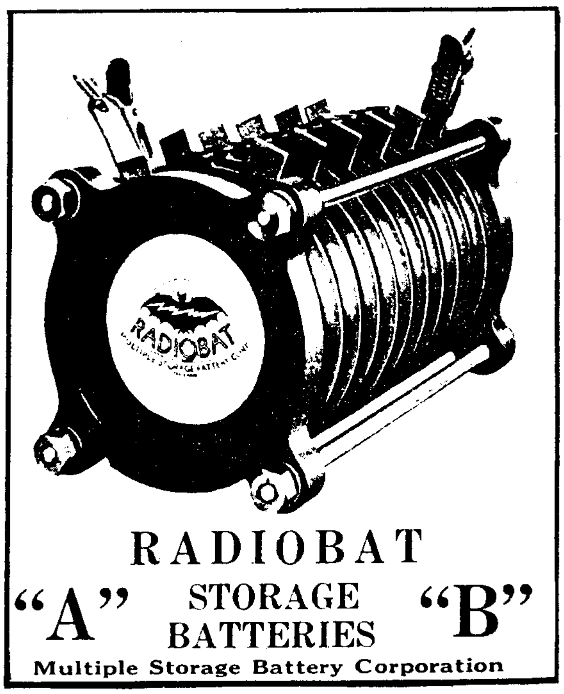
speleonics 9

winter-spring 1987-88

"BETTER CAVING THROUGH ELECTRICAL STUFF" volume III number 1

CONTENTS

NO. 4 NO. 6 NO. 8



(Above): Giant No. 8 dry cell with bat trademark, circa 1906, beside more-familiar No. 6 size. The number indicates height: #6 is 6 inches tall. (Below): Another old BATtery.

(From "Collecting Early Radio Batteries" by **Bob Allen**, <u>The Old Timer's Bulletin</u> Feb. 1988. see RESOURCES, p. 11).

SPELEONICS 9

Volume III, Number 1. Fall-Winter 1987-88

SPELEONICS is the quarterly newsletter of the Communication and Electronics Section of the National Speleological Society. Primary interests include cave radio, underground communication and instrumentation, cave rescue communications, cave lighting, and cave-related applications of amateur radio. NSS membership is encouraged but not required.

Section membership, which includes four issues of SPELEONICS, is **$4.00 in USA/Canada/Mexico, $6.00 overseas.** Send subscriptions to section treasurer **Joe Giddens** at the address below (make checks payable to SPELEONICS). If you have a ham-radio callsign or NSS membership number, please include them when subscribing.

Foreign subscription can be paid in U.S. "paper" dollars in the mail; an international money-order may cost as much as the subscription. Many members have sent cash without problems.

Editorship rotates among the officers. **Volunteers are encouraged to guest-edit or produce an issue.** A technical session, followed by election of officers, is an annual event held during the NSS Convention.

Complimentary copies of SPELEONICS are mailed to NSS offices and sections, the U.S. Bureau of Mines, U.S. Geological Survey, and the Longwave Club of America.

Chairman (and editor of issue #11):

Ian Drummond
5619 Dalwood Way NW
Calgary, Alberta
CANADA T3A 1S6

Secretary (and editor of this issue):

Frank Reid, W9MKV
PO Box 5283
Bloomington, Indiana
47407-5283

Treasurer (and editor of the next issue):

Joe Giddens, N5IOZ
PO Box 170274
Arlington, Texas
76003

Publisher:

Diana E. George, N9DEJ
1869 Trevilian Way
Louisville, Kentucky
40205

Editorial

JUST FOR FUN...

How would YOU design a powered vehicle for hauling a caver through a crawlway?

Nevin Davis' famous precedent, the Motorized Ascending Device (MAD), is a man-carrying, gasoline-powered rope climber. It was demonstrated to enthusiastic crowds at the 1970 NSS Convention in State College, Pennsylvania, and used successfully in Sotano de las Golondrinas and other large pits.

Some caves have wide, smooth-floored crawlways; in Coach Cave (Kentucky), cavers used snow-coasting "saucers" for dragging heavy ropes and equipment, and later built 4-wheeled carts called "CRABs" (Crawlway Reconnaissance And Bivouac). The CRABs were very successful, especially when one was used to haul an injured caver through the 1200-foot crawlway. Where ceiling height permits, a caver can support his upper body on the cart and use his feet for propulsion.

The effort of actually building a powered crawler is probably better spent elsewhere. On the other hand, anticipated advances in motors and energy storage could make them practical, and revolutionize other areas of caving-- See the article by **Luther Stroud** in this issue.

Practical or not, a crawler would be great fun to drive around caving convention campgrounds, under vehicles, etc. It would make a good project for an engineering-school design competition. One envisions a "crawl off" with prizes for speed, range, minimum height, obstacle negotiation, etc.

Share your though-experiments or bring them to the NSS Convention Electronics Session. In the interest of safety and conservation, we will disallow nuclear "subterrenes" which make their own tunnels. We will not otherwise debate ethics of powered caving; this is only an exercise in imagination. Some ideas already suggested are:

"It should be an articulated tracked or multi-wheel-drive vehicle... Motors from battery-powered kiddie cars might be suitable."

"Like the MAD, but horizontal; string a rope through the crawlway."

"It should be amphibious... Counter-rotating auger propulsion would work in mud and water..."

"A gasoline-electric drive could switch to battery like a submarine when it goes below the surface... The gas motor could be left behind."

"Motorized Stokes litter: Driver lies on back or stomach, steers with ropes or foot pedals... This would need mirrors, windows and a side escape-hatch... Use vertical curb-feelers to warn of low ceiling."

"A loop of conveyor belt with caver and drive mechanism inside the loop might work if you could steer it... maybe by dragging feet outside."

"Attach hydraulic cylinders beneath caver's forearms; pistons extend rearward from the elbows to push him forward. Hands control valves... Caver wears teflon coveralls and wheeled kneepads... Drag the power supply on a trailer."

"It should be an analog of nature... A snail-like mechanism which crawls by sequentially inflating and deflating rubber tubes on the bottom, a slithering mechanical snake, side-winding inchworm, mechanical centipede, or earthworm-like device which elongates, holds on, and contracts."

Steering: Handlebars, ropes, asymetric thrust, aircraft-style rudder/brake pedals...

"It should have remote control so that the vehicle can be fully loaded with equipment, and steered by an accompanying caver."

"Caving dogs used as beasts of burden cannot negotiate many obstacles... Genetically engineered dog-sized domesticated slugs with appropriate load-bearing collars and harnesses would work better, except in salt mines, of course..."

- NEWS AND ANNOUNCEMENTS -

INFORMAL SECTION MEETING AT DAYTON HAMFEST

Luther Stroud writes, "I plan to attend the Dayton Hamfest. Maybe I can meet some of the other members there. If you publish a list of others that plan to go, that would be helpful also."

Great Idea, especially since many of our members are non-cavers and do not attend the NSS Convention! I already know at least 10 members who will be there. Let's meet at **11 AM local time** on **Saturday, April 30,** on the right side of the ticket-sales room inside the front entrance. I'll tape a SPELEONICS cover to the wall. I will attempt to find a quiet place to sit and talk (no guarantees). Perhaps it will become an annual event!

The Dayton Hamvention (Dayton, Ohio, April 29 - May 1) is the world's largest hamfest. It's a good place to shop for cave radio parts, and a wonderful experience for anyone who loves electronics. For details, see January 1988 issue of any U.S. ham magazine, ask anyone who has been there, or write to Frank Reid.

--

ADDRESS CHANGE

The new post office in Bloomington, Indiana is a nice facility, however, they have changed one digit of the postal code (ZIP) of the SPELEONICS mailing address. Effective January 1, 1988, the new code is **47407-5283.** So far, the last 4 digits are optional.

-=-

ANTENNAS

SPELEONICS #11 will be on the topic of antennas for cave radios.

* CONSTRUCTION DETAILS
* THE LARGEST
* TESTING METHODS
* SPECTACULAR BURN-UPS
* E-FIELD ANTENNAS
* DESIGN METHODS
* THE TOUGHEST
* UNDERWATER UNITS
* THE SMALLEST
* CALIBRATION

We need PHOTOS, SKETCHES, ARTICLES, STORIES.

Please send material to Ian Drummond or Frank Reid (Addresses in masthead).

-=-

SECTION MEMBERS PUBLISH

John R. Barnes (NSS 17192), electronics engineer at IBM in Lexington, Kentucky, has published ELECTRONIC DESIGN: INTERFERENCE AND NOISE CONTROL TECHNIQUES (Prentice-Hall 1987, ISBN 0-13-252123-7) $30.67. He has donated a copy to the Section.

Luther Stroud published "Phone Sentry" in December 1987 HANDS-ON ELECTRONICS magazine. He has written an article to be published about June, 1988 in RADIO-ELECTRONICS, about a one-MHz frequency standard of extreme accuracy derived by phase-locking to the 3.58-MHz television color-burst frequency, inductively coupled to any nearby television set. (R-E, by the way, now carries **Don Lancaster**'s monthly "Hardware Hacker" column, formerly in MODERN ELECTRONICS.)

--

BRITISH FORMING CAVE-ELECTRONICS GROUP

CAVE RADIO SYSTEMS FOR COMMUNICATION AND SURVEYING

"A discussion session...was an opportunity for various people who had been involved with different systems to discuss ways of co-operating to help the development of different systems. The meeting resulted in the setting up of a "subject group" of thos interested enough to keep in contact via some sort of newsletter and the desire to hold a study weekend in 1988."

[from "1987 BCRA National Caving Conference Lecture Review," BCRA Caves & Caving No. 38, Winter, 1987, p. 45. Contributed by **Angelo George** and **Ian Drummond.**]

Also from Caves and Caving No. 38:

PROPOSED BCRA RADIO & ELECTRONICS GROUP

At the BCRA Conference, a discussion was held on the subject of cave radio systems. It soon became apparent that quite a few people were working on various systems but it seemed that there was a lack of any communication between these various persons and groups. To this end, it was decided to "get it together" and start a newsletter to keep all interested parties in touch with each other and provide a framework within which ideas and thoughts could be exchanged or discussed. Later in the Conference discussion, the subject changed to other applications of electronics within caving. In this context, one can see the advance of computers for survey and logging work and also the advance of electronic systems for actual survey measurements and location. The proposed newsletter could also carry news and views of this type of work, in fact forming a much needed communication for this new and rapidly expanding field of caving.

In order to get the thing off the ground, I need to know who is interested and what their interests are. I would therefore, ask anyone who is interested in radio and electronics within caving (amateur or professional) no matter what their specific interest is, to contact me at the address below:

PHIL INGHAM, 49 Highfield Road, Farnworth, Bolton, BL4 0AH. Tel. 0204 791918

Congratulations and best wishes of success to our British colleagues! We hope to exchange newsletters and other information.

ANNOUNCEMENTS (continued):

RADIO INFORMATION AVAILABLE

Our file of radio information potentially valuable in cave rescue includes the following:

* U.S. National Park Service radio frequencies.

* How to modify the following types of Japanese amateur-radio transceivers for operation outside the ham bands:

Icom	Kenwood	Yaesu
IC-2AT	2600	FT-23R
IC-02AT	TS430S	FT-727R
IC-04AT	940	FT-757GX
IC-28A		
IC-28H		
IC-720	**Tempo**	
IC-735		
IC-745	S1	
IC-751		

The information is collected from magazines and other sources. If you have similar information not on the list, please share with us. Copies of specific items are available from Frank Reid for SASE. Please don't request the entire file; it's much too large (same policy as NSS Cave Files).
--

AVALANCHE BEACON INFORMATION WANTED

"Avalanche Beacon" transmitters carried by skiers help rescuers find them if they are buried by an avalanche. Austrian caver **Peter Ludwig** reports that their range is only about 200 feet. Recreational Equipment Inc. of Seattle sells ORTOVOX-brand avalanche transceivers ("Switches between receive and transmit at 2.275 kHz and 457 kHz simultaneously... Compatible with units used in North America and Europe... Two 1.5V batteries with 300-hour life..." 7/8 x 3 x 6 inches, 11 oz., $180.00).

Avalanche beacons or derivatives thereof might be useful as cave radios, perhaps with external amplifiers and antennas. They're obviously rare here in the Midwest; anyone knowing details of their circuitry, especially that of the receivers, please contact **Frank Reid.**
--

LIGHTBULB DATA WANTED

Grotto newsletters have published tables of data (voltage, current, etc.) for miniature lightbulbs likely to be used by cavers.[1,2,3] SPELEONICS publisher **Diana Emerson George** notes that with so many new and exotic bulbs now available, the data should be updated. Cavers use everything from tiny Mini-Maglite(tm) bulbs to quartz-halogen automotive lamps. The editors of SPELEONICS seek a volunteer for this project. We also need a new article on the physics of tungsten lightbulbs, discussing voltage versus output and life, effect of inert gasses in bulbs, the tungsten-halogen cycle, etc.

References:

1. Varnedoe, Bill. "About Electric Lights," Huntsville Grotto News v8 #7,8,9. reprinted: Speleo Digest 1967 p. 3-44.

2. Crombie, Ed. "A Survey of Electric Caving Lights and Techniques," Cascade Caver 16(4)31-37. reprinted: Speleo Digest 1977 p. 301.

3. Vaughn, Michael T. "Electric Caving," GCG Electric Caver v1 #1, p. 5-6. #2 p. 13-17. reprinted: Speleo Digest 1963 p. 3-62.
--

COMPUTER "CAVE NET" ESTABLISHED

An electronic mailing-list of cavers is being formed. Anyone interested in joining should reply to **Ron Lussier** (address below). Include your location, locations where you've caved, NSS # if you have one, net address and path(s), and any other information you want to throw in.

Grendel! {.}	ARPA: Lussier@BCO-Multics USMAIL: Ron Lussier 918 St. James Pl. Nausea,NH 03062-2650 TELCO: (603) 888-9610

We would also like to compile a list of e-mail addresses of SPELEONICS subscribers. Send to:

Frank Reid
PO Box 5283
Bloomington, IN 47407-5283

reid@gold.bacs.indiana.edu.arpa
BITNET: reid@iubacs
--

NEW LORAN-C TRANSMITTERS TO FILL MID-CONTINENT GAP

Aviation Week & Space Technology magazine (Sept. 28, 1987, p. 120) reports that four new stations of the LORAN-C radionavigation system will fill a large area of west-central US where signal quality has been marginal (see "LORAN-C for Cavers," SPELEONICS 5; updated reprint: COMPASS & TAPE, v. 5, #1, Summer 1987). To be operational by 1990, the new transmitters will also cover southern portions of Alberta, Saskatchewan and Manitoba, and northern Mexico. The AWST article includes maps of the new coverage areas.
--

From SUNDAY TIMES (United Kingdom), 5th July, 1987:

TAKING DATA UNDERGROUND

"An electronic life-line could be a big boost for the safety of Britain's 24,000 pot-holers. The device, developed by students at York University, transmits data instead of the human voice - an underground first.

Pot-holers key in messages on a water-proofed word processor which transmits the messages as digital code. These are decoded on the surface, and displayed on a small screen.

The light-weight system, which s no bigger than a car battery, and comes complete with battery power-pack and transmitter, uses ultra-low frequency electro-magnetic waves to combat the age-old problem of speech becoming garbled when it passes through conductive rock, such as limestone.

ANNOUNCEMENTS (contunued):

The device, which is carried underground in a World War 2 ammunition can, presently works just one way, but is capable of being adapted for two-way performance. So far it has been successfully tested at depths of up to 600 feet.

Dr. Andy Marvin, senior lecturer in electronic engineering at York University says: "The key entry system is a more efficient means of transmitting the same amount of data, and it is smaller than a voice system, so it needs less power to transmit.

"As far as we know, this is the first time text material has been used underground as opposed to voice. So far only 400 pounds has been spent on developing it, but the system may have significant advantages if it works well at greater depths. It would be quick and simple to transmit a message if somebody had an accident."

The means of underground communication favoured by Britain's five cave rescue teams up to now has been the "mole phone" developed at Lancaster University. It passes messages by modulating a magnetic field and can operate up to depths of 1,000 feet in good conditions. But each set costs 1,400 pounds, which is an expensive item for hard-pressed cave rescue team budgets.

Members of the York University Caving Club will be giving the electronic life-line its full field trials when they set off for the deep caves of Picos De Europa in northern Spain tomorrow.

Further uses could be in the surveying of caves. When cavers are camped underground, the surface party can pass on messages such as the state of the weather. Deep cave expeditions spending a long time underground would benefit as well.

Bill Whitehouse, chairman of the British Cave Rescue Association, says: "With conventional voice sets there's no problem through 300 feet of rock; the problem comes when you go deeper than that.

"You have to step up the power for less and less additional range. There comes a stage where you could plug a power station in and it wouldn't do to well." --Martin Charlesworth

[Contributed by **Ian Drummond**]

LETTERS

Dear Joe,

...Underground pipelines, power lines, telephone lines, fences and other metallic lines can carry cave radio signals for long distances. Don't know how much distortion of magnetic field shape can occur near ground zero.

At Benedict's cave, Greenbriar Co. WV, an underground noise source was found and ground zero (roughly) was determined. Later, cave passages were discovered in the immediate area. The source was never determined. I wonder if anyone else has had such an experience.

Roy Charlton
Rt. 2 Box 42
Dilwyn, Virginia 23936

--

Ian Drummond encountered a field-distortion anomaly in New Mexico, reported in this issue. **Earl Biffle** of Missouri detected an underground noise source believed to be a gas pipeline which was parallel to large power lines, and may have been carrying ground-return current.

There may be unusual effects at 2025 Hz, the proton-precession frequency of water molecules in the earth's magnetic field (see The Scientific American, February 1968, p. 124). Noise might could come from natural or power-line-induced currents in the ground, which become concentrated or forced to change direction by anomalies such as cave passage or vertical joints. If mineral crystals form nonlinear junctions causing such currents to intermodulate, then perhaps two currents of different frequencies could be injected into the ground, and a receiver tuned to their sum or difference could be used for prospecting.

Roy's observation is certainly worth further study! It would be interesting to search for other noise sources, measure shapes of their associated magnetic fields, study frequency spectra, and determine if the noise varies with day/night, seasons, wet/dry weather, etc. --FR

--

Dear Joe,

...I hope this copy of an article from **Electronics Australia** about a 13-kHz receiver helps further your research on underground radio. I really enjoy reading **Speleonics** and plan to contribute an article in the future. I am open to suggestions from other members for a subject to write about.

Sincerely,

Luther M. Stroud
P.O. Box 1951
Fort Worth, TX 76101

--

Luther sent "Omega Derived Frequency Standard" by Ian Pogson, VK2AZN, in Electronics Australia magazine, May 1987, p. 92. Copies of the 10-page article are available from Frank Reid for SASE with 2-ounce postage (39 cents in USA).

Advanced weak-signal recovery techniques require very stable frequency control. Many designs exist for oscillators which are locked to LORAN-C (100 kHz) and WWVB (60 kHz) signals, which are difficult to receive underground. The worldwide Omega navigation system uses very powerful transmitters between 10 and 14 kHz (see chart, from above-mentioned article). The Soviet Union operates a similar system called Alpha. Frequencies are controlled by cesium-beam atomic clocks, accurate to a few parts in 10^{13}.

An early version of my own cave-radio surface receiver detected Omega signals, a pattern of one-second tones repeating every 10 seconds. Omega should be detectable underground. The 13.0-kHz frequency is unique to the Australian station, so the frequency standard would require modification

LETTERS (contunued):

to work with the USA's Omega transmitters in North Dakota and Hawaii.

I sent a copy of the Australian article to **Max Carter**, who experiments with BPSK (binary phase-shift keying) modulation. He has received low-speed data more than 100 miles from his one-watt transmitter in the 1750m "Lowfer" band. BPSK requires precise frequency control. Max replies,

> "...The Omega standard uses roughly the same method I use with WWVB. Looks like the standard could be simplified somewhat by using a 4046 to generate the 13 kHz instead of the harmonic filter shown.
>
> I see by Speleonics that cavers still have not discovered the ultimate underground communications system yet. Finding the right combination of power sonsumption, weight, ease-of-operation and range at the right price is a difficult challenge! I haven't given much thought to the question of underground data transmission lately but it seems to me that if Lowfer BPSK ever becomes viable, the techniques could easily be adapted to cave use. For instance, the second IF frequency for the latest BPSK receiver design is 1888 Hz, not that far removed from caver frequencies."

Max lives in eastern Wyoming, near the 1988 NSS Convention. We hope he will attend the electronics session and demonstrate BPSK. --FR

SENSITIVE SLAVE-FLASH FOR CAVE PHOTOGRAPHY

by Bo Lenander, SM5CJW

[Abridged reprint of original 2-page article in Swedish. Illustrations and notes are reproduced here:]

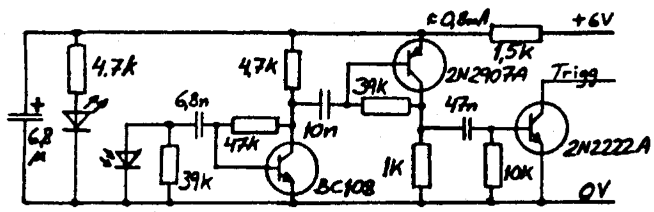
The trigger circuit is extremely sensitive to pulsed light but not to carbide or electric light. The trigger works without problem with indirect light. The slave trigger is...so sensitive that you can flash the main flash within your flat and the slave will trigger wherever it is within the house (almost)! This system has proved to be a fast and easy way to get reasonably good cave pictures without disturbing the non-photographers of the caving team.

A small computerflash is mounted on the camera, set for one-step underexposure to create a dark foreground. An assistant carries a more powerful computerflash working as a slave flash set to give correct exposure in the rest of the picture. The camera is always set to the working aperture of the slave flash.

On my camera is a small flash "Minolta Auto 11X8" with one-step underexposure. The slave is a "Nissin 28TSO Thyristor-SO" which gives correct exposure... I have used it together with 200-ASA film:

200 ASA	Auto setting Minolta	Nissin
f/4	red	red
f/8	yellow	green

+6 Volts is taken from the flash.

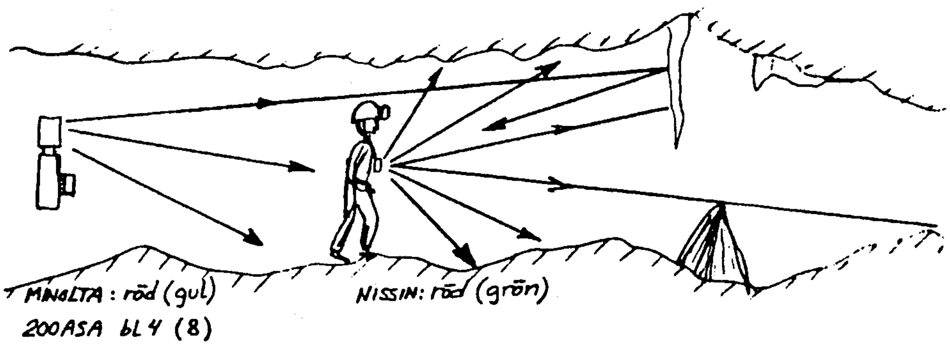


|_Photodiode 2-5mm^2

|_The LED is only an indicator.

A computerflash automatically varies its output to make a correct expoure. Film speed and camera aperture are set on dials, and a photocell detects light reflected from the subject. The flash is terminated when the proper amount of light has been received.

NOTE: Before building this circuit, measure the voltage at the trigger terminals of your flash unit. The 2N2222 transistor has a maximum voltage rating (BV_{ceo}) of 30 volts. Some electronic flash units (especially non-computing types) may have higher voltages at their trigger terminals.



RECENT DEVELOPMENTS IN SUPERCONDUCTIVITY RESEARCH

by Luther Stroud

Researchers have learned more this year than in the entire 75-year history of superconductors. Once only a laboratory curiosity, recent discoveries are making the widespread application of superconductors possible.

Most metals become more conductive with lower temperature. In 1911, the Nobel Prize- winning Dutch physicist Kamerlingh Onnes discovered that common metals like lead or mercury, when cooled to the temperature of liquid helium (-459°F) lost all electrical resistance. This phenomenon fascinated scientists, but the cost of maintaining such a low temperature, and the extreme brittleness of the supercooled materials showed no practical uses. Other scientists experimented with combinations of rare-metal alloys that become superconductive at -428°F but still require liquid helium coolant. In 1953, an alloy of germanium and niobium became the industry standard, with a superconductive transition at -418°F. Because of the extreme cold and expense of liquid helium ($11.00 per gallon) the use of superconductors was limited to high-level technical research equipment.

In February 1986, Alex Muller and George Bednorz of IBM produced a new class of superconducting materials, made of ceramic metal oxides that have a transition temperature of -390 Fahrenheit. This breakthrough began a frenzy of activity worldwide. Scientists have defined a new classification of materials that are non-conductors of electricity at room temperature but become perfect conductors when cooled below the transition temperature. The race is on worldwide to find materials that are superconductive at higher and higher temperatures. The ultimate goal is to find a practical material that is superconductive at room temperature or higher. In February, 1987 Dr. Paul C.W. Chu of the University of Houston announced his discovery of a new group of metallic oxide ceramics that become superconductors at practical temperatures. The yttrium barium copper oxide ceramic material becomes superconductive at -284°F, well above the -320°F temperature of liquid nitrogen (22 cents per gallon).

The new class of superconductors is not without problems, one of which is how to form the brittle ceramic material into wire. One method suggested is to pack a metal tube with crystals of the material and draw it into a fine wire. The Argonne National Laboratory has a contract with the U.S. Department of Energy to study the problem. Another method pioneered by IBM involves spraying a thin coating of the ceramic over the surface wires. With the Nobel Prize and patents worth millions of dollars, scientists are somewhat reluctant to share information about individual discoveries, which slows the progress of superconductor research.

Superconductors can make possible inexpensive, practical and powerful electric cars. The Argonne Laboratories announced last month their success with an electric motor made with superconducting materials. Superconducting power distribution lines would be twenty percent more efficient than existing power lines. Computers can be made faster, smaller and more powerful with superconducting components. Superconducting appliances that will use far less power are also possible. Superconductors may also hold the key to a much more practical propulsion system for spacecraft based on magnetic attraction/repulsion of the natural planetary magnetic field. Small and portable CAT (computer aided tomography) scanners of much lower cost with improved functions are also possible with the new superconducting materials. Currently, CAT scanners are costly and immovable due to the need for liquid helium coolant.

It will be a few years before the technical problems are worked out and superconductors get into the consumer marketplace. Superconductors are apparently not a passing fad, but a new, unexplored science that will have major impact on industry and consumers. Cave explorers will benefit with less power-hungry electronic devices and possibly very small electric generators with large power output.

Advances are occurring daily in superconductor research. The inventor's dream of perpetual motion is close at hand.

References

1. Editorial staff, "The Search for Superconductors." Elektor Electronics, September 1987, p. 17.

2. Editorial staff, "Toshiba Produces Wires and Tapes of Superconductor." Electronics Australia, August 1987 p. 36.

3. Sienkiewicz, J. "Superconductivity at Record High Temperatures." Hands-On Electronics, November 1987 p.31.

4. Rowe, Jim. "Superconductors: The Heat is On." Electronics Australia, July 1987 pp. 10-13.

5. Maranto, Gina. "Superconductivity: Hype vs. Reality." Discover, August 1987 pp. 23-32.

6. Editorial staff, "The History of Superconductivity," Superconductor Application Association Newsletter, August/September 1987 p. 5.

[Microwave System News & Communications Technology, February 1988 (p. 24) reports that a superconductor which works up to 500°K (227°C) has been produced at Georgia Tech.] --ed

A CAVE RADIO IN THE FIELD - SUMMER 1987

by Ian Drummond

The ASS radio was well used this summer. Four projects were planned, of which three were successfully carried through.

The first project was the one which fell-through, but the preparations for it helped in the success of the others. This project was the connection of Nita Nanta and San Agustin in the Huautla area of Mexico. The two caves come very close together at a huge boulder-choke. All efforts to connect the caves at this point had failed and it was felt that a distance and direction, obtained by getting cave-radios to both sides of the choke, would help in passing this obstacle in the 150-foot wide passage. In preparation, the procedures and formulae were worked out for locating a transmitter by triangulation from a surveyed base-line. When expressed in the right form, these formulae are simple enough to be readily evaluated in the cave using a calculator with sine functions. (Published procedures for position-finding assume the point directly over the transmitter can be reached by the receiver operator).

The second piece of preparation was to make two 13 metre square antennas from a single turn of 2-conductor 1.024 mm (18 AWG) wire. The objective was to obtain 2-way voice contact to the surface 700 meters above, to support the complex logistics in having an underground camp for several weeks with parties diving, surveying, exploring, and moving supplies. The size of 13 m was initially chosen as the largest size which would fit in my back-garden so I could test it at home. Subsequent calculations suggested that the size was adequate to give speech communication to a depth of over 1000 m but this remains untested.

The Mexico trip was cancelled when the diving team made the connection via a 10 m sump, to make the Sistema Huautla the third deepest in the world at approximately 1370 m.

The cancellation left me with 2 weeks spare vacation and an itch to try out the new equipment and methods. The chance came at the Speleofest held in the Crowsnest Pass area of the southern Canadian Rocky Mountains. Yorkshire Pot is the third deepest cave in Canada at 384 m. The entrance is at 7,800 feet on the British Columbia side of the Great Divide. A series of six pits drop to 620 feet, where the cave enters a phreatic roller-coaster. At the far end of this series in a little-visited side passage, an extension had been found which contained pack-rat scat. An opportunity existed to check the accuracy of the survey and, perhaps, to find another entrance to the remote lower sections of the cave.

The radio was taken underground, the party stopping at the bottom of the pits to talk to the surface 620 feet above. Clear 2-way communication was established, confirming that the equipment was functioning, and the party progressed on schedule. It was also useful to know that in the case of a rescue, communications could be provided up and down this difficult section of cave. While the underground party continued to the rendezvous, the surface party surveyed up, over the ridge into Alberta. As expected, the null-point above the transmitter was under a cliff and not accessible. However, the triangulation method was used successfully to find the location of the transmitter. It was 95m into the cliff and 140m deep, with no chance of an entrance here, but it did provide a closed loop for the surveyors to use in checking the accuracy of the survey. Voice contact was made, and the underground party agreed to continue to the bottom of the cave for another location. Unfortunately, at the lower site no contact was made. The surface team was assaulted by a sleet storm at the critical time. Possible reasons for the missed contact are that water got in the "works," that the higher electrical noise present during the storm obscured the signal, or that the surface crew were too far from the null (and not willing to search vigorously on difficult ground in the storm). All was not lost, as several new holes were checked out, and one drafting entrance found.

Enthusiasm was high enough that the following day another attempt was made to do the bottom location. The author abandoned the surface radio in favour of going underground for a change, but the large party moved rather slowly. We were able to make voice contact with the surface crew to tell them of our progress, but our furthest point was not located by the surface party.

Thus ended the radio work at the Speleofest. We achieved a successful test of the triangulation method, a contribution to the survey of Yorkshire Pot, information on communication coverage of the cave in the event of an emergency, and a drafting lead for the diggers of the world.

The third project arrived out of the blue, an invitation to do some location work at Lechuguilla Cave in Carlsbad Caverns National Park in New Mexico. The overburden at Lechuguilla is as high as 400 m, so I knew that the standard 0.7 m antennas would not reach this depth. In addition, the EM noise in the area could be higher than in the Canadian Rockies, being nearer the tropics with their high frequency of thunderstorms. I felt these problems could be overcome by the 13 m antennas, but I was not sure if the magnetic field would remain "well-behaved" at these depths. (See Magnetic Moments #5 in Speleonics 7 for a discussion of the Phase Problem). In short, I was confident that I would hear and talk to the underground unit, but I might not be able to tell where it was from the surface.

The first day at Carlsbad we decided to check the performance of the units, using the theodolite survey of Carlsbad Cavern itself. One radio was taken into The Left Tunnel to the Bell Cord Room and The Lake of the Clouds, while the other was used to do locations on the surface. Upon turning-on the surface unit I thought I had gone to New Mexico for nought; the noise was overwhelming. Then at 5.00pm the noise vanished as the Park Service turned off the visitors' radio system, one channel of which operates at 115 kHz, right at the cave-radio frequency! We were able to do two locations, tying the null-point to a Park's survey monument nearby. At 230 m depth (750') the error was 7.6 m or 3% of the depth. At the Lake of the Clouds (depth 335 m or 1100') we had to use the 13 m antenna on the surface to communicate with the 0.7 m antenna underground. We had clear 2-way speech but could not do a location as the 13 m antenna cannot be rotated.

The next day we did 4 locations along the main Lechuguilla Cave passage at depths up to 210 m, and surveyed the null-points back to the entrance datum. A field calculation showed the first three points to agree well, but the fourth to be way off. Therefore the next day was spent in the cave resurveying part of the cave. The survey was correct, so on the third day the cave radio was taken back underground. A fifth point intermediate between the last good point and the troublesome one was done. The problem point was then repeated but using the triangulation method.

The purpose here was to sample the magnetic field over a large area to see if it was well-behaved, that is, to see if it did indeed diverge symmetrically from the null-point. Plotting the data showed that the field was badly distorted. Moreover, since the intermediate point only 110 m away in the cave was not affected, the cause of the problem must be close to the underground antenna. The most probable cause would seem to be heavy mineralization of a cross-rift right at the site of the troublesome point.

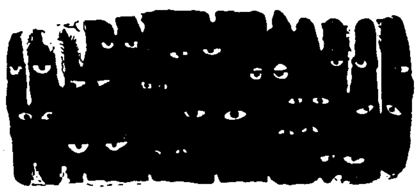
One other observation of interest was that at the points which were located without problems, the sharpness of the nulls obtained by rotating the antenna varied with the orientation of the axis of the antenna. The null was much clearer when the plane of the antenna was oriented at right angles to the cave passage than when it was parallel to the passage. Thus, the precision of the location on the surface was much better along the passage than at right angles to it.

In summary, the experience at Lechuguilla Cave confirmed the wisdom of performing a series of locations along the cave to provide a control grid for the survey, rather than relying on one single point at the far end of the cave to check the survey. Also, it was nice to have confirmation that those 13 m antennas really put out the signals. It was just like talking on the telephone at 335 m depth!

The final cave-radio trip this summer was to Vancouver Island, to Thanksgiving Cave in the Tahsis region. The highest point of the cave is at the base of a shaft estimated to be 60 m high. If an upper entrance to this feature could be found, the cave would move from fourth to second deepest in Canada (current depth is 356 m). Following a now-familiar pattern, the underground party started, pausing every 40 minutes or so to allow a surface location to be done. Interestingly, there was a strong interference present, a pulsed tone signal which could be nulled out by rotating the antenna so the plane was horizontal, or with the plane vertical on a bearing of 37°. This is the first time I have met significant man-made interference with the radio other than broad-band noise in town. Fortunately, it did not hinder the trip. For voice communication, the antenna was oriented to minimize the external noise rather than to maximize the signal from underground. And when doing a location I was able to switch in a 1143-Hz audio filter which cut out the interfering tone while allowing the signal from the underground unit to come through.

The surface conditions were a complete contrast to New Mexico. There I had been able to move freely in any direction. In the Vancouver Island rain forest my companions looked on in amazement as I "crashed" about trying to follow a compass bearing in the thick vegetation, over a heavily eroded karst landscape. In the end I had a "keeper" to look after me; we were followed by a party of two who flagged the trail so we did not become lost, and a survey party followed us all. They perhaps had the hardest job, as they could use only 10 m legs through the bush, and indeed they only managed to travel half the distance to the final location before dark and the start of a storm which dumped 50 mm of rain overnight.

All told, a fine summer of projects with the radio. I think the key thing I learned is the usefulness of the radio to establish a grid over a cave as part of a cave survey, rather than using it just to establish one point on the surface (often for a potential entrance dig).



[Art from **GROTTAN**, Swedish caving newsletter.]

MAGNETIC MOMENTS #7: ELECTROMAGNETIC NOISE - NATURAL SOURCES OF NOISE

by Ian Drummond

Previous "Magnetic Moments" have dealt with items affecting the strength of the transmitted signal from a loop antenna. Equally important in determining the performance of a cave radio system is the electromagnetic (EM) noise present at the receiver. The ratio of the power of the signal to the noise power (S/N, the signal-to-noise ratio) presented to the ear of the listener determines if the signal can be heard and if it can be understood.

A pulsed tone of the type used in cave radios can be recognized 50% of the time at a S/N of 6 dB (1). For voice communication, much higher S/N ratios are required.

EM noise can originate within the radio receiver, or it can be external in origin. The external noise can be further classified into man-made and natural noise. Man-made sources include deliberate transmissions such as navigation systems and broadcasts, and incidental RF emissions from motors, electric fences, power systems and myriad other sources. The incidental man-made noise can be very intense in areas of high activity but fortunately it is often (like cave radios!) very local in nature and the intensity drops rapidly, away from urban or industrial areas.

In the rrequency range of cave radios (2 - 200 kHz), atmospheric noise is a very important factor and the predominant source is lightning from thunderstorms. The storms need not be local; the EM energy propagates over thousands of kilometers. People are suitably impressed when I tell them that the performance of my cave radio is limited by thunderstorms in the tropics, and it may be true!

The best general source of information on natural noise seems to be CCIR Report #322, Geneva, 1963. While I have not seen the report itself, I have found a set of 24 world noise-contour maps in Saveskie's book (2), and further good information on using this data in a reference book published by Sams (3).

Noise levels vary with time of day and season of the year. Therefore the day is split into 6 four-hour periods and the year is divided into the four seasons, giving a total of 24 time periods, each with a map and two associated graphs. An example of one map is shown here for the summer period between noon and 4:00 pm.

The procedure to use these maps and graphs is as follows:

1) Find your location on the map and read the nearest contour line. Alberta is at 55°N, 115°W. The value is 40 dB.

2) Go to the graph associated with each map. Locate the frequency of interest (115 kHz) and find its intersection with the line marked "40". Read the Y-axis value of F (95 dB above kT_0b).

3) Convert this value to the magnetic field strength using the following formula:

$$H_n = F + 20 \log_{10} f(\text{MHz}) - 117.0$$

where H_n = RMS noise field strength in a 1kHz bandwidth in decibels above 1 microA/m
F = noise value in decibels above kT_0b
f = frequency in megahertz

In this example H_n = -41dB(1microA/m).

4) The field strength must then be adjusted for the desired bandwidth using the formula:

$$H = H_n + 10\log_{10}(\text{bandwidth(kHz)})$$

For the ASS voice radio, the bandwidth is 1.5 kHz, so H = -39dB(1microA/m).

5) Finally, the field strength can be expressed in microA/m using the conversion:

$$H(\text{microA/m}) = 10^{(H/20)}$$

In this example the noise field strength is 0.011 microamps/metre.

The remaining graph associated with each noise map (which is not shown here) gives the standard deviation of the RMS noise value., and the ratio of the first and ninth decile to the RMS value.

Knowing the atmospheric noise at a location, the maximum range of a cave radio can be estimated. If a signal-to-noise ratio of 10 dB is required at the receiver and the atmospheric noise is -39 dB(1uA/m), then the signal must be -29dB or 0.035ua/m.

The antenna used normally with the ASS cave radio (0.7 m square) has a magnetic moment (NIA) of 11 $A \cdot m^2$.

As noted in Magnetic Moments #1,

$$H = NIA \cdot G / 2 \pi d^3$$

where d is the range, and G is the attenuation factor.

As G is a function of d, exact solution of this equation is not easy (or necessary). Assuming G is 0.3 (corresponding to 3 skin-depths), then d is approximately 240 metres.

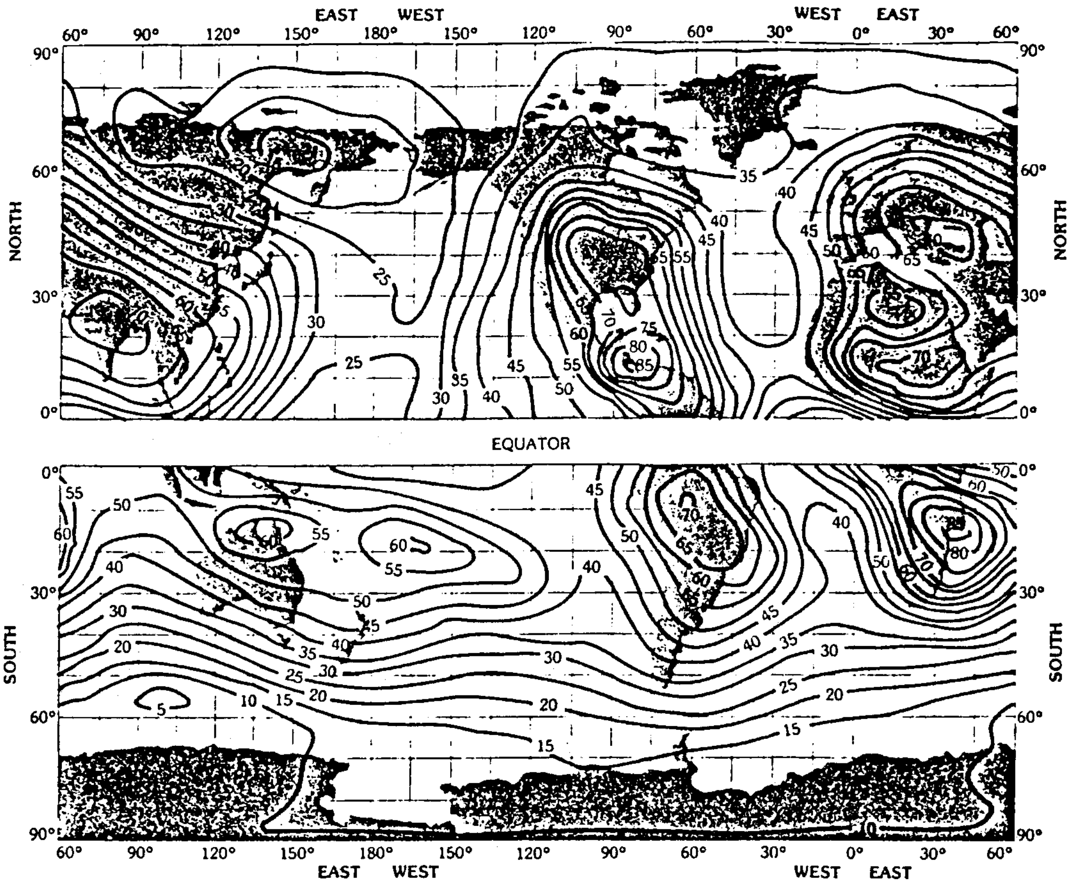
The ASS radio has achieved voice communication at depths of over 200m, with these antennas, in the summer in Alberta, suggesting that there are no major shortcomings in the receiver. Also suggesting that there will not be any more dramatic increases in range through refinements in the current SSB equipment operating at these frequencies.

References:

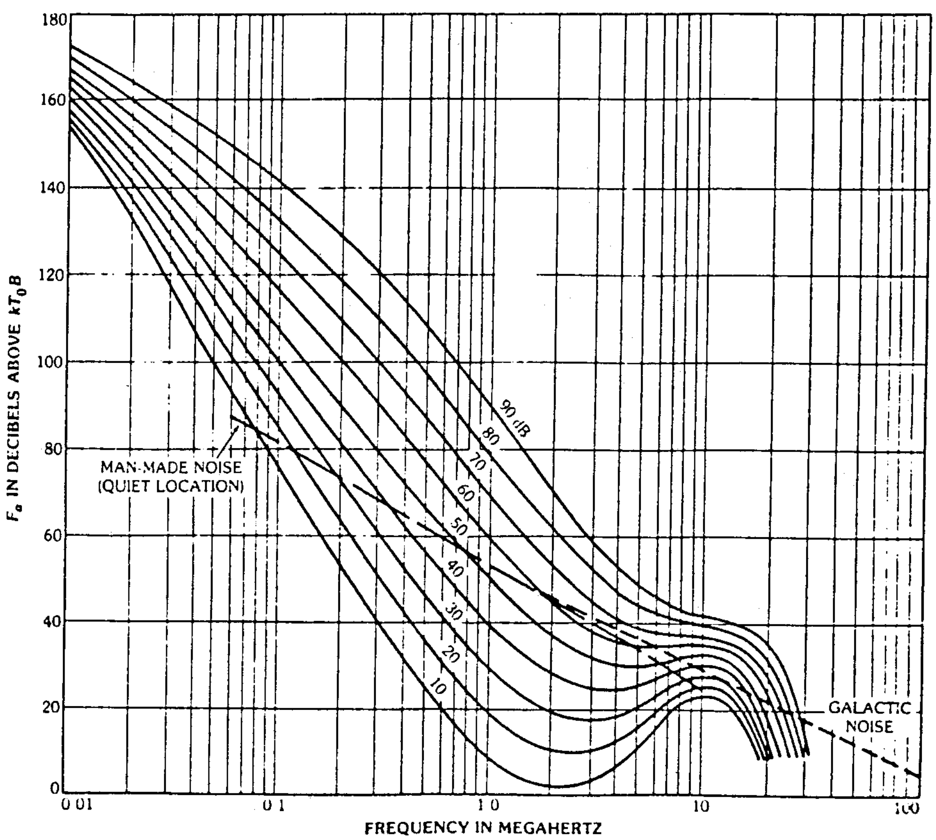
(1) R.J.Urick, Principles of underwater sound for engineers. quoted in US Bureau of mines IC8907, Post-disaster Survival & Rescue. 1975.

(2) P.N.Saveskie, Radio Propagation Handbook, Tab Books, Blue Ridge Summit, PA 17214, USA.

(3) Reference Date for Engineers, 7th ed. H.W. Sams & Co. (Macmillan & Co), Indianapolis, IN 46268, USA.



Atmospheric noise levels in northern and southern hemispheres, summer, 1200–1600 hours local time. The maps show the expected values of F_a at 1 MHz, in decibels above kT_0B. *(From CCIR Report 322, 10th Plenary Assembly, Geneva; 1963.)*



Variation of radio noise with frequency, for data given in Fig. 2 legend. *(From CCIR Report 322, 10th Plenary Assembly, Geneva; 1963.)*

BATTERY DATE-CODES

(adapted from article by **Stanley F. Quayle** on UUCP computer newsgroup rec.aviation)

On Mallory Duracell(tm) packages, the date of manufacture is marked in a code like "7DXXX," in the upper-right corner of the back of the card, for the ones mounted on cards. The first character is the last digit of the year. The next character is the month, where A = January, B = February, etc. The remaining characters are a batch number or something. The code above is April 1987.

BEWARE-- Duracell is pushing their new dated package. The advertising says that the cells keep up to 2 years on the shelf, but the date on the front (that is easily readable) is about 2-1/2 years from the date of manufacture. [New Mallory packages claim 3-year shelf life; we do not know their testing criteria. --ed]

The date code on the bottoms of Radio Shack batteries (regular and alkaline) is obvious, such as "0786" (July 1986).

Otherwise, you can tell old merchandise by seeing which packages have old or expired offers (free flashlights, rebates, etc.). You can also get a hint from the store's sticker. Many stores date their stock with a code like the Radio Shack one (a local store uses 8607 as a variation).

Radio Shack's "Free Battery Card" entitles you to one free battery per month (and you can have LOTS of cards). The batteries don't last long, but the price is right.

--

Cavers obviously should avoid batteries of uncertain age (Speleohucksters take note!). A survey of local stores the week after Christmas, 1987, found most batteries with readable dates to be less than one year old; a few 1985 and 1986 dates were found mixed with newer packages.

Military batteries are clearly marked with date of manufacture but are often outdated when they become available as surplus.

Kodak batteries have obvious dates stamped on their bottoms. Panasonic(tm) batteries (from Japan) have obvious year-month date codes, and are said to have exceptionally high capacity. Panasonic cells in the above survey averaged slightly older than domestic brands. Eveready(tm) and Ray-O-Vac(tm) batteries sometimes bear 2-character numeric and alphabetic codes, respectively. Anyone knowing the keys to these and other manufacturers' date-codes, please write. (Surely a few DC-area cavers work for NSA. :-) We also need a list of ampere-hour capacities of primary cells, by size and manufacturer. --ed

---

MORSE CODE APTITUDE TEST

Frank Reid, W9MKV

Do you want a ham (amateur radio) license but fear the Morse code requirement?

Aptitude testing was an important development during World War II; the military needed great numbers of pilots, radio operators, etc., but could not afford to waste time and manpower attempting to train unsuitable people.

The aptitude test for Morse code was very simple: Code was sent so slowly that the people being tested could write-down individual dots and dashes. Those who could tell the difference between a dot and a dash passed the test, and learned Morse code with little difficulty. It was noted that people with musical backgrounds ALWAYS passed, and became especially good code operators.

Oral history source: **Richard Blenz** (NSS 5671LF), Cpl, 100th Bombardment Group, Thorp Abbots Air Base, Diss, England, 1944. Dick Blenz, now a cave owner, was an airborne radar and ECM technician.

RESOURCES

Antique Wireless Association

AWA is a national organization for collectors of antique radio equipment, "devoted to research and documentation of the history of wireless communications." There are local chapters, and regional swap-meets similar to hamfests. AWA maintains a free museum in East Bloomfield, New York. The AWA Journal, The Old Timer's Bulletin, is published approximately four times per year and is available only through association membership.

Subscription address: Joyce Peckham
Box "E"
Breesport, NY 14816

Membership: $10.00/year, $12 overseas

--

Health Research
Box 70
Mokelumne Hill, CA 95245

Psychoceramic publications-- UFO's, numerology, Bermuda Triangle, Loch Ness Monster, etc. We include this resource because of the Nikola Tesla literature listed in the catalog.

THE MINI-MAGLITEtm AND VARIANTS: ELECTRICAL TESTS AND CAVER MODIFICATIONS

Frank Reid

The waterproof, machined-aluminum "Mini-Maglite" flashlight is very popular among cavers and the general public. Its durability, small size and surprising brightness make it an excellent secondary light source for caving. The light is turned on by unscrewing the head about 1/8 turn; further counterclockwise rotation focuses the beam. There are no fall-apart problems like those of flashlights which turn-on by tightening the headpiece.

Manufacturer:	Mag Instrument, Ontario, California
Length:	5.75" (147 mm)
Diameter:	
(barrel)	0.71" (18 mm)
(head)	1.00" (25.4 mm)
(reflector)	0.75" (18.1 mm)
Price:	$10 - $15

Bulb tests: (New bulb with two fresh Duracell-brand alkaline AA-cells under load.)

Current:	320 mA @ 2.6 V
Diameter:	0.117" (3.0 mm)
Length:	0.375" (7.5 mm) [not including pins]
Base:	Wires, 0.020" dia., 0.050" apart, 0.25" long. [0.05, 0.13, 0.65 mm]

A used bulb took 300 mA; resistance increases as filament metal evaporates.

Bulb life-rating is "4 to 5 sets of batteries." Some ads say that the bulbs are argon-filled. One package of two replacement bulbs ($2.39) was labeled "vacuum bulbs," which could explain their noticeable blackening after only one hour of use. (Evaporated tungsten collects inside the glass.)

Alkaline cells larger than size-AA, having lower internal resistance, would probably burn-out the bulb, however, it works well with a single lead-acid "gel-cell" (2.2 v). A 5-ampere-hour gel-cell should provide about 15 hours of light, and greatly increased bulb life due to lower voltage.

The tiny bulb could be built into a caving helmet. The wire-base makes such improvisations easy.

Errors in measuring the low voltages and high currents of flashlight bulbs may be appreciable unless metering circuits are carefully designed; I used a high-impedance digital voltmeter (Beckman DM73) to measure voltage directly at the bulb base. The same voltmeter was used to test voltage drop (0.006 v) across the ammeter (Beckman DM25L digital multimeter on 10-amp dc range).

Accessory kit: The optional Mini-Maglite accessory kit contains a short lanyard, metal pocket-clip, colored filters, and a hexagonal rubber lens-guard/filter-holder which prevents rolling when the light is placed on a flat surface. The rubber guard is the only accessory useful to cavers; I installed mine along with the clear filter to protect the lens.

MINI-MINIMAG and KEY-MATE. These variants use AAA-cells. Their two-pin wire-base bulbs are sometimes identifiable by a colored ring or plastic sleeve around the base. The tiny Key-Mate is a good addition to an emergency kit or, as its name implies, a key ring.

Bulb	Batt	Current	Color Identifier
Minimag	2-AA	320 mA	(none)
Mini-Minimag	2-AAA	170	blue
Key-Mate	1-AAA	220	red

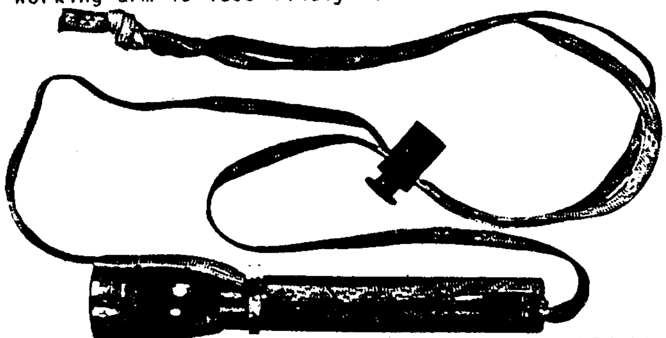
Horizontal Flashlight Lanyard. In CRF Newsletter, May 1986, **Rick Olson** suggests a better way for cavers to carry small flashlights around their necks:

"...Even with the shortest cord which will fit over your head, the flashlight winds up between the floor and your sternum in a belly crawl. A friend, Pat Porter, suggested that the light be suspended horizontally instead of vertically, like a St. Bernard's cask of brandy. This is easily accomplished by running the cord through a tight rubber band near the front of the flashlight. A much longer cord can be used if a loop is pushed through a small "Barrel-Loc" [spring-loaded sliding plastic cord-lock, as used on drawstrings]. The light can be raised high when not needed, and lowered as desired. A knot will prevent the cord pulling out of the Barrel-Loc again. The lanyard can also carry a folding hand-lens, small compass, or a tip reamer..."

I used a plastic cable-tie, and a continuous loop so that the flashlight will not be lost if an attachment point breaks.

Never wear a cord around the neck during any climbing operation-- Neck cords caught on projections during falls have resulted in injury and death. The original configuration, using a rubber band for the forward attachment point, allows the lanyard to break free if caught.

Make the lanyard long enough to allow a heavily-clothed person to hang the lanyard over the shoulder and secure the light tightly in the opposite armpit, for hands-free forward illumination. This configuration is almost as convenient as a head-mounted light; right-handed people should hold the light under the left arm so that the working arm is less likely to block the beam.



Horizontal-suspension lanyard holds flashlight three ways. "Mini-Maglite" balances with heavy head-end tilted slightly downward.

IN REVIEW

ELECTRONIC HYPOTHERMIA ALARM
From BCRA Transactions, December 1975, reprinted in The Underground Express, vol. 2, #2 (Spring 1976). 2 pages.

"... An electronic device the size of a matchbox which can be built for only a few dollars... will enable even a rank novice to know when a hypothermia victim can be moved under his own power. While the patient may still be mobile, his body temperature may have fallen to the point where movement may cause much more rapid and perhaps fatal deterioration by using up his last stores of energy... The device lights up when the patient's mouth temperature (a reflection of his core temperature) falls below 35ºC. At that point, the patient should no longer be moved under his own power...

A thermistor balances a bridge circuit at 95ºF (35ºC). A voltage comparator (LM308) lights a red LED if the temperature falls below that point. For waterproof operation, a magnetic reed switch is used to turn on the battery. One magnet and the relay are mounted inside the case, another magnet outside in a spring clip, so that the magnetic fields cancel in the vicinity of the relay. The device is then turned on (circuit closed) by removing the exterior magnet. Ingenious! The magnet is then clipped to the patient using the spring clip.
--

A CONTINUOUSLY VARIABLE LIGHT FOR CAVING
by **Bill Varnedoe**, Huntsville Grotto News, vol. XV, #10 (Oct. 1974). 2 pages.

"How often we've wished we could vary the intensity of our caving light, up to peer into a deep pit, or down to stretch the life of a battery... We've been forced to exchange bulbs of lower and higher current rating. This is an awkward and not very satisfactory solution There simply are not very many bulbs of a specific voltage to form a series, besides the bother of disassembly of the headlamp, etc."

The dimmer circuit is a switching-type dimmer with about 90% efficiency. The relatively simple circuit uses four transistors. The author gives credit for the design to **Mike Cox** (NSS 14031) of Indianapolis.
--

LAMP DIMMER MEASURED
by **Bill Varnedoe**, Huntsville Grotto News, vol. XV, #11 (Nov. 1974) 3 pages.

This companion article to the one mentioned above describes testing of the variable lamp, and contains a graph of candlepower vs. current.
--

DIMMER CIRCUIT, MODIFIED
by **Bill Varnedoe**, Huntsville Grotto News, vol. XVIII #1 (Jan. 1977). 2 pages.

A CD4002AE CMOS chip replaces two transistors in this redesign of the circuit of the December '74 article, lowering the parts count somewhat.
--

Above four articles contributed by NSS Librarian **Bill Torode**.

CONSTANT VOLTAGE SOURCE FOR BATTERY OPERATED LAMPS
Elektor Electronics (English-language German electronics magazine) February 1984. 3 pages.

This novel switching-regulator design can be used as a lamp dimmer but its primary purpose is to keep the power supplied to the lamp, and therefore the light intensity, virtually constant over the normal life of the battery.

"Unfortunately, dry batteries have a serious drawback: their output voltage falls linearly with time so that at the beginning of their life the lamp burns brightly, while long before they are exhausted, the lamp begins to resemble a glow worm! Not only is this highly undesirable from a safety point of view, but it also makes for low efficiency..."

The circuit contains four operational amplifiers (a single LM339) and two transistors. It contains a voltage reference; its main purpose is regulation, though it can also be used as a dimmer.

[Voltage regulators are recommended for some applications of the new rechargeable lithium cells (referenced in SPELEONICS 8), which change voltage rather drastically during discharge.] --ed.

Contributed by **Luther Stroud** and **Peter Ludwig**.
--

RADIO COMMUNICATION THROUGH ROCK
by **B.A. Austin**, Electronics & Wireless World, Sept. 1987 p. 943. 3 pages.

Underground radio in South African mines is highly developed. The author has designed SSB systems operating between 100 kHz and 1.1 MHz. Ruggedized mine transceivers use loop antennas built into the shoulder strap. **Ian Drummond** is now corresponding with the author.

Contributed by **Bo Lenander** and **Luther Stroud**.
--

Copies of the above articles are available from **Frank Reid** for SASE. One-ounce postage is good for 5 pages.

-=-

FREQUENCIES OF INTEREST: 1988 NSS CONVENTION

These are VHF FM frequencies of government agencies at some of the interesting places in and near the Black Hills region, for your scanning pleasure during the NSS Convention at Hot Springs, South Dakota, June 27 - July 1.

Agency	State	MHz		
Badlands NP	SD	169.40	170.05	170.10
BIA, tribal police	SD	39.10	39.16	39.24
		39.28	39.32	others
Devil's Tower NM	WY	169.40	170.05	
Jewel Cave NM	SD	170.05		
Mount Rushmore NM	SD	170.05		
NPS, Black Hills	SD	169.40		
U.S. Forest Serv	SD	169.95		
Wind Cave NP	SD	170.05	170.90	

Sources: cavers, POPULAR COMMUNICATIONS magazine January 1987, February, 1987.

ELECTRONIC WRISTWATCH MAKES EMERGENCY FLASHLIGHT

Frank Reid

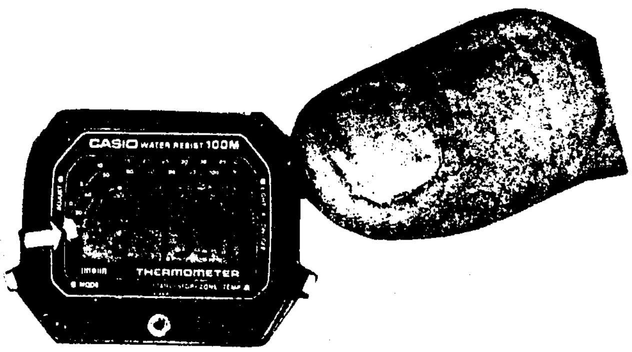
An LCD digital watch with internal illuminator makes a useful miniature flashlight if it can be modified so that the lightbulb is directly exposed through the watch crystal.

The light is surprisingly bright, adequate for emergency repair of other cave lights and equipment, or reading maps and instruments. Fully dark-adapted eyes require very little light.[1]

A watch-flashlight is always ready, but cumbersome; operation requires both hands unless the watch is removed from the wrist. Wristwatch illuminators quickly deplete batteries, which are expensive and sometimes difficult to replace. Watches should be used as flashlights only if no other light is available.

My Casio thermometer-watch contains a relatively large lithium cell which lasts 4-5 years in ordinary service, so seems a good candidate for modification. Some watches have separate batteries for light and electronics.

The Casio is easy to disassemble, by removing four screws from the back. The electronics package can then be removed from the case. The light is the size of a 1/10-watt resistor, has axial leads, and is beneath a layer of black plastic on the left side of the display. I used a small "X-Acto" knife to carve a hole in the plastic, and to scrape away a spot of paint inside the crystal to let the light shine out. When reading the watch at night, my thumb covers the direct light.



Casio recommends that watches be sent to their service center for battery replacement in order to guarantee the waterproof seal; an O-ring under the back becomes permanently deformed and should be replaced when the battery is changed.[2]

[Casio's digital-thermometer function is only marginally useful. There are two modes, on-wrist and off-wrist. On-wrist mode is accurate only in the absence of wind and water; it uses an additional sensor on the back for body heat. Response time for both modes is very slow, around 20 minutes.]

Tiny 1.5 and 3-volt bulbs can be salvaged from discarded watches, or bought from jewelers and other sources. Experiments continue with ultra-small lights for cavers: Watch bulbs could be transplanted into larger bulb bases (including Mini-Maglite(tm)) and used for long-duration emergency light. They are smaller and brighter than light-emitting diodes and could be used as compass illuminators.[3] Very small emergency lights can be built into caving helmets.[4] A tiny bulb could make a helmet-light for a "GI Joe" doll dressed as a caver, for scale in cave photography. <*:-)

References
----

1. Fermi, T. "Nuclear Flashlights," Speleonics 6, p. 2.

2. Reid, F. "Emergency Watch Repair for Cavers," Speleonics 7, p. 3.

3. Market, R. "Lighting Up Your Suunto," Speleonics 6, p. 14.

4. Stuproch, J.C. "An Emergency Light System," Georgia Underground v II #1 p. 10. Reprinted: Speleo Digest 1965, p. 3-82.

LATE NEWS

CALL FOR PAPERS

We need abstracts for papers to be presented at the 1988 NSS Convention at Hot Springs, South Dakota, June 27-July 1. NSS NEWS, February 1988 (p. 43) says,"The abstracts deadline is March 31, 1988. They should be no longer than 150 words in length. Since they will be published in the NSS Bulletin after the convention, they shoud be informative (give objectives, methods, results and conclusions) and do not refer to the presentation itself."

Send abstracts to **Frank Reid** (address on p. 1). Please indicate what audio-visual equipment you will need.

We also encourage informal presentations at the electronics session, for which abstracts need not be submitted. At this printing, a time for the session has not been set.

SPELEONICS
P.O. Box 5283
Bloomington, Indiana
USA 47407-5283

Bulk Rate
U. S. Postage
PAID
Bloomington, IN
Permit No. 202

LARSON, DAVID
14* 13906L
15 SOUTH 6TH AVE.
LAGRANGE IL
60525