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THE COVER

The cover depicts the official logo used at the 8th International of Speleology held in July, 1981 at the Western Kentucky University, Bowling Green, Ky. This issue features the historical papers which were presented at that convention.

BACK ISSUES

All copies of back issues of the Journal are presently available. Early issues are photocopied. Send requests to Jack H. Speece, 711 E. Atlantic Avenue, Altoona, Pennsylvania 16602. Issues from Vol. 1, No. 1 to Vol. 7, No. 2 are available from Kraus Reprint Co., Route 100, Millwood, New York 10546 on microfiche.

Editor: Jack H. Speece
711 E. Atlantic Ave.
Altoona, Pa. 16602

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THE JOURNAL OF SPELEAN HISTORY

Volume 15, Numbers 3 & 4 July - December, 1981

INTERNATIONAL CONGRESS OF SPELEOLOGY SPECIAL ISSUE

Early American Speleological Writings, Jack Speece 30

History and Contributions of the Western Speleological Society, William Halliday 32

The Guacharo Cave, Dr. Eugenio de Bellard-Pietri 34

Pioneers of North American Cave and Karst Science Prior to 1930, Ernst Kastning 36

Un Pionnier de la Speleologie: le Peintre Suisse Casper Wolf (1735 - 1783), Pierre Strinati 38

The World's Longest Underwater Cave, Sheck Exley & Ned DeLoach . . 39

Endangered Species Legislation in the U.S., Thomas Lera . . . 40

Cave Conservation in the U.S., An Overview in 1981, Robert Stitt . 42

Archeological Investigations in Sand Cave, Ky., George Crothers . 44

Cave Diving in England in the 1950's, Oliver Wells 46

The eighth International Congress of Speleology was held for the first time in the United States the week of July 18-24, 1981 on the campus of Western Kentucky University at Bowling Green, KY. Although the Congress is primarily for scientific aspects of caves, a formal history section was adopted and a session held on Wednesday morning. Chairman for the session was O. Ondroasek from Czechoslovakia and R. Gurnee of the U.S., served as secretary. Papers for this session was presented by P. Strinati, J. Speece, E. Kastning and W. Halliday.

This special issue of theJournal is an attempt to place all of the historical papers presented at the eighth International Congress of Speleology under one cover. Although only four papers were presented at the history session, other papers with historical significance were presented at other sessions and are included herein. A special thanks should be awarded to all of those who participated and served to make this event so successful.

At the end of the Convention a gala event was held at Cumberland Caverns under the supervision of Roy Davis. Even under stressful conditions, all who attended were awed at the magnificance of the cave, the meal, the fine entertainment and the spectacular chandalier. This happening can rank among the best of underground events of all times.

Early American Speleological Writings

Jack H. Speece
711 E. Atlantic Ave., Altoona, PA., 16602, U.S.A.

Abstract

Prior to 1750 the only mention of caves in America was contained in the journals of the early explorers and specific names and locations were omitted. Later, caves were mentioned as landmarks and curiosities. Thomas Jefferson was one of the first to recognize and write about the scientific aspects of caves in this country.

Although America is in its youth, little has been done to organize its early speleological writings. Caves have played an important role in the country's history and progress and have been the subject of great legends and folklore, but little has been written about them and the few writings which do exist are widely scattered.

Résumé

Avant 1750, la seule mention des cavernes en Amérique se trouva dans les publications de premiers explorateurs. Les déscriptions précises, les noms et les locations furent omis.

Plus tard, les cavernes furent mentionnees comme bornes et curiosités. Thomas Jefferson fut un des premiers à reconnaître et écrire au sujet des aspects scientifiques des cavernes dans ce pays.

Quoique l'Amerique soit jeune, on fit peu pour organiser des documents spéléologiques. Les cavernes jouerent un rôle important à l'histoire et au progrès de ce pays; et furent le sujet des légendes et des superstitions populaires, mais il y en eut peu ecrit les rares documents éxistants sont bien éparpillés.

Long before modern white man ever landed on the shores of the American continent, caverns were being used by the natives for various unique purposes. Archaeologists have been studying the remains of these people for more than 100 years. Caves have helped to preserve these pieces of historic data by preventing them from being destroyed by the elements. Russell Cave, Alabama, is a good example of such a site. A chronological order has been uncovered here which traces man for 8,000 years. Radiocarbon dating of charcoal remains associated with lithic remains at Meadowcraft Rockshelter, Pennsylvania, show that man has existed in these parts since 17,000 B. C. and is among the oldest discoveries in America.

The only ancient written reference to caves in America is found in the Book of Ether, Chapter 13. This was originally written by Ether in approximately 400 A. D. These translations describe how the author dwelled "in the cavity of the rock" during great battles between the Jaredites under King Coriantumr and the Nephites under King Skiz somewhere in northeastern United States (Ohio, Pennsylvania or New York).

The Northmen were believed to have visited North America about 1,000 A. D. It is highly unlikely that Eirik the Red, the Greenlanders, Bjarni Herjolfsson and other Vikings ever found any caves during their visits. Columbus, however, probably did view a few caves in 1492-1493 while on the islands of Bahama, Cuba and Hispaniola. The Spanish explorers who followed: Balboa (1513) in Panama, Ponce de Leon (1513) in Florida, Diego Velazquez de Cuellar (1516) in Cuba, Hernan Cortez (1519) in Mexico, Panfilo de Narvaez (1528) in Florida, Hernando de Soto (1539) to the Mississippi, and Francisco Vazquez do Coronada (1540) in southwestern United States and Mexico, all should have seen great caverns. No records have ever been reported from their reports or journals.

In 1566 Diego de Landa, a Spanish Priest, wrote on his travels through the Yucatan andincluded references to several caves. His writings are presently on file at the Franciscan Convent at Merida, Mexico. Antonio Vazquez de Espinosa in 1629 wrote descriptions of the karstic ebb-and-flow springs near Chiapas, Mexico. His works are found in Seville Archives of the Indies, Spain. Athanasius Kircher started to publish a series of encyclclopaedic works in 1655 entitled Mundus Subterranens. Another description of a Mexican cave which was covered with a kind of leaf-gold was written in the Philosophical Transactions, Vol. 3, No. 41, dated November 16, 1668.

Not only were early records made in Mexico but also of the islands which Columbus discovered. The underworld of Bermuda was recorded by Captain John Smith in 1624 while searching for fresh water, mentioning that in some places there were "verye strange darke and cumbersome Cause". The island of Madeira was described by Sloane in 1707. Barbados was mentioned by Hughes in 1750 and Long wrote a history of Jamaica in 1774.

The early explorers of the United States also left a few journal references. Friar Rodrigo de la Barreda in 1674 visited an impressive cavern in Florida "with three apertures buttressed by stonework of unusual natural architecture". Reports on the expeditions of such men as Hernando De Soto in southeastern United States, Jacques Marquette and Louis Jolliet up the Mississippi, Dulhut and Viele would be interesting to the speleohistorian.

In September of 1700, Le Sueur ascended the Mississippi River into the Meramec River and recorded in his Journal that he viewed several lead mines and small saltpetre caves in Minnesota. This area was explored earlier that year by Father James Gravier from Illinois and later by Father Jacques Marquette whom some give credit for discovering the Meramec Caverns. This distinction is shared by Philip Renault and dated somtime in the early 1920's. None of these claims, however, have been substantiated by actual written accounts. Le Sueur's journal has been reported to exist but its location is unknown. The first known written reference to a Minnesota cave was made by Jonathan Carver in November 1766 when he explored a cave which was named after himself.

An early landmark along the Ohio River is Cave-in-Rock, Illinois, which has quite an impressive entrance. This feature was noted on maps as early as 1764. Some reports state that M. de Lery observed the site as early as 1729 and referred to it as "Caverne dans le Roc". Charlevoix also recorded its existence in The History of New France (1744) which includes Bellin's Map of Louisiana. The cave's reputation for being a rendezvous for outlaws did not begin until about 1795.

The first American map to show a cave location was produced by W. Scull for Thomas and Richard Penn, Esquires, in 1770. This was a map of Pennsylvania which showed a cave along Maiden Creek about 12 miles north of Reading.

One of the first major settlements in the United States was Jamestown, Virginia, in 1607, but it wasn't until after the turn of the century that many ventured far from the coastal planes. A major trail westward into Kentucky was through the Cumberland Gap, also known as Cave Gap, where Cudjo's Cave and Soldiers Cave are located, which was first blazed in 1750. This brought about more writings on the natural wonders of Kentucky by such men as Filson in 1784 and Fiteroy two years later.

A forerunner in American Speleology was Thomas Jefferson. As early as 1783 he was working with Isaac Zane to verify the uniformity of temperatures within a cave. A year earlier he privately published Notes on Virginia in France. These "notes" contained the first known American cave map, that of Madison's Cave in Virginia, along with several other cave descriptions. Saltpetre caves also became a matter of great concern to Jefferson, along with other wealthy merchants, shortly after the Revolutionary War began. Blowing Cave at Panther Gap, Virginia, and the bones of a giant sloth discovered in a Greenbrier County, West Virginia cave also took his interest. Numerous letters were written to individuals concerning all aspects of speleology. Some have considered Jefferson as the Father of American Speleology but, due to his greater accomplishments as a Statesman, this title has not been imposed.

George Washington also was curious about caves, leaving his name on the wall in a small West Virginia cave named after him in 1748. This cave was later used by Washington and his compeers as a masonic lodge during the Revolution. Washington was the first to survey Natural Bridge and also left his name in Madison's Cave.

In the latter half of the 1700's and early 1800's, Europeans were making tours of North America and Virginia in particular and made extensive reports on their experiences. Most seemed to have viewed the same places,

such as Natural Bridge, a cave near Winchester, Virginia, where the water ebbs and flows, Lost River, Madison's Cave and several other caves of minor importance. Some of these better known explorers included Burnaby (1760), Carver (1778), Chastellux (1787), Anburey (1789), and Weld(1799).

By the end of the 1700's Americans were traveling to Europe and making reports on the great caves of the eastern hemisphere. Other foreign cave reports appeared in noted magazines of the day and were written by unknown authors, perhaps of British origin. Men with scientific interests were also discovering bones, fossils and saltpetre in caves and writing articles, making speleology a respectable study.

The search for obscure cave references in the magazines and journals of this country and Europe should still contain a wealth of information. It is interesting to see how our forefathers felt about this science which we consider so precious. A keen eye will observe speleological passages in the historical material one reads and only by publishing its existence can the bibliography of American Speleological Literature become more complete.

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History and Contributions of the Western Speleological Survey

William R. Halliday
117 36th Ave. East, Seattle, Wash., 98112 (U.S.A.)

Abstract

The Western Speleological Survey is a small, informal organization whose operations deliberately are low profile except in the field of conservation in which it is vigorously outspoken. It was chartered in the state of California in 1955 and now is incorporated in the state of Washington. Currently it has units in several western states, and has initiated or assisted in speleological studies in Vancouver Island (Canada), Belize, and Okinawa. It has had an especially active role in preservatin of caves and karst and their features, such as inclusion of the Mineral King caves in Sequoia National Park, protection of underground wilderness in Mammoth Cave national park and the Guadalupe Mountains, opposition to the use of certain caves as fallout shelters, protection of the Karst from overindustrialization, and assurance of safety in siting of nuclear plants in karstic terrains. Most recently, it has been very active in attempts to protect the caves of Mount St. Helens from post-eruptive mudflows. To date, more than 60 WSS bulletins have been published, and two monographs. On July 31, a fundamental change will occur in the WSS.

Zusammenfassung

Der "Western Speleological Survey" is eine kleine, zwanglose Organisation, deren Arbeitspensum absichtlich mit "Arbeit in der Stille" bezeichnet werden kann. Eine Ausnahme besteht jedoch, wenn es sich um das Gebiet der Naturerhaltung handelt, dann äussert man sehr kräftig seine Meinung. Gegründet wurde der WSS in Jahre 1955 im Staate Kalifornia und besteht nun auch im Staate Washington. Zur Zeit bestehen Verbände der WSS in verschiedenen westlichen Staaten der USA und man hat mit folgenden Höhlenforschungen entweder begonnen oder dabei assistierti` Vancouver Island (Canada), Belize, und Okinawa. Der WSS spielte eine besonders aktive Rolle in der Erhaltung von Höhlen und Karst und deren Charakter, wie zum Beispiel die Einschlüsse in den Mineral King. Höhlen im Sequoia National Park and Schutz der unterirdischen Wildnis im Mammoth Cave National Park und in dem Guadalupe Mountains. Eine entscheidende Rolle spielte Opposition zum Gebrauch von einigen westlichen H-hlen als Fallout-Deckungs-schutz, Schutz des Karst von Überindustriegebrauch, Erforschung und Zusicherung von Sicherheit, sollten nucleare Anlagen im Gelünde des Karst erbant werden. Gerade jetzt war der WSS ungeheuer tätig, um die Höhlen des Mount St. Helens von Erdrutschen, welche noch nach dem Vulkanausbruch stattfanden, zu schutzen. Mehr als 6+ WSS Bulletins sind bis heute veröffentlicht worden und ausserdem noch zwei international anerkannte Monographs. Am Ende dieser Aufseichnungen soll eine specielle Ankündigung stehen, sie ist von sehr grosser Bedeutung für den weiteren Weg der WSS.

* * *

The Western Speleological Survey is a small, low-profile group of western NSS members dedicated to systematic exploration, study, and preservation of caves of the western United States and elsewhere. Informality is its keynote. Often we do not know how many members we have and for many years the WSS existed entirely without funds or even a treasurer. Yet its contributions to world speleology have been significant.

The WSS Constitution was dated July 11, 1955 and it was chartered by the state of California on December 9 of that year. Its roots, however, are several years older. The late 1940's saw a sudden mushrooming of speleological activity in California. Three new NSS grottos -- the only ones in the western half of the United States -- were vigorously hunting for caves. In late 1948 or early 1949 NSS Bulletin Ten - The Caves of Texas - reached the membership. In California, we reasoned that a similar bulletin on the caves of California would greatly advance California speleology. In 1950 the California grottos jointly proposed such a publication, and the idea was favorably received "back East", where the rest of the NSS was located. Various individuals and teams undertook feature articles and systematic regional reports. Teams engaged in the latter increasingly formalized as a Clifornia Speleological Survey. The results soon exceeded the ability of the NSS to publish them. The California Division of Mines took over the project and for several years it considered publishing the report. Having been appointed coordinator of the Caves of California project by the NSS Board, I became Director of the California Speleological Survey and continued in that position until 1974 when Dell Quick was appointed. Beginning in 1955, in the later stages of the Caves of California project, some of its units began to publish, mostly in the form of field trip reports or preliminary drafts of their sections of the report. These were the first WSS publications even though most of them bore no WSS serial number. To date, its Mojave Division has published 5 bulletins, its Mother Lode Division 2 bulletins, its Santa Cruz-Monterey Division 7 bulletins and its Southern Sierra Division 4 bulletins. Its Shasta-Siskiyou Divis.on never has been activated. In 1962 Caves of California (Halliday, 1962) was published as the first special publication of the WSS. Although it is long out of print, it remains the definitive study and is greatly sought by today's speleologists.

Charter members of the WSS included members of the Salt Lake and San Jaquin Valley grottos of the NSS as well as myself. Our initial plans were for units like the CSS in all the western states, but our studies soon trended more and more to its western part. Initial WSS compilations on New Mexico were transferred to the Texas Cave Survey which published an initial review of this and other data in 1958 (Widener, 1958).

The Washington Speleological Survey began almost as early as the California survey, and even more informally. It preceded and helped create the Cascade Grotto of the NSS, first in the entire northwestern quarter of the United States. All other NSS grottos in Washington and Oregon are second or third generation offspring of the Cascade Grotto. Initially, few caves could be found in Washington state. Enthusiasm waned. The grotto became inactive for several years, and only the Washington survey continued speleological activity here. Nineteen fifty-six to 1959, however, saw tremendous breakthroughs in knowledge of caves at Mount St. Helens, Cave Ridge, and elsewhere. Much of this was the result of WSS field parties. The Washington survey has published 15 bulletins to date (1-26-81). The last four issues have dealt with posteruptive studies of Mt. St. Helens caves; the WSS is the only organization which has received a permit for such studies. Other reports are in preparation. Other topics include two bibliographies, spelean fallout shelter studies (which were effective in preventing inappropriate designation of some of this state's caves as fallout shelters), the first published call for a national mounument to protect the Mount St. Helens caves, and reports on several unusual glacier caves. I served as Director until 1979 when Jim Nieland was appointed. In 1963, Caves of Washington (Halliday, 1963) was published by the state's Division of Mines and Geology, as a result of the survey's activiites. Among its effects was the recruitment of a president-to-be of the NSS: Charles V. larson, who first learned about speleology from Caves of Washington.

The Oregon Speleological Survey has had the most complex and controversial history of any WSS unit (Halliday, 1978). Its existence was announced in 1956 (Halliday, 1956), but it continued mostly as a one-man survey (myself) until 1958 when Portland and Bend cavers formed OSS units. I continued as Director until 1969 when Steve Knudson briefly served as Acting Director but soon abandoned his appointment. I took over again until 1975 when Charles V. Larson was appointed Director. Late in 1977, three friends of the former acting director incorporated another OSS and another WSS in the state of Oregon. As far as has been determined, these organizations exist in name only. The OSS has published six bulletins to date, a monograph should appear in 1981.

The history of the Idaho unit also is complex. It formally began in 1956 with M.W. Echo as Director (Echo, 1956), but he subsequently moved away and the ISS became inactive. Subsequently the Idaho Bureau of Mines developed its own statewide cave survey, leading to the publication of Introduction to Idaho Caves and Caving (Ross, 1969). A year earlier, The Gem State Grotto of the NSS had published Caves of the Gem State (Thornton, 1969), also based in part on WSS and ISS data.. Unfortunately, its title page erroneously stated that it was "Publication #1 of the Idaho Speleological Survey." This was not authorized and would nothave

been authorized because of the report's inclusion of overexact, potentially harmful location data, contrary to WSS policy (Halliday, 1960). The ISS actually was not reactivated until 1977, when Frank Ireton became Director. To date, ISS studies have appeared in the WSS Miscellaneous Series.

The Utah Speleological Survey began in 1952 (Halliday, 1952). Dale Green became Director in 1957. It has waxed and waned, functioning mostly as an arm of the Salt Lake Grotto of the NSS. Because of that grotto's Technical Note Series, there has been no need for USS bulletins.

The caves and some cavers of Arizona presented special problems. One problem was the potential initials of an Arizona Speleological Survey. In 1958, John Shaydak, its director, therefore named the first Arizona survey the Arizona Thunderbird Speleological Survey. After his transfer to Kansas in 1959, the ATSS became simple the Arizona unit of WSS, and its contributors remain anonymous.

No Nevada Speleological Survey has been organized. A so-called California-Nevada Speleological Survey was merely a summer-long field trip by members of the former Sanford Grotto of the NSS in 1952. Alvin McLane has served well as an unoffical on-man survey in this state, publishing A Bibliography of Nevada Caves (McLane, 1974) and other reports. His work is independent of the WSS but correlated with it.

In 1959 Howard McDonald became Director of the Montana Speleological Survey. He collected and systematized much data and in 1960 he published two MSS bulletins. After 1963 his owrk was continued by the Shining Mountain Grotto of the NSS, eventually leading to the publication of Caves of Montana (Campbell, 1978) by that state's Bureau of Mines and Geology. Caves of Wyoming (Hill et al, 1976) and Caves of Colorado (Parris, 1973), however were entirely independent of WSS work.

Outside the United States, the Vancouver Island Speleological Survey formally arose out of a meeting between Derek Ford and myself at Glacier, B.C. on July 3, 1966. But its roots informally date to 1962. Dave Dunnet and I served as initial co-directors. Its field work and publications formed one of the two initial mainstreams of the Vancouver Island Cave Exploration Group. By 1970 the success of VICEG ended the need for a VISS, from 1963 to 1967 it published three bulletins.

In the Pacific, I began to study and collect data on Okinawan caves in 1955, and subsequently maintained a repository for what became the Okinawa Cave Society. In 1979 this material was transferred to Shigeru Ohde at the University of Ryukyus. For a time, these efforts were called the Okinawa unit of the WSS.

Also in 1955 I published an initial report on caves of Hawaii as a Bulletin of the Miscellaneous Series of the WSS. Subsequently it was reprinted in the NSS Bulletin. No Hawaii unit of the WSS has existed.

In central America, Barbara MacLeod conducted systematic speleological studies in Belize from 1971 through 1975. These and other's subsequent work have been termed the Belize Speleological Survey (MacLeod, 1972). WSS personnel assisted and participated in some of these studies, but the relationship was extremely informal and no one seems quite sure whether these should be considered WSS activities.

Informality and lack of funds were not wholly without problems, however. In 1977 it was decided to reorganize the WSS, the Washington survey, and the Oregon survey as tax-exempt corporations. This was done on January 9, 1978, under the laws of the state of Washington. Immediately prior to this action was its publication of the Proceedings of the International Symposium on Vulcanospeleology and its Extraterrestrail Applications as a WSS Special Publication when the NSS was unable to finance it.

In addition to the two Special Publications and the bulletins of the component state surveys, the WSS also has published 19 Miscellaneous Series bulletins including the Hawaii report, various speleogenetic, speleomineralogical, and speleobiological reports, additional spelean fallout shelter studies, bibliographies, and conservation analyses (primarily on underground wilderness in Mammoth Cave National Park, and protection of Rainbow Bridge from the Glan Canyon reservoir). To date, WSS publications total 64.

The WSS has played an especially important part in preservation of caves and karst and pseudokarst and has been vigorously outspoken in many conservation actions. As its Director, I have written many letters, articles, reports, and other writings for this purpose. I have participated in formal and informal meetings and conferences from Washington, D.C. to Washington state, and was the NSS representative at the First World Congress on National Parks. The WSS has been particularly active in preservation of the Mount St. Helens cave area, the Mineral King and Stanislaus River caves in California, Rainbow Bridge National Monument, the proposed Great Basin National Park in Nevada, the Guadalupe Mountains, the karst of Lost River, Germany Valley, and the Meramec River, underground wilderness in Mammoth Cave, and, recently, the preservation of karstic areas from unsafe nuclear plants. In 1980 it was my special honor to be a speaker at the International Symposium on Uses of Karstic Areas, in Trieste, to help save The Karst from inappropriate industrialization.

At the January 1980 meeting of the WSS Board of Trustees, I informed the WSS Board that I wished to retire as Director, effecgive July 11, 1980 when I officially would have completed 25 years in that position. The Board accepted my retirement and appointed Charles V. Larson as the second Director of WSS. However it proved impractical for him to assume the Directorship until July 31, 1981. My presentation of this paper, therefore at the 8th International Congress of Speleology should be my last formal action as Director of the Western Speleological Survey. I wish to express my thanks to all those who have assisted its work through the years, and my best wishes to its new Director.

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The Guacharo Cave

Dr. Eugenio de Bellard-Pietri
Apartado 80210 - Prados Del Este, Caracas - Venezuela 108

Abstract

Guácharo Cave is Venezuela's largest cavern (10,200 meters explored). The tourist sector (about 1,200 meters) harbors the largest known colony of oil birds in the world (about 19,000) and has an interesting fauna (rodents, bats, spiders, centipedes, and miriads of insects). Due to the fact that the birds bring seeds in their crops and regurgitate them, the cavern's Humboldt Hall (759 m. long) holds a number of seedling forests during the breeding season. The tourist sector can be divided in three successive sections: a) Humboldt's Hall, b) the Hall of Silence (240 m. long), c) the Precious Hall (100 m. long).

The beautiful cavern has been developed for tourism having in mind two parameters: (1) keep the cave as wild and as natural as possible, (2) give the visitors minimum adequate facilities. For this, a rock slab walkway 1,500 m. long with four well spaced and ample areas and a number of natural rock bridges were constructed. All possible effort was put in camouflaging as best and as safely as possible the full walkway. No railings of any sort appear and steps only when necessary. Due to the birds, no electric light has been installed. The results have been rewarding: 65,471 visitors saw the cave during 1979. No accidents have been reported and wheelchairs for disabled can reach 400 m. in Humboldt Hall. A visitor with two artificial legs managed with reasonable ease the full tourist development. Guides with gasoline lanterns lead the tourists.

Résumé

La Grotte du Guacharo est la plus grande du Vénézuéla (10.200 metres explorés). Le secteur touristique (1.200 metres) abrite la plus nombreuse (19.000) colonie de guacharos conneu dans le monde et présente une faune interessante (rongeurs, chauve-souris, araignées, mille-pattes et miles d'insectes). Du fait que les guacharos transportent des fruits dans leurs gosiers et les regurgitent, le Salon Humboldt de la grotte (759 metres de long) est partiellement recouvert de végétation durant l'époque de l'élevage. Le secteur touristique peut se diviser en trois sections successives: a) le Salon Humboldt, b) le Salon du Silence (240 metres de long), c) le Salon Précieux (100 metres de long).

Cette belle caverne a été developpée pour le tourisme en prenant compte de deux parametres: (1) maintenir la grotte dans un état le plus primitif et naturel possible, (2) donner aux visiteurs les facilités minimums adéquates. Dans ce but, un chemin de 1.500 metres a été construit avec quatre petites plateformes suffisamment espaceés et unies par plusieurs ponts de roche. Le maximum a été fait pour disimuler tout le chemin en restant dans les marges acceptables de sécurité. Il n'y a pas de passerelles ni de marches sauf la ou c'est absolument nécéssaire. Du fait de la présence des guacharos, la lumiere électrique n'a pas été installée. Les resultats ont été excellents: 65.471 personnes ont visité la grotte en 1979. Il n'y a pas eu d'accidents et les chaises roulantes pour handicapés peuvent entrer jusqu'a 400 metres dans le Salon Humboldt. Une visiteuse, avec deux jambes orthopédiques a pu voir sans trop de difficultés tout le secteur touristique. Des guides avec lampes à essence conduisent les touristes.

Resumen

La Cueva del Guácharo es la mayor caverna de Venezuela (10.200 metros explorados). El sector turístico (unos 1.200 metros) alberga la mayor colonia de guácharos conocida en el mundo (unos 19.000) y presenta una fauna interesante (roedores, murciélagos, arañas, ciempies y miles de insectos). Debido a que los guácharos traen semillas en sus buches y las regurgitan, el Salón de Humboldt de la caverna (759 m. de longitud) presenta unos pequeños y precarios bosques durante la época de la cría. El sector turístico puede subdividirse en tres secciones sucesivas: a) el Salón de Humboldt, b) el Saló del Silencio (240 m. de longitud), c) el Salón Precioso (100 m. de longitud).

Esta bella caverna ha sido desarrollada para el turismo teniendo en cuenta dos parámetros: (1) mantener a la cueva tan primitiva y natural como fuera posible, (2) darle a los visitantes las mínimas facilidades que fueran adecuadas. Para ello se construyó una caminería de 1.500 m. con cuatro - plazoletas bien espaciadas y varios puentes de roca. Se puso todo empeño en disimular lo mejor posible dentro de márgenes aceptables de seguridad, la caminerí entera. No existen barandas de ninguna especie y escalones solo donde eran imprescindibles. Debido a los guácharos, no se ha instalado luz - eléctrica. Los resultados han sido generosos: en 1.979, - - 65.471 personas visitaron la cueva. No han habido accidentes, y sillas de rueda para lisiados pueden llegar en el Salón de Humboldt hasta los 400 m. Una visitante con las dos piernas ortopédicas pudo ver sin excesivas dificultades todo el sector turístico. Guías con lámparas de gasolina conducen a los turistas.

Introduction

The Guacharo Cave, by far the largest so far explored in Venezuela (10,200 meters known so far) and, without question, one of the most complete caverns to be seen anywhere in the world, was first seen by europeans in 1657 (de Bellard, 1960). Explored by Humboldt in 1799 (Humboldt, 1956), Codazzi in 1835 (Codazzi, 1835) and by the Speleological Group of the Venezuelan Society of Natural Sciences in a methodical and systematic way starting in 1951 (de Bellard, 1968), the cave's first sector now called "the tourist sector" has been vandalised since 1900, perhaps earlier.

Besides its spetacular crystals, speleothemes of every variety and color, gypsum river, etc., the Guacharo Cave is an incredible fauna and flora sanctuary. And its colony of some 19,000 guacharo birds (oil birds, Steatornis caripensis Humb.) living in the first hall and fully protected since 1949 is, without question, one of the paramount attractions offered by nature to the visiting tourists (de Bellard, 1979).

Both in 1953 and 1974, absurd plans to illuminate the cavern with powerful lights were prepared and engineered. The 1953 project was rapidly stopped after the birds left by hundreds their nests and began to abandon the cavern. The 1974 project, disregarding the previous experience, included the construction of a massive concrete walkway all through the tourist sector (some 1,500 meters).

Alarmed by the information received, the Venezuelan Government's Ministry of the Ambient and Renewable Natural Resources and the Speleological Group of the Venezuelan Society of Natural Sciences, working in a joint team, stopped altogether the irresponsible project which would have probably wiped out the guacharo colony there, so far the largest colony of Steatornis known in the world, and severely affected the troglobites and troglophiles of the cave (Ad Honorem Commission, 1975).

The experience never the less helped to point out that the very large numbers of visitors entering the cave then (40,264 in 1974; 46,241 in 1975) would welcome and aplaud any reasonable tourist development made in the cave. This view was jointly appreciated by the above mentioned Ministry and by the speleologists and conservationists of the Venezuelan Society of Natural Sciences. So both institutions planned and developed a master project aimed at the detterment of the wild conditions still to be faced by all visitors entering the cavern.

The Project

The principal aims of the new project were:

(a) to keep the cavern as wild, natural and unspoiled as physically possible;

(b) to give the visitors of the cave the minimum adequate facilities and safety.

With these two parameters in mind, the Government project was carried out and executed as follows by the already mentioned Ministry of the Ambient, the Ministry of Agriculture and Livestock and, principally, by the National Parks Institute (Instituto Nacional de Parques 1980).

During July 1976 a specially designed limestone slabs walkway was constructed without railings, banisters or lights of any sort, and the use of bridges (over the cavern rivulet) and stone steps was reduced to the absolute minimum.

The first lap, easily covered even in wheelchairs, permits the visitor to enter Humboldt's Hall (759 meters long) up to the horizontal depth of 400 meters. Thousands of guacharo birds live in the nooks, crevices and balconies of this sector right up to the ceiling, some 40 to 45 meters above the rivulet. The walkway is 2 meters wide but widens considerably to form small plazas in six selected sites. Four somewhat camouflaged bridges span the cavern rivulet. Although easily identifiable, the walkways and plazas made of limestone slabs match very well the surrounding rockfall and therefore fit in perfectly with the natural structure seen all around. A well hidden water line allows the cleaning of the walkway for the full initial 400 meters, thus simplifying the maintenance. This first span required the handling of 3,026 cubic meters of rock, guano and earth at the cost of U.S. $42,000 (at 1976 rates).

The second lap, 600 meters long and 2 meters wide, covers the second half of Humboldt's Hall right up to the small crevice which connects with the second hall of the cave, known as the Hall of Silence (some 240 meters long). In this sector, limestone gravel was used and compacted for a better footholding. Two bridges span the rivulet in this part and 253 cubic meters of rock, guano, earth and gravel had to be handled. Footsteps were made in site with the original rocks found and a large plaza was erected at the point where Humboldt turned back finalising his visit of September 18th, 1799. A simple marble slab with a brief inscription marks the place and constitutes the only non-natural item in the cavern. The cost of this second lap mounted to U.S. $59,000 (1977 rates).

The third and last lap was developed from the entrance crevice to the Hall of Silence up to the Hall of the Breasts, the very extreme corner of the tourist sector, itself the final room of the Precious Hall (some 100 meters long). This span is 800 meters long, has seven bridges and the walkway somewhat reduced in comparison with the previous sections. 48 cubic meters of rock, gravel and earth had to be handled in this part, and the cost of the third lap mounted to U.S. $22,000 (at 1977 rates).

The total cost of the full works developed in the cave mounted to U.S. $123,000. The complete walkway is 1,800 meters long and occupies an area of some 4,500 square meters.

The Results

This magnificently designed walkway has given immediate and most unexpected dividends.

Before, since the cavern floor was uneven and irregular and visitors were not limited to a certain trail, the latter walked all over the open areas, got extremely dirty with the mud to be found, wet to the knees in the rivulet, and killed inadvertently thousands of all sorts of troglobites, troglophiles, guanobies and plants growing from the seeds dropped by the guacharo birds after feeding. The so called "cave rats" (Heteromys anomalus and Proechimys guyannensis) were scarce and fishes were rarely seen in the rivulet.

Nowadays the cavern reminds those who entered thirty or more years ago, the very scenes they saw back in the late 1950's: millions of insects live all over Humboldts Hall; spiders, centipedes, millipedes and rodents have multiplied; fishes of the cavern stream are no longer a rare sight and beautiful dense little seedling forests of laurels and palms greet the visitors with their pale yellow leaves and palid stems, a most unforgetable sight for those who visit the cave during the breeding season of the guacharo birds.

Visitors are conducted by guides using Coleman 300 candlepower gasoline lamps (which eventually will be substituted by adequate and sturdy electric lamps) and are instructed to stay at all times on the walkway and plazas. During 1979, visitors came to see this spectacular cavern from all over Venezuela and from overseas, and their number summed 65,471. Although the walkway and plazas are extremely simple and somewhat camouflaged, no accidents have been reported so far and a visitor with two artificial legs managed with acceptable discomforts to walk the full tourist sector, that is, 1,800 meters.

We feel that this philosophy of trying to keep this magnificent cavern as wild looking as it possibly was back in 1657, gives the visitors the additional thrilling experience of a visit to a very large natural and untouched, semivirgin cave, a nowadays rare sight if we consider the tourist caverns open all over the world. If we add to the previous statement the fact that visitors to the Guacharo Cave arrive all the way from Caracas city on an asphalted road that allows the finest cars to park within 80 meters of the huge cave entrance, we feel we have managed to give a most unusual experience to any caver and naturalist that comes to this grandiose cavern.

If only the indispensable artificial elements are incorporated into nature so as to guarantee a very safe visit to prudent and averagely careful visitors, the two principles can be kept and exercised to the benefit of Nature and man's unbending desire to know more.

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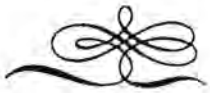

Pioneers of North American Cave and Karst Science Prior to 1930

Ernst H. Kastning
Department of Geosciences, Murrary State University, Murray, Kentucky 42071 U.S.A.

Abstract

Fifty years ago William Morris Davis published his celebrated study, "Origin of Limestone Caverns." Within twelve years, no less than four other benchmark papers on speleogenesis appeared in prominent American geological journals; some of these embellishedvis' ideas while others proposed alternative theories. This flourish of conceptualism provided in impetus for subsequent regional cave studies in many states, including Pennyslvania, Virginia, Tennessee, Alabama, Indiana, Kentuck, and Missouri. Ultimately, many of these simplistic theories were refined and synthesized into modern views that now treat caves as products of multiple or complex interactions among diverse factors such as bedrock lithology, geologic structure, chemical kinetics, hydrodynamics, and topographic evolution.

Physical speleology in North America did not have its beginnings in the deductive works of Davis and his contemporaries, but was founded instead in a host of descriptive studies concerning selected cave areas in the easter United States and Canada. Many of these works are well known today because they address the classic karst regions of the United States, notably central Kentucky, Indiana, and Tennessee. However, some of the earliest literature, published during the interval 1820 to 1930, is relatively obscure and rarely cited because it concerns less spectacular karst regions, such as those of New York and New England. Among the unsung pioneers of American speleology are Amos Eaton, Ebenezer Emmons, Charles U. Shepard, Edward Hitchcock, William W. Mather, Lewis C. Beck, James Eights, Amadeus W. Grabau, John H. Cook, George B. Shattuck, George H. Hudson, and Herdman F. Cleland.

Zusammenfassung

Vor 50 Jahren veröffentlichte William Morris Davis seine berühmte Studie "Entstehung der Kalksteinhöhlen." Innerhalb von 12 Jahren erschienen vier weitere bahnbrechende Artikel über Speläologenesis in führenden amerikanischen geologischen Zeitschriften' einige dieser Artikel bauten auf den Ideen von Davis auf, während andere Artikel wiederum alternative Theorien vorschlugen. Dieses plötzliche Interesse war ein Antrieb für spätere regionale Höhlenforschungen in vielen Staaten der USA, einschliesslich Pennsylvania, Virginia, Tennessee, Alabama, Indiana, Kentucky und Missouri. Schliesslich wurden viele der einfachen Theorien weiterentwickelt und ausgebaut bis hin zu den modernen Ansichten, in deren Rahmen Höhlen heutzutage als Ergebnisse von vielfachen und kmoplizierten Wechselwirkungen verschiedener Faktoren wie Grundgestein, Lithologie, geologische Strukturen, chemikalische Kinetik, Hydrodynamik und topographische Evolution behandelt werden.

Die physikalische Speläologie (Höhlenforschung) in Nord-Amerika hatte ihre Anfänge keineswegs in den aufschlussreichen Werken von Davis und seinen Zeitgenossen, sondern wurde vielmehr durch eine Reihe anschaulicher Studien über auserwählte Höhlengebiete im Osten der USA und in Canada begründet. Viele dieser Werke sind heutzutage wohlbekannt, weil sie sich insbesondere mit den klassischen Karstgebieten in den USA befassen, nämlich hauptsächlich in Kentucky, Indiana und Tennessee. Ein Teil der ursprünglichen Literatur, die zwischen 1820 und 1930 veröffentlicht wurde, ist jedoch verhältnismässig unklar und wird kaum zitiert, weil sie sich mit den weniger spektakulären Karstgebieten befasst, wie zie z.B. in Staate New York und in Neu-England vorhanden sind. Unter den weniger bekannten Pionieren der amerikanischen Speläologie finden wir Amos Eaton, Ebenezer Emmons, Charles U. Shepard, John H. Cook, George B. Shattuck, George H. Budson, und Herdman F. Cleland.

Introduction

The onset of contemporary cave science in North America is usually ascribed to William Morris Davis' celbrated deductive study, "Origin of Limestone Caverns" (Davis, 1930). In the ensuing years, several other benchmark papers on speleogenesis appeared in American geological journals, offering support or alternatives for Davis' theories, and fueling a debate on cave origin that continues today (White, 1959; Halliday, 1960; Warwick, 1962; Powell, 1975; Ford and Ewers, 1978). Regional cave studies prior to 1930 are sparse in the geologic literature. The best known concerned cave development in Pennsylvania, Virginia, Tennessee, Alabama, Indiana, Kentucky, and Missouri (See Davies, 1966 and Powell, 1975 for selected references).

The origin of caves is but one aspect of karst science, and North American contributions on karst are scant, at best, when compared to the vast world literature (Davies, 1966; Quinlan, 1968, 1978; Shaw, 1979). Physical speleology in North America began as isolated and relatively obscure descriptive studies in the eastern United States and Canada. A few works are well known today because they address the classic karst of Kentucky, Indiana, and Tennessee. However, much of the early literature (1820-1930) is rarely cited because it concerns lesser karst areas. This paper focuses on geologists from the northern U.S. who have contributed to North American speleology, and briefly serves to introduce early American cave geologists to the international speleological community, establish the role of the northeastern U.S. in North American cave and karst science, and credit some heretofore unsung pioneers of American speleology.

Pioneers of North American Speleology

The earliest reported writings on northeastern caves concern caves in Albany and Schoharie Counties, New York (Hanor, 1950; Kastning, 1971, 1975, 1978, 1979; Engle, 1979). The prolific works of Horace C. Hovey (1833-1914) and Edwin S. Balch (1856-1927) greatly advanced speleology in the northeast, but because these contributions are discussed in detail elsewhere (Halliday, 1970a, b), and are internationally well recognized, they are omitted herein.

Amos Eaton (1776-1842) was a pioneer of North American geology, taught at Williams College in Massachusetts and founded the Rennsselaer school of geology at Troy, New York in 1824. Two of his earliest work (Eaton, 1818, 1820a, b) metnions caves in the Helderberg Limestone units of Albany County.

Ebenezer Emmos (1779-1863, geologist of the Second District, New York State Survey and noted mineralogist, identified the first occurrence of strontianite in the U.S. (from Ball's Cave, Schoharie County)(Emmons, 1835). His work on carbonate cave minerals, in conjunction with that of Shepard and Beck (below), represents one of the earliest cave-mineral studies in north America.

Charles Upham Shepard (1804-1886), State Mineralogist of Connecticut, examined strontianite and other calcareous spar from Ball's Cave (Shepard, 1835). He brought to the attention of the scientific community a previously published, but obscure description of Ball's Cave (anonymous,1832). This account, along with the published discovery of Howe's Cave (Squier, 1842),led to later scientific cave studied by Beck, Mather, Grabau, and Cook (below).

Edward Hitchcock (1793-1864), Professor of Chemistry and Natural History at Amherst College, Massachusetts, and later State Geologist of Massachusetts and Vermont, published a volume on the geology of Massachusetts (Hitchcock, 1835), containing some of the earliest geologic material on New England caves, which included natural marble bridges near North Adams, pseudokarstic cave at Sunderland and limestone caves near West Stockbridge, Lanesborough, and Adams. He also described Spouting Cave, a sea cave at Newport, Rhonde Island.

William Williams Mather (1804-1859) served as Geologist of the First District, New York Geological Survey; and in the final report for that work (Mather, 1843), he described Ball's Cave (with a profile drawing) and Clarksville Cave, noting the hydrogeology of both. An announcement of the discovery of Howe's Cave and plate illustrating it entrance were included as well.

Lewis Caleb Beck (1798-1853), noted chemist and mineralogist and author of the mineralogy volume of the Natural History of New York (Beck, 1842), described carbonate minerals from several caves in Albany and Schoharie Counties, extending the work of Emmons and Shepard. The volume included a profile of Ball's Cave

Cave and a crude map of Knox Cave, one of the earliest maps of a northeastern cave.

James Eights (1798-1882), the noted Antarctic explorer and geologist, wrote several geological reports on New York State. His only known sepleological paper (Eights, 1848) is an exacting description of Mitchell's Cave, Montgomery County, for some time the deepest known cave in the northeast. Eights explored the cave to its lowest point in an unsuccessful quest for vertebrate fossils.

Amadeus William Crabau (1870-1946) was one of America's most noted and controversial stratigraphers. During his tenure with the New York State Museum, he studied the geology and paleontology of the Schoharie Valley (Crabau, 1906), the most cavernous area in the northeast. Grabu's mongraph includes brief descriptions of Howe's, Ball's, Clark's, Becker's, and Strontium Mine Caves, the first photographs of northeast caves in the geologic literature, and a profile and map of Ball's Cave modified from Knoepfel (1853), Beck (1842), and Mather (1843).

John Hawley Cooks was employed by the State Museum of New York in the early 1900's to investigate the Quaternary and glacial geology in east-central New York. During this interval, he was instructed to explore, survey, and geologically examine all accessable caves in the Helderberg Plateau of Schoharie and Albany Counties. His report (Cook, 1907) is a landmark paper in northeastern speleology that describes 18 caves (with maps of 6), and discusses in detail the role of stratigraphy, structure, and hydrogeology on speleogenesis.

George Brubank Shattuck (1869-1934), Professor of Geology at Vassar College, wrote a small geological guidebook to southeastern New YOrk (Shattuck, 1907). He described Eighmyville and Stone Church Caves, Dutchess County, and briefly discussed the origin of limestone caves and speleothems.

George Henry Hudson (1855-1934), teacher of science at the State Normal School at Plattsburg, New York, spent twenty years studying the geology of the Lake Champlain region near Plattsburgh. His meticulous work on solution phenomena of Valcour Island included joint-controlled caves, dolines, karren, pitting, and scallops (Hudson, 1909, 1910, 1912). Hudson's lucid discussion of solution scallops is the first to appear in the North American literature, and accurately attributes their origin to turbulent flow.

Herdman Fitzgerald Cleland (1869-1935), Professor of Geology at Williams College, investigated the morphology and origin of natural bridges, including those of solutional origin (Cleland, 1905, 1910, 1911a). Later, his interests turned to dolines and karst springs (Cleland, 1911b). He was the first to relate Thompsons Lake, Albany County, to underground piracy of surface streams and to nearby Pitcher Farm Spring. He explained the role of solution processes and glaciation in the development of the Helderberg Escarpment (Cleland, 1930).

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Un pionnier de la spéléologie: le peintre suisse Caspar Wolf (1935 - 1783)

Pierre Strinati
35, Chemin Du Pré-Langard, 1223 Cologny, Suisse

Résumé

Peintre assez renommé de son vivant, Caspar Wolf n'a été redécouvert que tout récemment. Willi Raeber a publié en 1979 un important catalogue de ses oeuvres et le Kunstmuseum de Bâle lui a consacré une grande exposition durant l'été 1980.

Caspar Wolf était avant tout paysagiste; il a beaucoup voyagé en Suisse et il a visité et peint des grottes du Jura et des Alpes. Caspar Wolf est considéré comme un précurseur de la peinture romantique; il faut également le considérer comme un pionnier de la spéléologie.

Abstract

Rather famous when he was alive, Caspar Wolf has been rediscovered very recently. Willi Raeber published in 1979 a complete book about him and the Kunstmuseum of Basel (Switzerland) exhibited a great number of his paintings during the summer of 1980.

Caspar Wolf painted mostly landscapes; he travelled extensively in Switzerland and visited and painted caves in the Jura mountains and the Alps. Caspar Wolf is considered like a forerunner of romantic painting; he must be considered too like a pioneer in speleology.

Caspar Wolf est né à Muri (canton d'Argovie) en 1735; il est mort à Heidelberg en 1783. Durant ses années d'apprentissage il a surtout été un peintre décorateur ornant ou s'attachant à la réfection de cemeures seigneuriales. Plus tard il acquit une assez grande notoriété en tant que paysagiste; ce n'est cependant pas particuliérement ses toiles qui furent connues de ses contemporains, mais ses recueils de gravures représentant les montagnes de la Suisse. Il fut l'un des premiers peintres à s'aventurer dans les régions montagneuses et lors de ses voyages il eut également l'occasion de visiter quelques grottes. C'est pourquoi on peut le considérer comme un pionnier de la spéléologie.

Son oeuvre oubliée pendant près de deux siècles a été redécouverte par Willi Raeber qui a publié en 1979 une importante monographie à son sujet. Durant l'été 1980 une grande exposition au Kunstmuseum de Bâle a permis à chacun d'apprécier l'importance de Caspar Wolf en tant que précurseur de la peinture romantique. Un catalogue préparé par Yvonne Boerlin-Brodbeck a été édité à cette occasion. Dans un chapitre de ce catalogue intitulé "Die Höhlenbilder Caspar Wolfs" l'auteur étudie l'importance de la grotte au point de vue symbolique, puis montre la très grande place qu'occupe la caverne dans l'oeuvre de Caspar Wolf. Dans une première période Caspar Wolf a peint des grottes imaginaires; plus tard, à l'occasion de ses premières excursions dans les Alpes, il a figuré des grottes réelles, celles visitées ou explorées par lui.

Le rôle de Caspar Wolf en tant que précurseur de la peinture romantique et la place occupée dans son oeuvre par les grottes ayant été mis en évidence par Raeber et Boerlin-Brodbeck, il reste à voir quelle fut son importance en tant que pionnier de las spéléologie. Si l'on élimine les grottes imaginaires et quelques abris peu profonds, l'activité spéléologique de Wolf se résume en la visite de trois cavités: Beatushöhle et Chorbalm dans les Alpes, Bärenhöhle dans le Jura. C'est peu, mais cela indique cependant de la part de Wolf un intérêt très vif pour le monde souterrain, chose fort rare à l'époque où il vivait.

Les deux premières grottes visitées par Wolf sont bien connues et elles seront décrites ci-dessous. La troisième, la Bärenhöhle près de Welschenrohr, ne semble pas être imaginaire, mais il n'a pas été possible de la localiser; le paysage a beaucoup été modifié en deux siècles!

Beatushöhle

Cette grotte est située à proximité de la rive nord du Lac de Thoune, à environ 6 km. à l'ouest d'Interlaken. Connue depuis fort longtemps, elle est partiellement aménagée pour le tourisme. Son développement est actuellement de 8,4 km. Elle est parcourue par un important cours d'eau. Caspar Wolf a peint à de nombreuses reprises la Beatushöhle, qui fut l'un de ses sujets favoris. Toutes ces vues montrent l'entrée de la cavité; cependant Caspar Wolf a bien pénétré à l'intérieur de la grotte, ainsi que le prouve ce texte d'un prospectus de Wagner, éditeur de plusieurs séries de gravures:

"C'est la caverne de la source d'eau, qui entre à près de 500 pas dans la montagne, le peintre l'avoit lui-même mesurée; on se trouve souvent dans la nécissité d'entrer dans l'eau, ou de ramper sur la pierre unie, ce qui rend l'entrée assez pénible; le ruisseau qui sort de la montagne, qui est d'une pierre à chaux, fournit en abondance de l'eau excellente."

Chorbalm

Cette grotte se trouve près de Lauterbrunnen, à 10 km. au sud d'Interlaken. Elle consiste en un vaste abri se continuant par une galerie ascendante longue d'une trentaine de mètres. Caspar Wolf a beaucoup voyagé dans la région de Lauterbrunnen, mais il n'a consacré qu'une aquarelle à la Chorbalm.

Bärenhöhle

Comme dans toute la chaîne du Jura, il existe aux environs de Welschenrohr un certain nombre de grottes. Wolf en a figuré une qu'il nomme Bärenhöhle. Il n'a pas été possible de déterminer l'emplacement de cette cavité ni même de savoir si elle existe encore actuellement.

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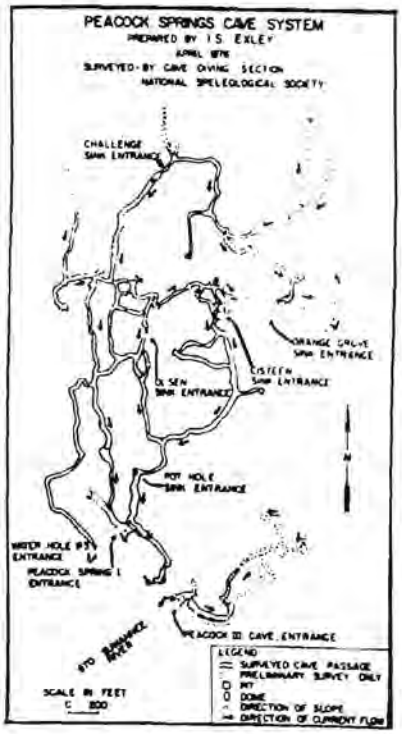

The World's Longest Un water Cave

Sheck Exley and Ned DeLoach
Florida, U.S.A.

Résumé

Le système "Peacock Springs Cave" dans la Comté de Suwannee en Floride, est un labyrinthe d'embranchement horizontal developé principalement à la base du couche Calcaire Suwannee de l'âge Oligocène. Les vingt-cinq ans d'exploration continuelle de cette grotte sont uniques non pour la longueur d'atteinte (7 Km.) ni pour la profondeur parvenue (67m) mais plutôt pour la manière d'exploration utilisé pour relever la caverne: le plongée de caverne sousmarine. C'est la grotte la plus longue de la Floride, mais plus impressionant c'est le fait que ça continue à être la plus longue caverne sousmarine connue au monde.

"Peacock Springs Cave" a joué un rôle de grande portée dans le dévelopement de l'equipement pour le plongée de caverne dans les Etats Ünis en étant usé comme "endroit de preuve" pour les equipages et les procés nouveaux. Depuis l'usage d'un seul caisson primitif, avec un regulateur a double tuyau et lampe de poche dans un sac a plasti plastique, utilizé par Vasco Murray en 1956 pour la premiere exploration de l'entrée de la caverne, l'équipement a progressivement evolué jusqu'a permettre les explorateurs NSS à penetrer plus que 700m de l'entrée la plus prôche les voies sousmarines et jusqu'a 67m de profondeur de l'eau. Les doubles caissons de 33m, les tuyauteries a double soupape, les lumieres de quartz halagène, les scaphandres, les scooters sousmarins et des techniques a plongée nouvelles sont en train d'être utilisé par les scaphandriers NSS pour atteindre des temps de submersion saufs pendant plus de 3.5 heures et continuer a maintenir une marge de securité 100%. Pendant l'evolution de cet équipement tout les 7 entrées passables du système Peacock ont été conjugués et de fait tout les passages ont été explorés et relevés, quoique des petits passages de côte continuent a être découvertent.

The exploration and survey of the Peacock Springs Cave System by N.S.S. divers is probably the crowning achievement of American cave diving. While the distance records for individual dives have left the U.S. for England and Australia, the discoveries of extensive air-filled galleries beyond sumps in America have yet to rival the success of the British at Ogof Ffynnon Ddu, Peacock remains the world's longest known underwater cave at over 7.0 km. It has now held that distinction since October of 1975, and appears unlikely to be surpassed for quite some time to come (Exley, 1979).

Located 3 km from the Suwannee River in west-central Suwannee County, Florida, the cave is almost entirely developed in the thinly-bedded, highly fossiliferous Suwannee Limestone of Oligocene age (Fisk and Exley, 1977). Water flow in the cave, which is entirely submerged, is from the north to the south, paralleling the trend of the majority of cave passage. In two areas short sections of the cave descend into the uppermost limestone beds of the thick Eocene Ocala Group. In both areas the general north-south trend of the cave is broken by the development of secondary passages with an east-west orientation. It is estimated that half of the total volume of water moving through the cave moves through these secondary passages to flow downward into the Ocala Group. Of the remaining half that eventually exits at Peacock Springs (measured at 15.0 cfs on 12/6/75), over 90% of the water re-enters the ground at Peacock III Cave. The remaining fraction trickles down a broad, sluggish stream through a picturesque cypress swamp to the Suwannee River.

Contrary to some descriptions (Erving, 1968; O'Keefe, 1975) Peacock is not a maze cave but fits more closely the classic branchwork pattern described by Palmer (1975). The exploration of the cave has been facilitated by the presence of eight passable entrances spaced at regular intervals throughout the system so that no point in the cave exceeds 700 m from the nearest entrance. Further, the water depths generally encountered are relatively shallow (12 to 21 m), with the deeper areas (up to 61 m) being short in nature and close to entrances. These facts have enabled investigation of a substantial portion of the cave at a time when the technology of cave diving was, at least by modern standards, quite primitive.

The exploration of Peacock began with Vasco Murray's tentative dives in the Peacock Springs I and Orange Grove Sink entrances in 1956. However, not until 1965 were any of the entrances connected, when George Krasle, Howard Lilly and Dick Olsen entered the Peacock entrance and exited via Pot Hole 135 m away. Within the next few years Rick Wright and Howard Bradbeer pushed on to the Cisteen Sink and Olsen Sink entrances, then in 1970 Tom Mount and Frank Martz followed a winding tunnel 429 m northward from the upstream Olsen entrance to emerge in Challenge Sink. Later that year John Harper, Randy Hylton and Frank Martz linked Orange Grove Sink Cave to the Challenge entrance via a 538 m-long conduit. The latest and most significant connection came on 7/7/73, when David Fisk, Dana Turner and Sheck Exley connected Waterhole III Cave to Peacock with a world record (for then) cave diving through trip of 704 m. A 5 m breach of the cave at Olsen Sink which effectively divided the cave into two separate systems was bypassed through exploration by Court Smith, Lewis Holtzendorff and Exley on 9/3/73 (Exley and Fisk, 1978).

The survey of the cave, which began in 1975, has been a project of the N.S.S. Cave Diving Section. Using guideline knotted at 3 m intervals, a Suunto diver's compass and depth gauges, more than 7.0 km of passage has been mapped using procedures described in detail by Exley and Maegerlein (1981). A relatively high degree of accuracy has been obtained by correcting to a surface transit survey of the entrances. The fifteen divers who have helped survey the cave have accounted for more than 1000 dives in Peacock since 1965, with absolutely no accidents of any kind.

Perhaps Peacock's greatest contribution has been the role it has played in the development of American cave diving equipment and procedures. From the early days of single tanks with double hose regulators and flashlights in plastic bags, explorers have progressed to twin 100 cu. ft. tanks, dual valve manifolds, octopus regulators and nicad-powered quartz-halogen lights in their quest for the means to explore the more remote areas of the cave. Improved safety procedures such as the "third rule" method of air planning, sharing air in emergencies and silt avoidance practices have also evolved as well as underwater cave surveying techniques. While they have not been necessary for exploration of that particular cave, Peacock has also been used as a proving ground for the most recent innovations in American cave diving technology such as multiple tank staging and the use of motorized Farallon Mark VI scooters. For these reasons alone it is probably that, even should another cave someday eclipse its record length, Peacock will still be revered as the cradle of American cave diving.

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Endangered Species Legislation In The United States

Thomas M. Lera
NSS International Secretary, 1266 Royal Oak Drive, DeSoto, Texas, 75115, U,S.A.

Abstract

In 1966, Congress passed legislation which afforded native animals legal protection. Since that time, this legislation has been twice revised. The current Endangered Species Act of 1973 provides not only animals but also plants with what appears to be a reasonable degree of protection. Recent court decisions support the concept and validity of the 1973 Act.

The 1973 Act has been amended by Congress four times. The last amendment in 1978 was the result of an extended and complex series of compromises between the Fish and Wildlife Service, the Carter Administration, Congres and the environmental community. Several important features of the 1973 Act have been strengthened including the consultant process, listing of species and critical habitat designation.

This paper discusses endangered species legislation and how it can be used as a management tool to protect threstened and endangered plants, animals and habitats.

Zusammenfassung

Im Jahr 1966 kam der amerikanische Kongress mit der Gesetzgebung heraus, welche eingeborene Tiere unter offiziellen Tierschutz stellte. Diese Gesetzgebung wurde seitdem zweimal ueberarbeitet. Das gegenwaertige Gesetz, erstellt im Jahr 1973, fuer "Gefaehrdete Spezien", umfasst nicht nur Tiere, sondern auch Pflanzen und verschafft einen angebrachten Grad von Beschuetzung. Neuerliche diesbezuegliche Gerichtsentscheidungen erhalten das Schutzgesetz von 1973 aufrecht.

Der Beschluss von 1973 wurde bereits viermal vom amerikanischen Kongress berichtigt. Die letzte Berichtigung im Jahr 1978 war das Resultat einer Reihe erheblicher und verwickelter Kompromisse zwischen dem Amt fuer Fischerei und Forstwesen, der Regierungsverwaltung unter Praesident Carter, amerikanischen Kongress, und der Umweltschutz-Interessengemeinschaft. Mehrere wichtige Punkte des Beschlusses von 1973 wurden verstaerkt, einschliesslich des diesbezueglichen Beratungsvorganges, Veroeffentlichung von Spezien und Bezeichnung/Ernennung von Vorkommen/Fundorten.

Dieses Dokument diskutiert die Gesetzgebung fuer gefaehrdete Spezien und wie es gebraucht werden kann als ein Verwaltungsinstrument, um bedrohte und gefaehrdete Pflanzen, Tiere und die Gegend der Vorkommen/Fundorte zu beschuetzen.

Early Congressional Activities

The first formal involvement by Congress in endangered species legislation began with the Tendangered Species Preservation Act of October 15, 1966 (Public Law 89-669, 80 Stat. 926). This law acknowledged a national responsibility to act on behalf of native species of wildlife which were threatened with extinction whatever the cause. Its amended version, the Endangered Species Conservation Act, was enacted on December 5, 1969 (Public Law 91-135, 83 Stst. 275). This revision to the 1966 Act greatly expanded the scope of effort to conserve endangered species. It also sought to ensure that the United States would not contribute to the extinction of other nations' wildlife. Although the 1969 Act laid the framework for an effective endangered species conservation program, with controls on traffic in threatened species as well as habitat preservation and restoration, it did not automatically afford native endangered species adequate protection.

A Congressional study has found "...that various species of fish, wildlife and plants in the United States have been rendered extinct as a consequence of economic growth and development untempered by adequate concern and conservation" and that others are "...threatened with extinction" (16 U.S.C. 1531 (1975)). After this study and Presidential urging, the Endangered Species Act was passed on December 28, 1973 (Public Law 93-205, 87 Stat. 884, amended by Public Law 94-325, 90 Stat. 724 (1976), Public 94-359, 90 Stat. 911 (9176). Public Law 95-212, 91 Stat. 1493 (1977), Public Law 95-632, 92 Stat. 3751 (1978).

A major purpose of the 1973 Act is the "conservation of endangered and threatened species" (16 U.S.C. 1531 (5)(b)(1975)) and "conservation" is strictly defined as "...the use of all methods and procedures which are necessary to bring any endangered or threatened species to the point at which the measures provided pursuant to this Act are no longer necessary" (16 U.S.C. 1532 (2) (1975)).

The 1973 Act also commits all Federal agencies to "utilize their authorities in the furtherance of the purposes of the Act by ...taking such action necessary to ensure that actions authorized, funded, or carried out by them do not jeopardize the continued existence of such endangered and threatened species or result in the destruction or modification of habitat of such species which is determined by the Secretary of Interior...to be critical"(16-U.S.C. 1536 (1976)). Also keynoted in the Act was "the President shall provide assistance to foreign countries and urge international cooperation in establishing programs to protect endangered species" (16 U.S.C. 1537 (a) and (b)(1975). Finally, the 1973 Act authorized legal action by provate citizens seeking "to enjoin any person, including the United States and any agency on other governmental instrumentality...whoe is alleged to be in violation of any provision of this Act or regulationd issued..." (16 U.S.C. 1540 (g)(1)(A)(1975).

Court Decisions

Inrecent years court decisions concerning endangered species have increased in frequency and have proven to be of major significance in that the decisions have embodied individual and governmental attemps to make difficult and yet practical decisions concerning the preservation of species in an increasingly technological and urbanized environment which often casts aside the fate of endangered species themselves.

The primary issue in Froehlke (534 F. 2nd 1289 (E.D.Mo., 1976)) became whether the Army Corps of Engineers had adequately considered the fate of the Indiana bat (Myotis Sodalis) in its environmental impact statement regarding the construction of the Meremac Dam near St. Louis, Missouri. Other major court decisions include National Wildlife Federation, (529 F. 2nd 359)5th Cir., 1976)), Hill(98 S. Ct. 2279 (1978)), Defenders of Wildlife(428 F. Supp. 167 (D.D.C.,1977)) and Capparet(375 F Supp. 456 (D.Nev.,1974)).

These decisions begin to show the basic judicial interpretation of the 1973 Act. The burden of proof lies with the plaintiff and not with the Federal agency responsible for the action. Secondary impacts must be evaluated in order to ensure the continued existence of an endangered species and to ensure that the critical habitat will not be modified or destroyed. Social and scientific costs are more relvant than the financial resources which ahve been expended. The Federal government must use all methods to encourage and promote recovery of an endangered species. The protection of an endangered species is more important than private property rights in some cases.

It would appear that, at least for the moment, through application fo the 1973 Act, the cours are engaged in ecological tinkering, getting species through the bottlenecks until management of entire ecosystems, including habitats, can be realized and accomplished.

1978 Amendments

On November 10, 1978, President Jimmy Carter signed the Endangered Species Act Amendments of 1978 (Public Law 95-632, 92 Stat. 3751 (1978)). This action reauthorized the administration of the Endangered Species Act of 1978 and, among other things, established an exacting two-tiered review process to consider

exemptions under Section 7. The amendments also affected the consultation process, listing of species, Critical Habitat determinations, cooperative agreements with States, enforcement and penalties, recovery planning, captive-held raptors, and public hearing/notice procedures.

A new section requires the Secretary of the Interior's biological opinion, which is rendered at the conclusion of the consultation process, to detail how the proposed action would affect the listed species or its Critical Habitat. The opinion must also suggest reasonable and prudent alternatives that would avoid jeopardy to the species or adverse modifications of its Critical Habitat.

Once the consultation process has been initiated, the amendments stipulate that no irreversible or irretrievable commitment of resources may be amde which forecloses the implementation of alternative measures to avoid jeopardy or adverse effects on the species or its Critical Habitat.

Critical Habitat has been defined for the first tiem, revising the Service's definition (by regulation) to include "the specific areas within the geographical area occupied by the species at the time it is listed ... on which are found thouse physical or biological features which are essential to the conservation of the species and which may require special management consideration or protection; and ...specific areas outside the geographical area..., upon a determination by the Secretary of the Interior that such areas are essential for the conservation of the species." (16 U.S.C. 1532 (5)(A)(1980)).

The amendments now require the Secretary of the Interior ot consider the economic impact of apecifying any particular area as Critical Habitat. In reviewing the economic impact the Secretary of the Interior may exclude any area from the Critical Habitat if he determines that the benefits of such exclusion outwiegh the benefits of specifying the area as part of the critical habitat, unless he determines, based on the best scientific and commercial data available, that the failure ot designate such area as critical habitat will result in the extinction of the species (16 U.S.C. 1533 (b)(4)(1980)].

In designating a Critical Habitat a public hearing must be held with notices placed in local units of government affected and scientific journals. Finally, to the extent posaible, the Secretary of the Interior must include a description of activities which may adversely modify the habitat or which may be affected by the designation. This description is to be included in the recovery plan for the endangered or threatened species.

Conclusions

The amendments retains the initial intergrity of the Endangered Species Act of 1973 while allowing some flexibility which permits exemptions from the Act's stringent requirements. It cannot be said that the Endangered Species Act of 1973 has been gutted rather a practical conflict resolution procedure has been probulgated. The important point to remember is that the destruction of the life on an endangered or threatened species should never be taken lightly, no matter how insignifican the species may appear today.

This legislation is a valuable tool for speleologists. There are five endangered species of bats with critical habitats indentified for several fo them. The endangered bats are Gray Bat (Myotis grisescens), Hawaiian Hoary Bat (Lasiurus cinereus semotus), Indiana Bat (Myotis sodalis), Virginia Big-eared Bat (Plecotus townsendii virginianus) and Ozark Big-eared Bat (Plecotus townsendii ingens).

Management of caves must confront two interdependent issues: protection of habitat and education of the public. Both issues must be undertaken if cave bats wre to survive as a viable segment of our fauana. As pointed out by Humphrey (1978), Tuttle (1979), LaVal (1980) and in many recovery plans, protecting caves will be to no avail if summer foraging habitat is so degraded that it will not produce a food supply sufficient to allow bats to increase or sustain their populations. I is unreasonable to expect the course of progress to be altered substantially in deference to endangered bats. Nevertheless governmental agencies thru the endangerd species legislation have become sensitive to the impact of their projects on these species in the last three years.

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Cave Conservation in the United States of America An Overview in 1981

Robert R. Stitt
1417 9th Ave. West, Seattle, Washington 98119 USA

Abstract

Growing out of a rising environmental awareness in Amerca in the 1960's, cave conservation activists have worked hard to obtain protection for caves during the 1970's. Efforts have concentrated in several areas: education of cavers, cooperation with government ladn management agencies, identification of and fighting against environmentally unsound projects affecting caves and karst, inclusion of caves in the National Wilderness Preservation System, ownership and management of caves by cavers, obtaining passage of state cave preservation laws, and in one case an official State Cave Commission, and protection of endangered species of cave life. American speleologists have chosen a low-profile path, avoiding that public media and shunning contact with the general public. This ostrich-style approach may have reduced the effectiveness of cave protection attempts, but has certainly preventing caving from becoming a widely popular sport which might result in the destruction of many, if not most, caves. Organizations most active in cave conservation efforts have been the National Speleological Society and its many local chapters, and the Cave Research Foundation with its close relationships with Federal agencies. The efforts of thousands of individual cavers, working on the local level, are probably responsible for the successes that have resulted, in spite of a lack of strong direction from the national level after 1975.

Résumé

Par suite d'une conscience élévée des environs aux Etats-Unis dans les années 1960, les activistes de la conservation des cavernes ont beaucoup travaillé d'obtenir la protection des cavernes pendant les années 1970. Les efforts ont été concentrés dans plusieurs domaines: l'éducation des explorateurs des cavernes; la cooperation avec les agences du gouvernement de l'administration des terres; l'effort d'identifier et de lutter contre des projets qui nuisent aux caves et au karst; l'inclusion des cavernes dans le Système National de Préservation des Régions Inexplorées; la possession et l'administration des cavernes par les explorateurs des cavernes; le passage des lois de preservation des cavernes au niveau des etats; et la protection des espèces de vie aux cavernes en danger. Les spéléologues americains ont choisi une voie qui évite la presse et qui fuit le contact avec le public general. Cette attitude a pu diminuer l'efficacité des efforts de protection des cavernes, mais elle a certainement empêché que la spéléologie devienne un sport en vogue, ce qui pourrait aboutir à la destruction de beaucoup de cavernes. Les organisations les plus actives dans les efforts de préserver les cavernes ont été la Société Nationale de Spéléologie et son grand nombre de groupes locaux, et la Fondation de Recherche des Cavernes avec ses proches relations avec les agences Fédérales. Les efforts des milliers des spéléologues individuels, travallant au niveau local, sont sans doute responsables des success qui en ont resulté, malgré la manaue d'une direction claire provenant du niveau national agrès l'année 1975.

In 1966, Victor A. Schmidt, who was at that time Chairman of the Committee on Conservation of the National Speleological Society, outlined the status of American efforts at cave conservation in an article in Studies in Speleology (1). In that article, Schmidt listed several problems of importance: both professional and casual vandalism, the over collection of biota, pollution of groundwater, and unexplained decreases in bat populations. He noted a trend towards increasing destruction of caves by public works projects, such as dams and highways, and finally he predicted that the major problems or protecting caves were yet to be faced.

When Schmidt wrote in 1966, the National Speleological Society (NSS) had about 2500 members, representing, it was supposed, about half the cavers in the U.S. The world's longest cave was still in bits and pieces awaiting connection. In spite of 25 years of attempts to convince the American public that caves were important and deserved protection--the message still hadn't gotten across.

Into this world of 1966 emerged the American and worldwide environmental movement. Laws were passed to protect the environment. Conservation activists within the NSS began pushing for more action. Cavers started putting their efforts into fighting conservation battles and attempting to save cavas from the outside world. Up until this time, American cavers had probably been most concerned and occupied with saving caves from themselves. The adoption of the NSS Conservation Policy, in 1960, presented a strong conservation ethic as the accepted mode of caving. But putting into practice what the Conservation Committee preached was a slow process, almost depending on a complete turnover of the membership and constant exposure to the message. But by the beginning of the 1970's, the battle had been won--at least within the NSS. Almost all NSS cavers accepted and practiced the high standards of the NSS Conservation Policy (2). In those instances where the policy was broken or misinterpreted, peer group pressure led to acceptance of the attitudes.

In the late 1960's, however, cave conservationists began to realize that too many people caving would eventually lead to destruction of many, if not most, caves. With the growing self-awareness of conservation came a growing sense that if the public didn't know about caves, it would limit the potential for damage from groups outside organized caving. So in the early 1970's it became official NSS policy to seek no new members--and especially to do nothing to encourage the general public to go caving. The result of this policy was that the general public did not recognize caves as being valuable, and thus the problem of obtaining protection for them became that much harder. As many people pointed out the problem did not go away, it just went underground.

Coupled with the environmental movement in the U.S. was an increasing awareness of outdoor recreational activities, and an increasing participation in such sports as mountain climbing, hiking, and in spite of the efforts of organized cavers to keep it under cover--caving. Especially in areas containing many caves, hordes of young people--ranging from Boy Scouts to school groups--ventured under the ground. Caves that they knew about were vandalized extensively.

A growing awareness of this problem has led the NSS in the last few years to modify its membership recruitment policies, but not without some controversy. In spite of the protestations of the radical secrecy advocates, the NSS now is attempting to recruit all "existing cavers" into the organization--not only to gain their support for cave protection--but to expose them to high standards and ideals of caving and cave protection.

While lowering their public profile, cave conservationists raised their private one. Since, in the western part of the country in particular, the majority of caves are owned by various government agencies, cave conservationists began to work closely with public agencies to influence policy and encourage good cave management practices--include limitation of access, gating of significant caves, and in some cases commercialization. The efforts of many local groups led to progressive policies on the local level, and it was soon recognized that there was a need for communication among cave managers and the caving public. This led to the first National Cave Management Symposium at Albuquerque, NM in 1975--since followed by annual symposia throughout the nation. These symposia have produced much communication and the publication of several volumes of proceedings (3). The dialogue has finally moved from considering whether we should save caves to how to go about it.

Although the bulk of the work on the Interstate Highway System was completed in the 1960's (at least in rural areas), continuing efforts at control of the nation's waterways by various federal agencies have continued. Cave conservationists have met these projects with varying responses.

In the case of New Melones Dam and reservoir in California, cavers decided to attempt the path of cooperation. By working with the U.S. Army Corps of Engineers to identify caves which would be adversely affected by the reservoir, and helping to mitigate the potential loss of caves and endangered species, members of the New Melones Conservation Task Force were able to obtain the creation of several cave preserves and the relocation of an endemic species of spider to another locale. Thus the loss of some caves will be offset,

hopefully, by the preservation of others which might not have ever been protected without the presence of the dam.

At the other end of the spectrum the Meramec Conservation Task Force fought successfully to stop the Meramec Dam project in Missouri, which would have inundated over 100 caves. Other conservation battles have involved strip mines, uranium mines, and the continuing battle for wilderness protection.

With the passage of the Wilderness Act in 1964 (4), the American Congress committed federal land management agencies to a review, within ten years, of all existing wilderness to determine if it should be preserved by statute permanently. Cavers had worked hard for passage of the Wilderness Act and now were faced with the monumental task of identifying which potential wilderness areas contained caves and which should be supported for inclusion in the National Wilderness Preservation System (NWPS). Efforts were in particular concentrated on the two most important cave National Parks--Mammoth in Kentucky and Carlsbad in New Mexico.

Although the Wilderness Act does not specifically mention caves, it was soon concluded (by conservationists at least) that it did not exclude them. And a new concept was developed--underground wilderness. The ideas was first proposed formally at a preliminary wilderness planning meeting at Mammoth Cave National Park in 1967 by the NSS. Although the surface lands in Mammoth Cave National Park are not considered suitable for inclusion in the NWPS because they have been recently farmed, the underground portions of the park are still of wilderness quality. Why not include just the underground part of the park in tne NWPS? This would provide additional protection for the caves, raise the standards of care, and assure that the world's longest cave (as it became five years later) was adequately protected and managed. Unfortunately the federal agencies have fought against this concept at every opportunity. Alghough they have been forced to acknowledge the legality and practicality of the idea, they have not yet created any underground wilderness areas. Thus the battle still goes on. At Carlsbad Caverns National Park, however, where the surface areas are of wilderness quality, large portions of the Park have been included in the NWPS, and thus many of the caves have been protected as wilderness.

In the Eastern part of the country most of the land is in private ownership, and cavers have worked with private landowners to assure continued access and in some cases have actually taken over management of caves, installing gates and attempting to limit access by peer-group pressure. But this has not been completely effective. Thus many cavers and organizations have acquired caves which they are managing themselves as cave preserves. The NSS owns two caves--Shelta Cave in Alabama and McFails Cave in New York. The Butler Cave Conservation Society was formed in the 1960's to own and manage the longest cave in Virginia (5). The Northeastern Cave Conservancy has recently acquired Knox Cave in New York. Many other groups of cavers have pooled their resources to purchase and manage other caves and cave systems.

There are no specific Federal cave protection laws, although caves and cave features are protected under statutes aimed at other problems, such as the Water Pollution, Endangered Species, and Antiquities Acts. However, many states have enacted cave protection legislation since the late 19th Century, when Wyoming and Colorado enacted laws to protect caves. Until the 1960's such laws were usually applied specifically to show caves. Beginning in the 1960's cavers, speleologists, and cave conservationists became more active in seeking cave protection laws, and by the end of the 1970's almost of the important cave states have adequate laws--Kentucky being the major exception. These laws usually go beyond merely prohibiting vandalism and also protect caves from pollution and protect cave life. Whether they are truly effective, of course, is another question, since there is little public pressure for their enforcement and unless a vandal is caught in the act it is difficult to obtain a conviction in the courts. The passage of adequate protection legislation remains high on the list of priorities for cave conservationists in the U.S., however (6).

Cavers in the state of Virginia have accomplished the most. The Virginia cave protection law passed in the early 1960's was the first of the more comprehensive laws and became the model for many others. In the late 1970's, cavers worked hard for the establishment of a State Cave Commission to review this law, and this Commission eventually recommended, and the legislature passed, a more comprehensive law. Although there has been little funding by the State, the life of the Commission has been extended and it continues to monitor the status of caves in Virginia and work for their protection (7).

Many states have laws protecting endangered species, but the most important means of protection is through the Federal act. Several species of bats and cave invertebrates and fish are currently so protected, and others are in the process of designation. Speleologists have continued to work with the office of Endangered Species to identify and obtain designation for endangered and threatened species of cave life. Currently, efforts are continuing to obtain listing for the Kentucky Cave Shrimp, Palaemonias ganteri, which is found in limited numbers only in Mammoth Cave National Park, and is threatened by pollution from the nearby sinkhole plain.

In spite of the efforts of Jum Quinlan at Mammoth Cave National Park, Tom Aley at the Ozark underground laboratory, and many others, the public still has little knowledge of the complexities of karst environmental problems. Land planners in karst areas still overlook what seems to speleologists to be most elementary--that just putting something underground will not necessarily get rid of it. Changing public attitudes by education has been a slow and frustrating process. But when the U.S. Environmental Protection Agency, in 1981, treats karst terrain and its special and difficult problems as a trivial case in developing its Proposed Ground Water Protection Strategy (8), one wonders just how much progress has been made in informing the very people who should be educating the public.

In working for protection of caves and related features cave conservationists have always faced the misconception on the part of the public that caves are dark places harboring evil and undeserving of public protection. In fact, the caving establishment has promoted this image, because it has been legitimately feared that if the public greatly appreciated caves they would wish to visit them and thus inadvertantly cause their destruction. Because the U.S. has been a relatively affluent country, with a large number of caves, there has been a relatively large number of show caves that have provided some opportunity for public visits. With the exception of a few government-owned show caves which have accented environmental education, until recently the show cave experience has usually been more of an entertainment experience and has lacked an education orientation.

Published cave books have tended to be the "Guide" type, which has made them controversial in the eyes of the caving community and has usually caused them to be of high circulation but limited value in promoting cave conservation. Most high-quality "cave appreciation" books that have circulated in the U.S.A. have originated in Europe.

Organizations active in cave conservation efforts have included the NSS, with its many local chapters, the Cave Research Foundation, principally involved in research and education but also concerned about conservation, and a variety of general conservation organizations including the Sierra Club, the Audubon Society, the Friends of th eEarth, the National Parks and the Conservation Association, and the Wilderness Society.

The NSS, with its over five thousand members and many local chapters, has probably contributed the most to the cause of cave conservation through its attempts to support and encourage local activists in their battles and via the communications afforded by its national publications and local chapter newsletters.

The Cave Research Foundation has worked hard to develop close ties with various Federal agencies in furtherance of its research goals, particularly at Mammoth Cave National Park in Kentucky. At the same time CRF leaders have realized that without preservation of the resource that they would be unable to study it. Alghouth CRF took a relatively low profile until recently, within the last three years it has vocally spoken out with respect to important issues at Mammoth Cave and in other areas. Other conservation organizations have generally tended to give support to cave related conservation issues when requested, but have generally not taken the initiative. The Nature Conservancy, however, has purchased and preserved many caves. Most conservation success that have occurred have been due to the hard-working efforts of local cavers who have become convinced that without their efforts to intervene in an issue that the caves would suffer.

Although the pronouncements of various cave conservationists (including myself) have tended to view the future with apprehension, I feel cautiously hopeful that an increasing number of caves will be preserved and protected. The trend in recent years for increasing caver control of caves through ownership is one hopeful sign. Increased awareness and activity on the part of Federal

cont. page 45

Archeological Investigations in Sand Cave, Kentucky

George Crothers
7254 Talave Ave., University City, MO 63130

Abstract

Sand Cave is a narrow, twisting passage formed by spaces between the large limestone breakdown blocks of a collapsed cavern. It was in January of 1925 that a local Kentuckian, Floyd Collins, while exploring Sand Cave in hopes of finding a large cavern below, became wedged in the narrow passage by falling rocks and was unable to pull himself free. For sixteen days rescue operations attempted to free the trapped man, but all efforts failed and Floyd Collins slowly died in Sand Cave.

In the Fall of 1980 archeological investigations were conducted inside and at the entrance of the cave to record, collect, and interpret the 1925 remains. The rescuers had left many of the tools, lanterns, bottles, cans, blankets, and other materials used in the struggle to free Floyd Collins. Wooden shoring is still in place where rescuers thought the passage needed stabilizing. Electric wires that supplied light for the rescuers and warmth to Floyd Collins still run through part of the passage. Some of the artifacts have deteriorated greatly in the wet conditions of the cave, but many of them, such as the glass objects, are still intact.

This paper is a report on the remains in Sand Cave: the original function of the artifacts, their possible function in the rescue operations, and how the types of artifacts and their location reflect the working conditions and activities in the cave.

Résumé

Sand Cave est un étroit passage tortillant formé entre de gros blocs d'effondrement en calcaire et causé par l'écroulement d'une caverne. En Janvier de l'année 1925 Floyd Collins, un natif du Kentucky, pendant l'exploration de la grotte en espoir de trouver une grande caverne souterraine, a été coincé par un effondrement et n'a pas su se lebérer. Durant seize jours on a essayé de libérer avec des opérations de secours, mais tous les efforts ont échoué et Floyd Collins a enfin décédé dans Sand Cave.

En automne 1980 on a conduit des recherches archéologiques à l'entrée et à l'intérieur de la grotte enfin d'enrigistrer, de ramasser, et d'interpréter les débris de 1925. L'équipe de secours avait laissé beaucoup de leurs outils, des lanternes, des bouteilles, des boîtes, des couvertures, et d'autres matériaux utilisés dans la lutte pour sauver Floyd Collins. Des supports en bois se trouvent encore là où l'équipe de secours les ont placés en mesure de stabilization. Des fils électriques destinés à conduire de la lumiére aux secoureurs et de la chaleur à Floyd Collins sont encore en place dans une partie du passage. Certaines restes ont sans doute été détruits à cause de l'humidité dans la grotte, mais beaucoup de vestiges, comme les objets de verre, sont restées intacts.

Cet exposé est un compte rendu des vestiges dans Sand Cave: la fonction originelle des vestiges, l'intesprétation des fonctions de secours, et la façon dans laquelle les vestiges et leurs enplacements reflètent les conditions de travail et les activités dans la grotte.

Field work for this paper was supported by the Cave Research Foundation and done in cooperation with the National Park Service.

Sand Cave is near the southeast boundary of Mammoth Cave Ridge and Flint Ridge. It is in Barren County approximately nine kilometers west of Cave City and 200 meters north of the Sand Cave historical marker on State Highway 255.

The Sand Cave site is a rock shelter approximately 20 meters wide, 15 meters long, with a maximum ceiling height of six meters. The shelter opens eastward into a valley formed by the collapse of a cavern ages ago. The mouth of Sand Cave is a short vertical opening at the back of the shelter, now sealed by an iron grate. The cave passage is approximately 45 meters long and formed entirely by spaces between the large limestone breakdown blocks of the collapsed cavern. The passage is narrow, twisting, and doubles under itself reaching a depth of 15 meters below surface.

Archeological investigations in Sand Cave pertain to the remains of unsuccessful attempts in the winter of 1925 to rescue Floyd Collins. Research for this project is partly based upon the reconstruction of the 1925 events published in 1979 by Robert K. Murray and Roger W. Brucker.

Floyd Collins was a semi-educated farmer and backwoods entrepreneur from Flint Ridge. He was an enthusiastic but foolhardy caver. Collins had discovered Crystal Cave and developed it for commerical business in 1917. It was a similar intention that led him into Sand Cave in 1925.

On Friday morning, January 30, Collins dislodged a rock in Sand Cave, trapping his left foot. Shifting dirt and gravel wedged him in the narrow passage. For five days rescuers brought him food and blankets, diverted water from dripping on him, and worked to free his foot. They enlarged the passage, installed shoring, and strung electric lights, but a cave-in early Wednesday morning, February 4, cut Collins off from the rescuers. A shaft dug to intercept Sand Cave reached Collins twelve days later, confirming what many already feared: he was dead. Collins' official death was put on Friday, February 13, 1925 (Murray and Brucker 1979).

In the summer of 1977 Brucker's group gained permission to reenter Sand Cave. They discovered that the cave was sealed by loose rocks and dirt at the First Squeeze, beyond this no one had entered the passage since 1925, remnants of the resuce still existed in the cave, and most astounding of all that a nine-inch crack bypassed the cave-in. The cavers were able to come within inches of where Collins had lain. The 1925 rescuers had never used this crack. Their original route lay up and over the nine-inch bypass; when that route collapsed they had given up (Murray and Brucker 1979).

Field work to record the remains of the Collins tragedy was conducted in the Fall of 1980. Work inside the cave was completed in two expeditions using three cavers and totalling thirty persons hours underground. An additional two working days were required to map the rockshelter and conduct an intensive surface collection.

Evidence of the 1925 activities at the rockshelter consists mainly of broken fragments of glass bottles and lantern globes, nails, and miscellaneous metal fragments. The most prominent feature is a two meter deep depression in the rockshelter floor left from the shaft excavation. The rockshelter site had also been occupied by prehistoric Indians as recorded by earlier archeological surveys (Schwartz 1958; Carstens 1980) and evidenced by the large number of chipped stone artifacts found there.

Sand Cave consists of four rooms large enough to sit up and turn around in. The rest of the passage is body-sized crawls and chutes connecting the rooms.

The cave mouth drops into the first and largest of the rooms. This room and a smaller adjoining room contain only a few modern items dropped through the grate by recent park visitors.

The bottom of the Second Room was sealed by rocks and dirt. Apparently no one had been beyond this point since 1925. The only remains in this crawl were several pieces of loose shoring and one shoring post held in place by a horizontal wooden wedge.

The end of this crawl forms the Second Squeeze, then opens into the Turnaround Room. It is large enough to fit three people and contained a concentration of 1925 remains. The artifacts include: a green "hobble skirt" Coca-Cola bottle manufactured in Bowling Green, KY and, similar to today's design but with a 1915 patent data, a small straight sided light bulb, a pocket size tobacco can, several fragments of a tin can, and several loose pieces of shoring.

The nine-inch bypass is a short, vertical corkscrew which only the smallest cavers were able to get through. It enters a steeply pitched chute just below the cave-in. Artifacts recorded in this chute include: a prescription bottle, the mouth of a broken mason jar, and two fragments of a rusted cylindrical lid with the stamped label, "Maxwell House, Good to the Last Drop." Features include two more shoring posts and a wooden wedge driven between two breakdown blocks. A pair of electric wires begin at the top of the chute, are wrapped several times around one of the shoring posts, and run to the end of the cave where they disappear into the sediment.

The "End Room" is the approximate location where Collins was trapped. The chute where Collins lay is now filled with water-deposited gravel and dirt. The largest concentration of artifacts was in this room: rusted fragments of three kerosene lantern bodies with cotton wicks, six other various metal lantern fragments, two prescription bottles, two plain bottles, a quart mason jar with screw cap, three fragments of a metal container or canteen with an outer textile cover, a painted rectangular metal "Maxwell House Tea" can, a fragment of a china cup, four wool textiles remains which may have been one or more blankets, several loose pieces of wood, a six-pound sledge hammer head with a broken haft, and a 1.2 meter long, L-shaped iron rod with a looped handle.

Murray and Brucker's account of the Sand Cave incident details the activities inside the cave as reported by the rescuers. The archeological remains relate closely to the details of their reconstruction. Hot coffee, milk and prescription whiskey or medicine were brought to Collins in bottles, jars contained hot soup or other liquids, and containers such as the Maxwell House Tea can were packed with sandwiches and other solid food. The lanterns were discarded by the rescuers. Blankets, quilts, and burlap were put around Collins to keep him warm. The sledge hammer was broken while attempting to enlarge the passage and also discarded. The L-shaped iron rod was possibly used to reach along Collins body and scrape out gravel or as a lever in attempting to pry the rock from Collins' ankle.

A total of 34 artifacts were collected and eight features were recorded in Sand Cave relating to the 1925 events. The artifacts represent mainly discarded remains of the rescuers: empty bottles, useless lanterns, or broken tools. Several key rescue tools, such as the several jacks and crowbars used in an attempt to lift the trap rock have not been accounted for either in the archeological remains or the historical records. Perhaps most of the items of value or potential value as souvenirs were collected by the rescuers as they departed at the end of the ordeal.

The 42 artifacts and features recorded inside the cave can be classified under five possible functions in the rescue: 1) seventeen are remains of containers for food or liquid, 2) eleven are remains of artifacts which provided light for the rescuers, 3) eight are remains of attempts to improve the passage, 4) five are remains of blankets, and 5) only one artifact, the L-shaped iron rod, can be classified as a tool used in the rescue.

Some questions remain unanswered about Sand Cave. The passage ends at the sediment-filled chute, but the electric wires continue into the sediment. The wires are known to terminate in a single light bulb placed on Collins' chest to keep him warm (Murray and Brucker 1979). Brucker's party attempted to excavate the chute following these wires, but never reached the end. To continue this work would require working upside down confined by the narrow chute, the exact situation which hampered the 1925 rescuers. To find the end of these wires would, however, mark the exact spot Collins lay in the passage.

No one has seen what lies below this filled chute since 1925. Collins rigged a rope and descended a pit some 60 feet deep before he was trapped when returning to the surface (Murray and Brucker 1979). Several passages of Bransford Avenue in Mammoth Cave lie underneath Sand Cave and the Cave Research Foundation has thoroughly surveyed each of these, but no leads were found to connect with Sand Cave.

Below the chute where Floyd Collins met his death in the winter of 1925 lies the last passage he explored, which no other caver has seen since. As Brucker wrote in 1955: ". . .one day, perhaps, the headlamp of an explorer will fall upon a rotten rope hanging from the top of a pit where Floyd rigged it. A few feet farther on he may come to the gallery that Floyd found (but) with prudence and care, the explorer need not be victim of a watermelonshaped rock and well-meaning but inept rescue attempts" (Murray and Brucker 1979: 272).

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continued from p. 43

and State land managers has resulted in a more enlightened management of government owned caves. And there is a large body of concerned cavers who will continue to be vigilant and to deal with issues as they come up. The combination of improved state laws, self regulation on the part of cavers and scientists, and an effort to halt public sales of speleothems via economic boycott and peer group pressure has succeeded to a certain extent in reducing the vandalism problems. A very conservative attitude towards collection prevails, especially with regard to bats. Although population declines continue, the increased awareness on the part of the cavers, scientists, and the Federal government have been hopeful signs.

Ultimately, however, the real conservation of American caves depends not only on continued vigilance on the part of cave conservationists, but an improvement of the public image of caves and cave related features, which will require increased public education about the need for cave conservation and protection.

As cavers are able to take management of caves into their own hands, they will be better able to control that management. Even though this control will represent only a few of the more than 20,000 caves in the U.S., at least some of them will be preserved. The rest of the caves may survive also, in varying degrees. Most of the traffic is to those caves which are well known, and although these caves will certainly be subject to destruction and degradation, others that are less well known will be relatively protected. But this puts the responsibility even more strongly on those who own and protect, and presumably manage well, those caves which cavers do control. Only by increased vigilance and efforts on the part of the conservation community will we assure that there are some relatively undamaged, wilderness caves existing in the next century.

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Cave Diving in England in the 1950's

Oliver C. Wells
1324 Leland Drive, Yorktown Heights, N.Y. 10598

Abstract

The author was active in cave diving in England between 1954 and 1959. Both the techniques and the equipment have improved considerably since then. This paper describes the methods used in the 1950's for the purpose of comparison with those of today.

Résumé

Les techniques et l'équipement de la plongée spéléologique s'étant beaucoup améliorées depuis l'époque ou l'auteur la pratiquait en Angleterre de 1954 à 1959. Nous décrivons ces méthodes anciennes à fin de comparaison.

Cave diving has made some impressive advances in the past few years. I dived in caves on more than thirty occasions in England between 1954 and 1959, and in America four or five times after that. The purpose of this article is to discuss some of the problems as they existed in cave diving in England at that time - NOT for the purpose of putting the clock back - but hopefully so as to encourage present-day cave divers to examine and then to re-examine their underwater techniques and training procedures so as to improve both the effectiveness and the safety aspects of their sport. (These problems have also been discussed by Boon, 1977 and by Farr, 1980.)

Visibility Underwater

Lack of visibility can careat serious problems for the cave diver. There are four stages involved: First, under exceptionally good conditions it may be possible to see for tens or even hundreds of feet, and you may find yourself being lured on and on and ON. Second, when the visibility comes down to five feet or less, you will only be able to see small parts of the walls and floor as they drift in and out of view. Next, comes essentially zero visibility, when the effect of a bright light to illuminate the water with a friendly glow, and when to read the depth gauge requires a bit of an effort. Finally comes total darkness, when you cannot even see a light that is held in front of your mask.

The water is usually clearer on an upstream dive than on a downstream dive, but you cannot rely on it remaining so. Thus, if you are swimming at some distance above the floor, then each time that you flip your foot there might be a puff of muddy water from the floor a second or so later. Each time that you release bubbles there might follow a shower of mud from the roof. A small stone rolling down a mud slope can stir up an amazing amount of mud. Of course, if you are swimming purposefully ahead, then you might not see that this is happening. The discovery that you are in opaque muddy water might therefore come as an unexpected and totally unwelcome surprise. In cave diving, you must always assume that you will not be able to see anything at all on your way out.

Floor or Roof?

Figure 1 has been drawn to emphasise the difference between the roof and the floor. Very often, the roof contains bell chambers and similar solutionally determined forms. The floor will very often consist of small stones, sand and mud that are rearranged by the water flow in times of flood. Indeed, it would sometimes even appear that passages underwater will all be silted up eventually unless they are periodically scoured out in times of flood. From the practical point of view this often means that you can learn more about the water flow by examining the floor than you can by examining the roof.

Figure 1 shows a mud floor sloping down to an opening at the lowest point, and on many occesions you may have to go to the deepest point to find the way on. The water flow in times of flood can determine the shape of the (sandy) passage floor in a horizontal submerged passage also. This can be helpful when exploring under conditions of limited visibility. For example, while walking along a horizontal underwater passage on an upstream dive in Threapland Cave in Yorkshire on 23 June, 1956 with John Buxton, I emerged into an underwater chamber having a height of 4 or 5 feet, and extending sideways beyond the limit of visibility. Such chambers often contain slow whirlpools, and this was no exception, with the mud cloud slowly sweeping across in front of me from the right. What to do? The first priority is to check for cracks in the walls of the passage that can accept the guide wire of the diver who goes straight out into such a place, and cause difficulties on the way out. This I had done. The next priority is to keep ahead of

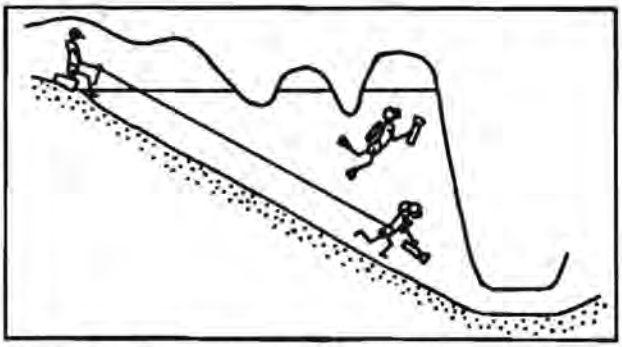

Figure 1. In an underwater cave passage or chamber, the shape of the roof is often determined by solutional effects, while the floor may consist of small stones, sand and mud which are rearranged by the water in times of flood.

the mud cloud. By advancing at right angles to the ripple marks in the sand on the floor I was able to find the way upstream. I then came to a definite funnel in the sandy floor going downwards at a slight angle under a low archway in the wall. This was the way on. I entered this through a low squeeze, and explored a gently rising passageway in total darkness by the sense of touch for about five or ten feet; at which point it was clearly time to return. Before returning, however, I sat there for a minute or two without being able to see a think, when I had the good fortune to notice that the top of my mask was in air. Dry land was only a few yards away. Later, we made the return trip without being able to see anything. This dive would have failed if I had not studied the floor. (J.S.B. dived in caves for several years before I did and, together with J.A. Thompson and F.G. Balcombe, initiated me into cave diving.)

Walk or Swim?

Present-day scuba divers are expert swimmers. In the 1950's, cave divers were influenced by the naval practice of those days, which involved the use of both swimming and walking divers (see, for example, Davis, 1955; pp. 290-324). In cave diving, a swimmer can investigate the cavities in the roof and can travel fast (hopefully in the right direction); while a walking diver can only easily examine the floor. It is easier for a walking diver to carry loads, he is less likely to get lost; he is less likely to kick his companion(s) in the face; he is less likely to get his feet tangled in the guide line; but he stirs up the mud faster; he cannot easily examine the roof; and he lives in mortal terror of falling into deep holes in the floor (see also Davies, 1949). In cave diving, the expression "walking" can also refer to a mode of progress when you are horizontal and only a few inches above the floor; bouncing along on your hands, which is not too difficult since you weigh only four or five pounds.

A swimming and a walking diver are shown in Figure 2. The equipment being used by the walking diver is rather simple. It is, in fact, the "bicycle respirator" as used by Graham Balcombe for his exploration of Sump 2 in Swildons Hole on Nov. 22, 1936. (Balcombe founded the Cave Diving Group in 1946 and was its principle organizer and later its President for many years.) This respirator (Balcombe, 1953) was refurbished for the purpose of a demonstration dive (Wells, 1960). Made from part of the seat tube of a lady's bicycle, it was the first self-contained respirator to be used for diving in a cave. The flexible tubes and the mouthpiece, which were missing when Balcombe gave it to me, have been replaced, but the basic configuration is unchanged. With this device, the breathing is controlled by valving the cylinder by hand, while the exhaled air escapes from the blow-off valve by the left shoulder.

Figure 2. Comparison between a swimmer (Jack Sofield) on the left, and a walking diver on the right. The so-called "bicycle respirator" as worn by the walking diver is substantially used by Graham Balcombe for cave diving in Swildons Hole in 1936 - see text. (Photograph by Jim Stark taken on June 21, 1960, using a Rolleiflex camera in a Rollei-Marin waterproof case, with number 5 flashbulb to provide added detail in the foreground.)

In the late 1940's, D.A. Coase and R.E. Davies carried out an extended series of swimming cave dives at Wookey Hole and elsewhere using what were essentially World War II "frogman" techniques. Balcombe (1981) offers the following tribute to Coase: "Coase was a first-class diver and a great companion always, and a steadfast support when I was stressed." Davies (1981) wrote: "Don Coase was a major force in the post-World War II diving explorations associated with the Cave Diving Group in England. He was bold, reliable and always ready to push ahead. His early death during surgery was a great loss."

Swimming is faster than walking. Thus, Davies and Coase covered 360 feet in less than seven minutes of "comfortable swimming" between the Resurgence and Swine Hole in Peak Cavern on June 12, 1949 (>50 feet/min). With Buxton, I walked 900 feet (total out and back) in 28 minutes going fairly hard over easy ground in Clapham Beck Head in Yorkshire on June 6, 1956 (30 feet/min). In the Threapland Cave dive described above we walked 65 feet in 7 minutes (~10 feet/min). In comparison, Statham and Yeadon swam 6,000 feet for the through dive at Keld Head on Jan. 16, 1979 in 150 minutes (= 40 feet/min) (Plant, 1979).

Choice of Respirator

Present-day cave divers have the benefit of greatly improved equipment. In the 1950's, closed circuit oxygen equipment was in used both by naval divers underwater and by fire-fighters on dry land, and it seemed to be a logical choice for cave diving also. The aqualung became available commercially in England in about 1947, but it was between ten and fifteen years before it displaced the World War II equipment obtained by Balcombe as Government Surplus at that time.

The closed circuit oxygen equipment could be used at shallow depths either for walking (which I preferred) or for swimming. The dry suits were generally very satisfactory, with the weakest point being the exposure of the hands of the diver to the cold water. For the exploration of the Fourteenth and Fifteenth Chambers at Wookey Hole at depths down to 65 feet on 6/7 Sept. 1957 and 14 March 1958 with John Buxton, we used the P-Party semiclosed-circuit mixture breathing set (Davis, 1955; p. 300). (Sir Robert H. Davis, who is well-known for his invention of the Davis submarine escape apparatus, was a supporter of cave diving in England for many years. He lent Balcombe the helmet diving equipment that was used for the 1935 Wookey Hole dives. He also donated the two P-Party sets that were used for deep diving in that cave.)

The semiclosed-circuit respirator lasts longer than an aqualung at depth, but the need to keep your soda-lime dry is a constant worry, and you must test most carefully for leaks. The correct operation of the constant-mass reducing valve is critical. The level of exertion must be kept low (which is another reason for walking rather than swimming when using this type of equipment). Here, we cannot do better than to quote from Empleton et al. (1962; p. 105): "Only a very few semiclosed-circuit scuba are in use by sport divers. Most of these are used by former commercial or military divers who have had several years of training and experience in the use of the equipment. The safe use of such equipment requires knowledge, training, and experience under the supervision of a competent instructor. . . . . The many disadvantages and limiting factors encountered in the safe use of closed- and semiclosed-circuit make their use for sport diving both impractical and hazardous."

In retrospect, it is perhaps surprising that the use of open-circuit equipment together with swimming for cave diving in England was delayed as long as it was. One of the pioneers of swimming in caves using open-circuit equipment was R.E. Davies. He obtained an aqualung in 1955 and carried out a number of dives. He had the right idea, but unfortunately he became separated from his fellow divers in Wookey Hole on 10/11 December 1955 (and greatly surprised everyone by reappearing several hours later); so that the use of these techniques did not catch on as rapidly as it should have done. I could have saved him a lot of embarassment on that occasion if I had had the intelligence to hold onto his elbow as he hovered in front of me while trying to untie the end of the line from his reel - but I digress.

Aqualungs were also used for non-CDG cave dives in England by J.A. Thompson in Hurtle Pot in 1956; by R.D. Leakey at Keld Head and at Austwick Beck Head in 1956; and by N. Brindle in New Goydon in 1957. Boon (1977) describes the use of aqualungs in Swildons Hole, starting in 1961. Nowadays, the use of open-circuit equipment with swimming (and caving helmets) is preferred.

Guide Lines for Cave Diving

In the 1940's and 1950's, it was common practice to use ex-army telephone line, with a cloth cover over steel strands and copper strands, as a guide wire for cave diving. This was satisfactory for the short term, but was vulnerable to attack by algae (Round and Willis, 1956). Nylon climbing ropes were also used for hand-held safety lines.

Communication Underwater

A major problem is how to communicate between two divers (especially in muddy water). According to the simplest scheme, if two divers are available, then they should go in together laying a guide line from a reel. The problem is, that as soon as any difficulty arises, then it becomes more or less essential to return to dry land in order to discuss whatever has arisen. (This problem is considerably more serious than it might appear at first sight because of the extraordinary difficulty that is experienced by most of us in summing up an unexpected situation underwater.) So why not leave your supporting diver on dry land with some method for asking him to join you if you would like him to do so? At least, this will free you from any worry about his safety. Besides which, if a real problem should arise, such as your guide line pulling across into a tight-place, then he will be in a far better situation to help you out.

The exploring diver in Figure 3 is on the end of a rope which is being paid out by the "controller" on dry land. How should the exploring diver indicate his wishes to the controller? Giving sharp pulls on the rope according to an agreed code has definite limitations. (I have a colleague that I shall never again invite to be the controller because of the occasion when, for no reason that I could detect, he pulled me out in a muscular manner as I was investigating an underwater tight-place.) Problems can arise, such as the occasion in Bouther Gill in Yorkshire on June 23, 1956 when my belt became hooked onto an underwater spike on the rock.

(The vertical drop that is shown below the air surface in Fig. 3 closely resembles one that exists at Deepdale Rising in Yorkshire. You must be very careful when walking over unknown ground.)

In 1958 I constructed an underwater signalling device in an effort to solve some of these problems. It contained a transistorised oscillator that allowed me to send dot and dash signals along the guide wire to a telephone receiver at base. This gave a "beep" which could be heard for several yards around. In addition, it carried a sound-powered telephone in a waterproof container which could be used if the diver reached dry land. During the dive there were two modes of signalling. For normal operation, the codes were as follows: three beeps for "more line," two beeps for "less line," and one beep for "Stop - everything is splendid." Under these conditions, the line could be paid out or pulled in as required. However, if a walking diver should have the misfortune of walking over the edge of an abyss, then a

tighter control would be required. There was a system of signals (which in fact were never needed) to allow for this. This device worked well during the successful passage of Sumps 4 and 5 in Swildons Hole on 13/14 Sept. and 8/9 Nov. 1958, when we used the sound-powered phone from the far side of each of these sumps.

(A telemetry system so that the controller in Fig. 3 could be continuously informed of the diver's depth would be a useful feature if it could be devised.)

Training and Background

Expertise in underwater work is not sufficient for cave diving. Phillip Davies, who was an active cave diver in the 1950's, wrote in response to the first draft of this paper: "It might be useful to add that people involved should be cavers first, using breathing apparatus as a tool to tackle a particular problem, just as they might use explosives under different circumstances. It is wrong to encourage divers to tackle caving problems."

I have saved until last my comments on the subject of commitment. As a one-time cave diver, I am sensitive on the subject of safety. In my active cave diving days I had convinced myself that, if you are willing to take the proper precautions, then cave diving can be a sensible thing to do. So what do we mean by "proper precautions"? The main requirement is to spend enough time underwater every month so as to maintain an adequate level of proficiency. In may types of activity for which a high degree of skill is required (such as flying a private aeroplane, for example) it is necessary to spend at least ten hours a month, every month, to stay competent. (This is in addition to the initial training, of course.) A similar commitment in underwater time is required for yourself and for your friends to maintain proficiency for cave diving. Think about this, please.

Acknowledgments

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Note Added in Proof

The walking diver in all three diagrams is tied onto a safety line which is held by a supporter on dry land. For longer dives it was common practice to lay lines from a reel. The device being carried by the exploring diver in Fig. 3 is the AFLO (Apparatus For Laying Out lines and underwater nagivation). The line reel is visible in Fig. 3 on this device.

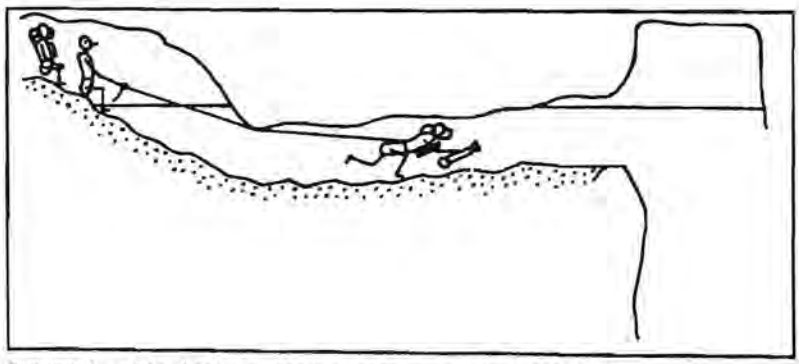

Figure 3. The basic question with a preliminary dive is whether the supporting diver should enter the sump with the exploring diver or whether, as shown here, he should remain on dry land and wait for a signal to go in.