the purpose of planning the subsequent photographic work for National Geo-

graphic. The following morning, Saturday, April 9, everyone ascended to the surface.

On Sunday, April 10, Stone gave a public slide show in Huautla. Nearly five hundred people crowded the central plaza. He later gave a special private lecture to town officials at a local restaurant. The following morning the team drove to Camarron Huautepéc on the south side of the mountain, where a horse and three burros were waiting to carry equipment down into the deep Santo Domingo Canyon. The purpose of this trip was to take the *National Geographic* photographers to the resurgence where the water emerges from Sistema Huautla in the form of a large spring. As it turned out, the trip was more interesting than anticipated. We had taken two rebreathers and some other diving gear for underwater photos. However, we found the visibility in the water at the spring to be better than it had ever been. We discovered that the underwater tunnel continued as a large gallery at 19 meters depth. In 1984, Noel Sloan had dived here in bad visibility and concluded that the spring could not be effectively explored. After the photos had been taken, an exploration line was laid by Bill Farr, Kenny Broad, Paul Smith, and Steve Porter. Most of these dives were on open-circuit gear originally brought along for use by the photographers, but the final and longest dive was done by Porter with a rebreather. A total of 250 meters of line was laid, and the passage continued north toward San Agustín at a depth of 17 meters below river level. This spring lies 800 meters south of the Cueva de la Peña Colorada, the site of the 1984 diving expedition. As there is no flow in the Peña Colorada system except during rainy-season floods, the active tunnel from the resurgence may completely bypass it.

Our base camp in the canyon was a pleasant, sandy beach on the banks of the Río Santo Domingo 200 meters downstream from the spring. Most of the group left two days later, when the burros arrived at the prearranged time to haul the diving equipment out of the canyon. Am Ende and Stone remained an additional day in the



Loading expedition equipment at Bill and Janet Steele's house in San Antonio. *Don Broussard.*

canyon to scale 110 meters up the north wall to gain access to a large cave that could be seen from the canyon floor about 100 meters south of Narrows Cave. It led only 120 meters into the mountain before pinching shut, but the view was spectacular and offered a revealing perspective on the Huautla spring where it merged with the Río Santo Domingo; the cave water is a dark, clear blue, and the river water a lighter turquoise. In the entrance of the cave there were laid stone walls that indicated that ancient Mazatecs had used it as a burial site. This is amazing, since we had to use modern rock-climbing equipment to gain access to this cliff cave. We named the cave Cueva Lagardo Grande after a large iguana that lived near the entrance.

On April 15, seven members of the team, including the *National Geographic* photographers, descended to Camp 3 in the Sótano de San Agustín to begin their final photo shoot of the lower cave. A day later the weather changed dramatically from hot and dusty to a torrential thunderstorm that dumped 10 centimeters of water in a single afternoon. Two days later, am Ende and Stone entered the cave with supplies that had been requested by the film team. They only reached the -660-meter level, well above Camp 3 and about a kilometer away, before being stopped by a raging whitewater river. There were 2-meter-

high standing waves where previously there had been cobbles showing in the stream bed. Stone and am Ende bivouacked just above this point, and seventeen hours later the water level still had not dropped. They retreated to the surface on the afternoon of April 19.

On Wednesday, April 20, a rescue package including food and rope was assembled. Stone and am Ende planned on entering the cave on Thursday to rig a dry bypass to the now-flooded gorge by means of a little-known route that Stone and Jim Smith had discovered in 1979 at the east end of Tommy's Borehole. However, early Wednesday night lights appeared coming up the doline toward base camp. The water-level had dropped enough for them to leave. In fact, Skiles had considered the high water a prime photo opportunity, and they had spent most of the day shooting off roll after roll of film in rare high-water conditions. They were all pleased with their results.

By this time, there had been no more rain for four days, and the locals were adamant that the storm was nothing more than a freak occurrence and not an early advent of the rainy season. We had approximately three weeks, at most, available to make another attempt at exploration beyond the San Agustín sump. Plans were formulated for placing a two-person reconnaissance team on the far side of the sump for a period of

about a week to ten days to survey what was beyond, and, with some luck, to significantly extend knowledge of the core of the plateau. This data, in the end, would determine the success or failure of the expedition. As of April 20, it appeared certain that the team going beyond the sump to set Camp 6 would be Noel Sloan and Bill Stone.

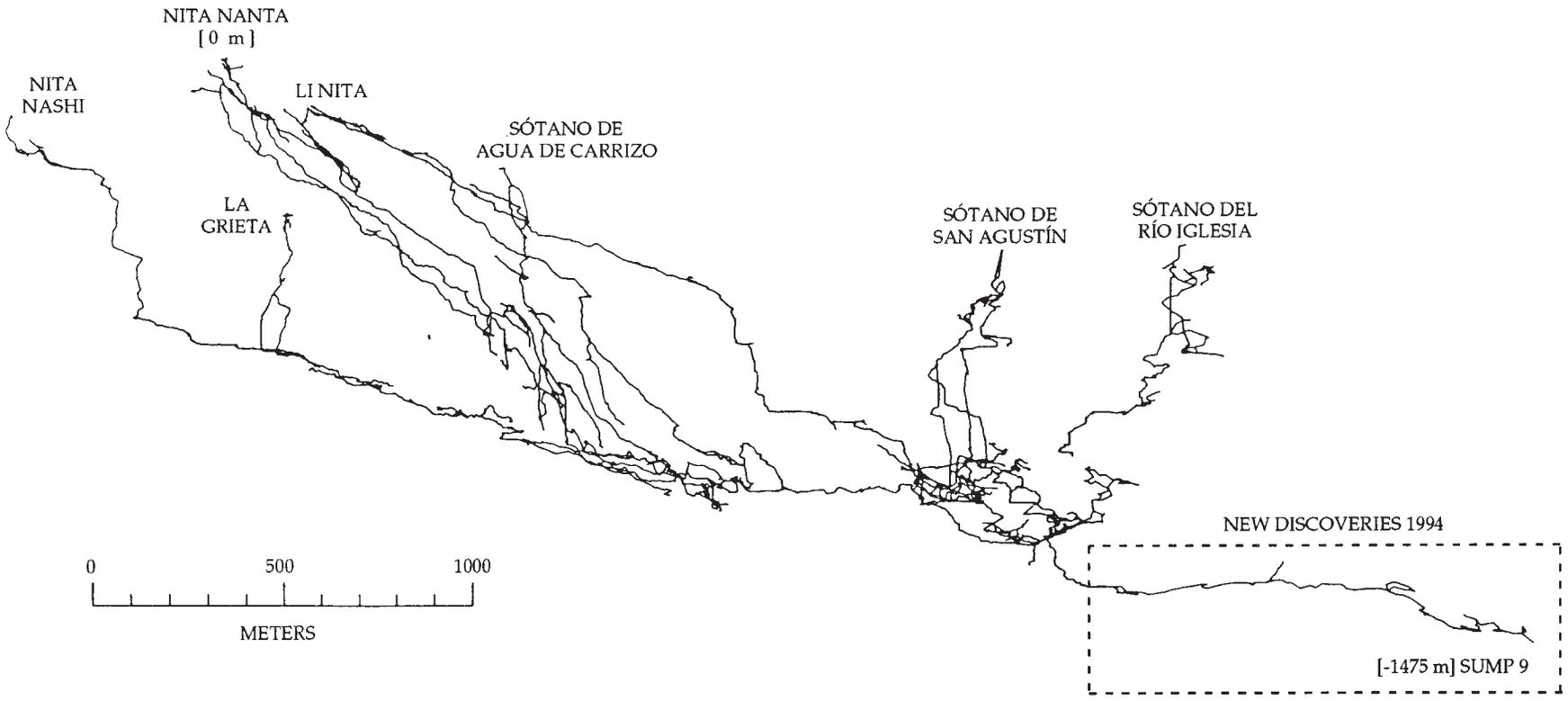
On April 23, the *National Geographic* photographers left for the United States. By this time two more members of the diving crew had also decided to leave the expedition. Both were overcome with monumental self-doubt. Kenny Broad, whose efforts had been crucial in cracking the San Agustín Sump, had never recovered from the death of his caving partner Ian. He had stayed only because the *National Geographic* people were personal friends. When they left, his enthusiasm plummeted, and within a day he was on a bus headed north. The other, Steve Porter, was also a new recruit in the last year. Both he and Broad had been to the training session in 1993, but neither had any significant expedition caving experience. Shortly after the flood, on April 19, Skiles and crew had ventured upstream to take dramatic photos of people traversing dangerous cascades. Porter slipped twice, once during the ascent and once during the retreat to Camp 3. On both occasions he disappeared into boiling plunge pools. At the second one, Noel Sloan counted to fourteen seconds before Porter reached the surface of the pool. This was a close call. From this incident and the situation with Ian Rolland, Porter's confidence collapsed. Although he stayed on with the expedition for eleven more days, his depression grew with each passing day, and he ultimately left shortly after the final push to establish Camp 6 began.

On April 26, after three supply trips to take in diving gas and other consumables, Barbara am Ende and Bill Stone descended to Camp 3 for what everyone knew would be a long stay down, the final push of the

SISTEMA HUAUTLA

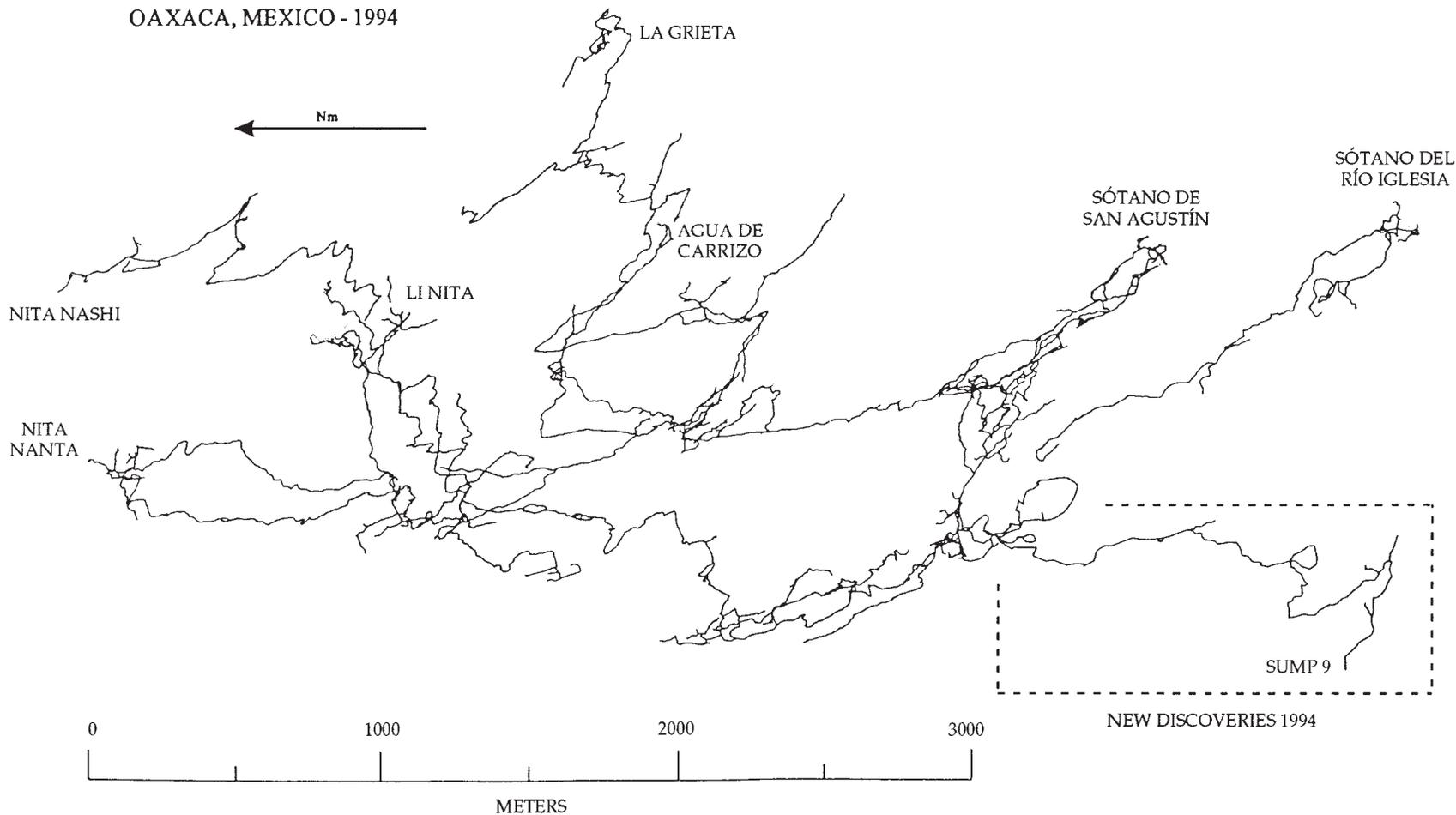
OAXACA, MEXICO - 1994

Profile rotated 135 degrees west



SISTEMA HUAUTLA

OAXACA, MEXICO - 1994



expedition. Two days later they were joined by Noel Sloan, Jim Brown, and Steve Porter during his final days on the expedition.

Stone writes: *On the evening of April 28, Barb and I returned from the first resupply trip to Camp 5, the end of our third continuous day underground. The remaining members of the team had reached Camp 3 earlier in the afternoon. Noel Sloan took me aside after dinner to say that he was having second thoughts about the dive. He was obviously torn and under a great deal of stress. He was at once worried and embarrassed. A month earlier he had personally thanked me at Camp 5 for selecting him to be on the lead team for the first push on the San Agustín sump. He knew he wanted, no, needed, to be out there at the frontier.*

I have known Noel, our expedition physician, for more than a dozen years. We had first met during training exercises in 1983 for the Peña Colorada expedition. I had been told in explicit terms by John Zumrick, the chief medical officer of the Navy Experimental Diving Unit, following a reconnaissance diving effort to the Peña Colorada in the spring of that year that "you need this man on your team." Sloan was the hyperactive, grinning, can't-get-enough-of-this lead physician for the National Cave Rescue Commission, which coordinates cave rescue and training in the United States. After completing medical school in Dallas, Texas, he was an emergency-room physician before taking residency in anesthesiology. Since then we have been on numerous expeditions together under extremely committing conditions.

Quite some time ago I had observed that there was a certain cachet to those who did well on deep-caving expeditions: the smiles on their faces grew wider the more remote and deep they got. Noel was the archetype of this image. He once left the operating room in Indianapolis on a phone call's notice, drove straight to the airport, and jetted to Oaxaca to attend to an injured caver deep in Cueva Cheve. Noel was the only other remaining member of the 1984 Peña Colorada team to have stuck it out those ten long years. In so many ways, we were on the same wavelength, he and I. Now I saw something utterly alien in him. He had a look of resignation.

There were a few character differences between Noel and me. He held great faith in his inner compass, to the extent that he

often perceived subtle signs as premonitions. He had told me after Ian's death that following the first reconnaissance dives he had a "bad feeling" that something was going to happen. Another facet of Noel's inner psyche was that he was an emotional amplifier. If things were good, or perceived to be good, then Noel became the cheerleader, pushing things forward. If things were bad, well, it would take a lot to convince Noel that things were bad. Ian's death and the flood were insufficient to shake him, and he had voted on April 3 for the expedition to continue. But he had been working daily with Porter, who had slipped into deepening depression following his near-drowning during the flood. Porter was one of two rookies (the other being Broad) who were divers first and had been drafted for the project. They had learned vertical caving on a crash-course basis. And so it was somewhat understandable that Porter was shaken by the events of the past month. It was his insistence that there was "a black cloud" over the expedition that finally began to get to Noel's subconscious belief in the superstitious. How else could one explain the events of April 24?

Under the cover of "curiosity," Noel had secretly contacted Marcos Escudero, our landlord's son, and made arrangements to travel to Río Santiago, two villages away and down towards the coastal lowlands. There, on an obscure trail leading off into the dense jungle, they met with Marcos's uncle, who was a curandero (traditional medicine man), and conducted a Mazatec spiritual curing ceremony. In a darkly lit chamber of a dirt-floored hut, the curandero cast corn, burned copal, and prayed to the god of the sierra for forgiveness and permission for the team to continue its mission safely.

Stone continues: Those of us on the team knew nothing of this until the following afternoon, when Noel asked me to come to the cook shed along with Marcos and him. He asked me to translate as Marcos recounted the events of the ceremony. Other things had transpired. The curandero had given Noel two stems of the Herb of San Pedro, one of which was to be planted at the entrance of the cave and the other carried "within the depths." Noel concluded Camp 3 would be deep enough. Marcos was insistent on this. He also said, "Each member of your team is to carry garlic on your person."

The last morning we went into the town of Huautla before the final push, Barb bought a bulb of garlic. As far as I am aware, all members of the team going deep that week had cloves of garlic in their packs. Noel had planted the herb the healer had given him at the base of the entrance shaft, within sight of daylight.

Now, at Camp 3, he informed me that he had, the evening after seeing the curandero, gone to Huautla to phone first his parents, his in-laws, then his wife. He was saying goodbye to them. This was not the Noel of ten years ago. But then, am I the Bill Stone of ten years ago?

"Noel," I said cautiously, "you don't have to make a decision just yet. Why don't you sleep on it and let's talk in the morning."

"You're right," he said, "there are a lot of weird vibes going on right now."

I mentally counted my options if Noel dropped out. Rob Parker, the young, athletic British superstar of the 1984 Peña Colorada expedition, had left immediately following Ian's death. So had Cal-Tech whiz kid Bill Farr. Tom Morris, the barrel-chested cigar-smoking biologist from Florida, had left with the film team, as had Kenny Broad, the wise-cracking professional diver turned PhD student in anthropology, who had played a pivotal role in cracking Sump 1. Brown and Porter were categorically against setting a camp beyond the sump and with each passing day were becoming more intimidated by the cave. And Ian Rolland was dead. That left two: am Ende and me.

The next morning, we descended through the Lower Gorge to the dive base at Camp 5. It was a somber journey. The endless rope drills went on mechanically, as we once again hauled heavy packs down the passage where the raging water coursed below us. My mind was occupied by other things. Two hours earlier, Noel had made his decision and had quietly informed me of it at his campsite.

"I can't do it," he said. "I've lost my edge. You've seen the crazy things I've been doing. I'm not ready to make the dive this go around."

I had been preparing myself for this. I tried to force a smile. "Will you support Barbara, then?" I asked.

"Yes," he said.

I nodded. "Will you stay as deep-level backup?" I said.

"You know that," he responded.

I needed to hear that. In the event of a more serious flood, there was the remote

possibility of a broken guideline in the sump. Someone on the upstream side, where supplies could be brought in, would have to trace it down and bridge the gap if the Camp 6 team did not return. Of those remaining at this late date, Noel was the only one who could be relied upon to do this.

That left it up to Barbara. Could she do it? Noel stopped to talk to her just outside of camp. He told her he wasn't going to do the dive. "You and Bill have been working together well as a team this whole expedition. I think you two should go," he said. She knew he was the better diver for the mission. Knowing that he would later regret not having gone, she responded, "Wait to make your final decision until we're at the sump."

This was not a simple handing off of the baton. Although am Ende was a certified cave diver and had trained extensively on the rebreather, she had no serious exploration cave-diving experience. All her underwater work had been under very controlled circumstances. Ahead lay 600 meters of biting cold, low-visibility underwater canyon that required precision buoyancy control and absolute concentration. This was no exercise. It was the real thing. Others far more experienced in diving had decided against going through.

Stone continues: *A few minutes after speaking to Noel, she came over to the cook circle where I was working on a pot of tea.*

"Let's do it," she said. "If Noel still doesn't want to do the dive when we're down at Camp 5, I'll go for it."

In a shallow pothole in the wall halfway down the 500 meters of rope leading to Camp 5, I spoke to her about the decision. Water spray boiled into the air as we leaned into the wall, ascenders clipped into the safety lines. Jet-black rock with white streaks of recrystallized calcite dived into the shaft below, where white water boiled furiously in a plunge pool. We had been down this route so many times it was like a commute to work. A bench in the park, waiting for the bus. She was at once enthusiastic over the prospect of finally getting a shot at the frontier, yet in resolute grasp of the seriousness of it. Perhaps it was this ability to focus despite enormous distractions, something we both shared as a result of our day-to-day lives as researchers, that enabled her

to cut through to the mechanics of the matter, while others had become consumed in fear. To a lay person, and to some members of the team, what we were about to do smacked of excessive danger. We did not see it that way. One critical element was am Ende's non-diving background. She had grown up exploring caves in Iowa at the age of fourteen. With twenty years of experience in all aspects of speleology, she was at home here; many of those who were most concerned about the dive had little or no experience in exploring deep vertical caves until very recently.

"I feel like I've trained for this all my life," she reflected. "I know I can do this. The line is there. I can handle the buoyancy. Can you handle the gear?"

"Yeah," I said. "It's going to be a mother of a pack. As long as we can get it neutral, I'm pretty certain I can do it."

I was relieved by this discussion. But I also knew that it placed a serious burden on me. Given her relative lack of cave-diving experience, I was going to have to be extraordinarily alert, looking for potential problems that she might run into and continuously planning the abort maneuver at each new turn, all the while carrying what would amount to an immense inertial mass suspended from my harness.

That evening, Sloan, am Ende, and Stone remained at Camp 5, while Brown and Porter, who had helped to haul some diving supplies that day, retreated to Camp 3. Two days later, after spending a day transporting equipment that was no longer needed to the 620-meter depot, they both left the cave. April 30 was to be the day that Camp 6 would be set beyond the sump.

Stone writes: *The next morning, I awoke to the roar of the falls. I swung slowly in my hammock, suspended from rock bolts 3 meters above the San Agustín sump. It was pitch black. No one had yet fired a lamp. I tried to doze, but it was useless. It was the sound. Last night I had simply been too exhausted to do much about it and had dozed*

off despite it. But now, I could feel it. That low-frequency resonance. It was like standing beside a row of big diesel locomotives that had just pushed the throttles full-forward trying to pull a mile-long haul out of the switchyard. Ear plugs were useless. It cut through everything and shook the walls. Kenny had come up with the best solution so far: Roll your balaclava six times over on itself, then yank the resulting ring of cloth down over both ears. It was not exactly comfortable, but it appeared to significantly cut the noise. It was not simply the noise that gave you the willies at this place. It was the numbing knowledge of what had transpired here, the inky cold blackness of the underwater tunnel leading off, bespeaking absolute commitment, and the subconscious knowledge that we were at the bottom of three kilometers of rope in a storm drain that, within weeks, was going to fill to the roof here and generate torrential maelstroms in the vertical shafts so powerful that there would be no escape. No one was immune to this knowledge.

Following a hot breakfast of powdered freeze-dried food and hot lemonade, we were anxious to get started on our dive. But one thing after another went wrong.

Typical dinner scene in the cook shack in San Agustín, March 1994. Left to right: Jim Brown, Noel Sloan, Ian Rolland, Barbara am Ende, Karlin Meyers, Steve Porter, Jim Smith, Ron Simmons, Don Broussard. Bill Stone.



At 11 A.M., while in the water, we discovered a leak in one of the five gas regulators in Barb's rig. It was the onboard first-stage diluent unit. It was not repairable. The dive was aborted. I then ascended nearly 300 meters vertically, three kilometers distant, up through the cave to the Camp 3 and Tommy's Borehole depots. There was one spare first-stage regulator at each location. Both were collected so that one could be taken beyond the sump as a spare. Noel set about replacing the errant regulator while I rested. The second regulator was packed as a spare unit to go beyond the sump . . . just in case. That maneuver cost us five hours.

After some considered discussion and a few hot drinks, Barb indicated she was ready for another try today. At 6 P.M. she was in the water, taking short runs down the dive line to rehearse buoyancy control, while I got into my rig on the dive deck. She returned shortly and indicated there was apparently a problem with her depth sensor. I asked her to descend to 3 meters and check it again. When she returned, she indicated that the depth display had never changed during this maneuver. I immediately realized what had happened.

During the April 8 reconnaissance dive, I had removed the "black box" computer board from Rolland's rig to take back to the surface for down-loading. The board I had replaced it with apparently required a depth-sensor calibration, and so I now set about doing that. Unfortunately, working in dim light, I connected

a high-pressure hose to the calibration port instead of the necessary low-pressure line and destroyed the sensor. The computer required a complete disassembly right there at the sump to replace the depth sensor. It was 6:45 P.M., and it was a desperate moment. Sloan was urging that the mission be aborted. Am Ende and I insisted that we exhaust all possibilities first. Fortunately, thanks to the foresight of Ian Rolland, the spare electronics kit at Camp 5 contained the necessary sensor. By 10 P.M. the rebuild was complete. The unit worked, and we were back in business.

It was, however, too late for any further work, and it was decided to spend another night at Camp 5. This led to further complications. Am Ende later wrote: The rigs were now working properly, but we had one other problem. All the gear we planned to take to the far side of the sump was packed in a giant duffel bag. Bill had packed it tightly and had carefully added lead to make it neutral before kitting up. We had to unpack the duffel to retrieve our sleeping bags for one more night at Camp 5. One of the Nalgene bottles containing our bags didn't have the lid screwed on properly and leaked! I tried crawling into the sleeping bag and drying it with my body heat, but the bag was just too wet. I was tired, cold, and soaked.

Stone continues: Barb was, by this time, sacked out and shivering in a wet sleeping bag. The Nalgene bottle had leaked when the duffel was underwater. Fortunately the second bag was dry. She

was exhausted and not happy. But who would be, sleeping in a soaked sleeping bag at Camp 5! We got her out of it and set the stove on the deck and fired it. We then took turns, with two people holding the bag upright while the other insured that the bottom opening did not directly contact the flame. It was kind of like trying to turn the bag into a hot-air balloon. During this time our one remaining lit carbide lamp waned, and so there were the three of us, standing in the dark broken only by the pale-blue flame of the butane stove suspended over the San Agustín sump. It took quite a while, but it actually worked; the bag dried out. We then let Barb hop into my hammock with the newly dry bag so that Noel and I could attempt to dry the hammock she had been in when it was wet . . . it had been that sopping wet. Noel and I were up for another half hour doing this task. We talked about old expeditions. I could sense he was returning to the "real Noel." I was glad he was here.

May 1 was unquestionably the pivotal day of the expedition. It is fair to say that a great deal of stress still existed at Camp 5. Everyone accepted the fact that those at the sump represented what was left of the diving team and that there would be no backup for those going to Camp 6. Each individual dealt with this realization differently.

Am Ende: Bill and I woke up early on the morning of the first. We sat in our hammocks in the faint glow of a carbide lamp and discussed the dive. The day before, I was really looking forward to going beyond the sump and setting Camp 6. But after the two delays in getting the rig running, a poor night's sleep, and the penetrating chill, my enthusiasm had taken a nose dive. The motivation, or perhaps more accurately the demotivating, factors were a little different for Bill and me, and there was a distinct possibility we wouldn't make the dive. But the facts of the matter were that ten years of design and construction had gone into the rebreather specifically for this project, we'd just spent three months of intense effort under very difficult conditions, and Ian died giving his all for the success of the project. Neither one of us

Noel Sloan climbing through the Washing Machine in the Lower Gorge. Don Broussard.



could throw it all away. Too much had gone into making this expedition successful. In the end, neither Bill nor I could accept defeat. We would make the dive."

Stone: The morning did not start off well. Barb was still cold from last night's stint in the wet bag. She had woken up at 4 a.m. to light the stove so we could dry out the foot of the bag, which had not gotten completely dry, and she had cold feet. We were sitting next to each other in the hammocks, much as Broad and I had been, and I said, "How do you feel?" She said, "I'm not as enthusiastic as yesterday about doing the dive." I said, "Look, if you don't feel good about it, let's abort now." She said maybe things would be better as things progressed. I was now apprehensive. I did not want to do this thing with someone who might take me down with her. I thought about this. We were talking about failure. To pack up and go home after having come so far. It burned harder than the fear of death that this place seemed to generate. In all honesty, Camp 5 should be renamed Camp Fear.

Finally, I held Barb's hand and said, "Look, let's give it one last try. If we get in the water and things are not working completely right, then we can bail out." She agreed.

In the face of this stress between am Ende and Stone, it was clear that Sloan had begun to recover from the effects of Porter's pessimism. Stone continues: Having made his decision not to dive, Noel gave 110 percent support to the operation, the kind of thing that those who knew him well normally expected of him. It felt like there was a core team again.

By late morning, both divers were in the water, and the 75-kilogram duffel bag that Stone would carry had been carefully weighted for neutral buoyancy under water. Stone continues: I double-clipped the duffel bag to my waist and chest D-rings and grabbed Noel's hand. "See you in a few days, brother," I said. He gave me a look that bespoke many years of friendship and expeditions together and said, "Come back alive." I held Barb's hand and said, "We are coming back. Abort this at any point if you don't feel good." She then held Noel's hand, and he said, "Be safe. Good luck." She then dropped under and headed down the line.

I followed then, pulling the orange

duffel. The visibility was down to 1.5 meters. She faded in and out of view ahead of me. There were several stretches through the initial large breakdown chamber where the walls disappeared from view and we were following nothing but the white parachute cord through a grey-white void. I briefly thought of Noel, Ian, Steve, and Kenny pioneering this route and was impressed. Then I was back to monitoring oxygen content, managing buoyancy, keeping the equipment bag away from the line, keeping track of gas pressures. All the while my eyes were riveted to the rearward facing display—an LED array—mounted to the back of Barb's rig. It gave off an eerie green glow. "Stay green, baby," I muttered to myself. It was telling me the oxygen content of her system. Green meant normal operation. No sweat. Line markers, which I had placed every 30 meters to mark the distance to dive base, slowly went by. The western canyon wall came back into view 400 meters in. Barb's fin grazed the wall. I could hear the fin scrape the rock. The rebreathers were functioning flawlessly. No bubbles escaped . . . and there was therefore no sound, absolute stealth. Barb's fin grazing the wall was the first thing I could recall hearing in more than a half hour. We soon began to follow the line up a huge deposit of coarse sand, and within 30 meters I spotted the mirrored surface. We arrived at Rolland Airbell.

It was quiet there. Very still. Echoes of water lapping at the walls reverberated down the 100-meter length of the big chamber. The water had risen a half-meter here during the flood, enough to cover all dry land and float an empty heliox bottle and Ian's boots off the sand bar and down the length of the lake. His footprints still remained in the sand, a mute testimony to his final passage. One cannot be here and not feel his presence.

"Is everything going OK?" I asked.

"Extremely well," she replied, "no problems with the rig. Oxygen level was on the money the entire way."

At the end of the lake, we went over our gear once more, checking gas usage. We had used less than one twelfth of our supplies to get there. The second, 170-meter sump went smoothly, and at 12:30 P.M. we surfaced at the downstream end of Sump 2. I held Barb's hand and said, "Very nicely done." I then took off my fins, while she began unclipping things in the water, and hiked my rig a good 8 meters vertically above the water

line, since my one-liter carbide bottle that I had left on the beach during the April 8 recon was now gone with the flood. Next I got Barb undone and carried the two Acurex bailouts, while she hiked up. Last came the orange duffel. I cut loose the ropes and gave those to Barb. We then unpacked it and took camp gear down the tunnel, after firing two carbide cap lamps. Up beyond the Sump 3 bypass we found a nice flat, sandy spot on the east wall just big enough for two and established Camp 6 there. We laid out the wetsuits inside four trash bags and checked to see that the stove worked; we had been concerned that the fuel canisters might flood at 28 meters underwater.

Camp 6 was set up 14 meters above and 250 meters south of Sump 2. There were sufficient provisions there for a stay of approximately one week.

Stone continues: Late in the afternoon of May 1, after three and one half months, we finally got to the business of this expedition: charting new territory. After unpacking the survey gear, we excitedly began the Beyoncé San Agustín survey. We had not shot ten survey stations before things went to hell in a hand basket. Barb had removed the diving helmet she was also using for dry caving to readjust the uncomfortable suspension. The bracket holding the lamp onto her helmet was loose, and the lamp suddenly fell off, bouncing into a crack between the rocks. "I think we have a problem here," she called out.

Using my backup electric light, I could see it at the bottom of the crack, more than 3 meters down, but there was no way to reach it. "This is not good," I said, wishing now that we had not decided to leave our big Petzl generators back at Camp 5. They would not have fallen into some godforsaken crack in the breakdown! But space in the duffel bag was at a premium, and using cap lamps meant we could carry less carbide.

As I attempted to lasso her lamp with the survey tape, Barb took my lamp apart to dry out the felt, which was still damp from the dive. During the reassembly, the cap, spring, and flint of the striker assembly flew off into another deep crack in the rocks. I was not pleased. Within a half hour our whole effort may have been scuttled. This was serious business. We each had two backup electric lights with three hours each of burn time. The remainder of the electrics (three each) had been carefully reserved for the return dive.

Some Key Locations in the 1994 Expedition

Site	Depth ¹ (meters)	Depth ² (meters)	Distance ³ (meters)	Days Used	Comment
Camp 1B	430	894	1236	2	derigging camp
Camp 2B	620	1094	1532	5	rigging and derigging camp
Camp 3	725	1174	2735	41	staging base for sump
Camp 5	840	1325	3485	11	dive base
Camp 6	830	1314	4320	6	advance base beyond Sump 2
Sump 9	990	1475	6080		limit of exploration 1994

1. Depth relative to Sótano de San Agustín entrance.
2. Depth relative to Sistema Huautla datum (Nita Nanta entrance).
3. Traverse distance from nearest (San Agustín) entrance.

They wouldn't do us any good, anyway, for in order to explore we needed a week's worth of light for two people. The only thing efficient enough to do that, even in 1994, is an old-fashioned carbide lamp. Just six liters of calcium carbide gravel was enough. A handful of that, plus an equal amount of water, dripped in slowly, and voilà . . . acetylene gas for three hours. Very bright when it burns in front of a polished reflector. The trick is, you have to light it. Although we had a spare lamp in camp, its single flint-wheel striker now represented the only way we had of firing the two remaining lamps . . . and our cook stove. A "flameout" several hours from camp could easily have left us in permanent darkness. We simply could not go on exploring under such circumstances.

"I'm sorry I screwed up," Barb said, genuinely distressed. "I didn't do it on purpose." I could tell she was groping for words, knowing I was so concerned over the matter.

"It happens," I said, and went back to fishing for the lamp. We moved several immense boulders en route to the lamp; I would pull on a rope that we tied around each rock as Barb pushed with both her feet. Once all the movable rocks were gone, I tried fishing for the lamp again. Finally, after an hour of trying, I caught the reflector with a knot in a piece of parachute cord and gingerly pulled it up, centimeter by centimeter, until I could safely grab it with the other hand. It was 7 P.M., and there was indescribable relief.

"We need to put these lamps on leashes," I said. Barb sorted out some parachute cord, originally used to strap our climbing rope to the duffel bag. She handed me several lengths of cord. We tied both lamps on 1-meter lanyards attached to our helmets, and we were back in business.

After a break at Camp 6 to munch on some trail mix, we continued to survey the cavern beyond for a few hours. Neither of us was ready for sleep yet. It was exhilarating to be there. We chose to follow the ascending borehole to the south that I had declined to investigate on April 8. It shot up steeply and continued 120 meters before abruptly stopping. The passage was so quiet that we named it the Silent Borehole.

Back at Camp 6, we had some freeze-dried dinner, then sacked out, using our fleece jump suits for pillows. Despite its minimal comforts, Camp 6 was warmer and much quieter than the dive platform had been last night. It had been a roller coaster of a day.

May 2 was the first full day of exploration based from Camp 6. Stone's log continues: We were up at 7 A.M. and hastily ate a large cup of hot oatmeal while sorting equipment. Despite the limitations of the orange duffel, we were well equipped with rope and rigging hardware. I was looking forward to exploring areas I saw briefly during my initial exploration on April 8. Would we discover any large shafts? Or just

more sumps? We were, for the first time in eight days, not burdened by diving equipment. The rebreathers remained stored on their ledge high above Sump 2. Given our remoteness and lack of backup, we made a conscious decision to do no further diving. One simply had to envision an irreplaceable component on one of the rigs being damaged during transport to know where to draw the line on safety. As it stood, our life-support lines to known territory were solid and conservative. We had only used a tenth of our consumable diving resources to reach Camp 6.

As to what lay ahead, well, that was going to be a roll of the dice. I had the good fortune of discovering a large, dry tunnel on April 8 that had bypassed Sump 3, where the river again dove under a vertical wall of limestone. Camp 6 had been set in this bypass. Three hundred meters farther on, the river reappeared, but just as quickly emptied into a deep green headpool marking the beginning of Sump 4. It was there I had turned around. There was no geological guarantee that another bypass would exist. All I could recall was seeing what appeared to be a dark alcove near the ceiling, 10 meters above the sump.

We hiked back to the pool at Sump 4. Hoping to find a way around the sump, I climbed up into the alcove. It was more than a little unnerving to find a Snickers candy-bar wrapper stuck to the wall 5 meters above the water level. The only way it could have gotten there

was during the flood on April 16.

I continued upward just far enough and then yelled to Barb, "Yes!" A small tunnel of clean-scoured bedrock led south. A hundred meters farther, the passage dropped down again. Success! I went back to lower a rope for Barb, who was carrying the duffel. At the southern end, I rigged a 15-meter rope down into what appeared to be Sump 5. Its green water was very deep and covered the entire floor of the tunnel. We searched along the east wall and found a steeply ascending ledge system. I scaled the wall 12 meters up to the roof and found a continuation of the upper stream-scoured conduit.

The new tunnel led to what appeared to be yet another sump. We stepped across a large opening in the floor that dropped 20 meters to the water. Ahead, we found a climb down to the apex of a pinnacle of pitted bedrock towering 12 meters above the water. The expanse of black, still water extending in all directions appeared even more ominous than the last sump. Anything this big and filled with water seemed unlikely to continue in dry passage.

We climbed down to the base of the pinnacle. The water extended off in four distinct directions, and there was no question that we had to swim. I took this in, rotating in a complete circle, searching, hoping I'd missed something obvious. "Welcome to Four Corners Sump," I concluded. Barb looked hard. "Whoa. This does not look good." We were both wearing only our fleece jumpsuits. This was going to be a cold swim.

I got the honor of the first dip. I swam 40 meters though the chilling water to discover that the southeast branch was a no go. The northeast one similarly ended in a flowstone-decorated chamber; the branch to the northwest led to what apparently was the downstream side of Sump 5. That left the southwest branch—the longest, deepest-looking passage.

I took a deep breath and swam like mad. Twenty-five meters later, I was happy to see the water getting shallow enough for me to walk out. Ahead, it became clear that this was no sump. The low ceiling had restricted our view from our perch on the pinnacle. I ran down 100 meters of gravel flats to where the tunnel, already 15 meters wide, expanded into blackness. I let out several war yells. The echoes carried off until they were drowned out by the soft rush of water in the distance. What we had seen before

was a measure of success. But this, this was victory! This was the open road, headed south to the resurgence. Only later, with survey data in hand, did we learn just how vast an open space we were about to enter, where walls stood separated by a gravity-defying span of 180 meters and the ceiling arched up out of sight in blackness. Barb quickly followed, and soon we were climbing down through huge, polished boulders, some 12 meters across. We heard the roar of the river below. We named this place Perseverance Hall, so hard won was this prize. The prediction that there would be large caverns beyond the sump had been borne out.

To the east I spotted a 10-meter tall stalagmite, standing like a citadel. Up beyond it was a high ledge leading out of sight. With a small, intense flashlight, I could see the chamber focusing far below into a funnel. The floor was littered with huge, rounded breakdown blocks. At first I thought these might fill the lower portion of the chamber to the ceiling and block progress. When we got there, however, we discovered a hole in the floor between the boulders. Two rock bolts later, we had a rope rigged, and we rappelled 12 meters to the bedrock floor. Ahead was the continuation of the river passage beneath the floor of Perseverance Hall.

Several hundred meters later, we hit a series of three long lakes. The first two were only waist-deep near the walls. The last one appeared to have no exit. It looked like a sump. But there was something odd about it. It was difficult to be sure, since the place where the ceiling came down was 30 meters distant down the lake. There was this small horizontal slit about a meter wide where the ceiling came to within 20 centimeters of the water. Maybe it was only a reflection. But then again, it could be airspace, a possible route on. Both of us were cold, and we were looking at a lot of survey distance to cover on our return trip. We declined the swim and broke out the instruments and tape. It was a slow, wet, cold retreat as Barb read off the numbers and I sketched what we had seen.

Eight hours later we abandoned the survey due to fatigue and retreated to Camp 6 at 12:15 A.M. We ate big cups of freeze-dried stroganoff. Barb had thoughtfully packed spices in the top of this freeze-dry bottle, so we had cayenne and seasoned salt, too. Nice. As I faded off to sleep, the day's events went through my

mind: three sumps that appeared to be dead ends turned out to have back doors, a giant cavern, and three large lakes, all heading south toward the resurgence. It was the best sleep I'd had in weeks. The following day, May 3, we took it easy and closed the survey between the Silent Borehole and Four Corners Sump.

Without question, May 4 was the most memorable day of the expedition. Am Ende and Stone got off to an early start with the intention of making a final investigation of the lake where they had previously stopped. They had no great expectations that this would be anything other than the final sump that would stop progress. It took two and a half hours of fast hiking to get there. Stone continues: We left in our wetsuit bottoms and carried the remainder of the 7-millimeter rope, the Ikelite strobe and Pentax camera with two rolls of film. I also had a 2-liter bottle with most of our remaining trail mix and about 1.3 liters of carbide, which we seemed to use much more rapidly today. Been only getting 1.5-hour burns, probably because you can't see anything without a near blow-out flame. Damn big passage we have found. We were quite hot by Four Corners Sump, and so the swim was not particularly bothersome, the way it had been when we were only in our underwear. By 10 A.M., we were at the low-air-space lake.

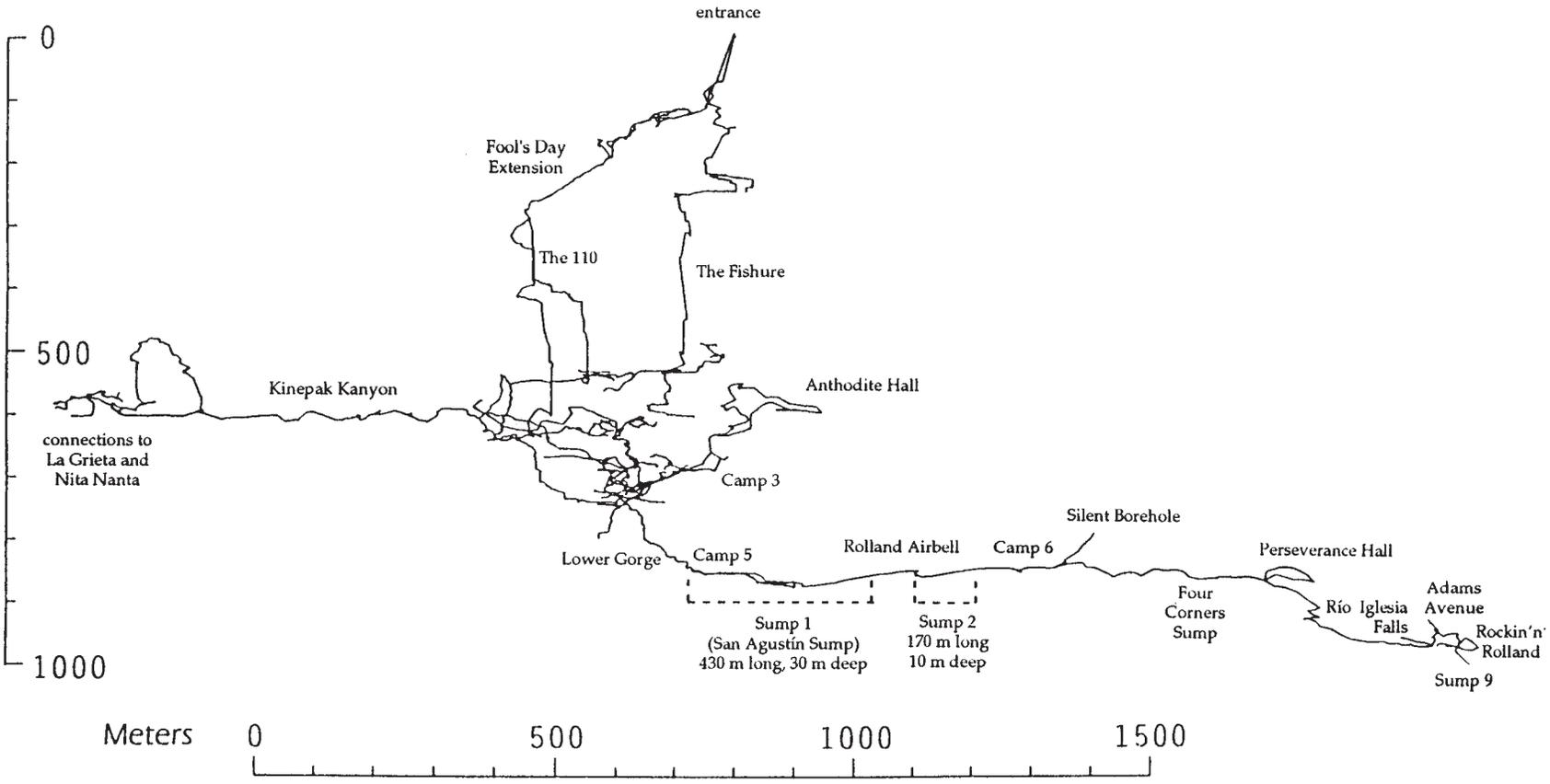
Barb was feeling quite spunky today. She swam out into the lake and disappeared under the roof with barely enough room above the water for her head. She took with her the free end of a 65-meter rope. According to our plan, she was to give it two or more hard tugs when she was ready to return. Then I would hold the line as she pulled herself back. Ten minutes passed. Then twenty. Nothing. I was just about to jump into the water to look for her when I finally felt the pulls. Soon reflections of her lamp appeared on the water.

On the far side of this lake, 60 meters distant, I installed a bolt in the rock to anchor the rope. If a flood should occur while we were exploring ahead, that would have been our lifeline back to Camp 6. We would, in theory, be able to pull ourselves through that short piece of what would then be underwater tunnel at the middle of the lake. While I was doing that, Barb took off into the distance to see if the

SÓTANO DE SAN AGUSTÍN

Oaxaca, México

Profile Rotated 240 Degrees East of Magnetic North



passage continued. I became concerned when I hadn't heard from her for a few minutes and gave a shout. She returned the shout and came back a little while later. "Do you want the good news or the bad?" she asked.

"Uh-oh, give me the good news," I said.

"The stream continues beyond the next lake, where it's dammed up by some boulders."

"That's the good news?"

"No, it gets better. About a hundred meters beyond the boulder field is a huge river coming in from the left. It must turn four times the flow of this one!"

"Río Iglesia!" I said.

"Yeah."

The Río Iglesia was lost by Ian Drummond, Peter Thompson, Mike Boon, and the Canadians in 1967 at -300 meters in the Sótano del Río Iglesia, what was then the deepest cave in the Western Hemisphere. The river filtered down into the boulder-strewn floor of the impressive Penthouse chamber, never to be seen again. Several dedicated efforts in later years had failed to follow it.

Stone continues: In 1968, John Fish, karst hydrogeologist and leader of the joint Canadian-American expedition that reached -612 meters in Sótano de San Agustín, wrote of the goal of their project: to get deep enough to access the "Main Drain," the master subterranean river in the Huautla Plateau. Of course, they never did reach it. And now, before Barb and me, with Fish's words echoing in my head, was the fabled river junction, the Main Drain. The flow in the confluence looked very close to what I had seen at the resurgence spring at the beginning of April. So we had found it at last.

"Okay, what's the bad news?" I asked Barb.

"You really want to know?"

"Shoot."

"Just beyond the river confluence, the passage sumps out. There's no way to get around it. I swam the whole perimeter. Looks like the end of the road.

I was not yet ready to buy that answer. We swam together to the confluence, a T intersection. Downstream, to the right, there was no question regarding the sump. Upstream, however, was a different story. The Río Iglesia gallery was so large we had to survey it. After 80 meters, we felt mist on our faces and heard a rumbling up ahead. Another 40 meters later, we

came upon a deafening waterfall—with-out question the largest amount of falling water I have ever seen underground. The passage we had been following ended at a sheer, vertical wall. There, 12 meters straight up, was a 6-meter-high by 6-meter-wide rectangular passage with an enormous river arcing out into space. We named it Río Falls.

I set a bolt here for a permanent survey marker. Some day, some way, someone was going to come down that shaft and find the bolt. Meanwhile, we began the survey out. We stopped after only five stations where the passage took an abrupt turn to the west. I had given a cursory glance at the southern corner on the way in, noting that there might be a fissure there. I told Barb to take a break while I investigated. Soon I realized it was a real passage headed south. But it was also filled with boulders. I called for Barb to come in and help find a route through.

The passage was going up. I soon broke out into a 5-meter-wide canyon and could hear the Río Iglesia falls in the distance. We had spotted a passage near the top of the south side, but had considered it inaccessible, given the volume of water. This must be it. Meanwhile, Barb was making progress going up and to the west. She soon came back saying she had climbed up some 30 meters through the breakdown and broken into a large room at roof level. We went that way, without pack and carbide, which for her was of concern since here lamp leaked water badly. I didn't realize just how big it was until much later, and also that it was not a room but rather an immense passage with a particular direction. (Survey data later showed that Adams Avenue was 50 meters wide, 363 meters long, and 15 meters tall.) Given the thousands of tons of dirt deposited here, it became apparent where the soil that had been eroded from hundreds of years of intense farming on the 45-degree slopes of the Río Iglesia dolina had ultimately ended up.

Barb quickly descended to the low point and followed the obvious drainage to the south. It ended in a smaller, meter-wide passage that eventually dumped into a miserable, muddy boulder crawl. No wind, no water, no go. Back at the main chamber, we agreed it should be mapped and that we needed to get the pack. However, I noted a blackness off to the west side and told her I would scout around that direction and meet her back at the breakdown. Very low at first, almost like

playing tricks on my ears, I heard the low rumbling roar. The mud passage continued, descending now at 20 meters width. The roar got louder, and within 100 meters I broke out into a 20-meter-wide, clean, cobble arroyo. In another 100 meters, I was back at the main drain river, beyond the sump! In the distance, across a 25-meter lake, I could see an immense boulder field. I went back to Barb with the news. We picked up the pack and ropes, and within an hour we were surveying into this new tunnel.

It rose gradually on the other side of the lake in a 40-meter cobble pile that continued several hundred meters. The river, strangely, had disappeared, no doubt filtering under this pile. While I caught up on the sketch, Barb again bolted ahead. She returned, excited, indicating there was a vast void ahead. Her exact words were, "It gets really big over the next rise." "You don't call this big?" I said as I waved my arms across the passage. She laughed. "You don't understand," she continued. "I mean it gets HUMONGOUS!"

Soon enough we crested the cobble-field rise and were looking at an immense funnel going down, perhaps 100 meters across, but the far walls were only guesses, even with our krypton dive lights. Within 100 meters, we surveyed down to the edge of what, from above, first appeared to be the blackness of a lower tunnel. But then we realized it was a lake. A big lake. Only when I reached Barb's final survey station did I see its full extent. It was at least 25 meters across to the far wall and quite likely twice that in length. There were steep (30-degree) sand piles coming down to it from all sides except the south and west walls, which were 40-meter sheer buttresses rising up into the gloom.

Later it occurred to me, given the survey, that this was no lake, but rather the Mother of All Sumps, and that this immense cobble tunnel just continued down right there, underwater. Sump 9. Rats! While I caught up the sketch, Barb climbed up to the right (north) side of the tunnel to what appeared to be an incoming tunnel 30 to 50 meters higher up. The ceiling was well over that, but the feel of this place was one of simply a big funnel where the main, immense passage bored into the super sump. Barb found a small incoming dome to the northwest. By this time I had also climbed up and could see a shelf to the northeast. There she found a continuing tunnel 4 meters high by 2.5 meters wide heading east-northeast. She



thought she felt airflow. Given its small size and heading, we abandoned it in favor of searching the south side of the big passage, which we later named 'Rockin' n Rolland in honor of Ian.

Until this moment, we had resisted thinking about the remoteness of this place. But now, as we searched for ways to continue along the north side of the funnel, we found little bits of man-made debris, including lollipop sticks and a toothbrush, that reminded us of the world above. Ripple marks in the sandy floor, moreover, warned us that the clock was still ticking for the onset of the rainy season, when the rush of the subterranean river formed a whirlpool where we stood. I imagined a 100-meter-wide vortex, like a watery black hole, sucking everything deep into the earth—and I felt humble.

While Barb rested, I traced the south wall from the point where the rushing stream sank to the funnel. No joy. We had resigned ourselves to surveying out, when I spotted a fissure 10 meters above the sump where the water sank. It looked like you could get to it via an extended overhang ledge that came within 2 meters of the floor. Took a bolt to get up there, and another for a belay anchor as I ran the 9-millimeter through my jumars. Very muddy, and it did not go. I burned nearly two hours up there, so desperate were we for a bypass. Around 8 P.M., we began surveying up into Adams Avenue, and I began thinking about how this whole pas-

sage was south of the main drain. Before heading back down the breakdown crawl, I wanted one last look at the southeast side (at the time I thought it was the southwest side). It led 120 meters to a breakdown and mud-floored end some 30 meters above the main level of the tunnel. Lacking any further prospects, we surveyed out from there back to the Río Iglesia and then upstream into San Agustín. Had to shoot the low airspace in two shots with Barb in the middle on each shot. She was a real trooper about it.

We then, with what energy we could muster at 3 A.M., headed out. At the formations at the top of Perseverance Hall, I looked up at the vast upper level, then over at Barb and said, "How masochistic are you feeling?" She had this glazed look over her eyes that indicated she was "on automatic." Nonetheless, we were soon shooting a perimeter survey up into the chamber. This took another two hours, and it was a gloomy, muddy time up there. Unlike the scoured active stream canyon, this appendage had more in common with Adams Avenue, with deep dirt deposits covering the massive breakdown slabs. There did appear to be a substantial passage down in a deep sink collapse on the southeast side of the chamber, a good 8 meters wide and 10 meters tall, but neither of us felt like going down to check it. We had been out nearly 22 hours at this point and staggered home. My wetsuit, as of the last seven hours, had acquired a massive rip in the butt, and

Dinner in Camp 3, San Agustín, March 26, 1994. Left to right: Jim Brown, Ian Rolland, Kenny Broad, Steve Porter. Bill Stone.

the swims had been cold. We arrived in Camp 6 around 5:45 A.M.

Sump 9 represented the limit of exploration in 1994 and the most remote point yet reached by speleologists inside the Huautla Plateau. It had been estimated that at least two weeks would be required to derig the cave. It was also likely that the rainy season would arrive by the third week of May. Because of this, it had been agreed with Sloan that the team would return to Camp 5 no later than May 7. Stone and am Ende slept most of May 5. Considering that it was already late in the evening when they awoke, a decision was made to retreat to Camp 5 the following morning, rather than attempt further exploration beyond Camp 6. Several leads, such as the one in Perseverance Hall, remained, but all were located well above the limit of exploration.

Stone's log from Camp 6 continues: On Friday, May 6, after six days at Camp 6, we began packing up our equipment. We finished off the last of the instant oatmeal. Before she had entered the cave, Barb had packed most of the bottle of oatmeal with fruit flavors, but included

a bag of maple. At that time she had thought Noel was going to do the dive, and she knew maple was his favorite flavor. But here we were just the two of us. Since she loathed maple, I volunteered to have it for breakfast. After wolfing down four ounces of the stuff, I had to agree. "Barb, you're right. This stuff tastes like glue." It made me stop and think. "Noel should have been here."

She responded, "Ian should have been here." I silently nodded. They both should have.

We suited up for our return dive through the first two sumps. It took us nearly an hour and a half to do all the pre-dive checks and to get into the rigs and our bailout equipment. Everything went well until we were in the water and just about to submerge. Normal procedure at this stage is to go into the menu system on the rebreather's onboard computer and tell it to start the dive. Actually, it automatically starts at a depth of 1.5 meters, but for safety reasons we do it manually, in order to verify that all systems are working correctly prior to going underwater. Due to the substantial abuse we had given these rigs in their transport to Sump 1, the cable leading to the main display on my rig had unscrewed, and a few drops of water had gotten into the display. These water droplets were enough to cause the computer to fail, and the display went blank. Given the effort of kitting up, I cursed this turn of events. Then I relaxed and broke into a grin. The computer on the MK4 actually consists of three separate units, each of which can run the system automatically. I flipped up the head-up display, and the remainder of the electronics were working properly. We began the dive, and the system took over automatically at 1.5 meters as expected. I never had to deal with it for the remainder of the trip.

The final trip through Sump 1 was surrealistic. The visibility, due to a long stretch of dry weather on the surface, was the best it had ever been, about 15 meters. With Barbara in the lead, I could, for the first time, see the entire dimensions of the corridor. It was a solitary canyon, 6 meters in width by 10 meters high with a sand floor. The whole voyage was totally silent. The rebreathers were working flawlessly, so there were no bubbles, and therefore there was no noise. It was about as close to being in space as I can imagine. After sixty minutes we safely surfaced at Camp 5. We had shot

four rolls of film and surveyed 3.3 kilometers of virgin tunnel beyond the San Agustín Sump. This and our written personal logs all fit into a single two-liter bottle. I later reflected that this was pretty amazing: four months of back-breaking effort had been distilled into this bottle, the product of our sweat. But we had done it. We had *DONE IT!*

Arriving back at Camp 5 was, of course, not the end of the trip. For the following seven days the team worked ten hours a day hauling equipment and rope upward. At Camp 3 they found Noel Sloan and Don Broussard. Stone continues: It took until 8:30 P.M. to return to Camp 3. We didn't expect anyone to be there, but when I saw lights ahead I gave a hoot. Noel hurried down to greet us. I extended my hand, but instead he gave me a big hug. "I can't begin to tell you how relieved I am to see you," he said. Then he gave Barbara a hug, too. Everyone was smiling. "Well?" he said.

"We did OK man. Welcome to the deepest cave in Mexico," I said, after which we eagerly related the story to both him and Don. The two of them had been manning Camp 3 alone for the past week, hauling equipment that was no longer needed to points higher in the cave.

It was an emotional reunion. At that instant, we no longer felt remote. In the past, Camp 3 had been considered extremely distant from the surface, and perhaps it still was. The National Geographic film team was constantly concerned about being there. They were always worried about whether they would be able to climb out. But compared to Sump 9, it was like being in your living room. Like being home.

These four, Broussard, Sloan, am Ende, and Stone, carried out the deep-level derigging of the cave alone for the following five days. On May 12, help arrived from the surface in the form of Jim Brown and Bev Shade. With a team of six, the derig continued. Camp was successively moved to points higher in the cave, first to the -620-meter level (Camp 2B), then to the -430-meter level (Camp 1B) at the base of the longest shaft in the cave, a 110-meter sheer drop. Problems were developing, however. Both Sloan and Stone had developed staph infections on several fingers of each hand due to constant hauling with

wet gloves with ground-in fine silt and sand. It got to the point where they could no longer sleep at night, so penetrating and continuous was the pain. Others had severe chafe from working in their harnesses all day. Upon reaching the top of the 110 Meter Shaft, a decision was made to rest for several days on the surface.

Stone's log continues: *After eighteen days underground, we left the cave in the dark to the sound of a thunderstorm. I could smell the vegetation, and I could hear the rain hundreds of meters before I got to it. When I reached the field house, my first act was not to go for some cherished food stuffs—the subject of constant conversation in the camps, since we were now down to a monotonous diet of nothing but powdered freeze-dried chicken stew—but to scrub my hands and fingers in warm, soapy water.*

Others, including Sergio Zambrano and Angel Soto, joined the team at San Agustín base camp. During the course of the following week, three further trips were made to derig the cave. On Tuesday, May 17, some twenty-three packs were hoisted up the 110 Meter Shaft and then transported up five additional pitches to the -280-meter level during a fifteen-hour trip. On May 19, all equipment was transported to the base of the entrance shaft during a twelve-hour trip. On Saturday, May 21, a tyrolean bridge was rigged at the entrance, and the loads were sent up the diagonal line on pulleys. Arrangements were made with the local villagers to haul the equipment from the entrance to base camp. This was not an inconsequential task, since the entrance to Sótano de San Agustín lies nearly a kilometer away and 120 meters vertically below camp.

On May 22, a press conference was held in Huautla de Jiménez. The United States contingent of the expedition returned to the United States on May 25.

The survey data from beyond the San Agustín Sump have now been processed. As a result, the geography of the known cave has changed dramatically. The new tunnels clearly demonstrate the presence of a large river passage leading south and west from Sistema Huautla in the direction of the Cueva de la Peña Colorada.

The length of Sistema Huautla has increased by 3.3 kilometers to 56 kilometers.

When the final depth of the cave was determined, there was considerable surprise. There had been some speculation that Sistema Huautla might barely surpass Sistema Cheve to become the deepest cave in Mexico. But we had significantly underestimated how far we had descended in Perseverance Hall. The new depth, 1475 meters, moved Sistema Huautla from twelfth in the world to fifth. The table shows a list of the ten deepest caves in the world as of August 1994. These numbers say little concerning the relative effort that was involved in the 1994 expedition to San Agustín. The limit of Sistema Huautla is now at an immense unexplored underwater tunnel, Sump 9, a point that may be considered the most remote yet reached inside the earth.

As with any claim to a superlative, one must qualify what is meant by "remote" in the context of cave exploration. One might be tempted to equate remoteness with distance from the nearest entrance. Under this definition, the -1386-meter sump in Sistema Cheve, Oaxaca, at nine kilometers from the entrance, would surpass Huautla, since Sump 9 in Huautla is only slightly more than six kilometers from the entrance to Sótano de San Agustín. However, as at any frontier, one must consider

physical effort, the level of enabling technology required, and the degree of psychological commitment needed in order to extend that frontier. It is the presence of 655 meters of underwater tunnels at the -1353-meter level and the significantly more serious rigging requirements in Sistema Huautla, with more than three kilometers of rope rigged in 1994, that place a journey to Sump 9 in a class by itself.

By comparison, the most remote points in the Jean Bernard, Panjukhina, and Lamprechtsofen can all be reached on a three-week expedition. Over the coming years, many will visit the -1602-meter sump in the Reseau Jean Bernard and the -1386-meter sump in Sistema Cheve. It is highly unlikely that human eyes will again set sight on Sump 9 in Sistema Huautla within the next decade.

Another measure of the energy involved in reaching Sump 9 is the number of days spent working in complete darkness. After many days of rigging and gear hauling based in surface camp, there were four major underground efforts in 1994, of sixteen, six, four, and eighteen days. These accounted for forty-four days spent in total darkness in deep subterranean camps located at five different sites in Sótano de San Agustín; see the table. On many occasions, several camps were occupied simultaneously by different elements of the team.

This has been a tremendous odyssey for all of us. For many, it was the culmination of a ten-year mission that dominated our lives. Like many things in real life, the ending was not black or white. The success that was achieved, the cracking of the San Agustín sump, one of the most formidable challenges in speleological history, was hard won. Although we did not reach the ultimate goal of the world's deepest cave, there is strong satisfaction in the knowledge that the limits of human endeavor were pushed further and harder on this expedition than ever before, and that the challenge still continues deep inside that remote plateau. More than three kilometers of galleries that led into completely unknown territory south of Sistema Huautla were explored on this expedition. In the process, several of the largest chambers and tunnels beneath the Huautla Plateau were first entered by humans.

But the price of our progress was high. Two members of the original team that began formal training for the project in 1992, Rolf Adams of Australia and Ian Rolland of Scotland, both young, vital, intelligent, and driven men, perished in accidents related to the expedition. The exploration frontier, as it was five hundred years ago, is an unforgiving place. All of us accepted that risk for the sake of the reward of going where no one has gone before, a privilege

World's Ten Deepest Caves, August 1994

Rank	Name	Country	Depth (meters)	Length (meters)
1	Reseau Jean Bernard	France	1602	17,900
2	Gouffre Mirollda	France	1520	9,000
3	Shakta Vjacheslav Panjukhina	Georgia	1508	4,000
4	Lamprechtsofen	Austria	1483	14,657
5	Sistema Huautla	Mexico	1475	55,953
6	Sistema del Trave	Spain	1441	7,300
7	Boj-Bulok	Uzbekistan	1415	15,000
8	Laminako Ateak (BU56)	Spain	1408	11,893
9	Sistema Cheve	Mexico	1386	22,499
10	Sniezhnaja-Mezhonnogo	Georgia	1370	19,000

known to but a handful of individuals in our age. As explorers have done for millennia, we took the prerogative of naming new territory in honor of fallen friends. Rolland Airbell and the two largest single passages yet discovered beneath the Huautla Plateau, Adams Avenue and Rockin' 'n Rolland, will be landmarks for future explorers.

Personnel

Personnel requirements on a project such as this are complex. The focus of the project was on diving the San Agustin sump. The dive-team members were fully certified cave divers who were specialized in the use of rebreathers. However, it must be emphasized that the actual time spent diving was only a small fraction of the time spent underground. Most of the effort involved the transport of supplies and equipment. This left open the opportunity to involve additional people with expertise in vertical rope techniques and a desire to see the goals of the expedition accomplished. One of the non-diving members attended most of the expedition with the intention of hauling gear or whatever else was necessary. Most other non-divers were cavers

who were in the area to work on other projects and stopped in briefly to be of assistance on just one or two trips.

It should be noted that this was an especially difficult project. The duration was much longer than most people could find the time or enthusiasm for. Of all the personnel associated with the project, only four were present for the entire duration.

The expedition was led by Bill Stone. It was coordinated by Bill Stone and Barbara am Ende in the United States, Sergio Zambrano and Angel Soto in Mexico, and Ian Rolland in Scotland.

Dive Team

Barbara am Ende (USA)
 Kenny Broad (USA)
 James Brown (USA)
 Bill Farr (USA)
 Rob Parker (UK)
 Steve Porter (USA)
 Ian Rolland (UK)
 Noel Sloan (USA)
 Angel Soto (Mexico)
 Bill Stone (USA)
 Sergio Zambrano (Mexico)

Support Team

Dick Ballentine (UK)
 Don Broussard (USA)
 Harry Burgess (USA)

Leonardo Altamirano Casimiro (Mexico)
 Mike Cicheski (USA)
 Don Coons (USA)
 Renato Garcia Durantes (Mexico)
 Jaime Escudero (Mexico)
 Tony Finnegan (UK)
 Pete Hall (UK)
 Joe Ivy (USA)
 Pat Kambesis (USA)
 Ted Lee (USA)
 Mike Madden (UK)
 Karlin Meyers (USA)
 Don Morley (USA)
 Matt Oliphant (USA)
 John Palmer (UK)
 Nancy Pistole (USA)
 Bev Shade (USA)
 Chris Sobin (USA)
 Shirly Sotona (USA)
 Carleton Spears (USA)
 Rick Stanton (UK)
 Bill Steele (USA)
 John Thorpe (UK)
 Alex Wade (UK)
 Pete Ward (UK)
 Yvo Wiedman (Germany)
 Paul Whybro (UK)
 NGS Photo Team
 Neal Messler
 Tom Morris
 Wes Skiles
 Paul Smith
 James York



The Camp 5 dive platform suspended about the water at Sump 1, San Agustín. The camp platform is above.
 Don Broussard.

Camp 6 Supplies

The duffel bag going through the sumps to Camp 6 contained the following items.

6 liters calcium carbide
 three carbide cap lamps
 two sleeping bags (in 4-liter Nalgene bottles)
 complete vertical gear for two
 bolt kit with twelve sets, and hammer
 Suunto dive computer and compass for underwater surveying
 30-meter Keson survey tape
 two sets Suunto surveying instruments
 one Pentax waterproof camera
 one Ikelite 225 strobe and slave
 one pot, one stove, three isobutane cans, two used MRE wrappers for a pot lid, two cups, two spoons
 one 2-liter bottle with two rolls of toilet paper and six trash bags (for putting wetsuits in for sleeping pads)
 80 meters of 8-millimeter PMI rope
 4 liters freeze dried stroganoff (powdered and compressed)
 4 liters instant oatmeal (compressed)
 1 liter trail mix

flagging tape
 one hundred pages survey paper
 five rolls of film
 four 4-liter Ziploc bags
 six mechanical pencils
 Stone's log book
 one spare regulator
 100 meters of 7-millimeter PMI line (lashed to outside of duffel)
 10 kilograms lead ballast

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Expedición en San Agustín de 1994

En la Primavera de 1994, una gran expedición buceó el sifón terminal del Sistema Huautla, abajo de los 840 metros de la entrada del Sótano de San Agustín. Nuevo equipo de buceo, fué proporcionado a la expedición (con sistema de aire reciclable). El campo 5 se instaló en una plataforma suspendida de las paredes sobre el sifón. Se requirieron 10 ocasiones para los espeleobuzos en lograr bucear una cantidad de 1450 metros y encontrar un pasaje con aire. Ian Rolland, un Escoses, se ahogó en un pasaje no inundado por completo, despues de haber pasado el sifón 1 en vias al segundo sifón. Despues, Bill Stone y Barbara am Ende establecieron el campo 6 al otro lado de los primeros dos sifones y exploraron arriba de 2 kilómetros a lo largo de pasajes secos, traspasando varios sifones mas. Finalmente, ellos se detubieron en el noveno sifón dando al sistema una nueva profundidad total de 1475 metros. Una gran cascada entra al nuevo pasaje; probablemente es el agua del Sótano del Río Iglesia.

Historical Reprint

THE CAVERNS AND PEOPLE OF NORTHERN YUCATAN

Leon J. Cole

The northern part of the Yucatan Peninsula, instead of having the luxuriant tropical vegetation often found in countries of low latitude, is in reality a great semi-arid plain. The forests, nowhere dense, dwindle away in parts to a stunted "brush" barely supported by the scanty soil which only partially covers the underlying limestone rock. It is, indeed, to the porous character of this rock and the absence of pronounced relief, rather than to a deficiency in the rainfall, that the aridity must be chiefly ascribed. The porous, fissured limestone rock is like a thirsty sponge which soaks in the water with only less avidity than the hot sands of a desert. Under these circumstances, it is of interest to note that, before the Discovery, this region supported probably the highest civilization of the western hemisphere, and that the conditions of human occupancy at the present time are not wholly unfavorable.¹

The great plain of northern Yucatan extends southward from the Gulf of Mexico as a gentle, even slope, at an average increase in elevation of about one foot per mile. To the northward it sinks almost as gradually under the surface of the sea, forming the great Yucatan Bank with a width of some 100 miles, beyond which it sinks rapidly to the great depths of the Gulf. There are no harbors on the coast and the shoal water of the Bank makes it

necessary for large steamers to anchor some miles off shore, whence freight and passengers are carried back and forth by lighters. Steamers must be ever in readiness to seek deeper water upon the approach of one of the dreaded "northers," those fierce storms that sweep from our southern states across the Gulf and down upon the unprotected coast. The coast itself is low, and, for 170 miles, skirted by a narrow sand reef, behind which lies an extensive lagoon of brackish water, which is called "el rio" and "la cienaga," and which opens to the sea at the west. At only two or three places along the entire reef do tidal inlets occur.²

To the southward of Merida, about 50 miles from the sea, the land rises in the form of a series of low hills, locally known as the "sierra," which have a general trend from northwest to southeast. Their average height is 400 to 500 feet. According to Mr. E. H. Thompson, in the neighborhood of Xul, they reach a greater elevation of nearly 900 feet (Heilprin, 1892, p. 136). The extent of this range of "mountains" to the southeastward is not accurately known.

At San Ignacio, about half way between Merida and the coast, the general surface appears to be almost as flat and level as a floor; and here one may look for miles, with almost unobstructed view, across the enormous plantations of henequen, the plant which supplies the "sisal" fiber of commerce, and which constitutes one of the greatest sources of wealth in Yucatan. South of Merida, however, the dissection of the plain has progressed further, and the surface topography is much more irregular. On account of the porosity and fissured surface of the limestone that

constitutes the country rock, the heavy rains of the wet season cut irregular channels or "arroyas," whose positions are dependent upon the local conditions; but nowhere are these of any great length or permanency. For it should be understood that nowhere in the whole northern half of this great peninsula are there rivers or permanent surface streams, with the exception of a few short ones on the eastern coast; and these, as will be shown later, were probably underground streams whose roofs have fallen in. But in certain parts of the country there are more or less permanent pools or "aguadas," and water is also to be found in deep caverns and sink holes. Many of the latter are of a peculiar chimney-like structure, and are known as "cenotes." It is with the nature of this underground drainage that the remainder of this paper will be chiefly concerned.

The rainy season in Yucatan is from about July to October. During the rest of the year the rainfall is small, though there may be occasional heavy thunder showers. In all parts of the country, the surface water quickly finds its way underground, and in the hill region it has formed many caverns and subterranean passages, which, if we may judge from the descriptions of those who have explored them, are similar in most respects to the caverns of any elevated limestone region. There is one peculiarity, however, which appears to be rather characteristic of the Yucatan karst, and that is the prevailing vertical character of the underground caverns. In the lower north country horizontal tunnels appear to be entirely absent, or at least very unusual; in the caverns of the hill region they do occur,

Reprinted from the *Bulletin of the American Geographical Society*, volume 42, number 5, pages 321-336, 1910. The footnotes originally at the bottoms of the pages have been numbered and moved to the end. It has not been possible to reproduce photographic figures 9 through 14.

There can apparently be little doubt that these peculiar water holes were formed, in the first place, by the solution of the rock, so as to make great underground dome-shaped caverns. The surface rock, as is common in limestone regions, is much harder than that below. The water therefore makes its way down through crevices in the resistant upper layer causing comparatively little solution; but when it encounters the softer strata below, its solvent power is exercised and large caverns with roofs intact are the result. In the walls of the Sacred Cenote at Chichen some of the lower strata are so soft that the rock can be crumbled in the hand almost like dust. The essentially horizontal position of the strata may be another important factor in giving the cenotes their vertical walls and few horizontal passages. The dip of the strata is so slight that it has probably been easier for the water to work its way directly down than to run off laterally. Either by the too great extension of the cavern or by the gradual sapping of the roof, the latter eventually collapses, and the cenotes, such as have been described, are the result. One has but to witness the effects of a heavy tropical thunder storm upon the steep walls of one of these cenotes to realize how important an agent is erosion in their subsequent development; and considering the number of stones that go rolling down even during a brief storm, it seems strange that the walls are not worn back faster. They wear back first at the top, the lower part of the wall remaining vertical (Fig. 6); but the process of wear is continued until the cenote consists of a pool of water at the bottom of a funnel- or basin-like depression (Fig. 7). The twin cenotes of Shkolak (Xcolac) and Skashek, about two-thirds of the way from Izamal to Tunkas, would appear, according to the descriptions of Baker (1895) and Charnay (1887), to belong to this stage. In some cases the bottoms appear to have become entirely filled in, and such depressions then hold water only temporarily after rains.

The Underground Drainage

There appears to be a common belief in Yucatan that the water which

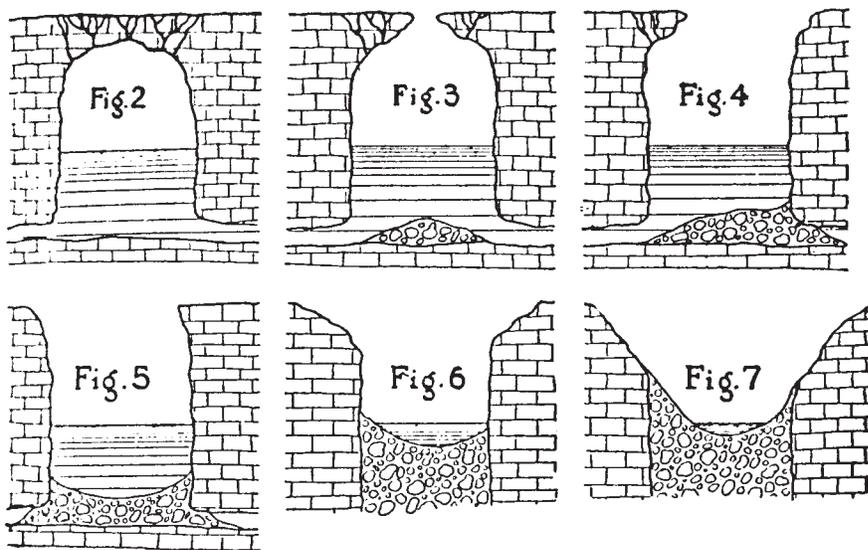


Fig. 2. Dome-shaped cavern, the roof of which has not yet fallen in; 3. A later stage in which the middle of the roof has given way; 4. Most of the roof has given way, but a portion still remains; 5. The typical cenote with vertical walls; 6. A later stage in which the walls are being worn back; 7. A topographically old cenote or "aguada" resembling a kettle-hole with a pool at the bottom.

sinks into the rock gathers into well defined subterranean rivers, which in turn empty into the sea. The reasons brought forward in support of this view may be briefly summarized.³ In the first place, it is to be noted that the water in the cenotes is fresh and sweet as a rule, and it is argued that if they were not in some way connected with underground streams it would become stagnant and foul. It should be borne in mind, however, that in many countries, even in the tropics, water is often stored in cisterns for long periods and remains reasonably sweet. Another argument is that the water level in the cenotes remains fairly constant, having only minor fluctuations corresponding with periods of rainfall and drought, showing that the waters must have a ready escape. Cases are known in which neighboring cenotes are actually connected, the connection being in some cases (as at Motul) below the surface of the water.

Boys have sometimes thrown in gourds and hats, which have later been recovered from another well. In 1900 a domestic duck fell into a well (which opens into a subterranean cavern) at Izamal, and the following day was taken out of a well some one-

fourth mile to the north. Izamal is probably situated over a great subterranean river; a line of important towns can be picked out which mark its course from the southern hills to the Gulf.⁴

Further evidence of subterranean streams is furnished by the numerous "boiling" springs along the north coast. Many of these open into the coastal lagoon while others open out in the salt waters of the Gulf itself. This water bubbles up from the bottom of the "cienaga" through holes from 6 to 15 feet in diameter, in which the sand is constantly agitated. Ober (1884) states that a fresh water spring in the Atlantic has long been known off St. Augustine, Florida, and quotes Humboldt as follows, regarding their occurrence on the Yucatan coast:

On the northern coast of Yucatan, at the mouth of the Rio Lagartos, 400 meters from the shore, springs of fresh water spout up from amidst the salt water. It is probable that from some strong, hydrostatical pressure the fresh water, after bursting through the banks of calcareous rocks between the clefts of which it has flowed,

rises above the level of the salt water.

As Oben says, Florida and Yucatan are of similar geological formation, which may account for the appearance of these springs on the coasts of both peninsulas.⁵

The coastal springs mark the mouths of underground rivers, and the villages in their vicinity are the terminal ones of the lines that mark the courses of the streams from the hills to the sea. The inhabitants of these coastal villages, in some cases, place hollow tree trunks in the holes of the sea floor through which the water gushes, thus leading it to the surface of the Gulf without commingling with the salt water. They, in this way, obtain their supply of fresh water by going out on the Gulf in canoes! During times of storm, when the Gulf is too rough for canoes, it is necessary to go inland a mile or more across the "cienaga" to get fresh water. All the towns along the north coast, except Progreso, are said to be located where these subterranean streams open.

At Ascension Bay, on the east coast of the Yucatan peninsula, one of these rivers, 30 feet wide, has its roof broken in for about a mile inland, and, for this distance, runs between vertical walls not over three feet high. This probably represents the type of drainage in all the peninsula, merely differing in the fact that the roof of the once subterranean stream has here given way.

Another noticeable fact is that in most and possibly all of the cenotes in the more northern part of the peninsula the water stands at a common level. The available data as to altitudes and depths of the cenotes to water level are so incomplete and inaccurate that a consistent table cannot at present be prepared; but the bulk of the evidence seems to indicate that, in all of those cenotes north of the "sierra," the water stands at a level only a little above that of the Gulf. The land surface rises on an average of about a foot to the mile and, making allowance for local irregularities, the distance in feet from the surface to the water level, at any particular point, is approximately the distance of that place from the Gulf

in miles. Thus we find that close to the coast the water lies very near the surface. Merida is 25 miles from the coast; according to Schott (1866) and Heilprin (1892), its altitude is 28 to 30 feet, and, on the testimony of the same authors, the water in the cenotes is some 26 to 30 feet below the surface. Other striking cases of agreement might be adduced, but these will suffice to illustrate the point.

There are two ways in which we may account for the maintenance of such a condition of the karst water. Either there are connecting passages between the different cenotes below the level of the sea, or else the rock at that level is so porous that the water can traverse it easily, or there may be a combination of these two conditions. Some of the evidence for believing that these are real subterranean streams has been given above. Against such a view must be put the fact that in two cenotes only some three miles or so apart, entirely different species of catfishes were found living, although the general conditions seemed much the same. In one of the cenotes, however (the Sacred Cenote), the water was only 36 feet deep, while in the other (the Ikil) a sounding line was lowered to 95 feet below the water surface! Such being the case, there can be no doubt that extensive subsidence has taken place in the Yucatan peninsula since its principal drainage features were formed; for in no other way can we account for the great depth of this cenote below the level of the sea. At one time the land must have stood at least 95 feet higher than it does to-day. At that time, the drainage conditions were probably similar to those found in any ordinary limestone region, with long horizontal tunnels and caverns, some distance above sea level, and vertical shafts leading down to them. Subsequent subsidence carried the horizontal passages below sea level, thus gradually raising the level of the water in the vertical shafts, but maintaining practically the same height all over the peninsula.

While it is possible, then, that there exist actual underground rivers, they are in most cases more than that, for they are actually below the level of the sea as well, and are to be looked upon as connecting tunnels com-

pletely filled with water rather than as real streams. There were, however, undoubtedly in some cases, horizontal passages at higher levels, which might not yet be entirely "drowned," and which would account for the transportation of floating objects such as hats, etc., as already described. In other cases no doubt the caving in of the roofs and the accumulation of debris has blocked the passages from many of the cenotes, the water now having to make its way out by seepage. This would account for the comparatively shallow water in some of them, and also the restricted distribution of certain species of fishes.

In the hill region the drainage system is still largely above the sea level, and it here presents the features more commonly associated with limestone caverns. Here there are more lateral passages that can be traversed, but though, here and there, water may stand in impervious pools, the lower levels appear to be practically coincident with that of the sea. In Figure 8 an attempt has been made, by a schematic north-and-south cross-section from the hill regions to the Gulf, to represent the principal features of the Yucatan karst which have been so briefly outlined.

Relation of Hydrographic Conditions to People

The natural semi-aridity of northern Yucatan is accentuated by the fact that the soil covering the rock is in many places very scanty. The semi-arid quality is especially marked during the dry season, when many of the trees lose their leaves and the general appearance of the forests reminds one strongly of our own forests in early spring or late fall; and many of the native birds migrate to the southward from the peninsula, just as many of our birds go south (some of them to Yucatan) during the winter months.⁶ The failure of the soil to retain moisture also limits very closely the kinds of crops that can be cultivated successfully. It is true that during the rainy season many garden crops may be grown successfully, but the two most important products of the country are corn and henequen. Sugar cane is cultivated to some extent. The raising of cattle is limited by the scarcity of forage, while

the leaves of certain trees have to be gathered for the horses in place of hay.⁷

As to the corn and henequen, the former is all consumed in the country, the latter is practically all exported as the crude fiber. The method of raising corn employed by the natives is dependent upon the weather conditions, and is very impoverishing to the soil. At the close of the dry season, the Indian prepares his "milpa" or cornfield by burning the timber from a tract of land, which is then planted in corn when the rains begin. A good crop is dependent upon plenty of rain. Corn is the staple food and a scarcity of this cereal, due to a bad season, is a serious matter to those living at a distance from the towns.

Henequen is grown on the dry, deforested plains, especially of the northwestern section. It is the staple product of the country, and the demand for it, created by the shutting off of the supply of manila fiber from the Philippines during the Spanish-American war, returned princely fortunes to the class of Yucatecans who own the enormous henequen plantations. As a consequence Merida is a city of life and gaiety, and has been referred to as the Paris of America.

There seems to be no evidence for believing that the climatic conditions in Yucatan were any different at the time the Maya civilization was at its height than they are to-day, and it seems remarkable that so high a state of culture and civilization should have arisen under conditions which seem in many ways so unfavorable.

Although it is believed that the ancient Mayas built reservoirs for the storage of water, they apparently did not know how to dig wells to obtain it. It is accordingly found that all their important cities were situated where there was access to the aguadas and cenotes, or to the caverns of the hills, the floors of some of which have been worn smooth by the generations of bare feet that have gone down into their depths and toiled back with the day's supply of water. Mention has been made of the fact that, on the northern coast, the villages were located in intimate relation to the supplies of fresh water. With the advent of the Spaniard came a knowledge of well digging. It is said that good wa-

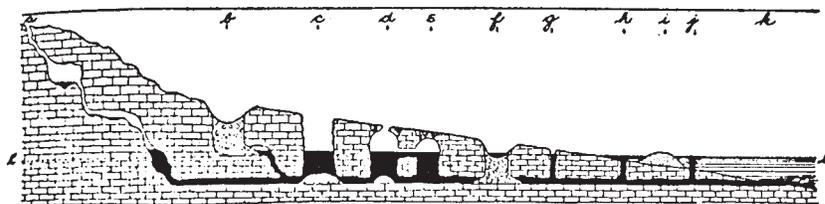


Fig. 8. Schematic North-south section from the "sierra" to the coast illustrating types of cenotes and caverns, relations of water level, subterranean connections, etc. *a*. Hill cavern, with long passages and pools of water held in impervious depressions; *b*. An old age cenote ("holla") holding water only temporary after rains; *c*. Typical cenote (see Figs. 5 and 9); *d* and *e*. Young cenotes or dome-shaped caverns (see Figs. 2 and 3) connected by a passage at water level; *f*. Old age cenote with permanent pool of water ("aguada," see Fig. 7); *g*. Water-hole near the coast, when water level is very near the surface; *h*. Fresh-water spring in a brackish lagoon or "cienaga"; *i*. Coastal sand reef on which coastal towns are located; *j*. Fresh-water spring a short distance from shore; *k*. Gulf of Mexico; *l*. Sea level.

ter may be obtained by sinking a well almost anywhere. In ancient times the water was brought up by hand; later it was drawn from the wells by ropes and buckets, and sometimes, at the deeper wells mules were employed for hauling it up; but now windmills have been introduced, and as there is usually plenty of wind, these do the work economically and well. The city of Merida and vicinity is, when viewed from a slight elevation, a veritable forest of steel windmills of American make.

The dry climate of Yucatan, with its cool nights, has a decided influence on the conditions affecting health. It is much healthier than most countries lying so well within the tropics, and lacks almost entirely the terrors of the "tierra caliente" of Mexico proper. Yellow fever is endemic, it is true, but apparently has seldom or never been very prevalent, and Casares (1906) is authority for the statement that it has now "been almost completely expelled." The fishes in the cenotes and larger pools keep the mosquito larvæ largely exterminated there, and a little systematic effort would do much to exterminate them in the temporary pools of water which are held in hollows in the rock for a few days after a rain, and which are quickly taken advantage of as breeding sites by the

mosquitoes. In certain regions, where there are open aguadas, malaria and dengue fever are a serious menace, especially to foreigners; but here, also, a consistent crusade against the mosquitoes would undoubtedly better conditions. This should be comparatively easy in a karst country where the greater part of the water quickly disappears underground.

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Notes

1. The writer's personal knowledge of the country has been gained from a trip made early in 1904, the principal object being the collection of zoological materials and data. The work was in the interests of the Mu-

seum of Comparative Zoölogy at Cambridge, and consisted of a stay of several weeks at Progreso, a few days at Merida and Izamal, and nearly two months at Chichen-Itza.

2. The method of formation of this coastal strip of sand and the consequent lagoon has been ably discussed by Schott (1866).

3. Many of the facts and ideas here expressed are on the authority of Dr. G. F. Gaumer, an American physician who has for many years resided in Izamal.

4. On the authority of Dr. Gaumer.

5. Ballou ("Due South, or Cuba past and present") wrote in 1885 that much of the drinking water, and certainly the best in use at Nassau, as well as at some of the neighboring islands, was procured from fresh water springs bubbling up through

the salt water. He says the same is true also on the shores of the Persian Gulf. In the former case, the water was brought to the surface through barrels filled with sand, while in the Persian Gulf divers go down with leather bags which they open over the bubbling fresh water springs at the bottom. Hitchcock (1905) mentions fresh water springs in the ocean on the volcanic shores of the Hawaiian Islands.

6. Some evidence for such a migration has been presented by the author (Cole, 1906, p. 112) in the introduction to a paper on the birds of Yucatan.

7. The stock can be turned loose and does not have to be herded during the day. It cannot get to the water in the cenotes, and consequently has to return to the tanks in the corral.

THE EXPLORATION OF SÓTANO DE ALFREDO, QUERÉTARO

James H. Smith

Frustrated with the fourth 4- to 6-meter drop in a row, I wheeled my duffel bag laden with 130 meters of rope out of the pool and ambled to the edge of the next precipice. Looking down the shaft, I morosely guessed the drop to be 15 meters deep, with a pool at the bottom. To verify my suspicion, I tossed a rock, and five seconds passed before a voluminous echo came.

Sótano de Alfredo was discovered on November 26, 1992, by Gerald Moni, Teresa Williams, and Chris Hudson during the fifth Xilitla Project expedition. The cave is near the community of Agua Zarca. On the day Sótano de Alfredo was found, only Chris descended the 19-meter entrance pit to a ledge. Since the expedition was primarily for ridge-walking, the cave was left as a lead for the spring 1993 expedition.

The cave had its first two push trips on April 5 and 8, 1993. My account of this exploration is taken from Paul Aughey's cave journal. The first push trip was by Paul Aughey, Gerald Moni, Chris Hudson, Cecil James, and Pete Hall. They descended the entrance pit on a 60-meter rope to a spacious ledge at 19 meters. A natural tie-off was used to rig the following 17-meter pit. On the bottom, the only lead was a tight crawl from which a strong draft came. Paul and Pete squeezed through, and Gerald dug the crawl out large enough for him. A few meters of passage led to a 22-meter pit. With a 60-meter rope, they rigged the 22-meter pit, a 3.5-meter pit, and another drop of 22 meters. Pete and Paul continued down eleven climbs with depths of up to 6 meters. Finally, they came to a pit that looked about 10 meters deep

and could not be climbed free. They derigged, vowing to return on the ninth.

Bernardo Mozales and Carlos González from Mexico City joined Pete and Paul a day earlier than planned to resume exploration in Alfredo. The team was heavily laden with rope. They carried rope lengths of 180, 60, 30, 30, 20, and 6 meters and assorted pieces of webbing. They rigged eleven drops and climbed numerous sporting free climbs. They admitted that handlines would have been appropriate on some of the climbs. Their exploration terminated below a 28-meter shaft, at the top of a 5.7-meter pit. They claimed they had lost the air, but had a promising lead 10 meters down the 28-meter pit. It was a chamber with 3-meter columns, where they ate lunch. Having run out of rope, they derigged, and left the cave after twelve hours.

The Xilitla Project fielded its seventh week-long expedition November 22 to 26, 1993. The expedition was manned by Gerald Moni, leader, Mark Richardson, Shari Lydy, and Marion O. Smith from Tennessee, Alan Cressler, Andy Porter, Jeff Dilcher, John Stembel, and James Smith from Georgia, Pat Smith, Roger Haley, Paul Dever, Bob Ilges, Chris Hudson, and Greg Armstrong from Alabama, Lisa Frick and Kerry Roland from Missouri, Gary Burwasser from Florida, Chris Stine from Oregon, and Ted Wilson from Indiana. Our sponsor, Pigeon Mountain Industries, participated in spirit. PMI supplied 75 percent of the rope utilized on the expedition.

The expedition had three goals: to look for new caves, to explore Sótano de Alfredo, and to survey Sótano de

Lutevio. [See *AMCS Activities Newsletter* 19 for a report on the initial exploration of Lutevio.] The expedition achieved the first two goals and partially accomplished the third. The main thrust of the trip was toward Sótano de Alfredo.

On November 22, the first group to enter the cave was a rigging crew of Alan, Jeff, Ted, Marion, Shari, Chris Hudson, and me. The second crew was a survey team consisting of John, Gary, Chris Stine, and Mark. The survey team began at the entrance. When the rigging team ran out of rope, they were to begin surveying back toward the other team.

Alan and I carried in two rope bags with PMI ropes 217 and 137 meters in length. Starting at the entrance, Alan rigged each drop, cutting and taping the piece from the

Chris Hudson in one of the entrance-series pits.
Marion O. Smith.





Jeff Dilcher at the top of the third pit. *Marion O. Smith.*

217 at the bottom of each drop until his bag was empty. He did his best to rebelay as necessary to prevent rubs on the rope. On the fifth drop, Alan set an 8-millimeter bolt 5 meters down, rebelaying the 22-meter pit. Two more bolts were set at the top of a 6.4-meter-deep pit. The cave passage was essentially a narrow canyon from vertical to the inclination of the bedding and was quite comfortable, averaging 1 to 5 meters wide in the canyon and pits. The passage trend is quite steep, following the beds, which dip between 40 and 70 degrees. Consequently, the drops are for the most part steeply sloping wall drops, ideal for the Texas climbing system. The distance between pits or climbs rarely exceeded 60 meters; usually they came one right after another.

The next pit was only 10 meters from the bottom of the 6.4-meter drop and consisted of two drops of 5.5 and 5 meters. We encountered several 2.5-meter climbs over potholes and through drips. The next pit had a depth of 7.9 meters, and it was followed by one of 5.2 meters. Alan ran out of rope on the tenth pit. With 137 meters of rope, I rigged twelve drops. Most of the drops were small, consisting of pits of 3.3, 2.8 (to crotch-deep water), 3.3, 3.2, 7.0, and 5.2

meters. I set an 8-millimeter bolt to rig the 5.2-meter pit. The top of the drop was narrow and awkward to negotiate, as were many of the short drops. An 11.5-meter pit led to a 21.7-meter pit that required another bolt to rig. It was our last bolt of the day, as we forgot the other five hangers for the remaining anchors we'd brought into the cave. Fortunately, those five anchors were not essential, since we were soon to run out of rope. I continued to rig from stalagmites and flakes and through solution holes. The steep slope of the bedding made rigging free from abrasion impossible or unreasonable, and rebelaying a 5-meter pit would be a waste

of time anyway. The next drop of 6.5 meters was followed by a 1.5-meter handline to assist at a nuisance climb over slick chert. Around the corner, we rigged a 6.9-meter pit to a deep pool. I had only 10 meters of rope left and saw the end swinging in the air in what measured to be a 28-meter pit. We had rigged five more pits or climbs than the original exploration team had to get this far. They had descended the 28-meter pit. Out of rope, we surveyed thirteen stations to link up with Stembel's survey team, who had surveyed forty-nine stations. We had rigged to a depth of 250 meters. The last cavers left the cave at 6 p.m., after nine hours.

The next day, November 23, the same team, except for Shari, returned to continue exploration in Alfredo. Chris Hudson hauled a 189-meter PMI in a duffel bag to the top of the 28-meter pit, which we named Purge Plunge. Additional ropes with lengths of 60, 60, and 91 meters were also taken into the cave. In addition, twenty 3/8-inch bolts, twenty rapid stoppers were in the rigging list. In the entrance pit, a bolt was set at the top of the second drop to eliminate a rub point. At Purge Plunge, I set a 3/8-inch bolt to rig most of the pit free. From there, I took the 189-meter

rope to the next pit.

We were finally looking down a virgin pit, 5.7 meters. Another bolt was set to rig the little pit, as there was no reliable natural rigging point. The canyon narrowed to less than 0.3 meters wide, and a short crawl was required to a narrow walkway and the next drops of 3.8 and 8.5 meters. A bolt was necessary to rig the offset shaft. The last part of this pit reminded me so much of Nita Nanta in Huautla, as the pit is actually a 45-degree slope parallel to the dip of the bedding. While it is actually a free climb, the rope was most appreciated. A 4.5-meter climb led to a 3.7-meter pit that was rigged from a formation and a breakdown block. The next pit was 2.7 meters free and required a bolt. I was beginning to think that if this cave were to go 1000 meters deep, there might be hundreds of pits 5 meters deep. What a drag!

The next pit was almost immediate. I looked down and thought it was 15 meters or so. It took the rock 5 seconds to hit, and the sound indicated that the pit was large in diameter. The others were still at the top of the little shaft, and they yelled excitedly at the echoes from the deep pit. Finally, we were in exciting cave.

Alan set a bolt for a traverse line. I rigged in and stepped around the corner of the deep shaft and set two bolts to rig the pit free and out of the water. Even though the cave is warm and comfortable in a tee shirt, the crew wanted a dry rig. However, what you want and what you get are not always the same. The bag with the remainder of the rope was lowered, and the end was dropped into the shaft. I carried an extra rope and prepared to change over if necessary. Halfway down, I encountered a tangle in the rope, and several minutes were required to untangle the mess. I had attempted to rig out of the water, but the rope hung in the middle of the shower 30 meters below the rigging point. The drop was sheer to free. On the bottom, I landed in ankle-deep water. The shaft turned out to be 97 meters deep and 30 meters in diameter. I cut the end of the rope as Alan touched bottom. I named the pit Rolf Well, in memory of Rolf Adams.

Less than 50 meters from the bottom of the shaft, we encountered a 24.5-meter pit that was redirected 7 meters down from a large, rounded pendant. A short free climb of 2.5 meters led to a 2.7-meter drop. Alan stepped across a deep pool at the bottom of the little shaft to peer down the deepest shaft in the cave. The rock soundings were comparable to those of the 97-meter pit. We fed in 91-meter and 25-meter ropes tied together to insure Alan would reach the floor. Alan set a bolt at a ledge 2 meters below the top and a rebelay from another bolt 10 meters down and then disappeared. He yelled up that we would have to cross the knot and that I should bring down a 30-meter rope. I could hear him tapping another bolt into the rock as I descended into blackness. From my lofty position, I could see that this shaft was very large, at least 40 meters in diameter. From the bolt, the drop was a sheer 80 meters. I encountered the knot 7 meters above a large ledge. We had to tie another short rope onto the remainder of the 25-meter piece to reach the bottom. Alan descended, passing the last knot 5 meters from the floor. From the ledge, the drop was 28 meters. Including the drop from the ledge, the shaft taped out to be 113.2 meters deep. Alan named this pit Andgy Well.

When I touched down, Alan reported he had found a further deep pit, but couldn't get to the edge. Instead of retracing his steps over a huge flowstone, we followed the water route down a canyon. We rigged a 4-meter drop that Ted Wilson later bypassed by a climbable route through breakdown. This rope has been dropped from the rigging list. Alan and I traversed down a short, 2-meter climb to a 5.3-meter pit. We rigged to some formations, and Alan descended the clean-washed drop. Almost immediately, we came to the deep pit Alan had found. We tossed another rock, and the report sounded like it might be 60 meters deep. We were out of rope. We dumped the bolts and survey gear at the bottom of the 113-meter pit. Marion descended Andgy Well and toured to the undescended pit. We estimated we had reached a depth of about 567 meters.

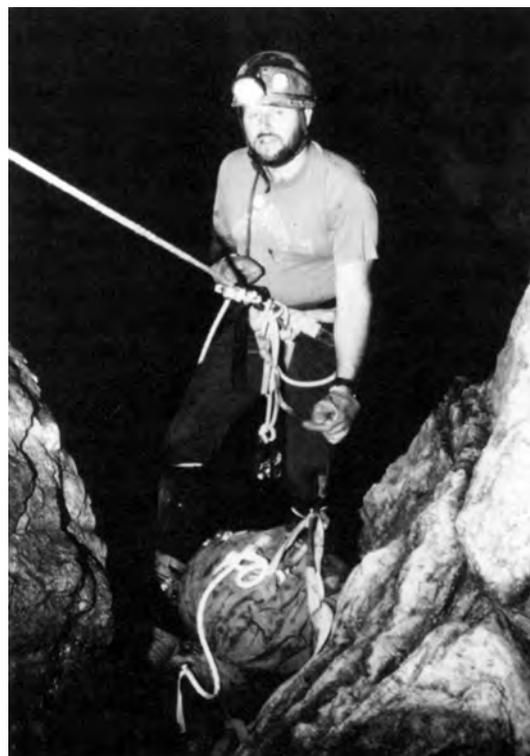
No one else came down the big pit. The survey team left a hanging survey, since they did not map the 97-meter pit. They set around thirty stations. The rigging crew did no surveying. On the next trip, a 100-meter tape would be brought into the cave to measure Rolf Well and Andgy Well. We had rigged ten additional drops, for a total of thirty-two drops, not including rebelays. We left the cave after 13.5 hours.

On November 25, the same crew entered the cave. Chris Hudson, Shari Lydy, Kerry Roland, and Lisa Frick would tour the cave to the top of the 113-meter pit. The rigging crew carried in PMI ropes of 99, 83, 60, 28, and 28 meters to push the cave. We rigged the 113-meter drop to eliminate the knots. I drilled a bolt at the top of the virgin pit and a second one 8 meters down. The top of the pit is like a high-angle chute. The walls are as smooth as glass. On the left-hand side of the pit is a massive flowstone that ascends on up the shaft. It probably links this shaft with Andgy Well. A third bolt was needed to rig the drop free, but the driver broke. Fortunately, the lip was smooth. I looked across the shaft and could barely make out the opposite wall, which I estimated to be as far away as the floor. I descended the 48 meters of wall drop and encountered a slight ledge 20 meters from the floor. On the bottom, I could see that the pit was at least 40 meters in diameter. I had landed at the top of a steep slope. I immediately noticed that giant mud domes ringed the walls of the chamber and sloped toward the bottom. It looked very much like Ocotempa. I realized that we might be near a sump. Too bad! I climbed down the slope over precarious breakdown, away from the bottom of the shaft and into a borehole 10 meters wide and 6 meters high. Alan caught up with me, and we found another drop, of 4.5 meters. However, there was nothing

handy to rig to. We tried to set a bolt with the broken driver, but failed. We wound up rigging a 60-meter rope to a huge breakdown block 30 meters away. It didn't matter, because it was to be the last rope needed. Jeff Dilcher, Marion, and Ted joined us with the remainder of the push ropes. Jeff descended the pit first and reported a slimy free-climb at the bottom. He descended the climb and was gone. The rest of us followed Jeff and descended a squeeze in breakdown and a short climb to a mud-sump chamber. Jeff and Marion pushed a 6-meter-long slime crawl to a 2-meter-deep pocket, the deep point.

Alan, Ted, and I surveyed toward the entrance, while Jeff and Marion, weighted down by 5 kilos of mud, headed toward the big pit. Chris Stine joined us and derigged the 4.5-meter drop. We linked up with the other survey crew at the bottom of the 57.4-meter pit. From the top of Purge Plunge, they had set 50 stations. In all, we had set a total of 126 stations. The total surveyed length of the cave is 1049 meters. We had rigged 34 genuine pits, or 39 pitches, including rebelays, to bottom the cave at a depth

Jim Smith at the top of the second pit. *Marion O. Smith.*



of 673 meters.

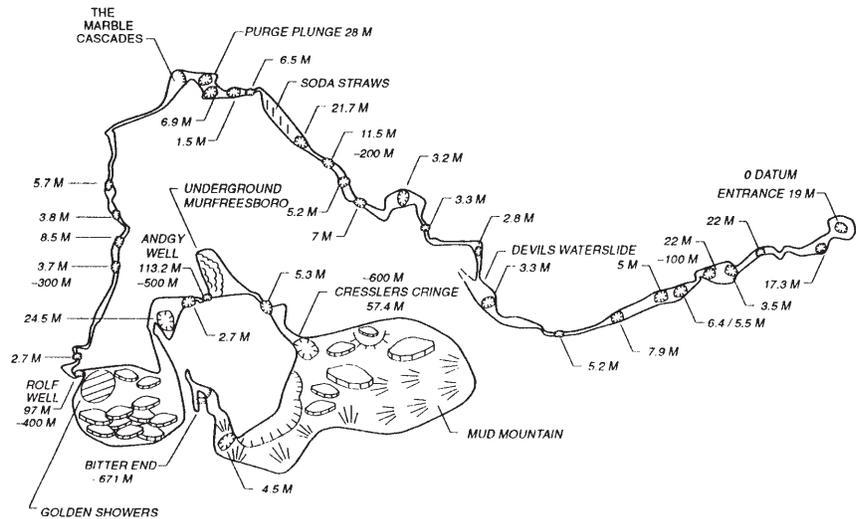
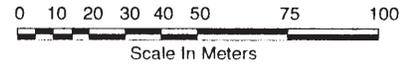
The hardest part of exploring any cave is the derig. There was noise about pulling the ropes to the top of Rolf Well and returning after a few hours of sleep to do the final derig. I knew that would be grimmer than just derigging the cave in one haul. The cave had been bottomed with about two hundred meters more rope than we needed. In all, there were eleven hundred meters of rope in the cave. Ted and I decided that we would bring up the rear. We pulled all the hangers and rigging links and organized snaking the ropes, tied together, up all of the drops. Jeff, Chris, Marion, and Gary climbed with the extra rope. I was last and left the bottom at 7 P.M., seven hours and forty-five minutes after entering the cave. At the top of the 57-meter pit, ropes were tied together and snaked to the top of the 113- and 97-meter pits. When Ted and I reached the top of Rolf Well, the lower ropes were gone, moving toward the entrance. We soon met Mark, who took the 110-meter rope we had just coiled. Ted and I snaked all of the little ropes up to Purge Plunge, where we met Marion. He had hung back to make sure that the cave would be completely derigged. We caught up to John and Gary, who were carrying 140 meters of rope each. At 7:07 A.M., I climbed out of the entrance pit into the pre-dawn air, which was cold and dense with fog. Marion and I pulled and coiled the last rope. We had invested in all 43 hours in rigging, surveying, and derigging this cave. It was a magnificent effort by TAG cavers.

Sótano de Alfredo

Querétaro, México

QO-7

Plan View



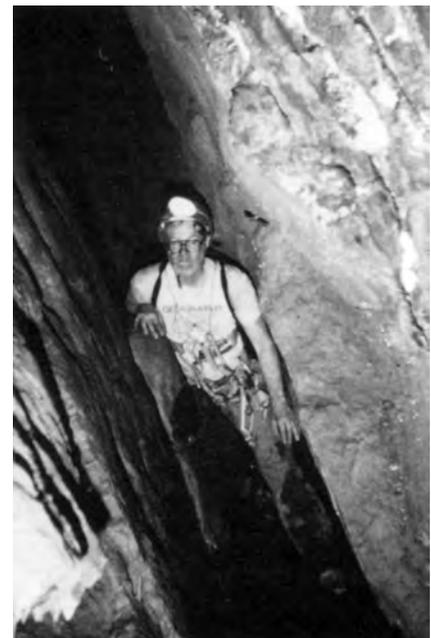
Survey Data

Surveyed Length ————— 1,049 Meters
True Horizontal Length — 566 Meters
Vertical Extent ————— 673 Meters

Surveyed 11-25-93 By :

- Gary Burwasser
- Alan Cressler
- Jeff Dilcher
- Mark Richardson
- Jim Smith
- Marion Smith
- John Stembel
- Chris Stine
- Ted Wilson

Created On Interleaf 5.2 Software By : David Parr

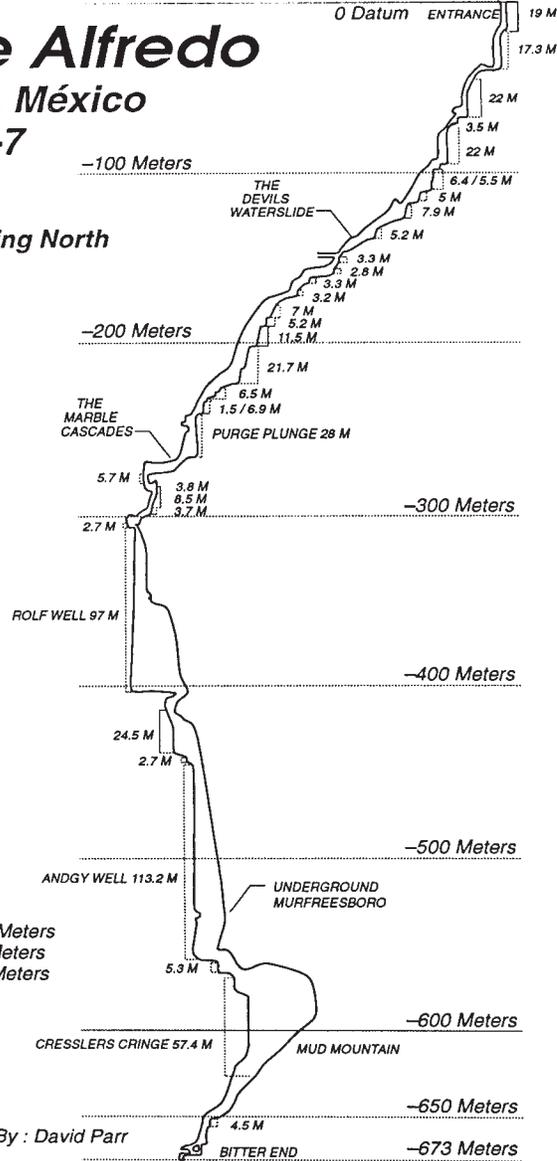
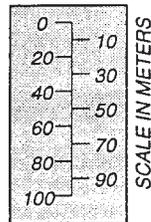


Marion O. Smith in a narrow passage between pits in the entrance series. *Jeff Dilcher.*

Sótano de Alfredo

Querétaro, México
QO-7

Profile Drawn Looking North



Surveyed 11-25-93 By :

- Gary Burwasser
- Alan Cressler
- Jeff Dilcher
- Mark Richardson
- Jim Smith
- Marion Smith
- John Stembel
- Chris Stine
- Ted Wilson

Survey Data

Surveyed Length ————— 1,049 Meters
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Created On Interleaf 5.2 Software By : David Parr

Sótano de Alfredo, Querétaro

Esta cueva esta en las cercanias de Xilitla, SLP. Fué explorada y topografiada in 1993. La cueva en muy vertical alcanzando los 673 metros. Entre los muchos tiros, dos de ellos se distinguen por su dimención 97 y 113 metros de profundidad.

SÓTANO BRILLANTE, QUERÉTARO

James H. Smith

During the Thanksgiving 1993 expedition to the Agua Zarca area, near Xilitla, San Luis Potosí, cave-hunting yielded many new caves and pits. On November 25, 1993, Gerald Moni, Paul Dever, and Bob Ilges discovered the entrance to Sótano Brillante in Querétaro. The next day, a team consisting of the three discoverers, Chris Hudson, and Shari Lydy rigged and descended the 35-meter-deep entrance shaft. Inside the entrance, they discovered a bat colony inhabiting the alcoves. A few meters from the bottom of the entrance shaft, another drop, estimated at 60 meters, was found. Paul and Bob rigged and descended this shaft to what they referred to as a land bridge. From here, shafts plummeted at either side. They attempted to descend the shallower of the two, and the rope hung free above the bottom. They estimated the floor to be at least 25 meters below the bridge. The crew tossed a rock down the pit on the other side of the bridge, and it fell for twelve seconds. The rock was reported to have hit the wall a couple of times.

One of the main objectives of the Easter expedition in 1994 was to return to Sótano Brillante and descend the Twelve Second Pit. Gerald Moni was driven by the report of the Twelve Second Pit and insisted that I should rig it for him, so he could have the honor of the first descent of this presumed new Mexican 300-meter pit. I agreed that he should do it first, but since I owned the virgin 400-meter PMI rope, I insisted that it be rigged free. If there were rub points, then I would need to descend first to rig rebelay. Gerald insisted that I was robbing him of his birthright to do Mexico's newest 300-meter pit, and he said I could rig the pit any way I

wanted to after he was on the bottom. If you know this group of people, you can imagine the comical interactions this caused. Finally, I insisted that if Gerald was to be the first down, he had to earn the right to do so by carrying the rope up the mountain. He was quick to grab a 60-meter rope, saying that would fulfill his obligation. At least it dispelled the myth he propagates that he is too old to carry any rope longer than 10 meters. He carried the rope for the entrance shaft, while I carried a 90-meter rope for the second drop. So on March 28, Gerald, Chris Hudson, who beat us to the pit by the direct, straight-up route, and I hiked to Brillante, gaining 150 meters of elevation from the road. It was a hot, sunny day, our last for the entire week.

Our goal for this day was to rig to the top of the Twelve Second Pit. As it was near dusk, large brown bats, which I at first took for pigeons, flew from the entrance of the cave. We rigged the 60-meter rope for the entrance drop, and I descended the pit first, to the rushing sound of wings. I expected at any moment to be engulfed in a huge colony of flying mammals, but it never happened.

At the bottom of the entrance pit, I set two 3/8-inch bolts to rig the next drop, 60 meters. As I backed down this drop, I could see that it was narrow and canyon-like. The acoustics were such that the fluttering of a few bats sounded like a large flight. It was evident that rebelay and redirections would be necessary to prevent abrasion of the rope in the narrow shaft. I was hoping that we would be making many trips to explore a deep cave, and, if so, there would be heavy traffic. At a ledge 19 meters below the rig point, I pounded

in a 3/8-inch bolt and installed a rebelay. I descended to the next rub point, 12 meters lower, and installed a sling rebelay around a natural rigging point. The shaft was increasing in length and width. The next part of the shaft plummeted 25 meters to the land bridge, the current end of exploration. In this stretch, the pit narrowed again, and a rub half way down required a redirection to pull the rope away from the abrasive flowstone wall.

Gerald joined me at the top of the Twelve Second Pit, anxious to know what I thought of the depth. He had heard me dropping rocks. I kicked a rock into the narrow abyss, and it hit the wall at least ten times. I laughed at the prospect of the Twelve Second Pit being 300 meters deep. Gerald was sullen, his hopes dashed. I estimated that the pit was 130 to 150 meters deep. Nevertheless, it was booty to me, and this pit might have been one of many more shafts in a deep cave. After setting a bolt, we both climbed toward the surface. I found another place for a redirection 10 meters below the top of the 60-meter shaft. We left the cave after three hours of caving.

The next day, Chris and I, accompanied by Jack Thomison, returned to the cave. I further improved the rigging with a long redirection sling attached to a stalagmite on the wall halfway down the entrance drop. This would keep the rope out of a batguano-coated slot. Another improvement was made below the sling rebelay on the second drop. I wedged a dubious chockstone in a crack on the opposite wall for a long redirection sling, again to keep the rope off the flowstone. It held briefly, before popping out on Jack. He bashed the

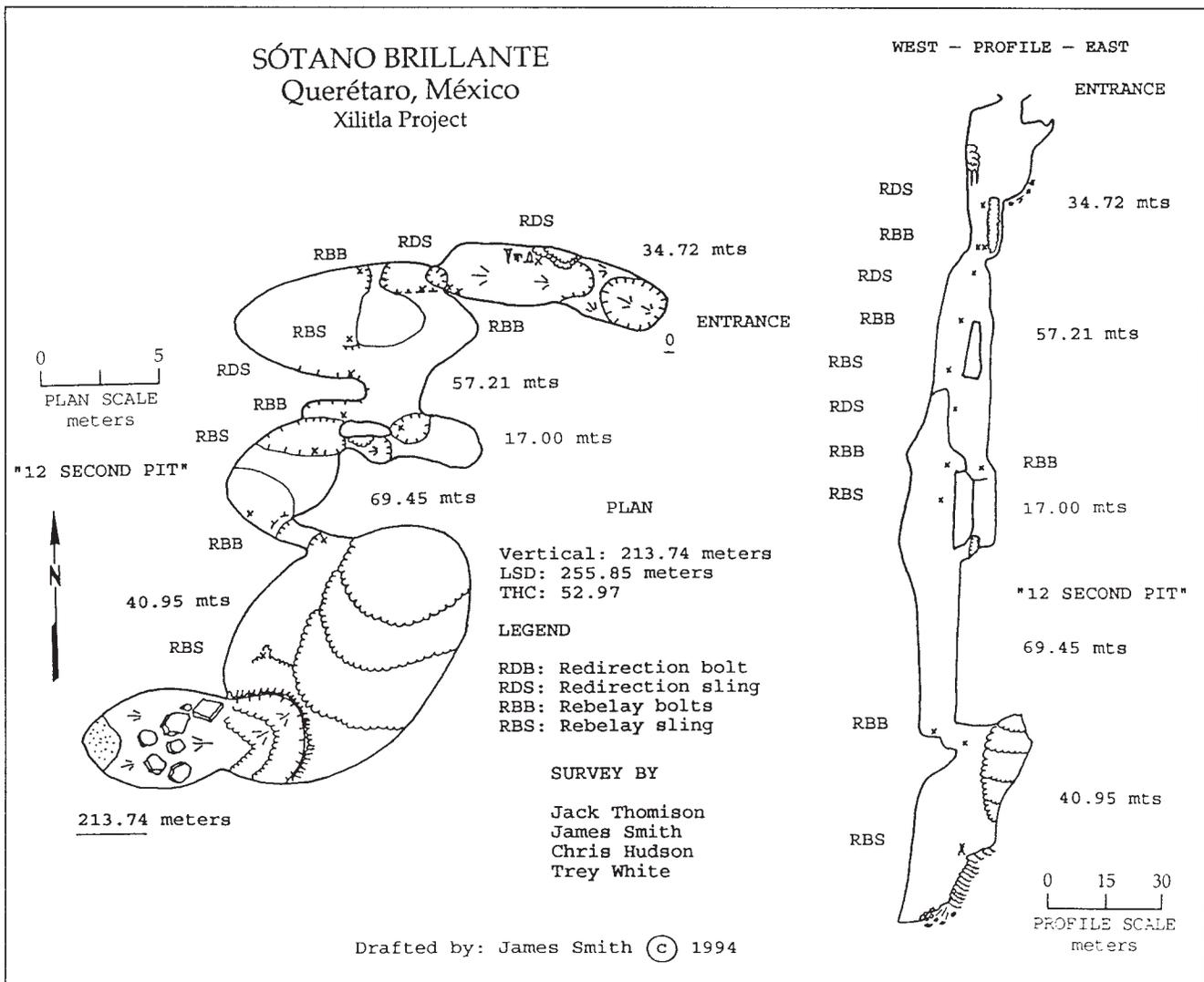
chock back into the crack with a rock he pulled from the wall, making it much more secure. Gerald Moni, Trey White, Shari Lydy, and Mark Richardson also entered the cave, but they got jammed up at the bottom of the entrance drop, since there wasn't room for the whole crew on the bridge. Chris and I had hauled 200- and 130-meter ropes into the cave. Jack brought in several short ropes. Other than my 400-meter rope in the truck, that was all the rope we had. The rest of the expedition's rope was with Alan Cressler and his group, who were exploring another cave, near León. Most of the group at the bottom of the entrance drop got tired of waiting and went ridge-walking. Only Trey remained and joined us on the bridge.

For the Twelve Second Pit, the long PMI ropes were tied together and fed

into the abyss. I could see a redirection would be needed 10 meters down the shaft. Since there would be no contest with Gerald over who would do the pit first, I descended the first 10 meters and installed a bolt, from which I redirected the rope for a free drop. While fumbling with my brand-new bolt kit, I accidentally dropped the whole thing down the shaft. I had to finger-tighten the bolt. I descended for what seemed like 70 or 80 meters to a huge pile of rope at the bottom of the shaft. In the 240 meters of spaghetti, I found my bolt kit intact. The bottom of the shaft was actually just an offset in the pit. Rock-fall indicated that at least another 50 meters remained to be descended. The next pit was slightly offset again by a small ledge 3 meters down. I requested that the others stay on the bridge to avoid "flat-rocking"

me. I placed a second anchor and rigged a free drop.

This drop was different from the canyon-like pits above us. It was more circular, and it was decorated with massive flowstone that spanned the full height of the shaft. I descended the glittering pit 25 meters to a stalagmite, where I rebelayed the drop. The last 18 meters were on a flowstone slope. There were 160 meters of rope on the bottom, and the cave decisively ended less than 15 meters away. Chris, Jack, and Trey descended to have their hopes for more cave dashed, too. We began to survey and derig the extra rope. Trey was the first to climb, so he hauled up the end of the extra rope and then pulled it up to the top of the shaft. Since this was a nice cave, we left it rigged. While climbing up the shafts, we looked for windows into possible



parallel shafts. It was windy at the top of the Twelve Second Pit, but not at the bottom of the cave. Not finding any windows to swing into, we continued our exploration from the top of the Twelve Second Pit, where I set a bolt and descended the pit on the other side of the bridge. The drop was 17 meters, and a narrow passage led back to the Twelve Second Pit. Convinced we had finished exploration and survey, we surfaced to a cool, drizzly day after eight hours of caving.

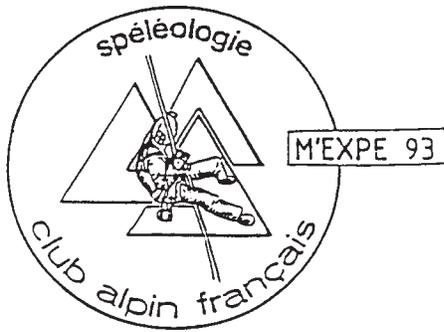
From the bottom out, the pits measure (not including rebelay) 41, 69, 57, and 35 meters deep. The total depth of the cave is 214 meters, and the mapped horizontal component is 53 meters. The next day, Shari, Mark, and Trey derigged the cave. From the standpoint of Mexican deep caves, Brillante would be classified as merely one for the record. But by United States caving standards, Brillante would be a sought-after classic.

Exploration of this cave was made possible by donations from Pigeon Mountain Industries to the Xilitla Project.

Sótano Brillante, Querétaro

Sótano Brillante fué encontrado por cueveros en Noviembre de 1993. Entusiasmados por el reporte de un tiro de 12 segundos en interior, regresaron a la cueva en la semana de pascua del 94. Los 12 segundos de tiro, resultaron ser únicamente 70 metros de profundidad. Las piedras rebotaron en las paredes al menos diez veces. La profundidad total de la cueva es de 214 metros.

TAKE NOTHING BUT PICTURES
LEAVE NOTHING BUT FOOTPRINTS
KILL NOTHING BUT TIME



M'EXPE 93

M'Expe 93 was the second speleological expedition to Chiapas, Mexico organized by the Club Alpin Français-Nice. The first expedition took place in 1987. During that expedition, the group discovered 17 kilometers of passage, including a cave 328 meters deep and an underground river 5 kilometers long located at the Río de la Venta canyon.

The 1993 expedition lasted for three months, with a team of eleven reinforced from time to time by an Italian, a Mexican, and a brief collaboration with an American. Thirteen kilometers of passage were explored. Our two most important discoveries were the archaeological cave El Tapesco del Diablo and the 9650-meter resurgence cave El Chorro Grande.

The primary goal of this expedition was a large shaft, first located in 1987, in the heart of the Selva del Ocote area. The absence of a guide and disagreement among the members of the expedition prevented us from reaching this objective. We did make three forays of four days each, as well as several prospecting trips in the vicinity of our base camp, which was located near the guard house that marks the beginning of the Selva del Ocote national reserve.

For caving, the area was a failure. We explored several shafts, including Sótano de Abejillas (Cave of the Bees, 93-1), 100 meters in diameter and 85 meters deep. A lot of the caves were unimportant; the most interesting was Cueva San Angel (93-13),

This material is reprinted from the report of the February-April 1993 expedition by the Club Alpin Français-Nice to Chiapas. The text is from the English summary in the report.

which is 270 meters long. There are large karst areas in this vicinity, but the approach is difficult. We were warmly welcomed by the local population.

In the valley of the Río de la Venta, which crosses the forest, an important discovery was made. Although El Tapesco del Diablo (93-A1) is a small cave, it is very important archaeologically. The cave was well protected from vandals by its position in the middle of a cliff, 40 meters from the bottom. This cave served as a burial ground, and artifacts were found exactly as they had been left eight hundred years ago. Offerings of grain, onyx vases, a wooden ax, textiles, and a skeleton in a fetal position were among the things found. The team that discovered the site was given technical assistance by archaeologists from the Instituto Nacional de Antropología. All the objects were removed by helicopter to the museum in Tuxtla Gutierrez, the capital of Chiapas.

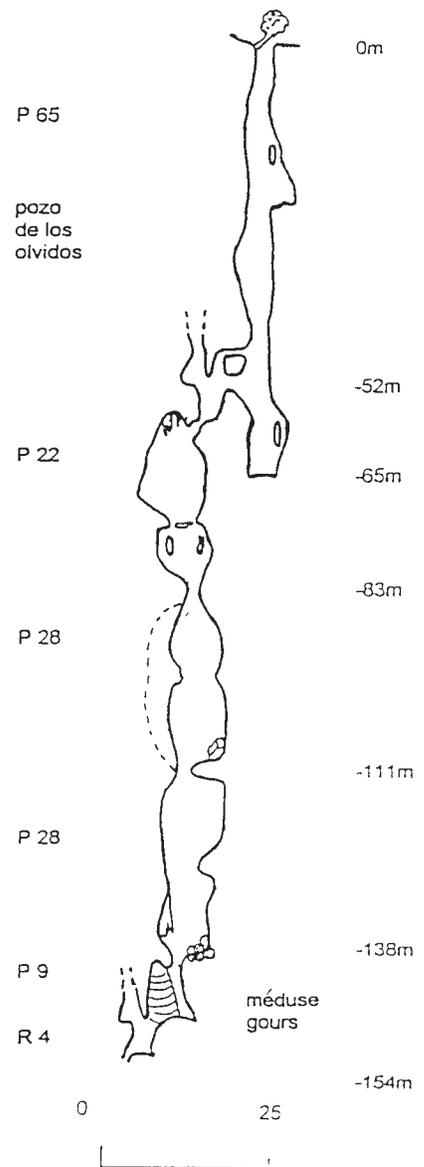
The Roblada Grande *colonia* is situated south of Tuxtla Gutierrez and is easily accessible by car. There are fields of corn as far as the eye can see. Prospecting is much easier than in the Selva del Ocote.

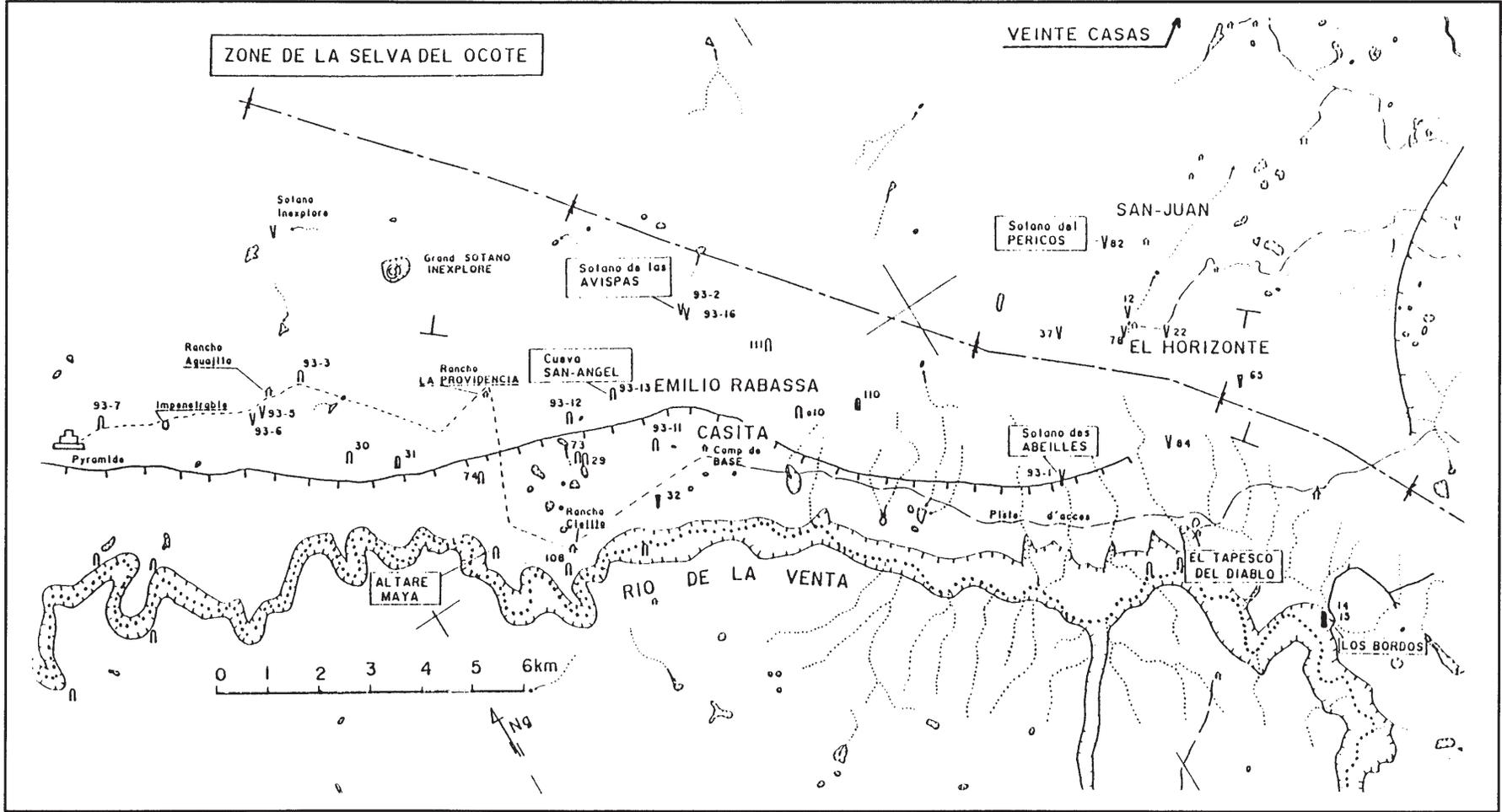
The Cueva del Agua (93-10) is 800 meters long. At the bottom of the cave is an underground river with a flow of approximately 10 liters per second. The river is reached after crossing a room 90 meters in diameter. The entire route had been improved by the Maya to ease carrying water jars. We discovered two stenciled hands on one wall and a large earthenware jar.

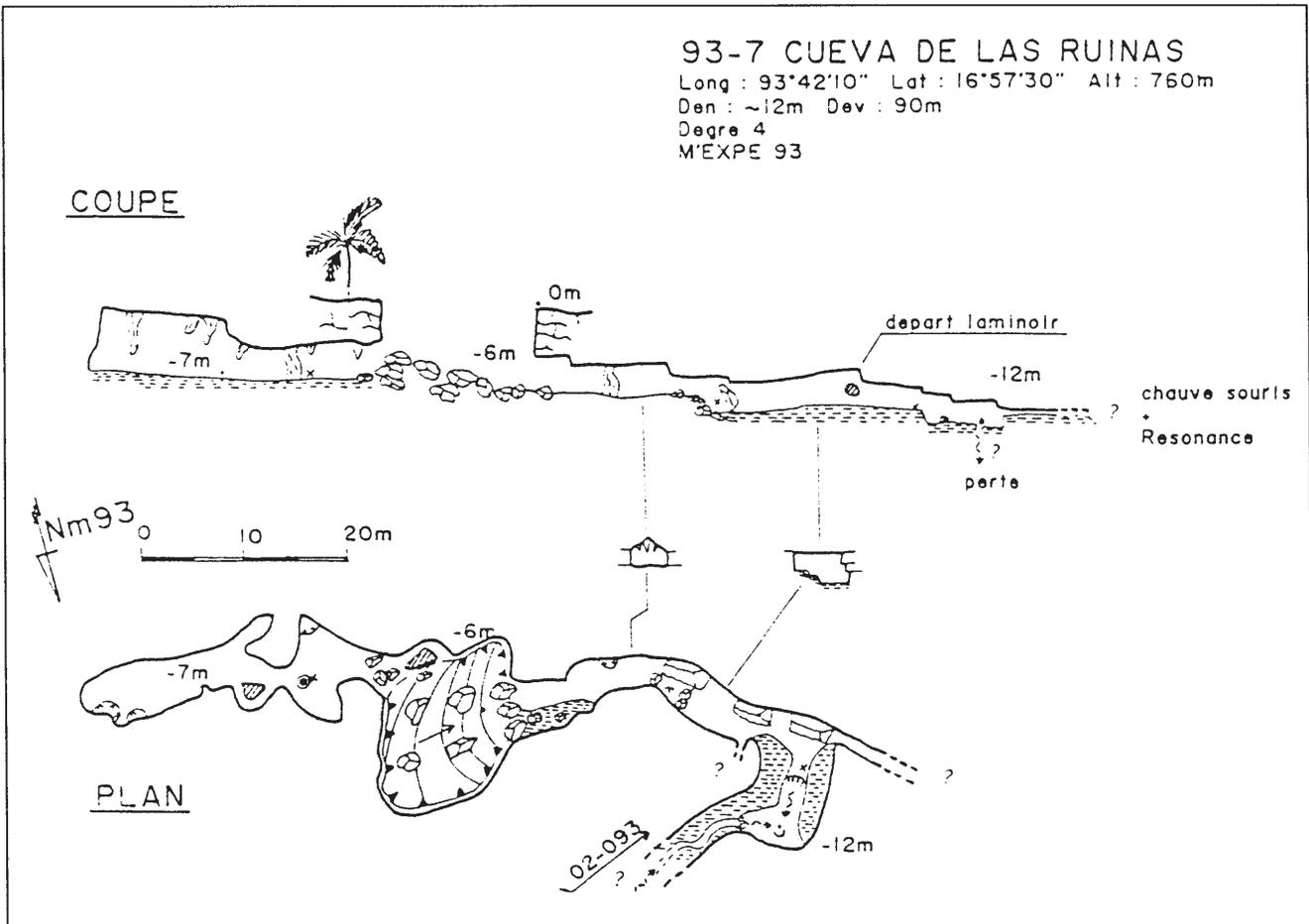
It is in this area that the expedition explored vertical systems, but they

93-19 sima de la covarde

Long: 93° 11' 49,8" Lat: 16° 29' 50,9"
Den: -154m Dev: 22m
Degre 4
M'EXPE 93







were modest. The Sima de la Covarde (93-19) has a depth of 154 meters. But there is better potential, and a connection between the highland plateau and the resurgence would allow a system 500 meters deep. The highlands are divided by the Río Suchiapa. The zone west of the river seems to have the same potential, but it has yet to be checked by any expedition.

It is in the valley of the Suchiapa

that the expedition's biggest discovery lies. El Chorro Grande (93-31), 9650 meters long and reaching 175 meters above the entrance, consists of two underground rivers that join 800 meters before the resurgence on the edge of the Suchiapa. Rooms measure from 10 to 40 meters in diameter. The largest found was 200 by 80 by 40 meters, but the impression of its size is diminished by fallen blocks

dividing the room in two. A lot of climbing leads still need to be checked. The flow from the cave is estimated at 50 liters per second. One of the streams presumably originates from a stream sink located on the highland near El Portillo. The second river is an enigma. Its passage carries a draft that varies in intensity during the day. A search of the southeast of the plateau may find a large entrance.

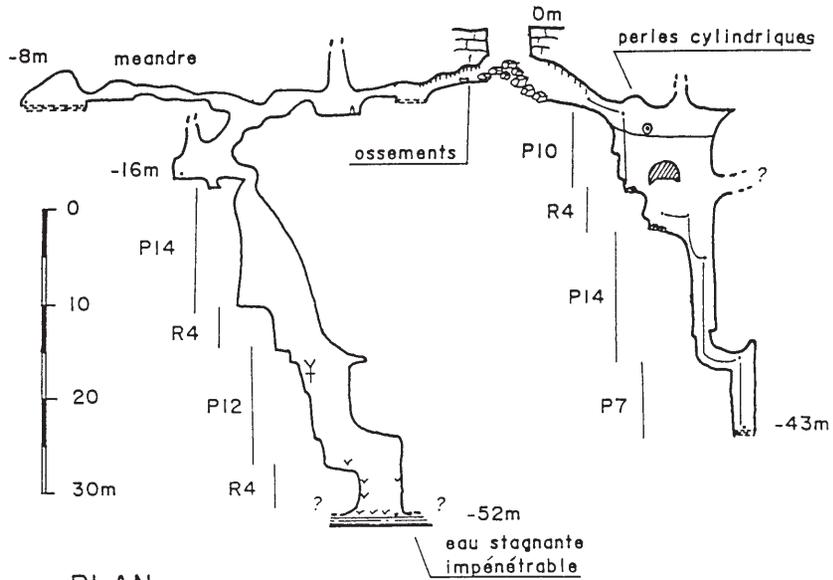
M'Expe 93

De Febrero a Abril, cueveros franceses visitaron dos areas en Chiapas. Un total de 13 kilómetros de pasaje fueron explorados. En la selva de el area del Ocote, ellos encontraron un importante campo arqueológico en El Tepasco del Diablo. En el area de Roblada Grande, ellos topografiaron la resulgencia de El Chorro Grande, 9650 metros de longitud.

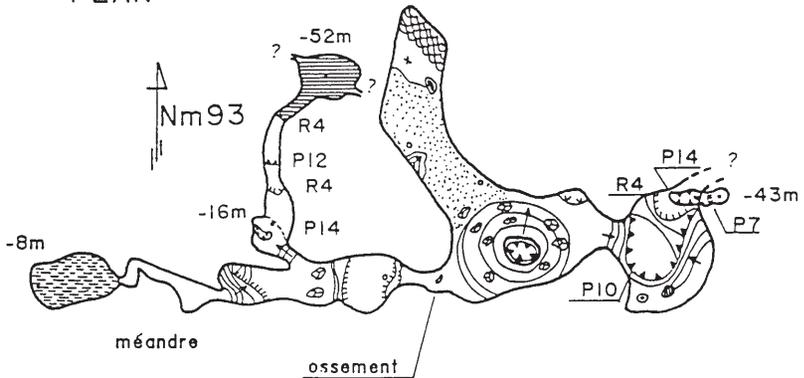
93-26 SOTANO

Long : 93°14'01" Lat : 16°30'48" Alt : 1005m
 Den : -52m Dev : 209m
 Degré 2
 M'EXPE 93

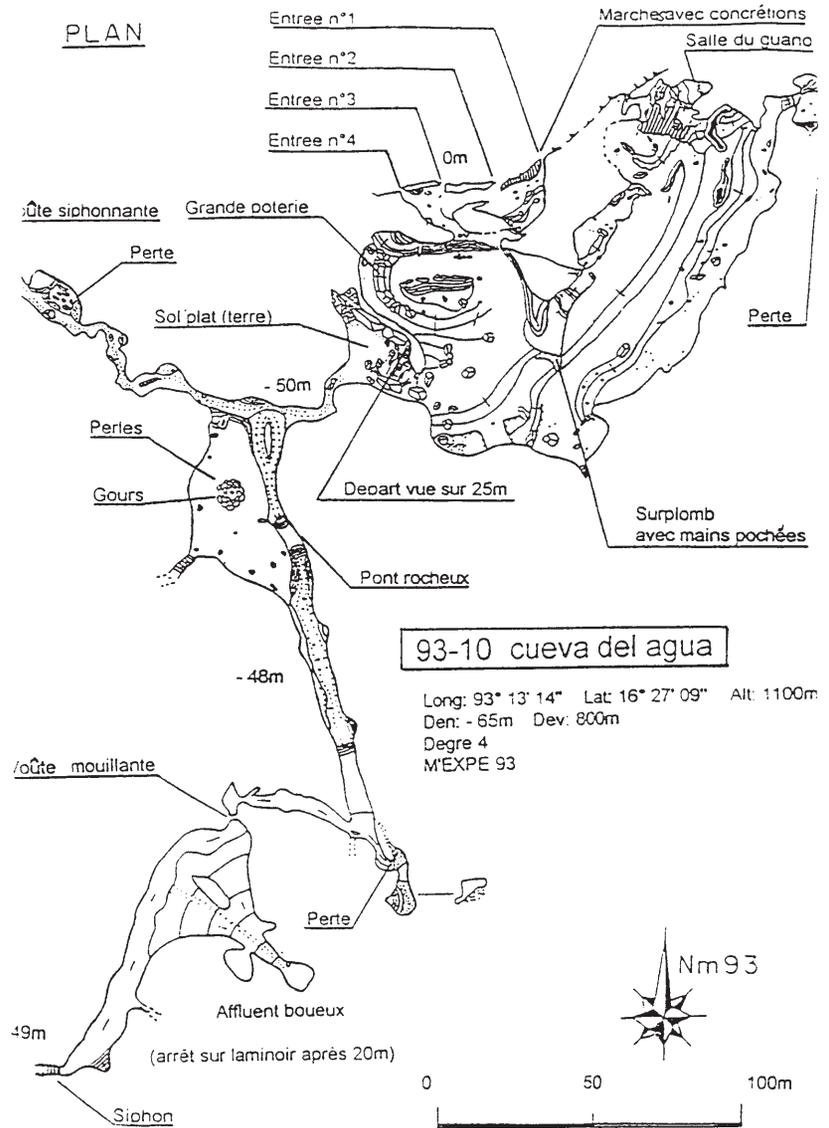
COUPE



PLAN

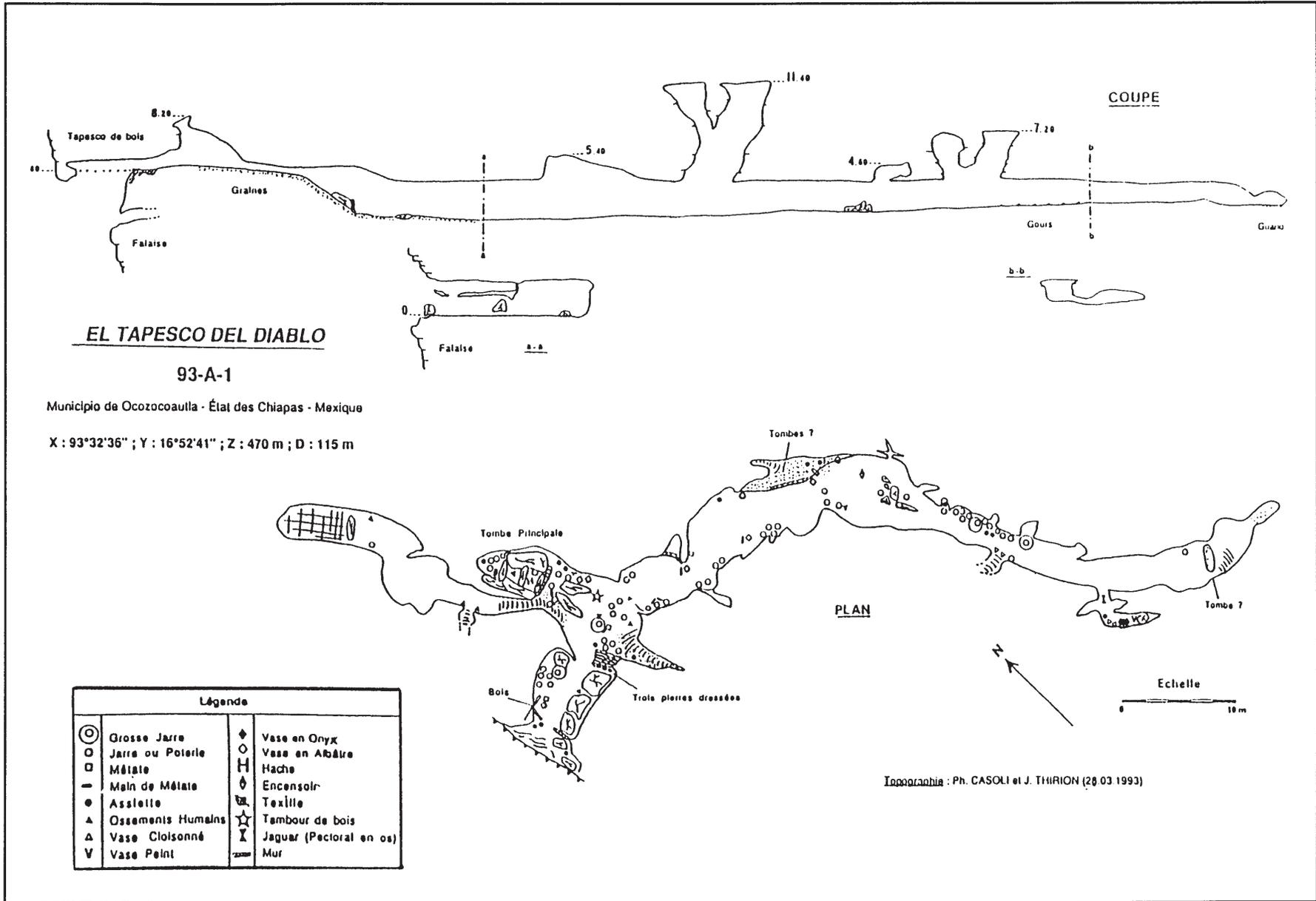


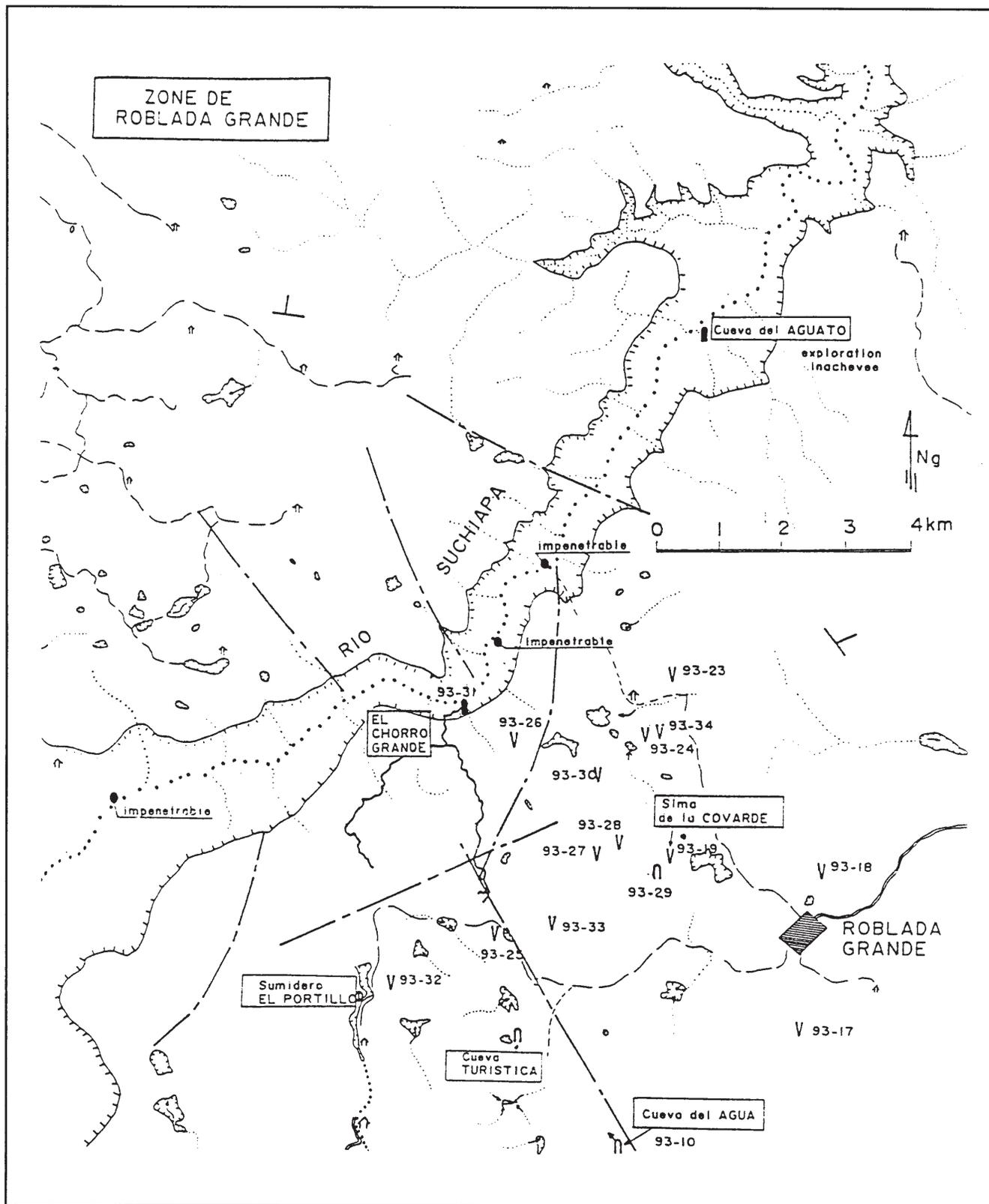
PLAN

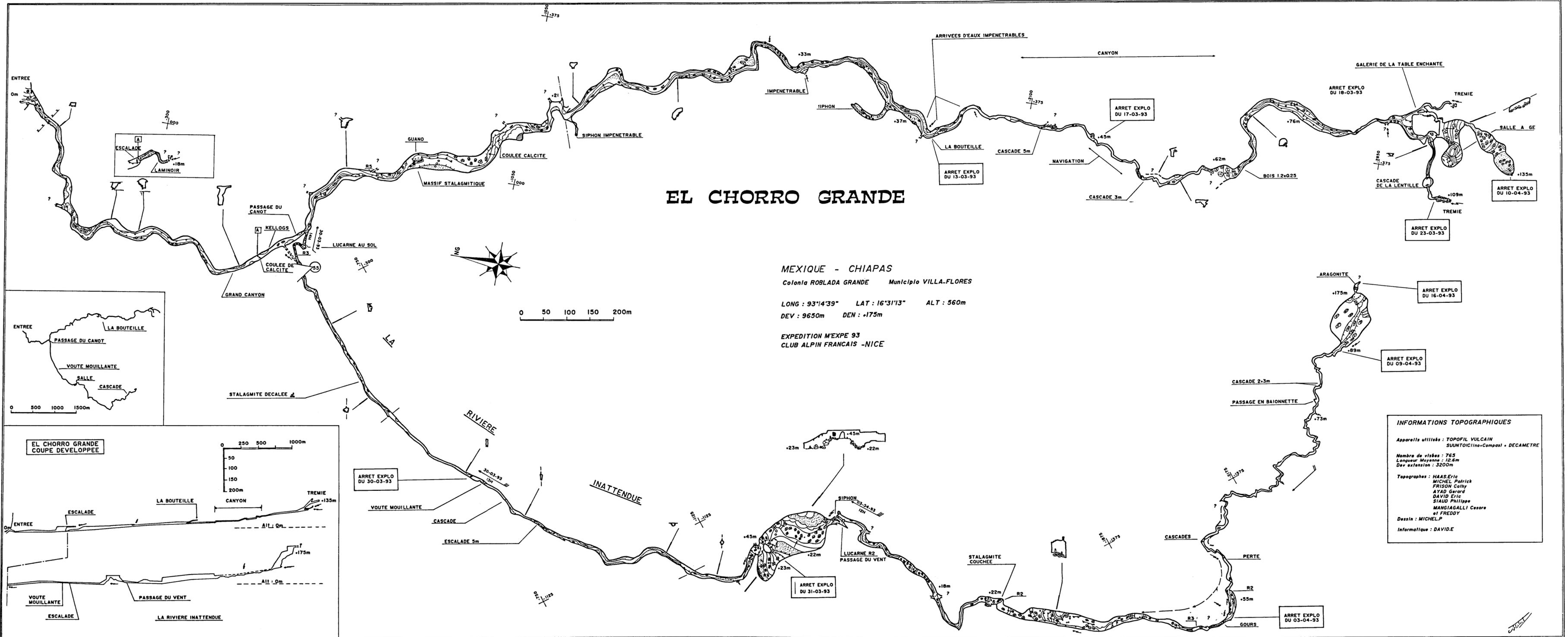


93-10 cueva del agua

Long: 93° 13' 14" Lat: 16° 27' 09" Alt: 1100m
 Den: - 65m Dev: 800m
 Degré 4
 M'EXPE 93







EL CHORRO GRANDE

MEXIQUE - CHIAPAS
 Colonia ROBLADA GRANDE Municipio VILLA-FLORES
 LONG : 93°14'39" LAT : 16°31'13" ALT : 560m
 DEV : 9650m DEN : +175m
 EXPEDITION M'EXPE 93
 CLUB ALPIN FRANCAIS -NICE

INFORMATIONS TOPOGRAPHIQUES
 Appareils utilisés : TOPOFIL VULCAIN
 SUUNTOIC(Ino-Compas) + DECAMETRE
 Nombre de visées : 765
 Longueur Moyenne : 12.6m
 Dev extension : 3200m
 Topographes : HAAS Eric
 MICHEL Patrick
 FRISON Cathy
 AYAD Gerard
 DAVID Eric
 SIAUD Philippe
 MANGIAGALLI Cesare
 et FREDDY
 Dessin : MICHEL.P
 Informatique : DAVID.E

AMCS ACTIVITIES NEWSLETTER NUMBER 21

N°	Dénomination	Den.	Dev.	Long.	Lat.	Alt.
93-1	Sotano des Abeilles	-85m	-	93°33'25"	16°52'27"	1135m
93-2	Sotano de las Avispas	-70m	-	93°36'00"	16°56'00"	1200m
93-3	Cueva de la Providencia	-23m	55m	93°40'03"	16°56'41"	615m
93-4	Cueva de las Apastres	±13m	80m	93°41'46" Coordonnées	16°55'01" incertaines	1000m
93-5	Sotano de la Lluvia	-17m	17m	93°40'36"	16°56'42"	900m
93-6	Sotano Acuaito	-10m	54m	93°40'43"	16°56'44"	920m
93-7	Cueva de las Ruinas	-12m	90m	93°42'10"	16°57'30"	760m
93-8	Cueva San Juan N° 1	-16m	730m	93°29'27" Coordonnées	16°59'47,5" incertaines	660m
93-9	Cueva San Juan N° 2	-18m	130m	93°29'27" Coordonnées	16°59'47,5" incertaines	660m
93-10	Cueva del Agua	-65m	800m	93°13'14"	16°27'09"	1100m
93-11	Sotano	-22m	30m	93°37'00"	16°55'01"	660m
93-12	Cueva	-1m	62m	93°37'38.6"	16°55'46.5"	760m
93-13	Cueva San Anael	-7m	270m	93°37'41"	16°55'45"	750m
93-14	Cueva	-14m	155m	93°39'05.8"	16°55'00"	750m
93-A1	El Tapasco del Diablo	+11m	115m	93°32'36"	16°52'41"	470m
93-16	Sotano del Perito	-31m	-	93°36'00"	16°56'00"	885m
93-17	Sima	-40m	-	93°11'40"	16°28'14"	1145m
93-18	Las Bincas	-25m	-	93°11'29"	16°29'43"	1140m
93-19	Sima de la Covarde	-154m	22m	93°11'49.8"	16°29'50.9"	1080m
93-20-1	Sima del Rastroia del Mais	-200m	-	93°27'48"	16°58'37"	980m
93-20-2	Sima de la Roca Perdida	-80m	130m	93°31'57"	16°57'47"	900m
93-20-4	Cueva de los Bananos	-6m	50m	93°31'36"	16°59'59"	600m
93-23	Sotano los Anaeles	-42m	67m	93°12'48"	16°31'28"	1000m
93-24	Sima Grande	-65m	-	93°12'57"	16°12'47"	1000m
93-25	Sotano le Canello	-8m	140m	93°14'22"	16°29'06"	1100m
93-26	Sotano	-52m	209m	93°14'01"	16°30'48"	1005m
93-27	Sima	-101m	20m	93°13'28.6"	16°29'48.5"	1100m
93-28	Sima	-21m	-	93°13'16.7"	16°29'58.4"	1060m
93-29	Cueva	-7m	18m	93°13'00"	16°29'45"	1060m
93-30	Sima de la Basura	-21m	-	93°12'28.4"	16°30'34.3"	1100m
93-31	El Chorro Grande	+175m	9650m	93°14'39"	16°31'13"	560m
93-32	Sotano	-25m	-	93°15'27"	16°28'46"	1020m
93-33	Sotano	-15m	-	93°13'54"	16°28'16"	1100m
93-34	Finca Los Angeles	-35m	80m	93°13'10"	16°30'55"	1000m

FEAR AND LOATHING IN THE SIERRA MIXTECA ALTA

Louise D. Hose

The Sierra Mixteca Alta in Oaxaca holds abundant limestone, but had been entered by only a few cavers prior to 1994. About a decade ago, Steve Knutson had visited the remote town of Itundujia, where he had seen spectacular karst, but had been denied permission to stay and explore. Jim Pisarowicz had made two return visits to the area since then, but he had the same results. When I mentioned to Jim in the fall of 1993 that I had an interesting and useful friend in the Oaxacan state government, he immediately suggested that we try to return to the Sierra Mixteca Alta. We set the date for Christmas 1993.

Dr. Germán Cruz Martínez, Director of the Office of Civil Protection, wrote a letter of introduction for us and arranged for one person from his office, Luis Javier Valeriano, and a member of Cruz Roja, Luis Gabriel (Wicho) Díaz, to accompany us. I knew both men and knew they would accompany us as fellow cavers and

friends more than as liaison officers. Luis Valeriano had helped negotiate the access to the Cheve resurgence area and has impressive diplomatic skills. As we left the office, Dr. Cruz told us that we were entering a "very dangerous area where people try to solve their problems by killing each other." Jim and I knew that city folks often warned us about the dangerous ways of their country cousins, as our friends in the villages always cautioned us about our stays in the cities, but I also had learned to give our benefactor's words more weight than those of others.

The road to Itundujia had consisted of about 100 kilometers of dirt when Jim had last visited, so we were surprised to intersect a paved road for about 30 kilometers of the trip. But the road returned to dirt, and we bounced our way towards Itundujia. At one point, Jim stopped to confirm that we were on the correct road. "Is this the road to Itundujia?" Jim asked

in his awkward Spanish. "No," came the simple reply. Surprised by the answer and the lack of further explanation, Jim repeated his question and was given the same abrupt answer. Dismayed, he turned to Luis Valeriano, who took the hint and asked again if it wasn't the road to Itundujia. Hearing the fluent Spanish of a Mexican, the man softened his expression and assured us that we were on the correct road. As we drove away, Luis told us the obvious: the road does not go to Itundujia for gringos, only for Mexicans.

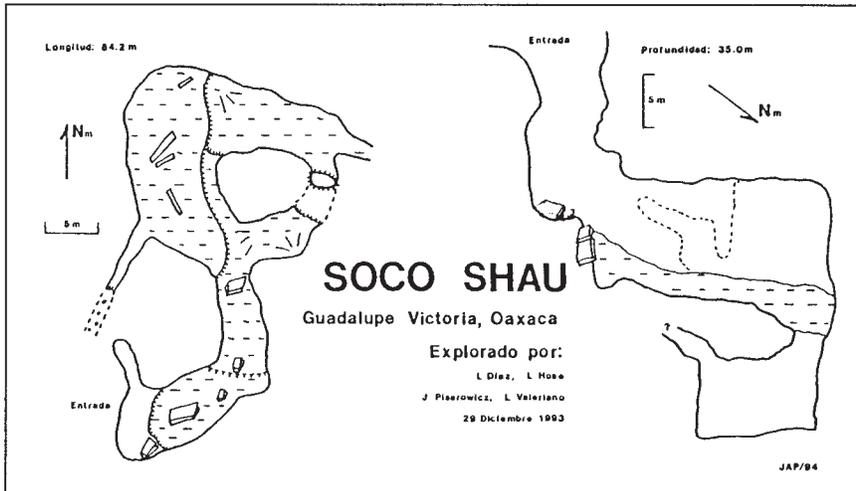
After we reached the town, Jim, Luis, and Wicho went in search of the presidente, and I pulled out our maps and GPS equipment to try to identify the location of the town, which was not on the map. I started a conversation with two pleasant young men who told me that there were many caves in the area, but we were soon interrupted by a *borracho*. Experience had taught me that the combination of a *rubia* and *borrachos* can quickly turn to trouble, so I put my equipment and maps away, excused myself, and went to join the others.

The presidente was not available, and Luis was talking with other town officials. They confirmed that there are lots of caves in the region, but advised us to stay at the hotel in another town about one hour away. They were cordial, but the atmosphere did not seem encouraging. As we left the municipal office, three *borrachos* accosted us. Their tone was not friendly, and I could only understand a little of what they said. As Luis tried to calm their concerns, I realized that the *borracho* who had



The karst near Itundujia.

Louise D. Hose.



approached me earlier had a large knife shoved down the back of his pants. He then pulled a second knife with a 25-centimeter-long blade out from the front of his pants, placing it only a few centimeters from Luis's face. I felt a pang of guilt that our curiosity about caves had put Luis in such a dangerous situation. After a minute or two, the *borracho* returned the knife to his pants and turned his attention to Wicho. At one point, he reached for one of the knives, but thought better of it and released the handle. We left Itundujia with a sigh of relief.

All four of us returned the next day and met with the presidente. Luis made a quick statement about our interest, which was followed by a half-hour monologue by the presidente. The town leader seemed respectful, but he used none of the words that Jim and I expected to hear. There was nothing of caves, pits, or even gringos. The usual concerns of antiquities or gold were not even mentioned. Instead, there were mentions of murders, an inability to protect us, and frustration. Luis listened respectfully, and we left with no attempt to change their opinion.

Outside, Luis and Wicho explained the situation to us. There had been twelve murders in 1993, three in the previous month. People had been shot in the street. One woman had been killed for picking a flower. The town was violent and lawless, and they didn't want the added responsibility of outsiders wandering around. In addition, the people were very possessive of the caves, the town fa-

thers thought, because caves are good places to hide bodies. With so much other unexplored karst in Oaxaca, now does not seem like a good time to try to work in the Itundujia area, and we agreed to withdraw our interest for the next few years.

We returned to the town with the hotel, San Miguel el Grande, and sought permission to explore caves in that region. As is customary in Oaxaca, all the town leaders were summoned to meet with us. Luis made the formal request, and we displayed *AMCS Activities Newsletters*, business cards, and our formal letter of introduction. A contract was drawn up assuring the town that we would send maps and reports on any caves that we explored. We were told that there were no caves near town, so they took us to a very small cave near a village called Benito Juárez. The local folks there told us that it was previously much longer, and animals were frequently lost in it, so they had intentionally diverted drainage into the cave in order to plug it with silt. Obviously they had succeeded. There were apparently no other caves, but there were *socos*. We learned that *socos* is the Mixtec word for pits, so we urged our new friends to show us their *socos*.

Guadalupe Victoria, a nearby village within the municipio, was the site of some reputed *socos*, so we once again did our dog-and-pony show for the community leaders there. Finally, in the late afternoon, we were ready to go caving.

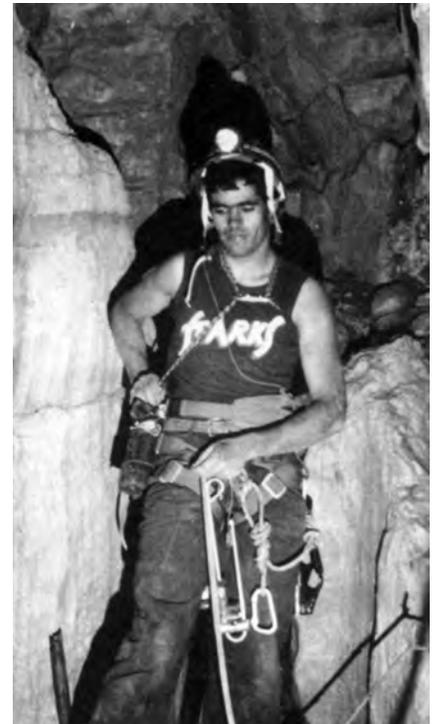
The first cave was Soco Shau (Rain

Pit). It is possible to climb down the first two entrance pitches, and we decided to pursue the cave. Luis and I returned to town, while Jim and Wicho started exploration. Luis told the village elders of our intentions, and their reaction was one of amusement. It was then after dark, and the idea that people would drive from the United States, or even the capital city, to enter their *soco* after dark seemed to strike them as charmingly ludicrous. Luis and I returned to the cave and joined the others. Unfortunately, the cave ended at the bottom of the third pitch. The four of us surveyed the cave on our way out.

The people of Guadalupe Victoria took us to Soco Vaja (Macaw Pit) on the next day. It is an impressive, large open-air pit, but our initial excitement faded when we found we could hike to the bottom, which had a small lake. It was becoming apparent that Sierra Mixteca Alta suffers from severe soil erosion and that the eroded soil was now plugging up caves that must have been extensive in the past.

Our time was up, and we had to return our companions to Oaxaca for family obligations and New Year's

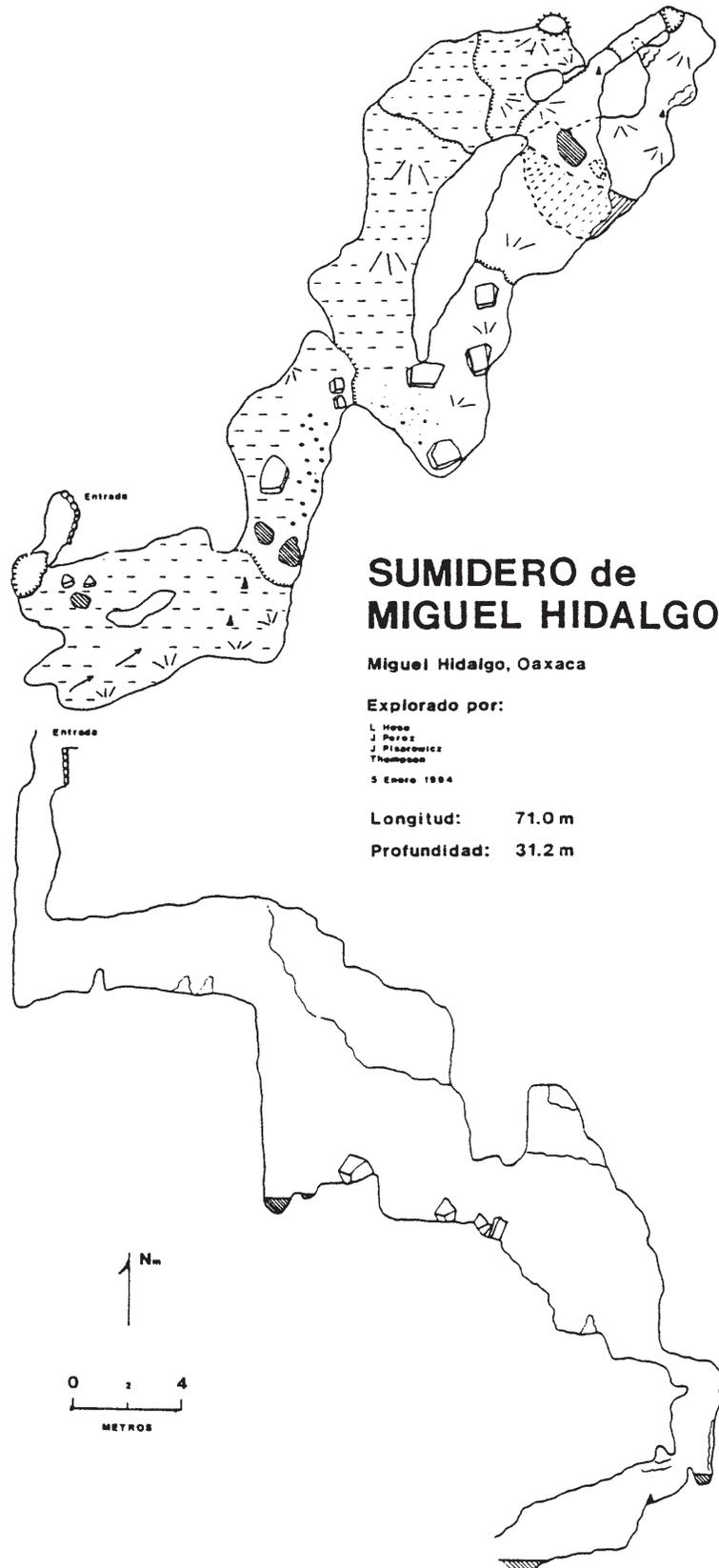
Thompson Guinea at the bottom of Tunchi Cruz ñu Teyuu. Louise D. Hose.



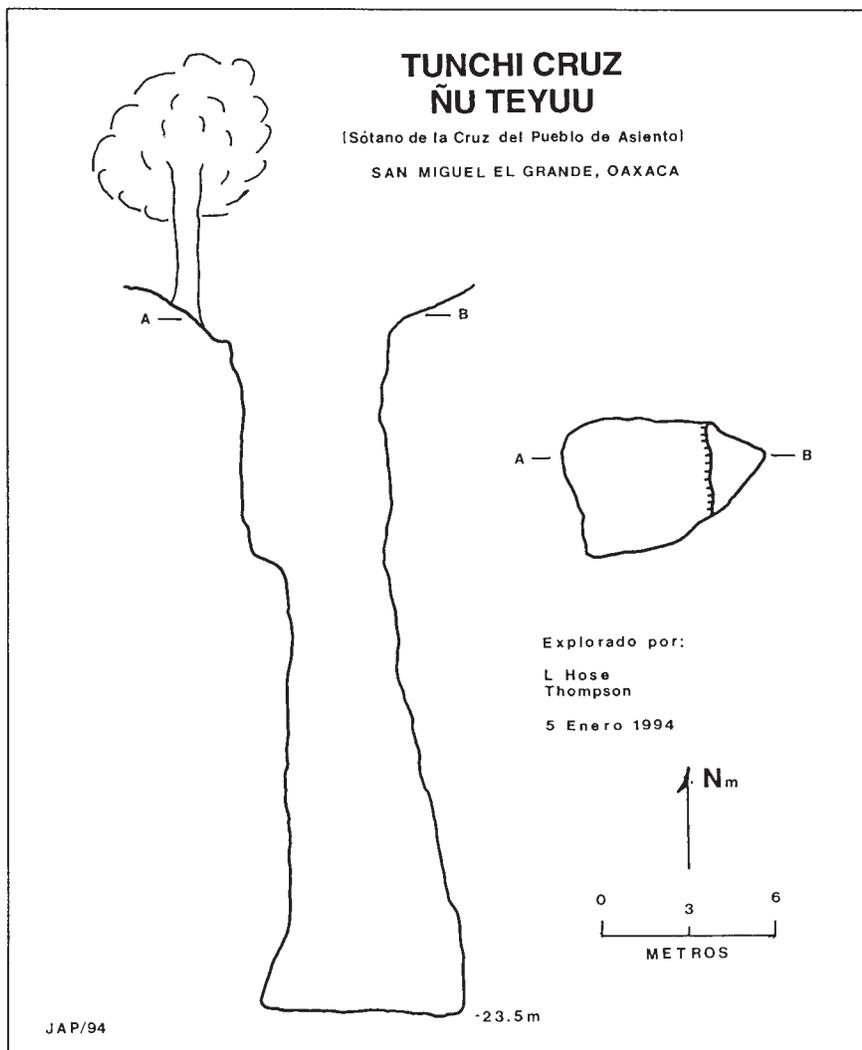
Eve partying. Jim decided to follow the paved road out, assuming that it remained paved to the main highway. But the paved road led to a horrible dirt road that passed through the most devastated landscape I have ever seen. Deforestation, overgrazing, overcultivating, high relief, tropical rains, and wind had combined to cause erosion as bad as any textbook example I have seen. Every plant and building was coated with a thick layer of fine dust.

I had observed some interesting karst features on the topo map near a village called Miguel Hidalgo, which is also within the jurisdiction of San Miguel el Grande. Jim, Luis "Thompson" Guinea, J. Javier Perez (another Cruz Roja caver), and I drove to this area and started our search for caves. On our first afternoon, we found several holes where water drained two large dolines, but only one was very encouraging. As the sun set and Thompson and I returned to the truck, several men approached wanting to know our purpose. It became clear that this community also wanted a formal meeting. We joined Jim and Javier, all the town elders, and a number of other townsfolk in the community building, and Javier made the presentation. The one difference was that one of the three people sitting at the head table appeared to be a woman. Although she had short hair, wore pants, and had an unusual confidence for a rural Mixteca, her voice and some of her mannerisms seemed to be those of a woman. I found her presence on the council very intriguing.

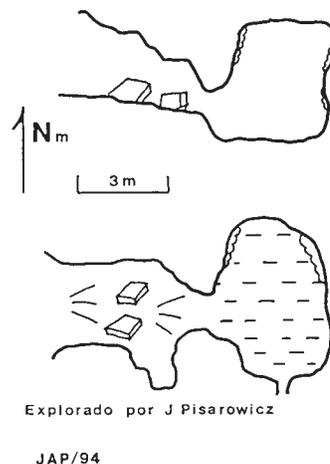
Allowed access to their caves, we returned in the morning to the best lead. It was a pit that the locals say takes large amounts of water during the rainy season. Several people watched, softly chatting in their beautiful Mixtec language, as we set bolts for the first pitch. It was Thompson's twenty-fourth birthday, so we promised him all first descents for the day. Descending the short entrance pitch, we found that the cave boomed off down a second drop. It looked like it was going to go, but it lacked air flow. Unfortunately, Sumidero de Miguel Hidalgo ended with a silt fill soon after the second drop. All leads



JAP/84



CASA de LLUVIA
YOSONICAJE, OAXACA



were checked, and the cave was surveyed. Our observers told me that there is no local source of water and they have to pipe it in. Therefore they were anxious for any information about water. They were disappointed to learn that the cave had only a small pool.

The local men led us to another pit, Tunchi Cruz ñu Teyuu, which proved to be 24 meters deep. The floor is dirt-filled. Thompson, Javier, and I made a map while Jim guarded the rope. Then illness forced an early retreat to Oaxaca.

While looking at topo maps of the Sierra Mixteca Alta, Luis Valeriano pointed out a promising area much closer to the main highway. Luis was unable to join us for our last excursion, but Thompson did. We said our goodbyes to our many friends in Oaxaca city and headed

once more for the mountains.

Our first stop was the town of Nunuma, where the people were standoffish. They told us that there are caves in the area, but that we must first see *La Agente*, who was not available on this weekend. There is also a cave in Benito Juárez (a different village than near San Miguel el Grande) that two people from California explored about three years ago, but that village's leader was not there, either. We speculated on the Californians. Many people cave in Mexico, but there are really very few who will undertake initial contact, especially as a group of only two, and especially in Oaxaca.

Stifled in that area, we drove further into the mountains to the next village. As we drove through Yosonicaje, Jim and I knew caves were nearby. We stopped the truck and encouraged Thompson to question a

local man, who confirmed that there were many caves in the area. Although the *agente* was not available, another village official assured us that there are many caves and we were welcome to visit them. Just one question: "Do you want to only visit our *cuevas*? Wouldn't you like to see our *sótanos* too?"

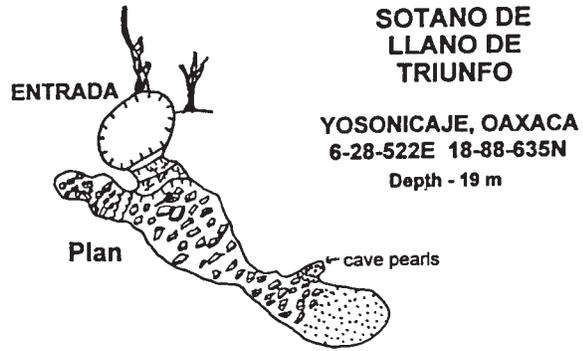
The next morning, we mapped a pit, Sótano de Llano de Triunfo, immediately next to the road. In the early afternoon, we met the *agente*, who was very friendly and struck us as very sharp. He told us that an Australian couple visited the area a couple of years ago on their way to the Sierra Mazateca. I asked their names, and he told me it was "Rolfo y Anna," whom I recognized to be Rolf Adams and Anne Gray. The story then made sense. Rolf had just finished a master's degree at Berkeley about that time and may have been driving a California vehicle. The *agente* assured us that they welcomed our interest in their many *cuevas* and *sótanos* and that they will look forward to our return.

Some local men showed us another pit, Pozo Loma de Pino, which we did not enter, and a small cave, Casa de Lluvia, which Jim entered and sketched. But Jim's truck was making strange noises, and we felt compelled to leave. Thompson, who insists that the number-one rule of life should be to never abandon your partner, remained with us until he



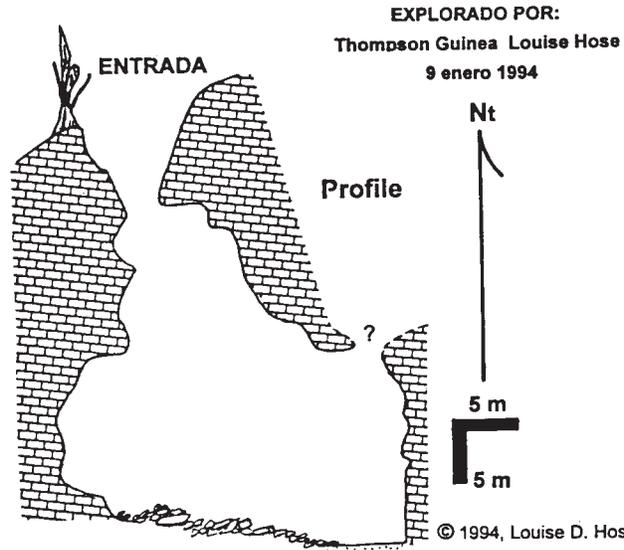
Thompson Guinea making the first descent into Sótano de Llano de Triunfo near Yosonicaje. Louise D. Hose.

was confident that the truck's brakes were fixed. We filled the time by plotting out our continuing alliance with the Oaxaca cavers in the exploration of the promising area at Yosonicaje.



SOTANO DE LLANO DE TRIUNFO

YOSONICAJE, OAXACA
6-28-522E 18-88-635N
 Depth - 19 m



EXPLORADO POR:
 Thompson Guinea Louise Hose
 9 enero 1994

© 1994, Louise D. Hose

Sierra Mixteca Alta

Dos cueveros americanos, acompañados por cueveros de Oaxaca, visitaron la Sierra Mixteca Alta en Oaxaca a finales de 1993. Hay varias cuevas alrededor de Itundujia, pero no pudieron quedarse ahí porque en el pueblo no había quien hiciera valer la ley. Otras áreas visitadas han sufrido de severa eroción terrestre y cuevas que eran de pequeña entrada han sido cuviertas por el sedimento arrastrado. De las áreas que fueron visitadas, la que mas promete, es la de la Villa de Yosonicaje, donde gente amigable les mostró numerosas cuevas. El autor y los cueveros de Oaxaca planean regresar a esa area.

RECENT UNDERWATER DISCOVERIES IN QUINTANA ROO

Steve Gerrard

with a contribution by Gary Walten

The coast of the Yucatán Peninsula between Playa del Carmen and Tulum, Quintana Roo, is part of a low-relief limestone platform with minimal soil cover and rapid infiltration of rain water. The rainy season is from June through December; little rainfall occurs during the rest of the year. Most of the rainfall becomes groundwater. This and the porous limestone create a topography populated with numerous cenotes (sink-hole windows into the water table) that are generally found along fractures reflecting regional northeast-southwest-trending normal faults. The coast contains crescent-shaped inlets (*caletas*) and beaches where fresh water emerges as springs into the Caribbean Sea.

The phreatic water column consists of a fresh-water lens resulting from the infiltration of rain water. Below it is salt water; there is sometimes a zone of brackish water in between. A halocline is the boundary between these layers, where there is a rapid change in salinity and a small change in temperature, from 77 degrees Fahrenheit in the fresh water to 79 degrees in the salt water.

The following descriptions are from a cave diver's point of view. The great majority of cave diving in the Yucatán is performed strictly for recreational purposes by qualified divers from around the world. This diving has led to numerous discoveries of archaeological, biological, and hydrological value. These finds have the potential to influence the future management and protection of the groundwater supply, the cenotes, and the development of this beautiful and environmentally sensitive area. I believe that the more people are exposed and educated about these in-

credible underground cave systems, particularly the people of Mexico, the greater the awareness that will be generated of this beautiful natural resource.

Cenote 27 Steps

Cenote 27 Steps is an unusual name for a cenote located in the Maya world of the Yucatán. It was first dived during the first week of August 1986. Ernesto Sainz, formerly of Akumal but now living in Cancún, and Dr. Les Willis, of Paamul, a tiny campground resort nestled sixteen kilometers north of Akumal, were enrolled in a week-long intensive cave-diving course taught by Steve Gerrard. At that time, cave diving in Quintana Roo was just in its infancy, as only two cave systems had been found for training, Cenote Carwash and Cenote Naharón. This was Gerrard's first cave course taught outside Florida and only the second course in the Yucatán. (The first was taught by Jeff Bozanic of Huntington Beach, California, during March 1985. Hector Indriago of Venezuela, Parker Turner, Mike Madden, and Johanna DeGroot were his students.) Everything was new, logistics were extremely challenging, and stress was a constant factor in hoping that equipment, air, and vehicles would fall into place for a productive and safe course. Luckily, both of Gerrard's students were excellent divers and adapted to the cave environment quickly and comfortably.

It was on the fourth day that Ernesto suggested that the class check out a cenote on a piece of property he was trying to make into a snorkeling and picnic area for his dive store's customers. It was across the highway from the entrance to Akumal

and reached by following a dirt road up a hill and past a water tower. One and a half kilometers farther, Ernesto had constructed two stone pillars as an entrance to a new vehicle trail. This had been difficult to make because of the rugged topography, but it led straight to a beautiful cenote with cliffs that dropped 5 meters to a dry basin, with clear water underneath an overhang that ran half way around the circumference. Densely vegetated with jungle growth, this was a classic depression where one could easily see what had prompted Ernesto's plans. He had already built concrete steps into the cenote. The twenty-seven steps slanted in various directions, with no uniform height or width. He had also built, on piles cut from the jungle, a pier extending 5 meters into the water. A virgin cenote and the opportunity for the class to experience true exploration. Great cave-diving training—perhaps.

Standing on a large, flat rock, the team performed the ritual bubble check and S, or safety, drill. Gerrard would run the reel with knotted line. Behind the rock, a shaft plummeted to 5 meters, where it went on through a slight restriction and the halocline and right into a jumbo passageway with vivid white walls. Laying line along the hallway, we reached a maximum depth of 25 meters, and, at a penetration of 75 meters, the passage began to get small enough that, in view of the tremendous percolation of litter disturbed from the ceiling by our bubbles and the experience level of the group, we called the dive, and a relaxed exit was made. Though the dive was short, the team was excited with the discovery. No survey was done because of the percolation and

the short distance. On the surface, the team decided to try the other side of the basin to see if a downstream passage existed. It did. Following a steep, muddy bank, the basin merged into a low, but navigable passage-way. After 18 meters, it emerged into a nice-sized room. Carefully laying line, the group swam 30 meters and found a vertical crack. Passing back into fresh water, the team slowly ascended to shallower depths. Twelve meters beyond a 90-degree turn to the left, a pleasant surprise was found, an air-filled room. The air was definitely breathable, but there was no evidence of daylight or a way to the surface. There were very few speleothems, but the room was a nice chance to talk and rest. Beyond the room, the passage ended after 18 meters. During the trip out, as they were swimming back through the halocline in the crack, a massive silt-out evolved, making visibility zero. It was at this point that Gerrard decided that taking students into virgin caves was probably not the wisest idea, but the students handled the situation admirably and gained valuable experience, while the instructor lost ten years of hair growth and learned a new definition of stress.

By May 1993, time had changed things. Ernesto no longer lived in Akumal, and the cenote never reached his goal of tourist development. It was abandoned and forgotten. Gerrard was now living in Aventuras Akumal and taking advantage of the opportunity to discover and explore. Had any cave divers been back to explore what had been left in 1986? Could the cenote even be found again? During 1990, the Mexican government had constructed a high-tower power line along Highway 307 at varying distances into the jungle. As cave-divers' luck would have it, the route of this line actually created new access to at least twenty-five cenotes in seven different cave systems. Among them was Cenote 27 Steps, which Gerrard found right next to the power line, with easy access. The concrete steps were still there, but the pier had rotted and sunk in the water. Gerrard invited German Mendoza, a recently graduated cave-diving student who worked at the Akumal Dive Center,

and Leo Sastre of Playa del Carmen, another former student. Both were originally from Mexico City. This would be a great opportunity to go back, check out the cave more thoroughly, and gain experience. Once in the water, the team found the original shaft and began laying line. Gerrard recognized everything. This time, the confident and more experienced team continued along in the main passage where it became smaller, and after another 45 meters they broke out into a much larger tunnel, where they were shocked to find someone else's knotted guideline. To the left, the line ended in a huge ball-shaped room after 90 meters. After retracing their way back to the intersection, the team continued on along the other line, wondering where it went. After 75 meters, they swam up a steep bank and into Cenote 27 Steps. Surprise. Though this entrance had been missed in 1986, someone had found it and laid line. The team then checked the downstream line from 1986 and found it still in place. German and Leo were impressed by the air-filled room.

When they were breaking down the equipment after the dive, Gerrard found the answer to the question of the mysterious new line laying in the dirt beside the ground tarp. He spotted a white line arrow. On one side was written in permanent ink the name Irving. It finally dawned on Gerrard that he had told George Irving of Boca Raton, Florida, about the cenote two years earlier.

On several later trips with various cave divers, the permanent line was extended another 90 meters upstream through a tight restriction, and a few side passages were found and surveyed downstream. During December 1993, Frans Vandermolten and Tom Flynn added another 200 meters of line that terminated in a small, pretty room on the back side of the air-filled room. Total surveyed line in this beautiful cave system is close to nine hundred meters. The maximum depth is 26 meters, with the average being 16 meters, mostly in the salt-water zone, with limestone highly crystallized and much evidence of collapse. All cave divers who have visited this cave have been pleased with both its large passages and its

few more technically challenging sections.

Cenote Ak Tulum Cave System

Reached by driving two kilometers through the back streets of Pueblo Tulum and east into the jungle, Cenote Ak Tulum was first dived in 1987. The team of Hilario Hiler and Noel Sloan, with the late Parker Turner as surface support, made a short dive upstream, installing approximately 100 meters of guideline. It pinched out, and they never returned.

During February 1993, Steve Gerrard performed a single-tank exploratory dive and was able to find the downstream passage by squeezing through a restriction in collapsed limestone. Returning on April 1 with Shelley Baker, he was able to install and survey 360 meters of line. During this dive, they found a huge fossilized sea-turtle shell and bones. The cave, because it is the siphon side of the cenote, contains a thick layer of fudge (clayey silt), and it begins to pinch down to too small for double tanks 300 meters downstream. Additional dives by various cave divers revealed a total of five turtle skeletons, mostly just bones with shell fragments. The obvious questions are, how did the turtles get into the cave, and when? The ocean is approximately three kilometers away. Did they swim in when the ocean was perhaps higher or closer to the cave?

The cenote has become a popular site for bathing and recreation by the Mayan villagers. Most cave divers feel that this surface intrusion has affected the water quality and made this system less appealing for diving.

Cenote Ek Be Cave System

This shallow cave system is located parallel to the high-tower power lines approximately two kilometers north of Cenote High Voltage, which is part of the huge Cenote Dos Ojos system. Ek Be means "star way" in the Mayan language; the name was chosen because of a beam of sunlight that was witnessed during the initial exploration. Cave divers first heard about the cave from members of the Mayan *ejido* San Jacinto Pat, and Frans Vandermolten, Tom Flynn, Steve Gerrard, and Buddy Quattlebaum set out on December 1, 1993, with Mayan

guides in search of the cenote. After a forty-minute hike, they came upon a large, shallow depression, with a crystal-clear body of water beneath an overhang on the north side. Gerrard made the initial dive, swimming upstream against the flow of water. After dropping through a vertical fracture from 5 to 10 meters of depth, he found an obvious large passage going in two directions. This cenote was later named Ch'ul Nay, which means "wet dreams."

The next day, Vandermolén, Flynn, and Hilario Hiler had their equipment and double tanks transported by Mayan sherpas out to the site. Their initial exploration dive yielded 360 meters of surveyed guideline and the discoveries of Cenotes Ek Be, which gave its name to the entire system, and Cot Tunich, "wall of stone," named for walls used by the ancient Maya to trap animals that fell into dry cenotes. They also found Cenote Luk Hole, "mud hole," 30 meters off the main line, not far from Ch'ul Nay.

Excited by their progress, the team took stage bottles the next day to extend their penetration upstream from Cenote Ek Be. They added another 800 meters of line and survey, finding a fifth entrance, Cenote Hep Holes, "tight spots," from its downstream side. (The upstream side of this basin was found by Gary Walten during August 1994.) A third day of exploration added little, but the total of 1201 meters for the initial exploration was exciting.

This system was not pursued again until July 1994. The survey data, plotted on the topographic map, showed that a connection between Ek Be and Dos Ojos was a possibility. Horses were used to carry equipment this time, and the difficult logistics of moving equipment to the cenotes led to the use of solo diving for efficiency. Steve Gerrard began this second phase of exploration in Ek Be. After three days of diving, he had added another 450 meters of line. Upstream only 90 meters from the end of the original Vandermolén, Flynn, and Hiler main line, the passage required side-mounted tanks. Buddy Quattlebaum pushed it a little further, to make this cave system over 1800 meters long. While so far the cave

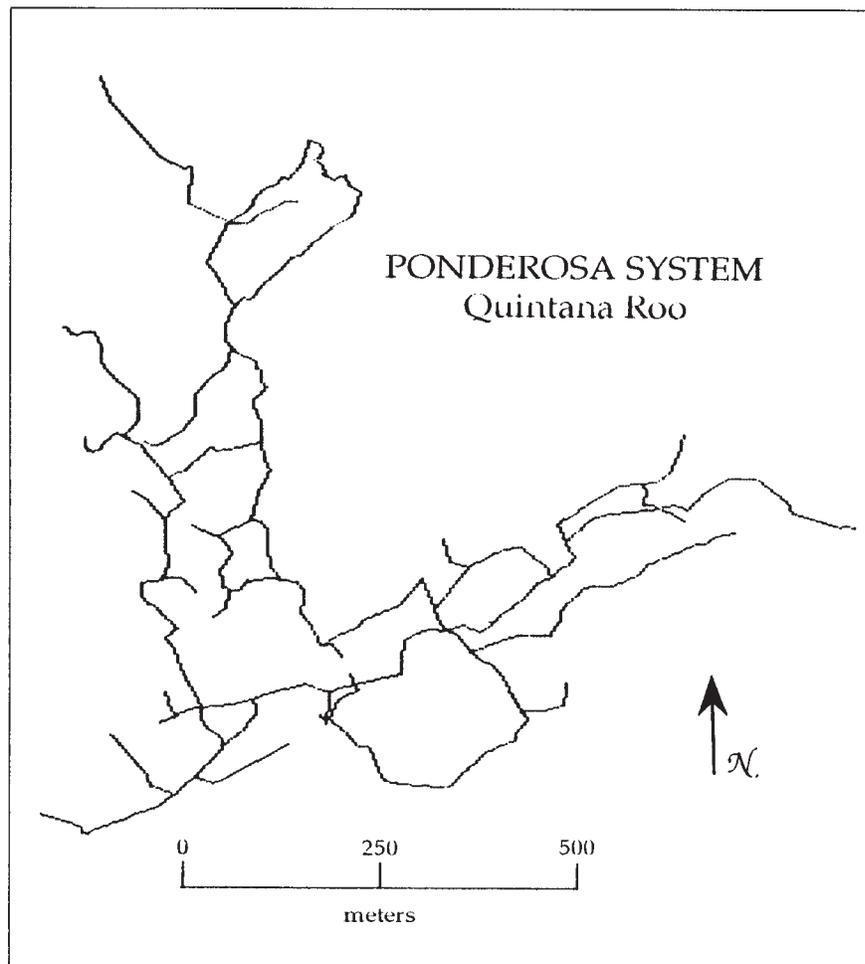
has been disappointing, hopes for a connection have not ended, and exploration still continues, checking every square foot of the cave for the right key to Dos Ojos. In late November 1994, Frans Vandermolén, Tom Flynn, Buddy Quattlebaum, and Kim Cochrane were working in the cave.

The Cenote Ponderosa Cave System

The Cenote Ponderosa is one of the larger cave systems in the Yucatán Peninsula. Currently it ranks number four in our local area, with more than 10,000 meters of surveyed passage and eighteen entrances. Initial exploration from the main Ponderosa entrance was begun in 1990. Nancy and Tony DeRosa and Steve Gerrard first dove the cenote and quickly realized they had a bonanza on their hands; Ponderosa is both a pun on the DeRosas' name and a reference to the classic TV series *Bonanza*. Major lines were installed on the downstream side to prominent areas of the

cave, producing some fine circuits and traverses to other cenotes. One of the best cavern dives in the area is the 90-meter traverse from the Cenote Ponderosa entrance to the Corral Cenote. The tunnel is approximately 24 meters wide by 6 meters high and leads to an area of the Corral Cenote with numerous shards of Mayan pottery on the basin floor. Several cave tunnels lead out of Corral Cenote. One such passage eventually carves its way to a large, oblong fresh-water room approximately 30 meters wide and 60 meters long, named the Pool Hall. Toward the rear of this room is an air-filled dome containing thousands of live stalactites. Since bats are occasionally seen in this dome, divers are assured the air is safe to breathe, and they take the time to fully appreciate this spectacular display. The dome is named the Chapel because of its tendency to confirm one's belief in a higher power.

Another line from the Corral Cenote makes its way to a double cenote



formed in a large collapse area. This dive, Alaina's Garden, is a bit siltier, and there are a couple of Ts in the guideline. Very few people go to this area, and it remains in virtually the same condition as the day it was discovered.

In addition to these, there is a lined passage that circumnavigates the Corral Cenote and eventually returns to the main Ponderosa Cenote. It's not unusual to see several blind fish in a large dome room on this particular route. This is another part of the cave system that very few people frequent.

An entirely different area lies to the north and west of the Ponderosa Cenote. This upstream side is also quite extensive and connects to several cenotes. The guideline to Little Joe Cenote continues north through a variety of passages. There are fragile speleothems in some small zig-zagging tunnel and some big bore-hole passageway through which the primary flow of fresh water passes. Stage dives can eventually reach the end of the line approximately 1200 meters upstream at an enormous cenote named X'tabay after an ancient Mayan god. Non-stage dives are usually turned at or before the Repair Shop Cenote, where double arrows mark a T in the guideline. This cenote got its name because it is a convenient spot to repair or adjust gear during the dive. Between the Repair Shop and X'tabay is a spectacular room called the Wizard's Den that has sizable speleothems. One appears to be a round table roughly 3 meters in diameter on stalagmite stilts. By this point, line arrows are pointing upstream toward X'tabay.

The original route upstream was found off a line in a tunnel that pumps fresh water into the Ponderosa Cenote. This line has now been changed to create a circuit dive with one short line jump. A guide is recommended for this circuit, since visual distortions are caused by the halocline in an area called the River Run. The cooler, flowing fresh water running over the warmer, stationary salt water looks like a flowing stream. Both salt and fresh waters are extremely clear when undisturbed, but when divers swim through, the visibility behind them can quickly drop to nil

because of the halocline. Since this area and much of the upstream part of the system are fairly new to cave diving, divers can expect their bubbles to disturb debris on the ceiling, which will percolate down through the water.

These are just some of the highlights of the Cenote Ponderosa Cave System. The main entrance is located twelve kilometers north of Aventuras Akumal; a key to the property gate and signing in for the landowner are required.—Gary Walten

Cenote Alhambra

Located across Highway 307 from Playa Aventuras next to the high-tower power line, this cenote was shown by local Mayan guides to Steve Gerrard, Shellay Baker, and Luara and C. A. Ernst in early March 1993. The original name was the Screaming Cenote, for Luara's having lost her balance on a log to fall into five feet of thick, sloppy mud, screaming in laughter the whole time. Gerrard and Baker did the initial exploration dive with single tanks and found a large room within natural light that was over 21 meters deep, with salt water below 10 meters.

Gerrard returned on Monday, May 23, with Robbie Osman intending to confirm that this cenote went no further. To their surprise, they were able to lay 300 meters of guideline and find a huge room, the Monolith, which contains a shrine of speleothems. The next day, they were able to add another 300 meters of surveyed line, for a total distance of 420 meters upstream and 180 meters downstream. On this dive they found a picturesque fresh-water dome room that then drops into a bedding plane at the halocline level, creating the image of the Mirror Room.

The downstream section carves its way through soft limestone and ends up in a room with a lot of evidence of collapse—not a confidence-inspiring place to be. One lead reaches a depth of 27 meters, with lots of percolation.

Access to this cenote has been difficult because of a very rugged roadway and trail. The diving center Aquatech/Villas DeRosa in Aventuras Akumal has cleared the trail and is working on the roadway to make it smoother. The large upstream

passage is mostly in salt water, but 95 percent of the cave is 15 meters or less in depth.

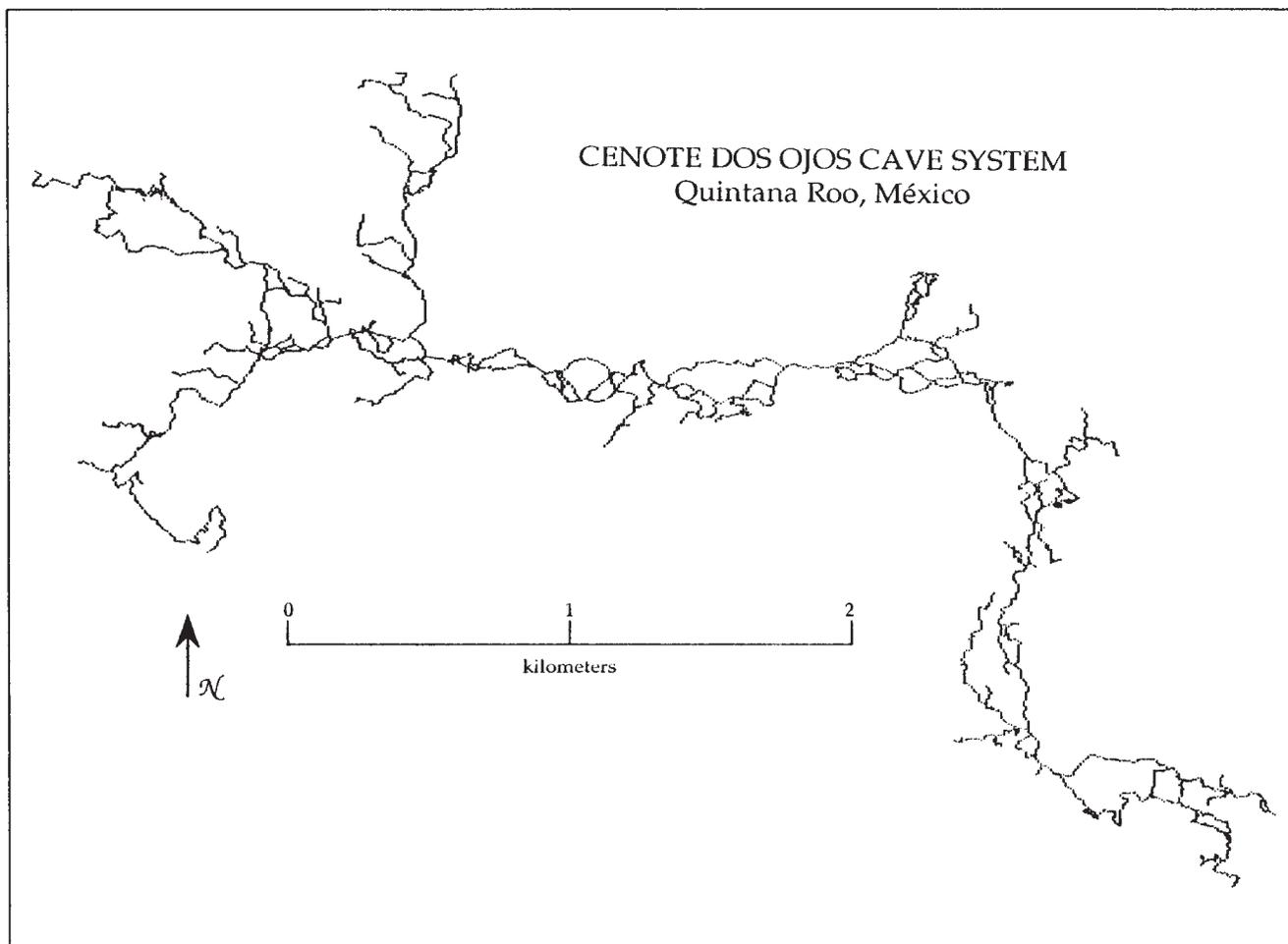
Cenote Dos Ojos Cave System

During 1994 several cave divers were able to explore and survey enough underwater cave passage in Cenote Dos Ojos (Two Eyes) Cave System to push it past 30 kilometers (100,000 feet) of survey, and it continues to grow.

Dos Ojos was first discovered and explored by cave divers Jim Coke and Johanna DeGroot in 1986. This double-collapse cenote is several kilometers into the semi-tropical jungle west of the Xel-Ha Mayan ruins on Highway 307. Access was gained by a road that could only be traversed in a four-wheel-drive jeep that died during early 1988, causing exploration to be dormant for several years.

In early 1992, Buddy Quattlebaum, originally from Miami, Florida, and Marcos Rotzinger of Mexico City established a diving business called Divers of the Hidden World. They made an agreement with the *ejido* San Jacinto Pat that controls a huge tract of 9700 hectares surrounding Cenote Dos Ojos and many more. The company is responsible for maintaining the road and enforcing safety regulations on cave and cavern divers and snorkelers. A fee is paid to the *ejido* by each recreational diver. This has reopened access to the cave system and allowed continued exploration.

Many new cenotes have been discovered and connected to the system during the past two years, and it is now known as the Dos Ojos Cave System. Upstream, connected cenotes are Tikim Chi and Kentucky Castle, while downstream, all of the following cenote entrances are known: Mot Mot, Dos Palmas, High Voltage (Tic Te Ha), Tapir's End, Monolith Room, Don Hilario's Well, The Crack, Where Are We?, and Estaban's. Many cave divers from around the world have contributed to the exploration and survey of this highly decorated and magnificent underwater cave system. The principal explorers have been Jim Coke, Johanna DeGroot, Lori Beth Conlin, Chuck Stevens, Buddy Quattlebaum, Steve Gerrard, Dan Lins, Gary Walten, and Kay Pozda



Walten, the last five being currently active in the system. Another twenty-five divers have contributed to the exploration.

The most popular recreational dive is the 1800-meter traverse from Dos Ojos downstream through Dos Palmas, High Voltage, and Tapir's End to the Monolith Room Cenote. Since the maximum depth is 11 meters and the average depth is 5 meters, the entire dive can be safely done within the thirds air rule from an entrance without staging tanks, and there is a single continuous guideline from start to finish.

Cenote Dos Ojos itself is considered the best cavern dive in the world. These two gigantic openings are approximately 60 meters apart from air to air, so the diver is never more than 30 meters from the air surface. Maximum depth is 7.5 meters. All dives are led by a fully cave-qualified guide, and the team never numbers more than four. The crystal-clear 77-degree water offers unlimited visibility.

[Cave divers make a distinction between "cavern" dives and full "cave" dives, with the former limited to short penetrations within sight of the entrance.]

Divers plan to continue pushing upstream to the west through borehole passages and to make connections to three major underwater caves nearby, Cenote Ek Be, Cenote El Mundo Escondido, and the Xel Ha Ruins Cenote area. The Maya have discovered on the surface several other, unnamed cenotes that have not been explored yet, but are within striking distance of the Dos Ojos Cave System.

In the first week of November 1994, cave divers Kay Pozda Walten and Don Lins made a huge discovery in the Dos Ojos system. They had been pushing a lead from the Cenote Tikim Chi, 2 kilometers west of Cenote Dos Ojos, using stage bottles and scooters, when they stumbled across a pit that drops to over 80 meters (265 feet) in depth, with horizontal passage con-

tinuing from the bottom. The top of the pit is at least 60 meters in circumference. What is truly amazing is that the entire body of water in the pit appears to be fresh water with flow. If so, this will be the first discovery of a deep-water spring vent in all the caves along the Caribbean coast of the Yucatán peninsula.

Cenote Nohoch Nah Chich Cave System

During October and November, the 1994 Nohoch Exploration Project took place. This annual exploration project is spearheaded by Mike Maden, owner of Cedam Dive Center in Puerto Aventuras. The system had approximately 25 kilometers of passage at the beginning of October, and the project had three goals. The first was to continue the superb artistic cartography by Eric Hutcheson of Ocala, Florida. The second was to connect Nohoch with Cenote Balamanche, which was located to the southeast and contained more than 3

kilometers of passage. The third was to push Nohoch to the west toward a cave system appropriately named Outland. In addition, the project planned to continue the video and photographic documentation of this beautiful system by photographer Bill Carlson of Minneapolis, Minnesota.

The team was camping in the jungle near Cenote Ferndock, with palapa huts, portable compressor, generator for charging lights and diver-propulsion vehicles, and daily food supplies eliminating long hikes and portage of tanks. The project had little success in extending the system

during the first five weeks, but the last week proved fruitful, as Madden and Hutcheson were able to find new, big passage heading northwest from the Pablo Díaz—X Line area and make a connection to a huge new cenote, the name of which is not known.

On Thursday, November 17, Chuck Stevens and Eric Hutcheson finally succeeded in connecting to Balakanche, after two years of effort with side-mounts. This significant connection has pushed Nohoch considerably over 30 kilometers of passage, with Stevens and Hutcheson

adding more line in huge new passage in Balakanche.

Dos Ojos and Nohoch Nah Chich both have over 30 kilometers of explored, surveyed passage, an incredible wealth of underwater cave in a small area. These two huge underground river systems are located less than three kilometers apart and testify to the massive underground drainage from the interior of the Yucatán Peninsula to the Caribbean coast. These new discoveries continue to demonstrate that the northeast coast of the Yucatán Peninsula offers the best cave and cavern diving in the world.

Cuevas bajo el agua en Quintana Roo

Muchos recientes descubrimientos de cuevas bajo agua (la mayoría de poca profundidad), han sido en la templada costa del Caribe de la Península de Yucatán; cerca de Tulum, Quintana Roo. Las dos cuevas con mayor longitud en dicha area, ambas con muchos cenotes como entradas, son el Sistema Dos Ojos, con alrededor de 30 kilómetros de pasaje y el Sistema Nahoch Nah Chich, con 39 kilómetros. En Noviembre de 1994, un tiro bajo agua, que alcanzó la profundidad de 80 metros, fué encontrado en el cenote Tikim Chi que es parte de el Sistema Dos Ojos. Quintana Roo tiene las mas largas y mejores cuevas bajo el agua en el mundo.

Sheck Exley

Every battle with death is lost before it begins. The splendor of the battle cannot lie in its outcome, but only in the dignity of the act.

—Paul Louis Landsberg

It has been two months now since that fateful day in Mexico. It hasn't been an easy time, probably due to my inherent nature to withdraw and draw lines that place me on the other side of any inquiry into what I deem sacred. I alternate between attempts to ignore, on the one hand, and to rein in my mercurial temper on the other. I've been angered by unkindness and idle speculation by armchair quarterbacks, and I have been touched by those who seem to understand and genuinely express sympathy without trying to pull something out of my soul.

Much has been written in praise of Sheck, and more will come. Ultimately, he will mean even more to us, as history, its eyes blind to the emotions of the moment, sees him as the pioneer he truly was.

With the help of fellow Texans Drs. Bill Hamilton and Gordon Daugherty, we will seek a cause or reason for his death. I know that we all seek that. Reason has an enormous weight for us, and we can't imagine living without the unrelenting pull of its gravity. It is a way of conquering the fear that accompanies the inexplicable. As for myself, I'm not sure that I believe there's an answer to every question, a reason at the core of every act or thought. I do understand why we all seek the answers. We have to seek the answers or find ourselves at the mercy of the questions. My seeking is also intimately entwined with my intention to again attempt to reach the bottom of Zacatón. After all, we *both* failed in that attempt. I possess a record I never thought I'd possess, but it is still short of Sheck's and my



goal. What do I hope to see or accomplish when I do reach the bottom? I'm sure that I will view a barren, frightening landscape much like the top of Everest. As for the accomplishment, I think few would understand, but my former comrade in arms would be among them. In fact, to even attempt to explain would be as distasteful as sharing an intimacy about this most dangerous of ladies—Zacatón.

I first met Sheck in Mexico in 1988, when he was there making his world-record dive to 780 feet in Mante. I drove up to the spring while he was in the cave. At that time I felt a bond that was, I believe, to be the basis for our friendship. He was alone in that great beautiful system. His support staff of only three, Ned DeLoach, Sergio Zambrano, and Angel Soto, were awaiting his return. In this ego-maniacal discipline (sport?) of cave diving, it was refreshing to see a man accomplishing the impossible without the fanfare and entourage that we see so often in much lesser endeavors. Sheck sought my friendship

as I did his for the same reason: we were loners for the most part. He was the only one of the northern Florida group that respected my work, as he did the work of other explorers in all parts of the world. I'm sure that Charles Maxwell in South Africa, Jochen Hasenmayer in Europe, and Zambrano and Soto in Mexico would agree that he was interested, humble, and supportive of projects that many cave divers didn't even know existed. Sheck and I were friends by a common bond. It is difficult to form close friendships at our age. Sheck and I didn't have the foundation of growing up together, sharing a background of youthful follies, adventures, and loves. We had only our obsession, our passion, our love of exploration. Exploration was a demanding mistress that, I'm sure, got in the way of our relationships with others, and I know it caused a great deal of pain to those who loved us. We could spend most of a day at Zacatón without even talking to each other. Our personalities were direct opposites. He was easily the most disciplined man I have even met. Sheck had a calm intellect and strength that he often cloaked in the "good ol' boy" image seen by others. A reluctant hero, if you will. On the other hand, I'm fifty-two years old, still get in fights, drink too much at times, and am competitive to the point of always being in a world alone. Yet we got along great. Perhaps we were most alike in our child-like excitement on our quest for the impossible. Karen and Ann have both said that we had looked like little boys who had found the greatest treasure on earth when we discovered that Zacatón was the world's deepest cave-dive site. Perhaps it shows in the photo that hangs over my desk and was published in *Outside* magazine. I do believe that we both were

never more alive than in those moments of trial in virgin space.

Mexico loved him. He truly respected the culture and ways of my adopted home, Mexico. The rural poor of Mexico have a remarkable ability to judge courage, honesty, and sincerity. The only time I allowed myself to succumb to emotion during those days of our loss was when I walked alone to the edge of Zacatón and saw the simple cross and flowers

put there by the people of El Nacimiento and Higeron. Mexico is still a place where a man can be a man and affection can be more binding than ceremonies and words. Sheck met life head on, with few misconceptions. Only death deceived him, taking him by surprise.

Project Zacatón will continue. There was never any question about that. I have been quoted as saying that it would be an insult to Sheck to

shut it down, and it would, but it will continue because it is essential to my nature. This is where I am most alive and where I am most happy. I found this system some five years ago and put it on hold to obtain the technical training and support to make its exploration possible. Sheck gave me that. I will miss him very much, but then we always dove alone. Perhaps now he will be with me more than ever.—*Jim Bowden, June 1994.*

Ian Rolland

I met Ian during my first trip to England, in 1985. We had both come at the request of Rob Parker to work on the exploration of Wookey Hole in the Mendips. Ian was barely twenty years old. Parker had told me how lucky he had been to find at the last minute this young, enthusiastic lad who would haul loads to and from Chamber 24 every day, and always with a smile. He was very good, and he had that route so well rehearsed that he was able to dive ten low-visibility sumps (five in, five out) with packs nearly the size of himself, yet reliably arrive at the Queen Vic Inn up the road by 6 P.M. each day, like clockwork, for a pint of Butcums. Now there was a man worth knowing! During the main push, we spent five days camped out in Chamber 24 supporting Parker in his effort to crack Sump 26. Ian had cheerfully played a supporting role until the final afternoon, at which point he quietly asked Rob, "Mind if I have a look?" He left camp by himself with three tanks of trimix and a bottle of oxygen and descended nearly to Parker's limit. It was his first mixed-gas dive. I never realized it at the time, but these were all trademarks of Ian: initiative, modesty, and being totally at ease working solo at the frontier.

In the following nine years, Ian and I became close friends with a



common goal, fielding an expedition to the Sótano de San Agustín in southern Mexico. The nature of this expedition particularly appealed to a man of Ian's professional talents, as well as to his unabashed lust for exploration. It involved the development of experimental closed-circuit backpacks for cave diving. From 1989 until 1994, Ian was present in the United States for more than four months of development, testing, and training

with the ever-changing apparatus. It was his precise feedback and "test-pilot" commentary that helped guide the development toward apparatus tailored to the needs of the team. His unrelenting enthusiasm served to push us all onward in the face of despair when some new idea failed to work.

On a cold January 16 this year, Ian came to my house in Maryland to help with the final organization of the expedition. During the two weeks that we lived and worked together before the main team arrived, I saw the same drive and dedication, but in an older, more worldly man. He was now a family man, too, and he loved his wife and children, not only his own three about whom he spoke often, but other children who would visit us during our month-long effort to make sure that everything was ready for the trip to Mexico. He carried photos of his family in his caving helmet and, quite often, had a small teddy bear up there too, lashed to the outside. That teddy bear had probably been on more expeditions than most individuals would be privileged to participate in over a lifetime. It was, apparently, also cave-diving certified, for I had certainly seen it a number of times lashed to the manifold of open-circuit diving hardware when Ian was on safety duty for someone diving the rebreather, and

later on the rebreathers Ian used. Ian often joked, "If he gets bent, that's when I know I'm really in trouble."

In the expedition world, leadership is recognized and respect is earned by actions, not words. Ian merited both attributes on any project he was involved in. At San Agustín he was always in the lead, rigging, hauling equipment, planning the next mission. There was not a day that went by that Ian did not bring a list of some sort to the breakfast table for discussion. At first it was a list of rigging requirements, later provisions for Camp 3, and finally auxiliary decompression tables, which he had generated himself, for the initial dives in the San Agustín Sump. His RAF managerial skills shined when it came to helping maintain the operation on an efficient track. He popularized the old RAF phrase "chocks away" to indicate to the whole team it was time for action, usually followed whimsically by, "Be back in time for tea and medals."

He had a team spirit and a sense of mission that were unstoppable. I distinctly recall one late evening in early March of this year. He and Kenny Broad, the wise-cracking professional diver turned PhD student who had become Ian's inseparable apprentice in deep caving, were down at the -300-meter level in San Agustín, rigging. The plan was for them to rig to a certain location, after which I and Barbara am Ende would take over. They were using an electric impact drill to set rock bolts. The battery had, some time earlier, been drained. Undaunted, Ian had taken out the drill bit and, holding it with his bare fingers, used a rock hammer to set the bolts. When I reached the rope above them at around 10 P.M., I yelled, "The cavalry has arrived." He

grinned and said, "Ah, Mr. Stone. Right on schedule." And so was he. They had painstakingly set those final bolts by hand, with no drill holder, to keep things on track. Only much later did I learn that when he set off, on March 27, to explore the chamber that now bears his name, the last words he said to Kenny were, "If I'm not back by 10 P.M., call out the cavalry."

Two years ago Ian was diagnosed with diabetes. His response was typically Ian Rolland: to tackle the technical problems that this change in his body would entail and then to press on at full power. His expedition schedule never skipped a beat. He had asked me directly whether this condition would affect his position on the team. He, of course, knew that none of us could stand in his way after nine years of his life had been dedicated to the project. It was just his polite way of putting the issue to rest.

In late March, two months into the expedition, we were finally at the obstacle that had brought us to Mexico, the San Agustín Sump. Ian and I were in the lead on this particular day, rigging the final stretch of the Lower Gorge. When we reached the bottom of the last pitch, I recognized the beginning of the sump, took off my vertical gear, and swam to the staging point used in 1981, a little in-feeder passage to the right with a one-square-meter flat space. When Ian arrived, I said, "Welcome to the San Agustín Sump, Mr. Rolland." He replied, as he always did, in his cordial fashion, "Thank you, Mr. Stone, and it is very good to be here . . . finally." I, for one, was awfully glad Ian was there.

On the basis of his drive and his proficiency with the rebreathers, Ian was a natural selection to be on the

initial exploration diving team, along with Noel Sloan and Steve Porter. Working, living, and sleeping at Camp 5, suspended over the sump, they began exploration of one of the most challenging obstacles in modern history. Although no lead diver had been designated, it was agreed among those at Camp 5 that Ian would make the first dive. Within three days, this team had explored 250 meters of underwater tunnel while operating in extremely poor visibility. They then took a rest break and retreated to Camp 3.

At that time, Kenny Broad expressed interest in moving on to Camp 5 and having a go at cracking the sump. Ian promptly offered to go in a supporting role. Kenny immediately succeeded in extending the line a significant distance to the south. The depth was decreasing. Fired by this breakthrough, Ian and Kenny began taking alternate leads toward what they were now sure would be the long-sought far side of the San Agustín Sump. When Kenny returned on dive eleven saying he had broken through at a distance of 430 meters, Ian immediately made plans for a solo reconnaissance of the new territory beyond. He was exploring virgin land at the limits of human endeavor when he died. For Ian Rolland there could be no more befitting epitaph.

For those of us who remain, there is an unfathomable sense of loss, not only of an irreplaceable team mate, husband, and father, but of a personal friend who shared some of our best memories. I shall remember his drive, wit, sense of mission, and unselfish team spirit. Ultimately, we must pick up and carry on, as he would have. Chocks away, Ian.—*Bill Stone, September 1994*

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