SUMMER 1978

Search & Rescue

MAGAZINE

THE OFFICIAL PUBLICATION OF THE NATIONAL ASSOCIATION FOR SEARCH AND RESCUE

NATIONAL ASSOCIATION FOR SEARCH AND RESCUE

THE BIG ELT CONTROVERSY

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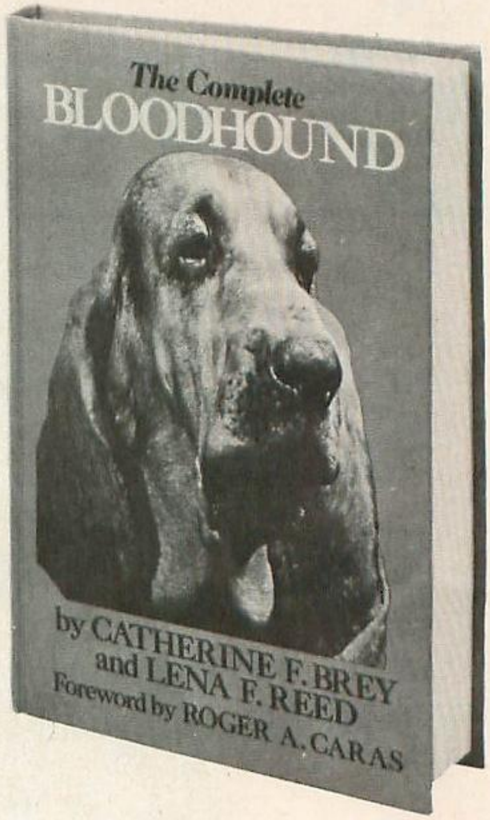
by Catherine F. Brey and Lena F. Reed

Foreword by Roger Caras, syndicated commentator for CBS **Pets and Wildlife**, and a Bloodhound "people!"



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Mrs. Reed got her start in Bloodhounds through Mrs. Brey and has achieved success in search/rescue work and in the ring. She is also a professional writer.

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COVER: Los Angeles County Sheriff's Department helicopter approaches fatal civil airplane crash in San Gabriel Mountains in Southern California. Foul weather prohibited ground teams from finding crash site the night before. (Photo credit: Los Angeles Times)

MAN LIFTED OFF FLAMING SILO IN DARING HELICOPTER RESCUE

By MILLIE BALL

The smoke was so dense and jumpy the two Coast Guard helicopter pilots couldn't spot the man as he scrambled around the silo's roof trying to avoid the wind whipped flames.

Cmdr. W. B. Watkins and Lt. Cmdr. David Kennedy maneuvered the helicopter around the smoke, hovered it over the roof, back out, hovered, back out and hovered over one more time as crewmen Gary Rauser auser and Jack Patton searched for the man and directed the pilots through the thick gray mass of smoke.

It was the third time over the Continental Grain Elevator that exploded Thursday morning that Patton again spotted the trapped man whose name they never learned. Patton realized the wind was about to shift one more time and told the pilots to stay in there. The man reached the unsteady white steel basket dropped from the helicopter and crawled in it.

The 20-foot trip to the idling helicopter was tenuous. The cable lifting the basket and man "was swinging like a pendulum at one time, maybe a 25-30 foot swing," said Patton. "It was a pretty big arch and we held the cable trying to keep him from the flames."

Once inside the helicopter, the rescued man as,ked a single question, "Are we going to the hospital?" He didn't say another word as he sat in the basket and stared straight ahead, unmindful of his scorched face, the debris in his eyes and the terrible burns on his legs which had been stripped of his slacks by the flames. They took him to West Jefferson Hospital and returned to the scene of the catastrophic grain elevator explosion in Westwego.

This was only one of two daring rescues Thursday by Coast Guard helicopter pilots and crewmen. Lt. Cmdr. David Scott and Lt. j.g. Phillip Fallis along with crewmen Mike Whitcomb and Terry Thompson rescued Flowers Wilson, who jumped from on top of a silo and landed on a ramp nearby. Gold old Cross ambulance driver Emory Hunt put Wilson's leg in a splint and he and firemen and deputies helped get Wilson in a stretcher for the journey to the helicopter.

Both crews received heaps of praise from onlookers. Veterans of many rescue operations, Kennedy, Patton and Rauser admitted Thursday afternoon at Belle Chasse Air Station that this one will stay with them. "It was terrifying to be that close to a roaring fire where it was possible the sillos could have exploded at any moment," said a weary looking Kennedy, still wearing his orange flightsuit.

"As we moved over the fire, you have to realize, the air currents changed and there was some kind of turbulence," said Kennedy. "The helicopter fanned the flames. There was a lot of debris flying through the air and our jet engines can only ingest a certain amount."

Kennedy, who should have felt like a hero, audibly sighed several times as he repeated his story for the press who demanded a meeting with the heroic pilot. He apologized for being "distracted" and obviously didn't want to talk too much about the events of the day. Neither did any of the other pilots in the closely knit group of 25 officers and 80 crewmen at Belle Chasse.

Though used to rescue operations, and taught to treat them as routine, this one was different. It hit home.

One of the casualties among the many killed in the explosion and fire was 19-year-old Scott Peterson, son of Lt. Cmdr. Charles Peterson, operations officer at the base. It was Scott's first week on the job. And after saving lives the pilots all went to the Peterson home to share in the grieving for one who didn't make it, one they couldn't rescue.

Courtesy of the Times Picayune, New Orleans

PHOTO #1
The helo in this picture attempted several times unsuccessfully to pick up the man shown on top of the silo with a rescue basket. The intense heat and smoke were creating extreme turbulence and visibility problems. On the final try the area directly behind the man (and almost directly under the helo) exploded. The flames and the heat became too much for the man and he jumped to the chute below him and then slid down to the sopot marked by the *. Firemen and rescue personnel climbed up to him at this point and carried him down to the base of the chute. He was injured from the explosion and from his jump to the chute.

PHOT #2 and 3.
Due to his injuries and the difficulty of attempting to get the man safely to the ground from their present position atop a silo, the fire and rescue personnel had him hoisted in a litter by the helicopter.

FOOTNOTE:
The helicopter is a Sikorsky HH3F from Coast Guard Air Station New Orleans. There were two helicopters making rescues from the Air Station. The enclosed news story from the New Orleans Times Picayune lists the crews of both helos. ■

ICSAR = "THE INTERAGENCY COMMITTEE ON SEARCH AND RESCUE"

LOIS CLARK MC COY
Executive Secretary, NASAR

PART ONE - WHAT IS IT?

The Interagency Committee on Search and Rescue (ICSAR) was established to coordinate federal involvement in search and rescue matters.

The ICSAR has five voting members consisting of representatives of the Department of Transportation, Defense, and Commerce, the National Aeronautics and Space Administration and the Federal Communications Commission.

The Chairman of the Committee is the ranking member of the Coast Guard representing the Department of Transportation, presently Rear Admiral Norman C. Venzke.

The members and alternates from the Department of Commerce and from the FCC have traditionally been from the Maritime Administration, and the Enforcement Division respectively.

The United States SAR positions in the Intergovernmental Maritime Consultive Organization (IMCO) and the International Civil Aviation Organization (ICAO) are addressed before this body.

With the above background it is easy to understand how much of ICSAR's interest and concerns have traditionally been focused on the maritime and aviation areas of search and rescue.

Now, under the leadership of Rear Admiral Norman C. Venzke, newly appointed to the position of Chief of Operations for the Coast Guard and Chairman of ICSAR and with the full support of the member for the Department of Defense and the advisor for the ARRS, the Interagency Committee is becoming more heavily involved with search and rescue concerns on land.

Recently the Department of the Interior has been invited to become a signatory to the National Search and Rescue Plan. As such, Interior would become the sixth voting member of ICSAR. Previously none of the federal land management agencies have been signatories of the National Search and Rescue Plan.

The objectives of the Committee are:

a. To provide a standing committee to oversee the National Search and Rescue Plan and coordinate interagency search and rescue matters.
b. To provide a forum for preliminary development of interagency positions in search and rescue matters.
c. To provide for an interface with other national agencies involved with emergency services.

In addition to the voting members and their alternates, there are advisors from other groups within the signatory department. These include the Office of Safety Affairs, the Federal Aviation Administration and the National Highway Traffic Safety Administration from Transportation; the Goddard Space Flight Center from NASA, the Air Force Rescue Coordination Center from the Aerospace Rescue and Recovery Services (MAC) United States Air Force; and representatives from the National Oceanic and Atmospheric Administration (NOAA) and the Defense Civil Preparedness Agency (DCPA).

In addition to the Advisors there are also Permanent Observers. Here we begin to see some of the Land Management and other federal emergency response organizations whose concerns are more related to land SAR. Among these permanent observers are the Department of State, the Federal Disaster Assistance Administration (DHUD), the Division of Emergency Medical Services (DHEW), the National Park

Continued

Mr. Eugene Ehrlich, Member; Communications Programs, Office of Applications, ICSAR Member, National Aeronautics and Space Administration.

Capt. Gordon Hempton, Member; U.S. C.G.;-Ret; Chief, Aviation and Marine Division, ICSAR Alternate - Federal Communications Commission

Major Raymond J. Hufnagel, Member; U.S.A.F., Defense Advisory Committee on Federal Aviation, ICSAR Member, Department of Defense.

Rear Admiral Norman C. Venzke, Member; U.S.C.G. Chairman, Interagency Committee on Search and Rescue; Chief, Office of Operations, U.S. Coast Guard Headquarters Department of Transportation.

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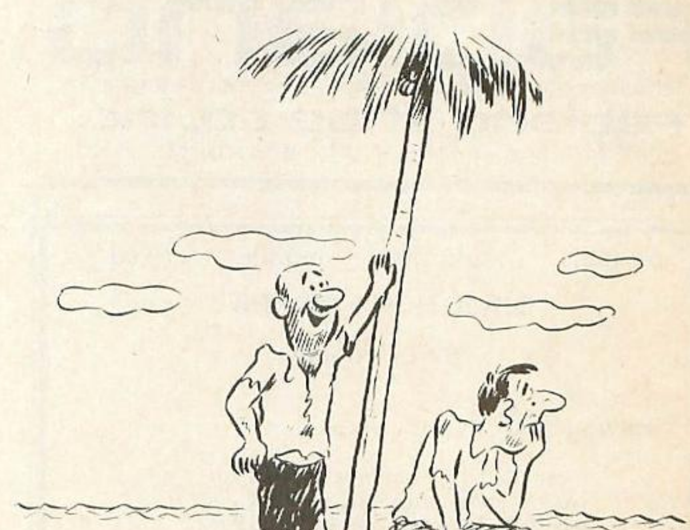

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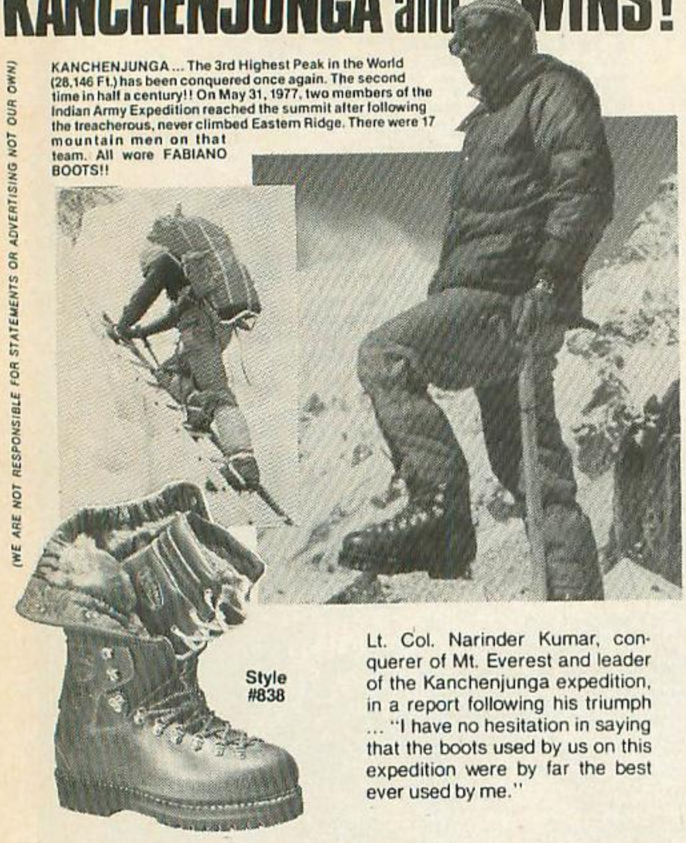

Lt. Col. Narinder Kumar, conquerer of Mt. Everest and leader of the Kanchenjunga expedition, in a report following his triumph ... "I have no hesitation in saying that the boots used by us on this expedition were by far the best ever used by me."

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Continued

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Mr. C. Dennis Wright, Non-Federal Ad Hoc Observer; Director, Technical Planning Department, Aircraft and Pilots Association.

Service (DOI), the National Transportation and Safety Board (NTSB), and three recent additions; The U. S. Forest Service (DOA), the Department of the Treasury (Customs) and the Department of Justice (Emergency Porgrams Center).

What has triggered ICSAR's greater involvement in Land Search and Rescue? Is it the change in the "players" in the program? Is it a heightened realization of the need for greater coordination in emergency response between the federal and state levels of humanitarian assistance?

It may be some of all these things. But perhaps the single greatest motivator may be that ole' devil, the malfunctioning ELT (Electronic Locator Transmitter). The ELT has come in for all types of verbal abuse over the years but it is saving lives. It's rather like the watchdog on the block whose fierce bark has kept the neighborhood from being robbed over the years—but the dog barks all the time and is more than a nuisance therefore.

Such is the ELT. When it works, it saves lives (such as the 9-year-old girl in our county) but it's a false alarm rate "barks all the time."

As a result of previous ICSAR recommendations NASA has been able to start putting together a low-orbiting position-locating Satellite system for monitoring ELT type transmissions.

This will permit a demonstration of electronic monitoring and position location via satellite by 1981-82. This could solve a primary difficulty with the Congressionally mandated ELT for general aviation aircraft. That is, you, by law, must have an operating ELT on your airplane, but nobody is mandated to listen for it. Now ICSAR hopes to have solved that problem.

ICSAR's newest effort is a thorough look at emergency response communications. ICSAR has authorized the formation of an ad hoc working group to develop an Emergency Response Communications Program.

The program is a multi-agency effort to consolidate known federal, state, and local emergency communications requirements throughout the spectrum of severity. Some examples of application are: a lost child, a downed civil aircraft or a disaster situation. The ad hoc working group expects to identify user requirements from all levels, consider preliminary system designs to fulfill those requirements, and to establish appropriate funding profiles for program development.

The program envisioned would be a national endeavor to improve the efficiency and capability of emergency communications to all state governments, federal agencies, and others desiring to participate. Inputs from these user-level organizations will assist in defining the magnitude and complexity of the problem and will help achieve a potential for an improved capability. The program may also assist communications planning efforts at all levels.

And that, in a nut-shell, is some of what ICSAR is all about these days. Here is the vehicle to help you see that your larger SAR problems are addressed.

The National Associationfor Search and Rescue (NASAR) is an ad hoc non-federal observer to this Committee. Let us hear about your larger needs. ICSAR wants to help you on National problems. ■

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State troopers investigating the crash site.

PLEA FOR HELP IGNORED DURING 10-DAY ORDEAL

His Anger Credited in Man's Survival

KETCHIKAN, Alaska (AP)—The survivor of an airplane crash that killed his family told rescuers two men had approached him during his 10-day ordeal but turned their backs on his pleas for help.

A man who did help rescue Michael George, 36, from uninhabited Etolin Island said his anger might have helped him survive.

"That was one of the first things we picked up on—his anger," Dan Vick, skipper of the fishing boat that rescued George, said in a marine telephone interview. 'I'll never forget it."

Vick said George, who otherwise talked little about the crash, had told a bizarre story about seeing two men near the wreckage of his twin-engine plane a day or so after it crashed Feb. 5 on the second leg of a vacation flight from Anchorage to Mexico.

"He said the men walked to within 30 feet of where he was lying," Vick said. "He said he yelled to them: 'Help! My plane crashed! My family has been killed! I need help!'

"He said the men just looked at him and turned and ran away."

The fishermen said George had not seemed delirious when he was picked up. They added that the two men could have been illegal trappers.

George's wife and four children were killed in the crash. His relatives have refused to allow reporters to interview him. George's ribs were broken and his feet injured.

Vick said he had been cruising slowly along the beach off Etolin Island about 60 miles northwest of Ketchikan Wednesday night when he heard a cry from the forest.

George had radioed control towers that he had problems with his instruments and that his plane was icing and was low on fuel.

During the 10 days between the crash and George's rescue, the weather was rainy but temperatures did not drop below freezing.

Los Angeles Times, Feb. 19, 1978

ALASKA PLANE CRASH

Seven p.m. Feb. 5, 1978. A twin-engine plane with six persons aboard was missing, reportedly crashed, and the Ketchikan (Alask[illegible] Volunteer Rescue Squad (KVRS) organized for a search. It was nea[illegible] dark and winds howled about 40 m.p.h.

This would be no ordinary search; a week of searching and researching would prove futile. The pilot would be found alive by fishermen 10 days later, or three days after the search had been scaled down, on an island 80 miles north of the area he had reported to crash land.

When the final total was in, the Coast Guard said it searched 5,500 square miles, using four helicopters and two cutters. Their operating costs were about $100,000. The 23 KVRS pilots and boat operators traveled 27,760 miles and consumed $5,354 in fuel costs, some of which will be reimbursed by the state. If KVRS pilots had recevived charter rates, the bill would have come to about $50,000.

In a similar future situation, KVRS president Dick Borch said he would cover more miles and allow pilots to follow hunches. During the search the Coast Guard had directed the overall strategy.

In this 900-mile-long, 100-mile wide island region, known as Alaska's panhandle or "Southeast," plane crashes happen too often. In the last two years, five twin-engine planes have crashed, killing twenty-nine. Only one person has srurvived.

On Sunday, Feb. 5, the KVRS and U.S. Coast Grard in Ketchikan launched their search. High-wind warnings had been out most of the weekend and what searching was done that night was done by Coast Guard cutters and a few helicopters that could fly until dark. KVRS pilots, workers and others put their heads together, trying to piece together the puzzle.

They knew the pilot had left Yakutat for Ketchikan at 2 p.m., on a run that takes two hours, 45 minutes under good conditions. He had five hours of fuel aboard. At about 6:50, he radioed that he had missed an approach to Ketchikan International Airport and would try to land 15 miles south of Ketchikan at Annette Island airstrip, a virtually abandoned runway without lights or other navigational aids.

At 7 p.m. he radioed that he was out of fuel and ditching his silver-colored Cessna 320 into trees. Searchers hoped that George had had time to turn on his emergency locater transmitter before he went down. They thought it was strange that he had not been able to see [illegible] lights of Ketchikan, its airport or the brilliant lighthouse marker t[illegible] can be seen in a radius of 15-20 miles. There was no sign Sunday night.

High winds and low visibility conditions persisted throgugh Monday, as the Coast Guard helicopters from Sitka arrived. Pilots, EMT's, and other rescuers huddled in the KVRS command base at TEMSCO Helicopters. Borch sat in the office, answering phone calls, conversing with pilots and Coast Guard cutter operators. Even though the Coast Guard directed the overall search, Borch kept detailed records on note cards of areas searched and who was searching.

Note: All photos were taken by Rollo Pool, except pilot in litter which was taken by Normand Dupre.

Another piece of the puzzle came Monday. A woman in a small logging camp 15 miles north of Ketchikan said she had twice heard a twin-engine plane fly overhead about the crash time. Others reported the sound. Later, fishermen near Etolin Island, 60 miles north of Ketchikan, said they heard a twin-engine craft. The search area widened and began stretching to the north.

An oil slick south of Ketchikan proved to be lube oil and a sonar search underneath it detected no plane. Searching for the ELT beam proved fruitless. If there was a redeeming hope, it was that the temperatures during the night did not get below freezing. But during the week nothing turned up and chances of finding survivors lessened.

Half of this region is salt water and half is mountains and islands. Most is uninhabited or sparsely inhabited with less than one person per square mile and nearly all is choked with Western Hemlock and Sitka Spruce trees.

In the early 1960's a plane crashed on an island near Ketchikan, and even though the site was pinpointed to a 15-mile stretch of mountainside, the wreckage was located two years later, not by searchers, but by a pilot who was routinely flying over a portion of the island [illegible] just happened to catch a glimpse of the plane. This year's Febru[illegible] crash may never have been found if 36-year-old pilot Michael George

by Rollo Pool
Ketchikan, Alaska

Continued

Pilot Michael George getting carried off the CG cutter Cape Romain at 3 a.m. Feb. 16. He suffered broken ribs, lacerations and from exposure after a 10-day ordeal in the Alaskan wilderness.

of Anchorage had not been thrown from the plane as it crashed and had not srurvived ten days in the wilderness.

His wife and their four children were not as fortunate; they apparently died on impact. The pilot had found his way down to an inlet on an uninhabited, 600-square mile island, where fishermen heard his cry.

At 7 p.m. Feb. 15, a Coast Guard cutter was dispatched to Etolin Island. Shortly after George arrived in Ketchikan he was taken to the hospital. The next morning his brother and sister arrived in Ketchikan and sequestered him from news reporters, FAA and National Transportation Safety Board representatives. Doctors reported he was in remarkably good shape for his ordeal. He had a few broken ribs, lacerations, and it was feared he would lose a few toes to gangrene. He flew back to Anchorage a few days later and checked into a hospital [illegible]e.

When George was found, Borch was not surprised he was on Etolin Island, 60 miles north of Ketchikan. Etolin had been searched, even though it was not considered a prime search area. It had not been overlooked. (Last August a plane had misjudged the height of an Etolin Island peak during fog and crashed 15 feet from its summit, killing six persons.)

The morning after George was found, two pilots, two state troopers and myself headed by helicopter for Etolin. We had a vague description of the crash site. We had heard the wreck was at 1000 foot elevation, one mile from the mouth of Burnett Inlet. It looked fairly hopeless; the trees were thick and broken snags and treetops appeared to have natural breaks.

Then we saw two fishing boats farther up the inlet and headed for them, not able to raise them on a radio. We landed on an exposed tideland rock, dropped off one of the pilots with walkie-talkie and left the area so the pilot could talk to the people on the boat without helicopter noise interference. It turned out that the boat crews were the ones that discovered George and from George's description they relayed to us the information of the whereabouts of the wreckage.

They said he had tried to land in a frozen muskeg, had overshot it and crashed on the mountainside. We found the muskeg dotted with human tracks. A few minutes later we wiped the well-camouflaged plane. It perfectly blended with a fresh trace of snow. The pilot dropped the troopers and myself at the mulkeg and he returned to pick up the other pilot. We began a hike through the steep mountain, an ascent of about 400 feet to the wreck.

Shortly after we arrived, another helicopter brought two loggers who felled timber to allow us to extract the bodies by net and rope with a helicopter.

All five bodies of the George family, with seat belts fastened, were still in the plane. The plane's wings had been sheared, its engines thrown; the props had landed upright in the snow. An NTSB official indicated the plane had been travelling at a fast rate prior to impact. A t[illegible] had torn open the cabin and rested in the cockpit.

[illegible]l the answers to the George crash have not been answered. One of the four Alaskan-based NTSB members flew to the crash site in early March. His job is to determine if George was, in fact, out of fuel and how he got into that situation. His report will be public in late spring. As a separate investigation, the FAA is trying to determine if any federal regulations were violated. ■

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THE ELT IS THE BEST SEARCH TOOL CURRENTLY AVAILABLE

Robert J. Mattson, Major, U.S.A.F.
Chief, Search and Rescue Activities
DCS, Operations
Civil Air Patrol Headquarters

Is the Emergency Locator Transmitter (ELT) really worth all the aggravation???? For the last few years I have been compiling **unofficial** figures on search and rescue missions for downed aircraft. Using the data collected by the Air Force Rescue Coordination Center (AFRCC), I analyzed the data concerning actual and false ELT missions. From this study I have concluded that even with the very high false alarm rate the ELT is an effective method for locating crashed aircraft. I will certainly admit that the ELT is not the best system and definitely needs much improvement; however, even with its shortcomings it has been instrumental in reducing the total effort expended in searching for missing aircraft.

First, let's look at the number of lives saved, and the number of families spared the agony of doubt when a crash site is not found. In 1977 the ELT could be credited with the **saving of 34 lives.** Unfortunately, on 22 of the ELT finds no one lived through the crash and no system could have saved the occupants. The ELT did limit the grief and difficulty for the families involved by quickly locating the wreckage. The families did not have to endure the additional suffering of a prolonged search, and the legal difficulties of a "missing" person.

In 1977 the AFRCC opened missions to look for 194 **crashed** aircraft (all false missions have been omitted). The ELT was instrumental in locating 43 of the crashed airplanes, and this is **22%** of the total. There were an additional 119 crashed airplanes that had properly activated ELT's, but the ELT was not needed to locate the crash site and the AFRCC did not need to conduct a search. If these 119 aircraft had crashed in more remote areas their ELT's would have made the search much easier. The average effort (determined by the number of flying hours) expended on the 43 ELT missions was 13 hours. This does not mean that it took 13 hours to locate the ELT. The time includes travel from a home base, time used to locate the ELT, time spent overhead waiting for a ground team to arrive, time spent by other aircraft on visual searches, and time to return to home base.

The average effort expended on non-ELT assisted missions (including 38 missions where radar tapes were used to identify the most probable area) was 83 hours. A quick check with my calculator shows the ELT aided search required only 16% of the effort of a non-ELT assisted search.

Of course we must consider the effort spent on the false ELT missions. In 1977 there were 381 missions initiated for what turned out to be false (improperly activated) ELT's. The average effort expended on these missions was 4 hours.

The time spent on false missions could be added to the actual ELT missions to determine the total effort spent searching for ELT's. Since only the actual crashes are of interest, we could charge all ELT effort against the actual crashed aircraft found. When all effort spent on all ELT searches (actual and false) (554 + 1526 = 2079 hours) is divided by the number of actual crashed aircraft found with the aid of the ELT (43), the average effort is 48 hours. This effort is still only 58% of the non-ELT assisted search, and leads me to believe that the ELT is worthwhile.

A last argument for the ELT is the AFRCC statistic which shows that the ELT will get rescuers to the scene of a crash in one-fifth the time required if an ELT is not used (18 hours elapsed time vs. 82 hours). The figures also show that 44% of persons lived if an ELT was instrumental in finding the crash site versus only 27% when it was not. These figures would be even more impressive if they discounted the persons who were killed on impact and could not be saved. If some occupants lived through the crash, the average time of 18 hours (with an ELT) to get assistance to the injured would allow some hope for their survival. The average time of 82 hours, for non-ELT searches, leaves little hope for injured occupants.

It is for these reasons that I believe the ELT is a worthwhile device; it is the best system **currently** available. I know it is not the ultimate system for finding crashed aircraft, and that much must be done to improve it. The National Transportation Safety Board (NTSB) has recently done an excellent job in identifying the problem areas and recommending solutions. It will take a long time to implement these changes, but we should understand that even in its present state, ELT is a valuable tool and is assisting in the saving of lives.

We should all remember **all** the time that we are in the search and rescue business for one purpose; to save a life. We are working for one person, the survivor. We must use whatever tools we have to make our job more efficient, and right now the ELT is one of the best tools we have. Just try to find a plane full of injured survivors in a heavily wooded area, in marginal wewther conditions, at night without an ELT!!! ■

Realtime SAR mission coordination at the AFRCC.

INTRODUCTION

Controversy regarding its effectiveness in search and rescue has engulfed the emergency locator transmitter (ELT) since 1970 when Congress mandated its installation in most general aviation aircraft. The ELT has been plagued with numerous technical and operational problems; often, during an accident, it has failed to activate and thus, failed to provide a distress signal warning of a downed aircraft. It has activated frequently when there is no emergency, thereby requiring the unnecessary expenditure of search and rescue resources. Committees comprised of representatives of governmental agencies, private industry, and special interest gropups have been formed to examine various aspects of the ELT program and of the wider problem of search and rescue. Although these attempts have not produced solutions for all the current problems, they are paving the way for the development of an improved emergency locator system.

A depefdable ELT will have a substantial impact on aviation safety. After an air craft accident, occupant survival may depend upon an ELT which transmits a distress signal. Furthermore, an ELT activation when no accident has occurred could result in an unnecessary airborne search for the source of the errant signal. This might needlessly create the potential for an accident involving the searching aircraft.

For these reasons and because of the current problems created by the ELT, the National Transportation Safety Board has performed this special study, which includes a review of the history of the ELT, of problems which arose from its use, and of efforts to solve these problems. The current situation is discussed and the persistent problems and benefits of the ELT are highlighted. This overview of the ELT also reviews the role of the ELT in the search and rescue mission.

Finally, the Safety Board has made recommendations to encourage and promote the development of a highly reliable, properly functioning ELT. The Safety Board hopes that these recommendations will provide additional support for the necessary work and will impart an added sense of urgency.

The sources of statistical data are the accident files of the National Transportation Safety Board and the quarterly and annual reports of search and rescue activity of the Air Force Rescue Coordination Center.

Sources of qualitative data included: The Air Force Rescue Coordination Center, Scott Air Force Base, Illinois; the Federal Aviation Administration; the Goddard Space *Flight Center, of* the National Aeronautics and Space Administration; the Office of the Secretary, Systems Development and Technology, Department of Transportation; the Crash Research Institute; the Technical Planning Department of the Aircraft Owners and Pilots Association; manufacturers of ELT's, crash sensors, and aircraft; members of the Radio Technical Commission for Aeronautics; members of the Interagency Committee for Search and Rescue; and the National Association for Search and Rescue, an organization which includes many State search and rescue officials.

Through visits and numerous discussions with these organizations, minutes of meetings, reports, and other documents, the data which forms the foundation of ths overview were obtained.

FIRST-GENERATION ELT'S: HOW THEY WERE DEVELOPED AND

ELT's have been used by the U.S. military for over 20 years. They signal the existence of downed air craft and aid search and rescue teams in locating a crash site. Typically, the ELT unit is self-contained within a plastic or metal alloy case, less than 12 inches long and weighing only a few pounds. A signal is radiated by a single flexible whip antenna, which is attached to the external surface of the aircraft. Many units are equipped with both an external whip antenna and a deployable antenna incorporated into the unit. The ELT unit is attached by a mounting bracket to a rigid structure within the aircraft to facilitate transmission of crash forces to the crash sensor in the main unit.

In 1963, the Federal Aviation Administration (FAA) conducted a study in the Los Angeles, California, and Salt Lake City, Utah, areas to evaluate ELT equipment. On January 9, 1964, the FAA issued Advisory Circular 170-4, which informed the aviation community that the study demonstrated the feasibility of the ELT concept. The Circular also solicited industry comments. On February 28, 1968, an Advanced Notice of Proposed Rulemaking was issued to invite public input toward establishing regulations on crash locator beacons. On

Continued

NATIONAL TRANSPORTATION SAFETY BOARD
SPECIAL STUDY Report No. NTSB-AA-78-1
Excerpts from
EMERGENCY LOCATOR TRANSMITTERS: AN OVERVIEW

March 17, 1969, the FAA issued another notice proposing that a crash locator beacon be required on aircraft operated by air taxis. Concurrently, the FAA issued Advisory Circular 91-19 recommending that aircraft owners install ELT's.

Before the FAA took final rulemaking action, Congress enacted Public Law 91-596, the Occupational Safety and Health Act of 1970. Section 31 of this Act amended Section 601(d) of the Federal Aviation Act of 1958 to require that ELT's be installed on all fixed-wing aircraft manufactured in the U.S. or imported after December 30, 1973. The following aircraft were exempted: Jet powered aircraft, aircraft used in air transportation other than air taxi and charter service, military aircraft, aircraft used solely for training purposes and involving flights of not more than 20 miles, and aircraft used for the aerial application of chemicals.

On March 10, 1971, the FAA issued a Notice of Proposed Rulemaking reflecting the requirements of Public Law 91-596, and in August 1971, the FAA amended the Federal Aviation Regulations (FAR), Parts 25, 29, 37, 91, 121, and 135. These amendments to the FAR's adopted Technical Standard Order (TSO) C91, which specified the minimum performance standards that ELT's must meet in order to be identified with the applicable TSO markings. Further, TSO-C91 required that certain types of ELT's meet standards prescribed in the Radio Technical Committee for Aeronautics (RTCA) Documents DO-145, DO-147 published on November 15, 1970. These standards relate to primary ELT design parameters, including operating frequency, radiated power, operating life, operating temperature, repetition rate, modulation, automatic activation, and battery replacement. The Part 135 revision required that, on extended overwater flights, a survival-type ELT be attached to one of the liferafts.

Amendment 121-93 was issued in July 1972 to require that air carriers be equipped with survival-type ELT's during all extended overwater operations after October 21, 1972. Advisory Circular 20-81 was issued on October 10, 1972, to alert the general aviation community of accidental or unauthorized activation of ELT's and the penalties involved. It also suggested means of controlling or containing the radiated energy on the emergency frequencies during testing. On October 27, 1972, Advisory Circular 00-35 was issued to provide guidelines for licensing, installing, maintaining, and testing ELT's.

Because of unwanted ELT activations, the FAA issued a general notice (GENOT) to its field personnel to emphasize that an aircraft accident or incident must be assumed whenever an ELT signal is heard or reported and that immediate action must be taken to alert rescue forces. Should the signal be found to have been accidentally triggered and the owner or operator could not be readily located, FAA personnel were to take steps to ground the antenna and placard the aircraft. They must then advise the owner/operator that the aircraft may not be operated without first having an FAA inspector check out the ELT installation.

Airworthiness Directives were issued to three ELT manufacturers to resolve inadvertent activation problems with their products. A fourth Airworthiness Directive was issued to require the inspection of 27,000 units and their replacement or repair as necessary. However, false activations and other malfunctions persisted, many of which required repairs and often the return of the units to the factory. Often, repairs were not made for long periods of time, and, as a result, the FAA received numerous requests for authority to fly without an ELT until it had been repaired. There were also requests that FAA grant exemptions from compliance with the mandatory date of December 30, 1973.

In October 1973, the FAA issued Advisory Circular 00-40 to state that the FAA Administrator was not authorized to grant exemptions from Section 601 (d) of the Federal Aviation Act of 1958; only Congress could grant such relief from the mandatory compliance date. On January 2, 1974, Public Law 93-239 further amended Section 601(d) of the Federal Aviation Act of 1958 to extend the compliance date to June 30, 1974. Thus, after June 30, 1974 no nonexempt aircraft could be operated without an ELT or with an inoperative ELT. This was implemented on February 5, 1974, when the FAA issued amendment 91-121.

On July 10, 1974, FAA amendment 91-124 to Part 91 of the FAR's became effective. This adopted the statutory exemptions contained in 601 (d) of the Federal Aviation Act of 1958 as amended by Public Law 93-239 and incorporated these exemptions into 91.52(f) of the FAR's. The amendment also adopted minor technical language changes enabling the FAR's to conform with 601(d)(12) of the Federal Aviation Act of 1958. In addition, several new exemptions were added, set forth in 91.52(f)(4), (5), (7), and (9), which permitted aircraft to be used in certain types of flight operations without an ELT. Also, the original exemption 91.52(f)(3) which permitted aircraft engaged in training operations conducted within a 20-mile radius to fly without an ELT, was extended to permit this operation within a 50-mile radius of the airport. A further minor change related to exemption 91.52(f)(6), aerial application of chemicals and other substances for agricultural purposes. This change allows exemptions during necessary flights to and from the location of the application operation.

In January 1975, the Radio Technical Commission for Aeronautics (RTCA), Special Committee 127 (SC 127), was convened at the request of the FAA to revise the Minimum Performance Standards of RTCA DO-145 and DO-147. The RTCA-SC 127 was especially concerned with the problems of inadvertent activation and nonactivation of ELT's.

To complement the intent of ELT legislation, in 1975 the National Transportation Safety Board required the inclusion of ELT information in its accident reports. At the same time, the Air Force Rescue Coordination Center (AFRCC) at Scott Air Force Base, Illinois, also began recording and publishing data on the ELT as it related to the AFRCC search and rescue coordination mission.

Because of continued reports of ELT malfunction caused by inadequate mountings, battery failures, and the failures of the crash sensor to activate, the Safety Board, on April 15, 1975, issued safety recommendations A-75-41 and 42 to the FAA. The Safety Board recommended that the FAA issue an Airworthiness Directive providing comprehensive design and installation specifications to assure that fixed-type ELT's remain in their mounts. It also recommended that the FAA amend 14 CFR 37.200 to require an easily accessible battery test feature and to provide for activation of the devices under conditions approaching those encountered in actual accidents. In responding to these recommendations, the FAA referred to its Directed Safety Investigation conducted in 1974. The FAA stated that, according to that investigation, about 12 per cent of ELT's were inadequately installed. The FAA then stated that the problem had subsequently been corrected and that the current frequency of the incidents did not warrant an Airworthiness Directive. It further stated that the RTCA-SC 127 was studying means of rendering the ELT's more crashworthy. The FAA said that no simple means of testing ELT batteries existed and additional circuitry for battery testing would reduce ELT reliability. It believed that current battery maintenance checks appeared to be acceptable procedures to assure reliable batteries. The FAA pointed out that the RTCA-SC 127 was studying the crash sensor problem with a view to developing more realistic standards and, at the conclusion of such study, appropriate amendments to the FAR's would be proposed.

Because the recurring problems which afflicted the ELT were accompanied by extensive delays in obtaining repairs, legislation was introduced in Congress in September 1975 to amend the Federal Aviation Act of 1958 to permit the temporary operation of certain

Continued

aircraft without ELT's. This legislation, however, was not enacted.

In 1976, the FAA issued the results of a Directed Safety Investigation conducted in 1975 to examine unwanted ELT activations and failures to activate in accidents. Accident investigators, repair stations, and equipment manufacturers were surveyed. The surveys confirmed that batteries continued to fail because of corrosion, leaks, short circuits, and expiration of shelf life; that crash sensors continued to fail because of improper design, jamming, and corrosion; and that ELT's continued to fail because of improper mounting, location, and short circuits. The surveys also indicated that about 90 per cent of the false ELT signals emanated from aircraft parked at airports.

On October 20, 1976, Amendment 91-133 to the FAR's was issued to eliminate certain exceptions to the ELT requirement which, as of December 30, 1975, were no longer allowable under the law. These exceptions were those aircraft built or imported before December 30, 1971.

As additional problems have developed with specific ELT's, the FAA has continued to issue Airworthiness Directives requiring modification, repair, and periodic inspection or replacement of the units or their components.

THE ELT IN SEARCH AND RESCUE

The National Search and Rescue (SAR) plan designates the U.S. Air Force as the Federal executive agency responsible for coordination of SAR activities within the inland region of the United States. The Aerospace Rescue and Recovery Service (ARRS) operates the AFRCC. Within the maritime region, including Alaska and Hawaii, this function is performed by the U.S. Coast Guard.

The basic responsibility for SAR rests with the State and local authorities. The State often coordinates with local sheriff departments, fire departments, or police departments who have the actual SAR responsibility in their State. The relationship of the AFRCC with the various State and local authorities is based on legal agreements between the States and the AFRCC, which define the State and local authorities responsible for the SAR function.

Volunteer organizations, including the Civil Air Patrol, are often requested by the State authorities or AFRCC to aid in SAR missions. The coordination of these efforts and Federal SAR assistance requested by local authorities is performed by the AFRCC. There are substantial differences in attitudes, organizations, capabilities, and facilities of the various State and local authorities. The AFRCC depends on the cooperation of State and local authorities to perform its function effectively.

Most ELT reports received by the AFRCC originate from airborne traffic. They are then forwarded to the AFRCC by air route traffic control centers, flight service stations, control towers, approach controls, or fixed-base operators.

Nearly 90 per cent of the ELT signals emanate from the vicinity of airports; most of these are false. Many airports have neither receivers to monitor the ELT channels nor direction finding equipment to tract the signals. They also lack the personnel needed to search for the source of the signals. The FAA is procuring and providing hand-held direction finding units to its flight service stations; however, the progress is slow.

The relatively high incidence of failure to activate when required combined with the high false alarm rate has creted apathy among users, flight service stations, fixed-based operators, and search and rescue organizations. There are numerous reports of delays or refusal of airport personnel to locate and silence ELT's in aircraft parked on their facilities. Some are not aware that the ELT signal they fail to silence can mask an emergency signal from an aircraft downed elsewhere in their area. In densely populated areas, there often is more than one airport from which ELT signals could emanate. The AFRCC Quarterly Report of SAR Activity Related to Aviation for July, August, and September 1976, contained an excerpt from an AR Mission Summary of such a situation: Two nondistress ELT signals masking a valid distress signal had to be silenced before the accident site could be located by triangulating the weak ELT signal from the downed aircraft.

The cost of locating false ELT signals and implementing search and rescue missions for signals not silenced has been substantial; the AFRCC estimates that this cost exceeds $800,000 a year.

Two significant advances were applied to search and rescue operations during 1976 by the AFRCC which can significantly enhance the effectiveness of the ELT in locating an accident site.

One of these is the ELT/TAP (Track Analysis Program) established in 1976. It utilizes both the ELT and Air Route Traffic Control

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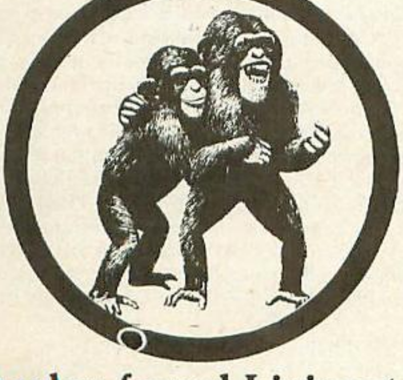

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Center's (ARTCC) computerized radar to determine a last known position (LKP). Once radar contact has been established and the aircraft identified, its position is automatically recorded as the flight progresses. This record may be recalled by the computer and the point at which radar contact was lost can be determined. Thus, the search area is narrowed considerably, the ELT signal can be monitored more easily, and the crash site can be located by triangulating the signal. Because of light conditions, terrain, or weather, it is not always possible to establish visual contact with the downed aircraft, and it is often necessary to use a combination of airborne and ground direction finding equipment to locate the accident site.

The time required to identify an aircraft as missing varies significantly depending on the details known about the flight and the specific location of the crash site. It is possible that an aircraft would not be reported missing until after the ELT's batteries have been exhausted, rendering it valueless in the search and rescue effort. A program employing the filing of flight plans and the use of ELT's and TAP can significantly reduce the search time, which can be critical when either serious injury or a hostile environment exists. The absence of any one of these three position-relating elements can substantially alter the outcome of a search. AFRCC records indicate that the life expectancy of injured survivors decreases as much as 80 per cent during the first 24 hours following an accident. The chances of survival of uninjured survivors rapidly diminishes after the first 3 days. Unfortunately, flights operating on either IFR or VFR flight plans constitute only 15 per cent of general aviation traffic.

TAP is currently available at 15 of the 20 ARTCC's in the continental U.S. This provides coverage of about 70 per cent of the continental U.S. now. When all ARTCC have TAP, about 90 per cent of the continental U.S. will be covered.

The effectiveness of TAP can be severely limited by mountainous terrain or low altitude, or both, which can block the radar line of sight and prevent the aircraft from appearing on the radarscope.

In addition to TAP, another significant technological advance was applied to SAR operations in 1976. The Air Weather Service Global Weather Central and the National Environmental Satellite Service began providing historical weather data, analysis, and satellite photographs at the known time of a missing aircraft flight. Such information provides an effective tool for predicting areas of high accident probability and thus enables SAR coordinators to reduce the size of the initial search area and decrease the search time.

CONCLUSIONS

The first-generation ELT has been plagued with numerous problems. NTSB and AFRCC data have revealed that many of these are technical and engineering problems and have resulted from inadequate design, testing, and installation. Operational and maintenance problems also exist.

Existing statistical data provide some insight into these problems; however, improvement is needed in data collection, recording, and interpretation. Data that are not readily useful must be replaced by data that will provide greater insight into current ELT problems. Accident investigators must adhere strictly to collecting and recording procedures, which must be accompanied by consistent and accurate interpretation of the data for storage in the computer system.

A well-designed, installed, and properly functioning ELT can be an extremely effective tool as part of a search and rescue effort especially when used in conjunction with TAP and a flight plan to complete the system. Most problems associated with ELT's are recognized and many have been and are being addressed by responsible organizations. Nevertheless, questions remain regarding the successful ou[illegible]come of the second-generation ELT.

Attachment of the ELT unit, including the type of mounting system and the location within the aircraft, remains a significant problem. Current tests performed by the National Aeronautics and Space Administration to determine deceleration forces experienced at various locations within an aircraft, must be supplemented by additional tests, if necessary, and the proper location for attaching ELT's in aircraft determined. Furthermore, additional testing is necessary to determine the type of mounting system required.

Adequate design and specifications for a crashworthy antenna also remain to be established. Success in this area will do much to prevent future antenna separations.

Numerous problems related to battery performance persist. The revised Minimum Performance Standards have specified inadequate operating life and low operating temperature for the requirements of search and rescue, due in part to current technical limitations of nonlithium-type batteries and the hazards associated with the lithium sulfur dioxide battery. Other lithium-type batteries currently being developed by various manufacturers must be considered; technical alternatives must be examined. A safe, economical, and technically feasible solution to this problem must be found.

Battery problems associated with corrosion, short circuits, or operation beyond shelf life must also be addressed. Much can be accomplished through the mandatory inspection of the battery during the annual or 100-hour maintenance checks, or both. Easy access to the battery unit would enable pilots to readily inspect their batteries during preflight checks.

Similarly, the recurrent ELT failures caused by corrosion, short circuits, and coaxial cable disconnection must be reduced. Again, the mandatory inspection of the ELT during the annual or 100-hour maintenance checks, or both, would hhelp. Providing ready access to the ELT unit so that it could be inspected visually would further reduce these problems.

Numerous ELT's have failed to activate during an accident because they were not armed before takeoff. The installation of an ELT cock[illegible] control and warning light, as provided for in the revised Minimu[illegible] Performance Standards, should reduce significantly this problem. The ability to monitor the ELT in flight should also reduce the number of false signals that come to the attention of search and rescue and yet remain unknown to the pilot.

Unfortunately, new aircraft are continuing to be sold without provision for the control and warning light. These cockpit aids should be provided as soon as possible.

Many failures to arm automatic ELT's during preflight preparation could also be eliminated if aircraft manufacturers would add an "ELT ARMED" check to the preflight and "ELT OFF" to the shutdown check lists when so provided with the aircraft. Perhaps the mandatory inclusion of such check lists in new aircraft would yield the best results.

The existing crash sensor fails to respond to the majority of crash forces actually experienced in accidents. Instead the sensor responds to vibrations and other nondistress forces. The Minimum Performance Standards for the second-generation ELT are currently being formulated by the RTCA. Many of the problems of current ELT's exist partly because component research and development and system field testing of the standards were not a part of the initial development of commercial ELT's for general aviation. The development of a redesigned crash sensor has theoretically solved this problem. Until the component is tested, however, solution of the problem will remain in doubt. Furthermore, ELT PROTOTYPES WHICH INCORPORATE THIS REDESIGNED SENSOR MUST BE FIELD TESTED. Without such testing even if the component operates as designed, there is no assurance that the system problem will have been solved. The time to xeal with these problems is during the preproduction testing phase, not after thousands of ELT's have been manufacturd and installed in aircraft.

Advances in the technological capabilities of search and rescue have significantly enhanced the value of satisfactory ELT capability. The ability to rapidly determine last known position and predict a[illegible] of high probability of adverse weather conditions have compleme[illegible] the ELT in the search and rescue mission.

To further this process of improving the overall SAR system, a highly reliable, properly functioning ELT is required. It is the intent of this report to provide impetus and a sense of urgency to the effort currently underway to produce such an ELT. ■

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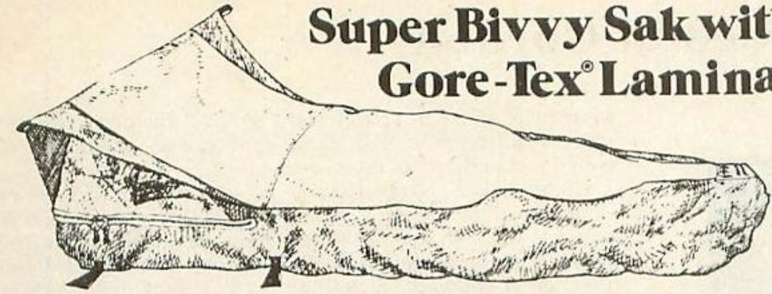

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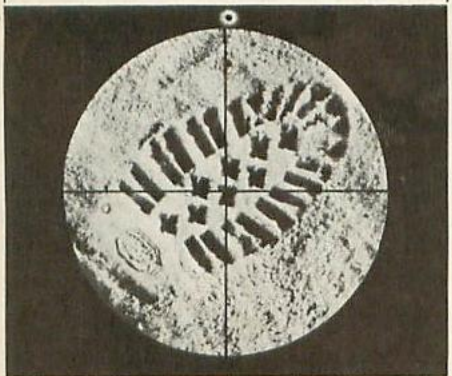

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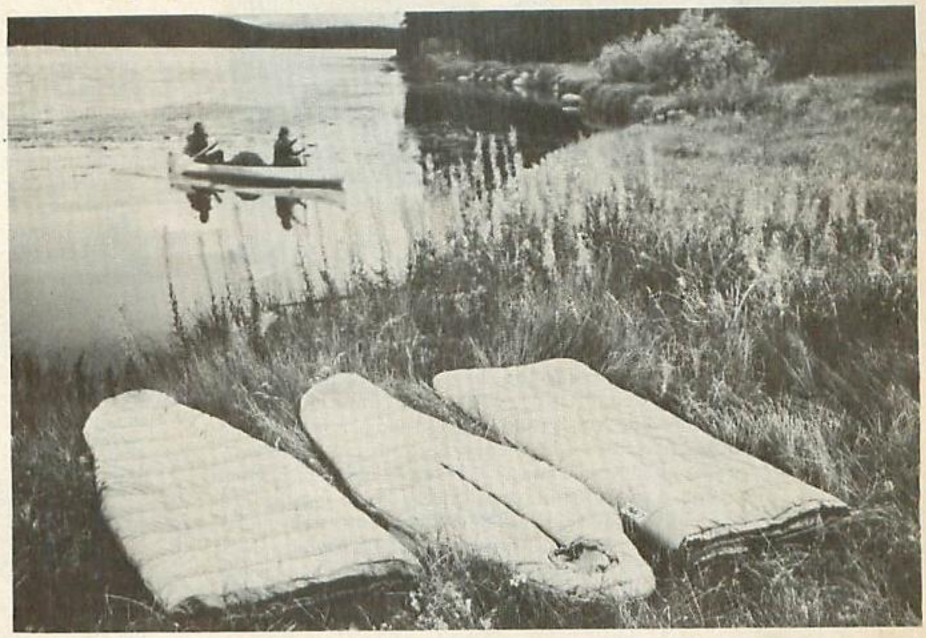

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AIR AND GROUND E.L.T. DIRECTION FINDING

By Bruce E. Gordon

CHARACTERISTICS OF THE ELT AND ITS SIGNAL

Most civilian aircraft are equipped with a battery-powered transmitter that is activated on impact of a crash. The power output is very small (1/16 to 1/4 watt), which makes the range over which it can be heard usually under a hundred miles (we will go into conditions later that will show you it sometimes has a range of less than a mile). These transmitters are officially called Emergency Locator Transmitters (ELT), and sometimes called rescue beacons, crash locators, or beepers. The ELT is designed to transmit simultaneously on two radio frequencies, VHF (121.5 MHz) and UHF (243.0 MHz), but sometimes are damaged and only transmit on one frequency. ELT's used by the military normally operate on UHF ONLY. Some boats are also carrying these transmitters; they have the same characteristics as those used by civil aircraft and are called Emergency Position Indicating Radio Beacons (fortunately shortened to EPIRBS). All beacons have a distinctive swept tone (usually sweeping downward in tone) with two or four sweeps per second.

Radio waves are invisible, and this sometimes makes it hard to visualize how they can be reflected, blocked, scattered and polarized. In many ways they behave like light, and this analogy should make it easier to make sense of an otherwise confusing set of DF indications.

THE ELT LOCATION PROBLEM

There are three parts to this problem:

1. Get to a point where the signal can be heard.
2. Establish a direction to the target or a target location.
3. Get to the target.

Execution of these steps will vary radically from incident to incident. On an airport, it may be as simple as walking out of a door, taking a single DF bearing and walking to the offending plane.

The vast majority of beacon searches so far have been non-distress or accidental. Most of these are undamaged and located in clear areas like airports. Finding them, particularly from high flying aircraft, is like "shooting fish in a barrel" and has led to exaggerated claims both for equipment and techniques. Unfortunately, the cases of real distress are also the ones likely to involve damaged beacons in awkward positions, rough terrain, wet or snowy weather, night operations, and difficult access, any or all of which will tax the best of our skills and equipment. While directed toward the ELT, the principles described apply to all types of VHF radio location and underlie the specific procedures outlined in later sections.

Under IDEAL conditions, the signal from an ELT (1) radiates equally in all directions, and (2) takes a path directly from the transmitter to the receiver. The first characteristic means that the signal strength gets stronger as the ELT is approached, regardless of the direction of approach. Signal strength or "build-fade" location patterns use this principle and work in many cases. Unfortunately, the condition of equal radiation in all directions is the one most radically violated in distress situations and the location procedure is slow at best and should never be depended upon as a primary search technique.

The second condition says that the direction to the transmitter is the same as the direction of arrival of the signal at the receiver. All direction finders use this principle.

You use this second effect constantly with light without thought. For example, if a light were turned on in a darkened room, you could easily "measure" its direction from you with your eyes and could easily "track" your way to it if required. There are two drastic differences between "optical DF" and radio DF. First, you have been practicing optical DF and becoming aware of its illusions and reflections all your life. Second, the eye has MUCH more resolution, or ability to distinguish between objects, than the radio DF antenna. A radio antenna equal to the eye's resolution would be miles in diameter and hardly portable. The small, portable or aircraft DF antenna "sees" the world in about the same way you would if your eyes were covered with 16 sheets of waxed paper. The larger portable or fixed antennas are better—like 6 or 8 sheets of waxed paper—but a long way from 20-20 vision. Even with all that waxed paper in front of your eyes, you would be able to track toward a single light in a room, though not with the precision as with no waxed paper goggles.

A word here about sensitivity. Sensitivity refers to the ability of a receiver to pick up a weak signal (to see a dim light). Both a good receiver and a "high gain" antenna are required for a sensitive DF. The ELT signal is weak, like a very dim light. Using a receiver with poor sensitivity would be like putting on sunglasses under the goggles or spraying them with black paint. They might still work, but you could do a lot of stumbling in the dark before first catching sight of the light. There seems to be no such thing as too much sensitivity.

If a good mirror were added and properly oriented, as shown in the sketch below, you would usually see two sources or lights of about equal brightness. The waxed paper goggles, our antenna of the moment, would average the two and give the impression of one light half way between. If the light were made directive, like a flashlight pointed at the mirror, or if a large obstruction (mountain) were placed between the light and your position, the apparent direction would be directly toward the mirror even though, with normal eyes, you still could see light from the side of the flashlight or light diffusing around the obstruction.

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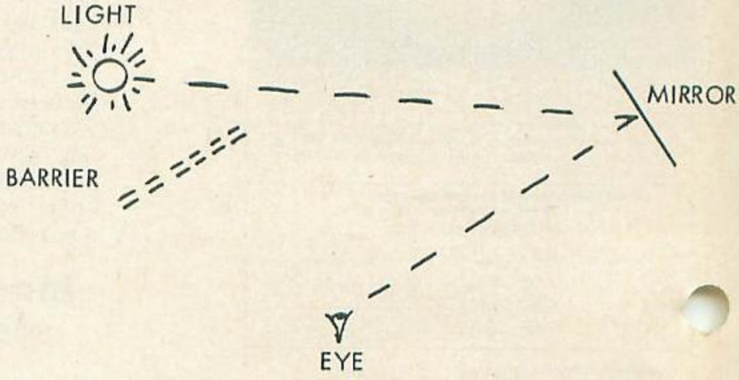


LIGHT REFLECTION PROBLEM

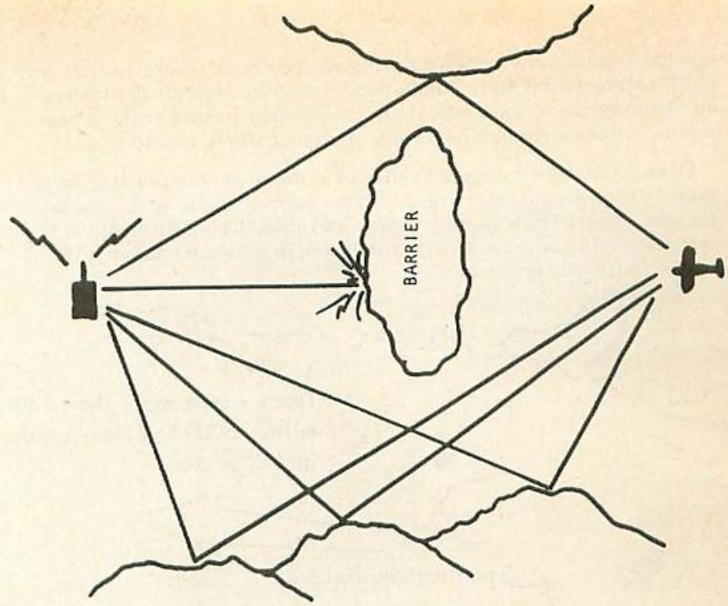
If the mirror, which is a very good reflector, were replaced in turn with a wrinkled sheet of metal foil, a white wall, a dark wall and a strip of black velvet, the reflection would grow progressively weaker and, at some point, our "antenna" would again "see" and point to the light from the side of the flashlight or sneaking around the barrier.

Natural terrain also varies in its efficiency as a reflector. Metal is obviously a good reflector but smooth, wet snow or smooth, wet grassy hills are almost as good. Rough, dry rock is closer to the dark painted wall, while heavy tree or brush cover approaches the "velvet" class. The reflective situation can thus change with the season or even time of day. This is why some easy summer exercises have turned into winter muddles in the same place.

So far we have dealt with one source and one mirror. With our waxed paper goggles in place, it should not be too hard to appreciate that if several mirrors were placed at various angles all around the observer's position while keeping the direct source obscured, any direction would be very hard to determine and directions that were found would change substantially with small changes in the observer's position. The changes in direction with observer motion would be particularly large and rapid if the reflectors were very close to the observer. The directions perceived might even be due to "wrinkles in the waxed paper" (small defects of the DF receiver). The effect is rather like trying to find the sun on a very foggy morning; you know it's there because it is light but you had better have a compass to find east! The solution to this problem is often the same as for the ELT —change position to get your head (antenna) out of the fog.

For ELT search, "getting out of the fog" usually means going higher for either ground or air search. This will both get away from nearby reflectors and improve the chance of getting a clear view of the source over the obstructions. Exceptions occur in air operations where the signal is blocked from going upward or is too weak to be heard 10,000 feet away. If climbing isn't possible or doesn't work, a methodical search will probably be required to find a place where the source can be seen clearly. In most cases, clear view is distinguished by a positive direction that does not change much as the observer moves. Before we leave our room with light and mirrors, imagine trying to find the light by plodding back and forth with an opal glass bowl over your head so that only changes of brightness could be sensed. This is essentially the build-fade location method. 'Nuf said.

The effects of obstructions in the path between the ELT and the DF can be roughly grouped according to their location: near the transmitter, near the receiver, or at intermediate range. Objects near the transmitter affect the signal distribution or directivity of the source like the reflector of a flashlight. They affect both the ability to hear a signal at a distance and the intensity of reflections. Both objects near the receiver and at intermediate range will block or reflect the signals but those near the receiver are more visible, more severe, and often avoidable. The sketch shows how reflectors near the receiver produce more severe errors.



Let's take a look at some of the things near the ELT that can cause directicity. The "wreck reflector" is fairly common. The plane may come to rest on its side or back or the ELT may come loose from the plane. In any case, conductive metal parts of the airplane arranged around the antenna will sharply alter its uniform radiation pattern. In the all too common case of broken antennas, these random metal parts may actually BE the antenna. The "t"T" hangar reflector is an

Continued

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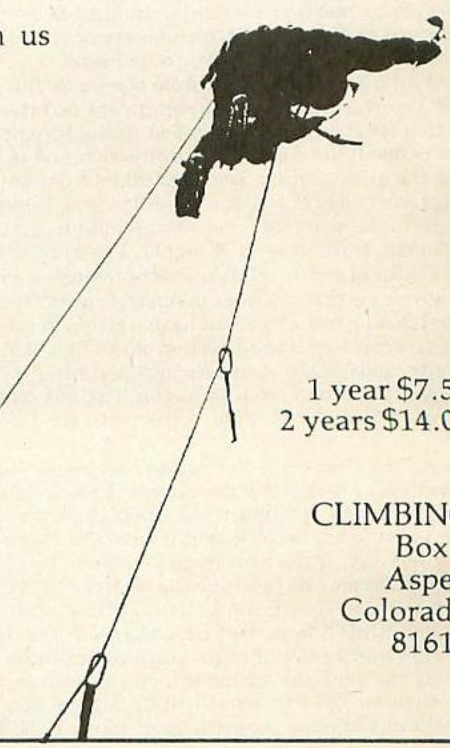

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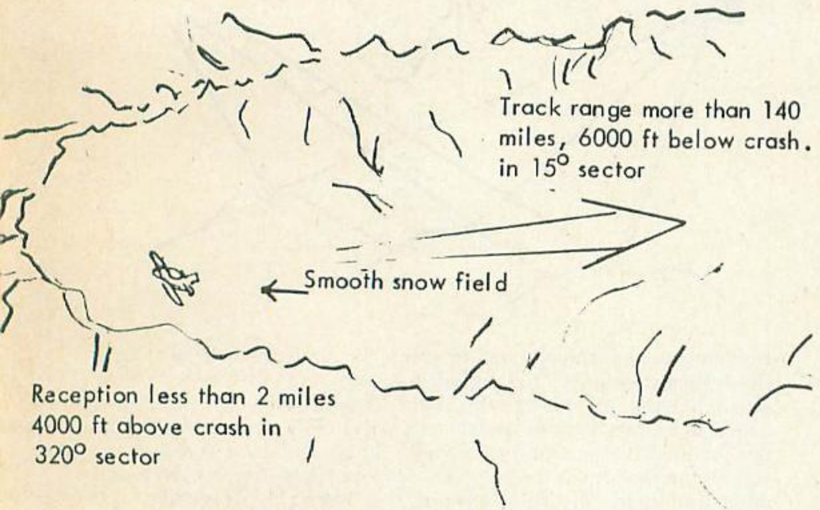
extreme example encountered during an accidental beacon search. It is difficult to deliberately build an antenna with that much directivity. An example of the vertical directivity mentioned earlier is also shown. Values were obtained from an actual wreck situation.

Open ground is not as good a reflector as metal as noted earlier but if there is enough of it, it can do a very good job of beaming the signal. Canyon directivity is quite common and pronounced although it is seldom as extreme as the situation depicted in the sketch taken from a recent California crash.



CANYON DIRECTIVITY

There is little we can do about the directive source except to realize how it can affect target location and perhaps avoid wrong conclusions and time-consuming detours. Poor DF environments near the receiver can be recognized and either avoided or compensated. In addition to the type of reflecting surface and amount of illumination mentioned in our light examples, the strength of a reflection depends on the angle of reflection and the distance from reflector to receiver. Fortunately, most natural objects are efficient reflectors only at small angles. The effect is rather like the reflection of the setting sun on a choppy like surface. The reflection sparkles and shifts about a bit but the average direction is still correct. Signals scattered or diffracted over the tops of hills have this same characteristic. On the ground, wires, metal poles, vehicles and even people near the DF antenna can produce large errors. People are not particularly good reflectors, but the tendency to gather close around the "source of the action" should be avoided. Ten-foot spacing is usually good. 20 to 30 feet spacing from vehicles and 100 feet from metal or masonry buildings is usually sufficient. Overhead wires or signs are often troublesome because more signal reaches them than gets down near ground level.

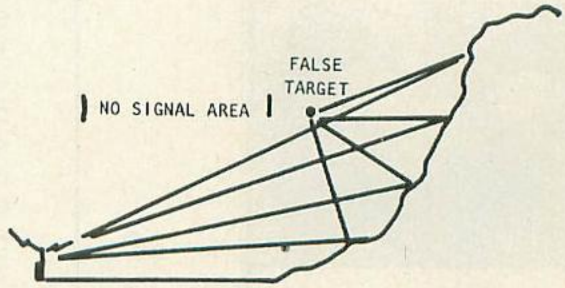
In almost all cases, interference from objects within a few hundred feet of a DF receiver will produce a significant variation in the measured direction for changes of 5 to 10 feet in the DF antenna location. This effect is due to interference or diffraction and is very useful in evaluating the quality of the bearings taken from any location.

Growing trees and high brush, especially if wet, can strongly absorb radio signals in the same way they absorb light from the setting sun. In dense foliage, most of the ELT signal, like most of the light, will come from overhead and no reliable direction sensing will be obtained. Even less obvious is that readings taken from a cut for a power line or road through heavy tree cover will have a strong tendency to line up with the cut, regardless of the direction of the ELT. This latter condition will give apparently good bearings according to the previous tests. The only solution is to find a more circular clearing of a few hundred feet in diameter or climb a tree with the DF receiver.

The last of the "hear receiver" effects concerns reception at the bottom of valleys or canyons. If the canyon is nearly aligned with the direction of the signal, it will act like the cut in the trees mentioned above. This is not so bad because that is where the best access route is likely to be anyway. If the direction is closer to right angles to the canyon, the signal may be reaching the receiver EITHER by scattering or diffraction over the canyon wall toward the source OR reflecting off the wall OPPOSITE from the ELT's direction. The first case is like seeing the glow over a ridge after the sun has set behind it. The second is like seeing the sunlight hitting a high ridge after the valley has fallen into shadow. The first effect will usually predominate in shallow, dry valleys while the second is most likely to be found in deep canyons with wet or snow-covered ridges. Scattering, which gives a correct bearing will usually give a constant compass heading over distances of a few feet to a mile or more. The reflection, which is in the wrong direction, will usually give bearings that swing about by more than c45° but the swinging is not so rapid with distance as where th reflecting surface was closer to the receiver. Full swings may ta several hundred feet of travel in large canyons. A third possibilit, which not be overlooked is that the ELT is IN the canyon. In this case, bearings will be fairly steady but will converge on a geographic point rather than on a compass heading. This case will produce much stronger signals. If the scattered and reflected effects produce about the same signal strength, no bearing may be obtained at all. The solution, as before, is to pick a new location, preferably higher and clearer.

Reflecting objects near the receiver are not a major concern to airborne DF mainly because the aircraft is not so close to reflecting objects (we hope!) and its motion automatically averages rapidly changing bearings. There are both vertical and horizontal focusing effects caused by large terrain features which can generate false targets as illustrated below. DF instruments will point to these false targets over a substantial area, causing unkind comment on the instrument quality. If the false target can be approached, it disappears like the ghost that it is, instead of increasing in strength and DF sharpness like a true target. The effect also disappears at high altitudes but light aircraft may not be able to go high enough. Many ELT's produce patterns of spotty reception over a wide area. Unfortunately, there appears to be no reliable way to distinguish between a false target and a weak signal from a damaged ELT if the ground cannot be approached, although the vertical sensors being used on some aircraft should help. Certainly, an aircrew should continue and extend their search if their first target is weak and diffuse. The target location should be marked before departure for later return if necessary, because a real target in a snow-covered valley may present the same indications.

The sketch below illustrates, from an airborne standpoint, the most prominent effect of intermediate range obstructions. This situation is the same as the blocked light and mirror discussed earlier. If only the reflections from the mountains to the bottom of the sketch we strong, the initial DF indication will be toward the reflecting hills a may be diffuse and swing about. When the aircraft gets to the reflecting hills, the ELT comes in sight, overpowers the reflections and provides a correct new course. The indicated course often swings about wildly for a minute or two during this transition. The aircraft arrives at the target, but by a curved path. This illustrates a basic difference between homing and triangulation. Reflections of the type described, DF instrument errors (like not having the course lined up with the airplane), and even wind drift will cause the course to the target to be curved but not much longer than a straight shot. The effect of reflection and DF errors on a triangulation plot are often drastic. This is the primary limitation of the triangulation technique.



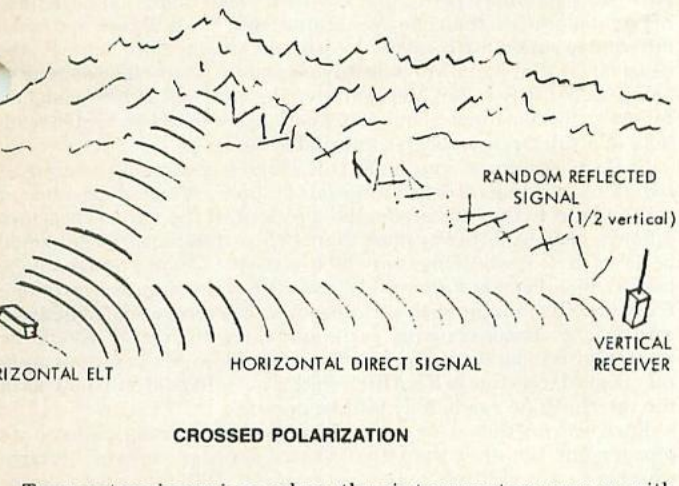
An effect particularly important for ground operations is blockage or shadowing by hills and how this affects signal strength as the DF team moves. Radio waves will bend or scatter around hills to some degree but the signal rapidly weakens as the angle of bend gets large. In the sketch below, the signal will fade and completely disappe even though the DF team is headed directly toward the ELT. N recognizing this situation and not having the confidence to continue to pursue a set of good bearings through a signal fade has been responsible for a lot of wasted motion. Once understood, shadowing can be a help rather than a hazard. For instance, if the ELT had been on the near face of the hill rather than on top or on the back side, the signal strength would have increased as the hill was approached rather than

Continued

fade out. Ground DF teams should listen continuously while traveling and note where the signal is heard and where it is lost. The shadows of an ELT, like the shadows of the sun, can be a good indication of direction.

All of the discussion so far has been about one signal and its eflections. Multiple, simultaneous ELT signals do occur and if they are about the same strength at the receiver, will act like strong reflections. Three differences: (1) two ELT's will produce confused bearings over a much wider area than terrain reflections, (2) climbing usually makes the situation worse, and (3) the situation can be recognized by listening for two unsynchronized tone sweeps. Note that both ear fatigue and severe reflections can cause a single ELT signal to sound funny; rather like a fading short wave signal, but two separate sweeps produce a distinctly different sound. As with reflections, the usual solution is to find a location where one signal predominates and clear bearings can be obtained. This is one place where the larger ground antennas have an advantage because they may be able to resolve the two signals.

Both radio and light waves have a property called polarization. Most light sources are of random polarization, but light can be polarized by passing through a special filter. If the light then passes through a second filter oriented the same way, not much happens. If the second filter is turned 90° (cross-polarized), most of the light is blocked. Radio antennas are usually polarized. Most amateur, aircraft, CB and commercial 2-way radio antennas are vertically polarized (antenna rods vertical); TV and FM broadcast are horizontal (antenna rods horizontal). The important thing is that for best performance, the transmitting and receiving antennas should be turned the same way. Most reflections from natural objects scatter and rotate the original polarization, so if a vertical antenna is used to receive a signal from an ELT lying on its side, the cross polarization effect can act the same as a barrier in the direct path and emphasize the reflection. This effect can be overcome by rotating the DF antenna for maximum signal reception. It is impractical to do this for an airplane, but the bend in the usual receiving whips helps some.



CROSSED POLARIZATION

Temperature inversions, where the air temperature goes up with increasing altitude, can hold radio waves as well as smog close to the earth. The effect is most common over water and near coastal regions and can make reception possible at ranges and in locations far beyond that normally expected. VHF communications has been established a number of times between California and Hawaii using this effect. The effect is often unstable so that signal strength varies substantially over times as shotrt as 10 or 15 minutes. Bearings, when obtained, are usually dependable.

When listening to an ELT or any other VHF signal from a moving car, the signal will often be heard to "flutter," or vary rapidly in strength. If this kind of flutter is observed when the DF receiver is held fixed, either the ELT or a reflector in the path between is moving. This can be a key item in finding an accidentally-activated ELT in a car or a mail sack. In at least one search, a valuable initial steer was obtained by noting that a fluttery ELT signal was received as an airliner passed over a ridge of intervening hills. The airliner was ıcting as a moving reflector.

In the beginning, the three elements of the ELT search were stated as: 1) get to a point where a signal can be heard, (2) establish a direction to the target or a target location, and (3) get to the target. Let us now look at some procedures for accomplisihing these steps based on the "rules" of ELT signal propagation.

Continued

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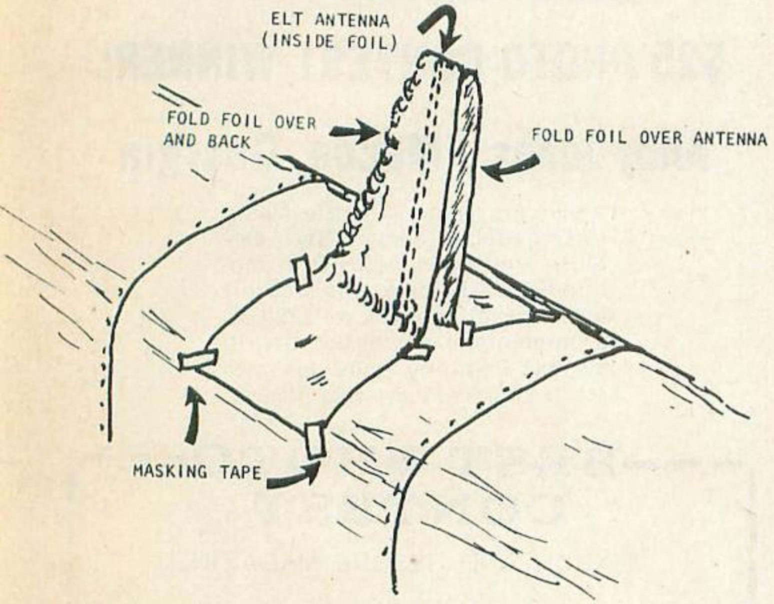
If the weather conditions permit, aircraft with trained crews can rapidly localize an ELT and direct ground teams at least close enough *to hear the* signal and finish the track from the ground. Because of the high work load, two pilots should be used for all IFR DF flights. A safety pilot is a good idea even VFR. In extremely bad weather where aircraft cannot be used, multiple ground teams coordinated in their efforts can use triangulation to establish an approximate location to start close-in tracking. This is usually a slower procedure than air search. In all cases, DELIBERATE speed and efficiency are important both to increase the chances of any survivors and to locate the ELT before its batteries expire (48 hours at low temperatures). Safety and organization should never be sacrificed for speed. A few minutes planning can save hours of milling about the field, or even catastrophe from convergence of uncoordinated efforts. Remember that the job of the rescue unit is to assist in the recovery from a disaster, not to become part of it.



In general, ELT searches are started either from the report of an overdue aircraft from flight plan or family information, or from the reception of ELT signals from one or more passing aircraft. Fastest response is obtained when both conditions are present. Records of the Air Force RCC indicate that most crashes occur within a few miles of the pilot's intended course, so if the course is known, a route search is a first priority. Weather data and satellite photos may suggest the most likely points to begin on a long route. An optimum altitude for first search seems to be about 4000 feet over the terrain, particularly if no reports from high altitude aircraft have been received. If more aircraft are available, several parallel tracks at 4000 feet and one at 10,000 feet can be flown. Both VHF and UHF should be monitored if the aircraft are so equipped. If more than one plane is used, a leader and communications between planes that can be maintained while tracking is in progress should be established for information and bearing exchange and to avoid dangerous congestion over the target if one is located. Don't forget to keep your eyes open, too, in case the ELT didn't work.

All civilian and military aircraft have been requested to report to FAA any beacons heard, giving their altitude, place first heard, place loudest and place where contact is lost. DF-equipped search aircraft can use these reports to select a place and altitude where initial reception of the signal is most likely. Preference should be given to lower altitude reports.

Ground teams usually operate over a smaller geographic area than aircraft. It is desirable that they have tood, accessible DF sites "staked out" in advance. People with access keys, and funny little back roads, are a lot easier to find on a sunny weekday than a rainy Saturday night. Choice of initial DF sites should be based on their time for access and field of view as well as the mission data described above. Because of the more limited range of ground DF, this initial hunt for a signal can be both time-consuming and frustrating. Where this search does not involve unacceptable receovery times, it probably should be used even if air support is available. The provision for central coordination of ground teams and their measurements is probably even more important than for aircraft. When selecting potential DF sites, care will be required to avoid loss of sensitivity and errors due to other transmitters which occupy the tops of most easily accessible mountains. On these mountains, walking 50 to 100 yards down the side in the suspected direction often yields better sensitivity and bearings than can be obtained on top because it gives some separation from the high-powered transmitters.

GROUND SEARCH

Ground search involves weaker and more obstructed signals than air search with less freedom of movement or maneuver. These disadvantages can be partially overcome by triangulation, particularly if multiple teams are available, but triangulation is more affected by measurement and reflection errors as we have seen so the evaluation of bearing quality becomes an important skill. Regardless of the type of equipment used, its performance on "clean" signals should be thoroughly in mind so changes in field performance can be evaluated.

Taking and evaluating a bearing has three steps:

1. Find an approximate heading and change the antenna polarization from vertical to horizontal and note which produces the strongest signal. If there is a large difference (6 dB or more) use the orientation that gives the strongest signal for the following steps. If the difference is small, do the following steps twice, once with each polarization to see if any big differences in indicated direction result. If the bearings differ by less than 20°, use vertical polarization. If a large difference shows up, report and plot both until either the difference disappears or it becomes apparent which polarization is producing converging bearings.

2. While standing in one place, swing the DF antenna through a full circle. If signal strength sensing is being used (yagi and quad beams, B-Line, etc.) a single maximum and one or two nulls depending on the antenna characteristics should be obtained. The sharpness of the maximum and position of the nulls should be judged against the particular antenna's performance with a "clean" signal. If no defined maximum or more than one are obtained or if the nulls are in a much different position with respect to the maximum than normal, the bearings at that point are probably unusable. If left-right homing is being used (Little L-Per, Memcon, etc.) the left-right indicator should center at two headings about 180° apart. More than two center readings in a full circle indicates unusable bearings.

3. If the results of step 1 are O.K., take a continuous reading or individual readings at 5 foot intervals for up to 50 feet along a line at right angles to the indicated radio direction. If the various bearings differ from one another by more than ±45°, a different DF site should be selected. If the bearings vary by less than ±45° an average can be taken which should be accurate to about 1/5 of the observed variation. Example: 10 readings with variation of ±25° average should be accurate to ±5°. Readings with variations more than ±20° should be treated with some suspicion. Less than that indicates no serious accuracy degradation due to NEARBY objects but effects of obstructions in the intermediate range may still be present.

Each bearing that is taken should be plotted on a map, preferably a topographic or other map that shows detailed terrain features whether or not multiple teams are involved. Different colors can be used to denote bearing quality and polarization. A good quality mapping compass with built-in protractor will be invaluable in doing this job without error. A magnetic north grid ruled or placed over the map will eliminate magnetic variation calculation errors. Also to be avoided are bearings taken with the compass laying on a car hood or against a radio speaker. Obvious? Yes, but even sillier things have happened without prior practice. For quick "how goes it" bearings, prominent landmarks can also be used for reference.

Theoretically, just two bearings taken from different locations will define a source location. In practice, 10 or 20 may be required to get a reasonable average estimate. In most cases, the eye is quite good at estimating the point of highest probability in a grouping of DF intersections. The number of bearings taken will depend largely on the difficulty of getting to the indicated point. The more difficult the access the more time can profitably be spent on refining the predicted location. Both the evaluation of bearing quality by the measuring team and terrain over which the indicated bearing falls should be considered in making this estimate.

In summary, the following general points are the basis for most ground search.

1) Use air direction to probable area if available. Prior coordination on ommunications is desirable.
2) Head for high ground in the suspect area. Walk around hilltops checking all possible sides.

Continued

3) Make multiple DF readings along a line at right angles to received signal. Average the results.
4) Listen while traveling in low country. Stop and take additional bearings if signal is heard.
5) Try to bracket target from high points before attempting detailed search.
6) Make notes of the quality of DF and the nature of surrounding terrain at each point as an aid for possible later data reevaluation.
7) Request assistance of other agencies (police, USFS, etc.) and private individuals for access as required.
8) Use multiple teams with radio communications between them for initial triangulation.

Most operating ELT's have been and will probably continue to be non-distress or accidentally activated. Many are on airports. The equipment for long range search is also very efficient in this environment, but most of the $20 to $30 transistor radios can also do the job using a simple procedure although it will take longer.

The trick is to adjust the radio so that the ELT signal is audible but quite weak or noisy so that the radio's automatic volume control doesn't cover up the changes in strength that indicate direction or target approach. This is done by retracting the antenna and tuning the radio away from the ELT frequency until the desired noisy reception is obtained. Hold the radio a few inches from your body at belt line with the antenna vertical and turn in a full circle. The signal will be loudest when you are facing the ELT and weaker when your body blocks the signal path. If no direction is obtainable, this same radio setting can be used as a signal strength memory to find the ELT by looking for the strongest signal. The further the receiver is tuned from 121.5 MHz, the tronger the signal. When standing next to the offending aircraft, most simple receivers will receive some ELT signal from one end of the dial to the other. Several articles have appeared describing screens or loops that can be attached to these receivers to enhance their directivity. In most cases, body shielding described above works better. This is particularly true of loops which suffer both from polarization errors and 180° ambiguity.

WHAT TO DO AFTER FINDING THE ELT

If you are in the air, notify the nearest FAA facility or your operating organization by radio of the situation. If an airport is nearby, you can then land and complete the search on the ground with a hand DF.

On the ground, the detailed procedure to follow upon locating an activated ELT will depend on the circumstances and the policies of your organization. One primary job should be to shut off the beacon or, failing that, reduce its transmission range so that it will not prevent reception of other distress or emergency communications. In an actual wreck, this, of course, is secondary to care of the survivors, but should be accomplished before leaving the site. Failure to do this simple step has caused a number of false searches with attendant risk and time loss. Find out what beacons look like and where they are located as part of your training. Disturb the wreckage as little as possible while deactivating the beacon and make thorough notes of what was done for later use by accident investigators. For non-distress activations, it is common to find the beacon inside a locked airplane or building. Assistance of the local police, sheriff, or airport manager should be obtained to locate the owner or otherwise gain access to the beacon. Neither FAA, FCC, CAP or other search organization has special entry authority in non-distress situations. If access cannot be obtained to a parked aircraft, the signal can be reduced by wrapping the external antenna with aluminum foil. Take a piece of foil 12" wide and about five feet long. Place the tip of the antenna in the center of the foil, being careful not to punch a hole in it. Fold the foil down on both sides of the antenna and let the ends lay flat on the fuselage. Tape the foil to the fuselage if possible and fold the two sides together to completely enclose the antenna. See sketch.

ELT's have a variety of switch mechanisms. Most are plainly labeled. Switch malfunction is fairly common, however, so always check the result with a receiver. If the switch can't be found or doesn't work, the unit can be disabled by removing the batteries. This operation often requires hand tools, but is a positive method to disable the beacon. Any time an aircraft or ELT is worked on, be sure to leave a warning note in a prominent place for the owner if he was not present. Do not depend on the airport operator or the police to pass the word. Also, notify the nearest FAA facility or your organization's controller of the time the beacon was shut off; the aircraft type and number, if any; beacon make; model and serial number; owner's name; and circumstances causing activation, if they can be determined. This information is being used to improve beacon design. ■

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NEWS AND RUMORS

AOPA Lodges Rebuttal on ELT Monitoring

The Federal Communications Commission has asked for comments on a tentative plan to require Unicom license holders to monitor for emergency locating transmitter (ELT) signals.

In reply, the Aircraft Owners and Pilots Association has gone on record to "strongly object" to the plan.

The FCC last month issued a Notice of Inquiry on the subject and has allowed until Feb. 9 for initial comments. Those who wish to debate in reply to these comments will have until March 13 to do so. In a typically time-consuming process, if FCC wishes to pursue the matter, it would emerge later as a rule proposal, with a new comment period.

FCC sees the proposal as one way to cope with the embarrassing performance of the ELT program. Yearly, upwards of 5,000 false signals occur throughout the country, due to flaws in the design of the device. Though this is being rectified, it may be decades before most present ELT's are retired from service.

Secondly, there is no comprehensive program of monitoring for ELT's. Many FAA facilities monitor the frequency, but many others cannot. Some can receive the signal but have no direction-finding equipment to locate the source.

Many ELT signals are reported but go off the air before being located, and nearly all located signals come from planes parked safely at airports. This has authorities worried that the aviation community might develop a callous attitude and not respond to a true emergency signal.

But placing the burden on fixed base operators is not the answer, AOPA's Dennis Wright told the commission.

Wright took issue with several of FCC's assumptions. One was the size of the network that would be created if Unicom operators were forced to monitor 121.5 MHz.

He said FCC suggested applying it only to public use airfields. But there are 13,700 fields in the nation, public and private.

"Therefore, if this proposal was implemented and no Unicom operators relinquished their licenses due to the increased burdens placed on them, less than 18 per cent of the airports in this country would have ELT monitors on them, provided that all FAA towers monitored 121.5 MHz, which they do not. This is significantly lower than the 36 per cent that is stated" by the FCC, he said.

Wright, noting that the monitors suggested by FCC would have to be "fairly sophisticated" in order to ignore ELT test signals (legal during the first five minutes of each hour), said no one knows how much the equipment would cost.

He questioned whether an FBO would have to monitor 24 hours a day, and if so, how the small operator could remain in business. Wright said direction-finding equipment might also have to be purchased, and the FBO might find himself liable if he hears a signal and does not try to locate it.

He also asked, "How will the FBO gain access to the ELT in a locked airplane?"

Wright said two efforts may obviate the FCC proposal. One is the pending revision of ELT specs so that new versions of the device will not be prone to false activations.

More important, he said the National Aeronautics and Space Administration is working on a plan to mount an ELT monitoring network aboard meteorological earth satellites already scheduled for orbit in the early 1980's. Such satellites would aid in prompt and very precise pinpointing of ELT signals.

As Wright noted, the FCC itself was a member of an intragovernmental working group that rejected other forms of monitoring in favor of the satellites.

Wright said if the FCC plan were adopted, operators probably would give up their Unicom licenses rather than foot the bill. Unicom is a service that doesn't produce profits for the operator. "If a Unicom were a money-making item, there would undoubtedly be more than the current 2,100 licenses," he said.

Any member of the public may comment on the notice, known as Docket No. 21495; FCC 77-791. The FCC is at 1919 M Street NW, Washington, D. C. 20554.

Boat Distress Signals Proposed

WASHINGTON (AP)—The Coast Guard proposed Tuesday that recreation boats be required to carry visual distress signals when operating in coastal waters and on the high seas.

Under the proposed rule, boats 16 feet and longer would have have day and night distress signals. Manually propelled craft such a kayaks, canoes, inflatables and rowboats would have to carry night signals only. Officials said the rule could be in force early next year unless serious objections were voiced during a 120-day public comment period.

Los Angeles Times March 29, 1978

VIPS LOST

Three lost hikers, including former Federal Communications Commissioner Nicholas C. Johnson and actress Kathleen Nolan, president of the Screen Actors Guild, were found by a rescue party in the rugged tropical Waikane Valley, across Oahu Island from Honolulu. The two, with Don Callaway, 14, hiked into the valley on the windward side on Saturday and failed to return. Johnson, 43, and Miss Nolan are house guests of the Callaway family, and the boy, who had never hiked in the valley before, took the two out for a hike. The next day searchers spotted their smoke signal and they were taken out by helicopter.

Los Angeles Times, Feb. 6, 1978

CIVIL AIR PATROL INCREASES SEARCH AND RESCUE ACTIVITIES

MAXWELL AFB, Ala.—Statistics compiled at Civil Air Patrol (CAP) National Headquarters in mid-April indicated CAP search and rescue teams have been busier this year than they were during the same period last year.

CAP, the all-volunteer auxiliary of the United States Air Force, h saved the lives of 22 persons this year—nine more than during the same period in 1977—and has succeeded 104 times in locating the missing person, aircraft, or the source of a signal from an Emergency Locator Transmitter (ELT).

There have been fewer missions this year-199 compared to 212 last year-but the number of search sorties (a sortie is one flight by one aircraft) is 3,270 compared to 2,840 for the same period last year.

Flying hours for the year stand at 8,851, which is considerably more than last year when only 3,840 flying hours were compiled at this time.

Search and rescue missions of CAP usually involve much more than aerial searching. Members are trained at three CAP schools and at the Air Force Academy to perform ground search activities. CAP has more than 3,000 vehicles, which include ambulances, vans, jeeps, and other vehicles for use in rugged terrain.

Another important part of the search and rescue activities of CAP is the more than 25,000 radios (fixed, mobile, and airborne) and personnel trained to operate them. This equipment is capable of communicating between different rescue organizations.

These search and rescue activities are carried out as part of the humanitarian services mission of CAP. What compensation do CAP members get? They receive only the satisfaction of helping their fellowman.

CAP News Release #78-013

LAY DYING FOR HOURS

A pilot who lay critically injured for hours in a remote mountain area west of Vacaville after the crash of his single-engine plane died at the scene before paramedics could reach him. The Solano County coroner tentatively identified the victim as Conrad John Grewfe, 54, of Castro Valley. Wind, rain and rugged terrain delayed t paramedics summoned by Pacific Gas & Electric Co. troubleshoote investigating the power disruption along lines severed by the plane. Authorities said they did not know where the pilot had taken off, where he was going or why he was flying in bad weather.

Los Angeles Times Feb. 14, 1978

Continued

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QUAKE KO's SHERIFF'S RADIO

A moderate earthquake centered in the ocean about 20 miles southwest of Santa Barbara knocked the sheriff's radio system off the air for two hours Monday but otherwise created no problems.

The quake, which registered 3.7 on the Richter scale, was felt by many residents in Goleta and Isla Vista. It occurred at 1:03 a.m.

Los Angeles Times May 2, 1978

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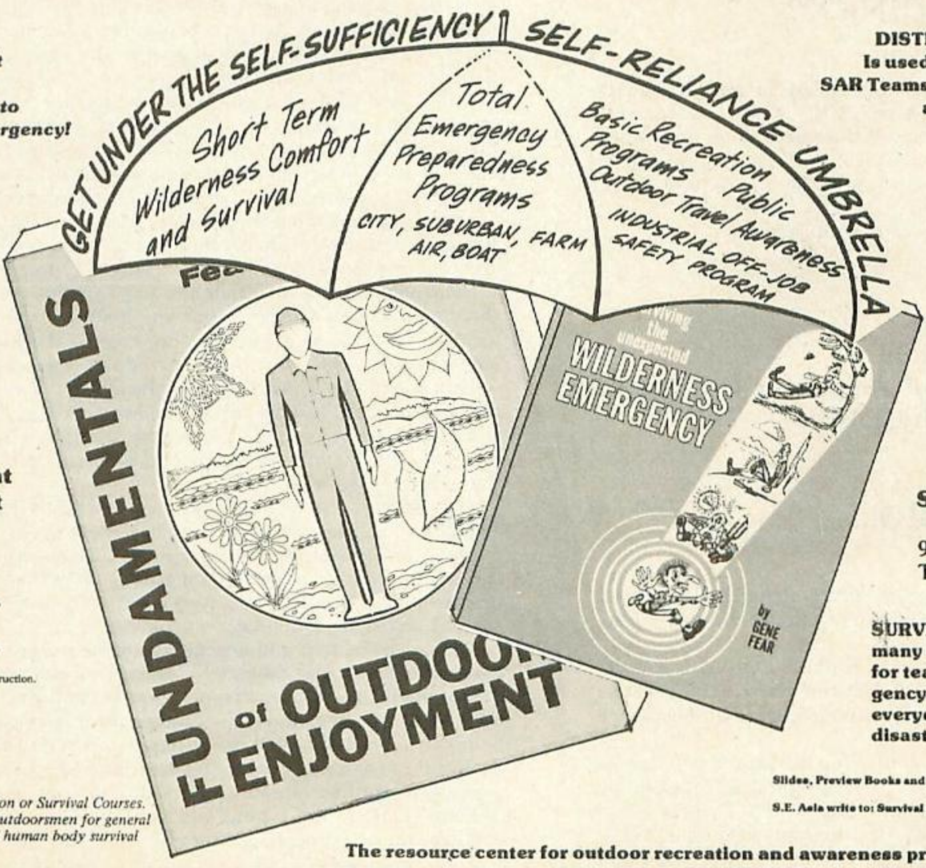

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LETTERS TO THE EDITOR

WHO IS THE EDITOR???

Dear Dennis:

In reviewing your spring issue of SAR Magazine, I find some inconsistencies that you should be aware of for possible correction in the next issue. On page three you list the credits and show yourself as publisher. There is, however, no editor listed. In the box in the bottom center of page three the editor is mentioned as well as on page 23, "letters to the editor." A small point perhaps but I felt you would want to know.

On page two, left column entitled "Oregon" there is a note about my rumored resignation. It concerns me that this issue, with 30,000 copies, reflects that the State of Oregon deals in rumors and comedy.

Back to your credits. I am not sure if it is proper for the Executive Secretary of NASAR to be a Consulting Editor. It seems to me that the Executive Secretary (Administrator) should be in a non-bias position and not be influencing the opinion of the readers and membership of NASAR.

These points are offered as constructive comments and I hope they will assist in building quality. Thanks for your continued efforts on behalf of NASAR.

Sincerely,

John Olson
NASAR 1st Vice President

EDITOR's note:

1. There is a search for an editor. The position is open.

2. I hope to continue to print excellent technical (unbiased) and (biased) material regardless of the title or titles of the author(s).

EMERGENCY MEDICINE???

Dear Mr. Kelley:

We appreciate your interest in exchanging JACEP and your publication, SEARCH AND RESCUE MAGAZINE.

Our Information Center has reviewed the publication and, while recognizing its worth in its field, does not feel that it is appropriate for our data base here. Therefore, we must decline your request to exchange.

We wish you future success with your publication.

Sincerely,

Susan Berman
Managing Editor
Journal of the American College of Emergency Physicians

CITIZEN BAND RADIO...

Dear Editor:

In reference to the "News and Rumors" blurb about the U.S. Coast Guard and CB Radio, I must take exception to a few of the statements made:

1. In reference to licensing, ALL LICENSE FEES FOR ALL RADIO SERVICES HAVE BEEN SUSPENDED! I emphasize this because unsolicited license fees have been a problem for the FCC ever since the Federal court suspension.
2. Penalties for misuse of distress signals: The maximum penalty for such is $10,000 fine and/or 1 yr. prison, which is imposed by Federal courts. **IN ADDITION**, non-judicial FCC fines of up to $100 per offense/$500 max. may be imposed. Either of these *punishments may be applied* to any station/operator in any radio service.
3. **BOTH** the Marine RADIO Service and the CB Radio Service fall under the jurisdiction of the FCC, by authority of the Communications Act of 1934. This is also true for all other non-government radio services. The FCC and the Comm. Act are not exclusive or conflicting entities.
4. The Range of Signal designations are generally correct, considering present CB band conditions. However, range can vary greatly, depending on conditions. I especially refer to path obstructions in the VHF Marine Band and "skip" conditions on CB.

Thanks for the soap box.

Glenn A. Elliott
KTP 7504 (CB)
Amateur (ham) call pending

Editor's Note: The "News and Rumors" article referred to is in the Spring 1978 issue.

GROUND SAR!!!

Dear Dennis,

I was delighted to receive the mantracking book you sent. It will be added to my rather large library of Ground Search and Rescue stuff and I hope to use it. You are right about it being a useful tool! I also plan to add it to the bibliography which will be part of my final report to Major Bob Mattson USAF/CAP Liaison and our Civil Air Patrol National Executive Committee.

In Virginia, there are a number of us that work closely with the Appalachian Search and Rescue Conference (AS&RC) which I understand from Keith Conover is seeking to become a part of the Mountain Rescue Association (MRA). We use the materials from MRA and train in much the same way. Of course our mountains are not as rough as the terrain in the Rockies, but thousands get lost or in trouble her each year. Our program was developed with their direct input and assistance. One member of our Ad Hoc Committee is the Operations Officer for ASRC and he has provided excellent liaison with them.

We are holding our second Ground Rescue College which we could not hold without the use of their instructors such as the ASRC Training Officer York Brown. Super people and such a help that I cannot thank them enough for their help.

Major Bob Mattson, as you know, pushes hard for interagency cooperation and feels it's a must in helping our prime reason for being the victim. I cannot feel anything but the greatest support for what he and you are saying. There is a change going on, on the West Coast, as more people realize just how important the victim is over their own personal organizations, aims, goals, territory, CAP is, to some degree, seeing the change. Here on the East Coast, I am beginning to see a growing awareness, but there is a long way to go.

Somehow, my organization has for years put the ground portion of their program on the back burner. It's my hope as with Bob that through NASAR we can force the issue to the front and make our leaders see just how much they can do to lead the way.

I am personally a long way from the "expert" I would like to be, but I am hopeful that I can use my administrative experience to pull something together that will better the victim's chances of survival through training of CAP teams and cooperation with folk who have the expertise we lack.

A question, on page 71 of your book the figure I've not been able to decipher. Are the condition lines based on age? Or what? I've used many of the concepts in your book in my training courses and must say it is a first-class job of pulling together a lot of theory, field developed practice and thought. You saved me from reinventing the wheel on several occasions. Thanks!

I enjoy the Search and Rescue Magazine a lot as well. One area I'd personally like to see more articles on the people side of SAR is team development, handling personnel problems, looks at why people do SAR as volunteers, and some on the technical side as what is bein being developed or tested, what happens when two ELT's go off nea each other, use of airborne metal detectors. I do recognize however the expense of publishing and the limitations that imposes. Thanks.

Please forgive the typing and spelling. I am the world's worst at this. Would sure appreciate input on the enclosed program.

Maj. Dave Carter CAP ■

MARCH ON SAR

Bill March
Faculty of Physical Education
The University of Calgary

Herewith some news snippets from the United Kingdom.

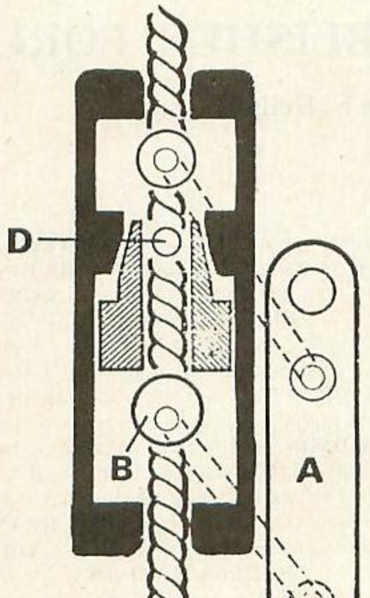
1.
A new call-out system has gone into operation for one of Britain's bravest mountain rescue teams in the Lake District. Alarm bells have been installed in the homes and workshops of 20 members of the Langdale and Ambleside team which will cut call out time by 20 minutes. The police at the town of Kendel are triggering the alarm system, the first of its type in Britain.

2.
This year's edition of the British Government Booklet, "Safety in Outdoor Pursuits" has one significant change from the 1972 Version.

In laying down the procedure for both leaders and members of a party when lost in the hills, it says, "If mist prevents the position being fixed, an attempt to descend below the cloud should be made. Every effort should be made to descend open shoulders and the descent should not be hurried."

This new procedure arises from the case of a lost group of boys who waited for rescue in the mountains of North Wales following the correct procedure. Many rescue team man-hours were spent on an extensive search when many climbers thought the group could have descended safely.

3. **Everest Cam-Lok fall arrest device**. The existing ascendeurs on the market are not designed to withstand shock loading and are therefore not satisfactory as self belay devices. The Everest Cam-Lok Mobile fall arrest device is specifically designed to protect steeplejacks and steel erectors under the same conditions as a top roping climber. It is designed for use on rope between 9 and 11 mm and although designed for use on hawser laid rope has proved to be effective as ernmantle rope (Tests by Al Evans, Crags Magazine, 1978).



The method of operation is simple. Thread the fixed rope through device and clip it onto your climbing harness. In the event of a fall the device arrests almost immediately. In a fall the outer attachment link (A) and the two D rings are swung downwards, pivoting the eccentric Cam (B) which forces up a conical plunger (C). Ball bearings (D) close in and lock the rope, thus arresting the fall without damage to the rope. This device may be useful as an adjustable belay point as a fixed rope and therefore have a mountain rescue application.

4.
The noted Scottish mountain rescue expert, Hamish MacInnes has been appointed Director of th Leishman Memorial Centre. The object of the Leishman Memorial Centre is to further research and development of rescue work. Emphasis is on items pertaining mainly to mountain and cliff rescue techniques for evacuating the injured. It is situated at Achnaen in Glencoe and also serves as the base for mountain rescue operations in the Glen. Initially, capital for the project was provided by Dr. Harold H. Barlend as a memorial to his late half brother, killed in the mountains of Switzerland. Further financial help was given by the Highlands and Islands Development Board and the Cross Trust.

Over the next few years, it is hoped to work on the development of helicopter rescue techniques, the use of power winches for patient evacuation and new designs of splints for mountain accidents. All work connected with the centre will be on a voluntary basis and new equipment or techniques evolved will be made available to British rescue teams free of charge. In the future, it is hoped to provide a snow conditions advice service for climbers on a weekly basis. The centre is the first of its kind to be specifically directed towards mountain rescue work and close contact will be maintained with other rescue bodies in the various parts of the world.

5. New Type of Splint for British Mountain Rescue Posts

This new splint is a two piece channel section of metal tube framework and wire which folds within itself for carrying. Traction is made using shock cord which runs inside the splint and then doubles up the outside to hook on when suitable tension is applied. The upper end has a shaped rubber covered tube for a snug fit under buttock. There is a special front opening gaiter, velcro fastened for going around the lower leg. The splint works very well and is now being issued to British Mountain Rescue Teams.

6. High Altitude Pressure Chamber

This is currently the biggest project at the centre and Hamish MacInnes worked with two Americans, Dr. Peter Hochett and Dr. Drummond Rennie, on this equipment. The object of the chamber is to pressurize patients suffering from pulmonary oedema. Slight pressurization has a dramatic and lasting good effect on sufferers. Existing pressure chambers are far too heavy to take to the location at Pheichi in Nepal, at 15,000 ft., close to Everest Base Camp.

A telescopic chamber was designed and made from magnesium alloy. The Pherichi Pressure chamber is telescopic and weighs some 72 lbs. It is large enough to accommodate one climber. Air pressure can be maintained at 2 psi by means of two foot pumps (operated by Sherpas) or by pressure line. Special blow-off valves were incorporated in the design as well as pressure gauges and flow meters. Tests will take place in Nepal. ■

BOOK REVIEW

MOSTLY IN FUN—Rhymes and Reflections on Outdoor Experiences

by Gordon Thomas
64 pages $3.95
Signpost Publications
16812 26th Ave. W
Lynwood, WA. 98036

Though I have never been into rhymes, this well-illustrated little book is a lasting pleasure. I found it entertaining and relaxing to reflect and relate to the outdoor experiences of Gordon Thomas. It is obvious Gordon has been around, particularly into outdoor activities, because of his apparent insight into these things. One of my favorites is:

"SECURITY
Security comes in many forms;
The kind that I would pick
Is not of money, faith or love,
But zippers that won't stick."

This is an investment in entertainment.

Dennis Kelley ■

Col. JIM BIGELOW, California Civil Air Patrol, has opened up CAP training to outside organizations in hopes of integrating SAR activities. . . ROBERT McINTYRE, Federal Communications Commission, enjoyed a trip to Geneva, Switzerland amidst the ELT controversy. . . CHUCK GREY os SARNAV sz he spent two days flying the Nevada brush triangle search. . . JERRY BARBER, California State Div. of Aeronautics, sz 28 ELT/DF units were purchased with the $8000 Aviation Fuel Tax Fund and given to Sheriff's Aero Bureaus and CAP. . . BILL KRATCH of ARRS 303rd sz tech order for VHF radios for Air Force and civil agencies communications was squelched by General, who said use CB's. . . DR. FINDLEY RUSSELL, University of So. Calif. Neurology Lab, sz there is recent interest in warming for snake-bite treatment. The precedent was set in 1916 by a Colorado country doctor. . . JOHN EMERY of Airborne Intensive Care, Illinois, sz FAA needs to address aid ambulances. . . Comdr. KENN CUTLER, USCG Hqtrs., sz the Interagency Committee on SAR (ICAR) meetings are open to the public. . . AB TAYLOR, U.S. Border Patrol sz send cards and letters for open file on importance of mantracking in SAR. . . Capt. JOHN ENGLEBERT, Larimer County Sheriff's Dept., sz Big Thompson flood still has 23 missing persons. . . GARY WILSON, Northwest Region CAP, sz he and Major BOB MATTSON, USAF, then of Nat. SAR School, attended night school together getting Masters Degree. . . JACK HAYS of Abbot Medical Electronics, Texas, sz monitoring the victims well-being in the litter electronically is here. . . LARRY MARCONI, San Jose SAR Calif., recently did 100 foot vertical mine shaft rescue. . . BILL FAHEY, Utah SAR Coordinator, sz he is optimistic about NASAR's 'Operation Clambake' which is scoping this Nation's SAR problem. . . JACK KEARNEY of the U.S. Border Patrol has his personal man-tracking book for sale. . . FITZ FITZGERALD, Airzona SAR Coordinator, sz Bureau of Land Management (BLM) is assuming SAR responsibility and supplementing local agencies with funding and resources. Washington required local BLM to submit SAR plans by March 1, '78. . . Brig. Gen. TOM CASADY, CAP Nat. Cmdr., sz it takes over 3 months of travelling to conduct this CAP business. . . NASAR 2nd VP RICK GOODMAN reports new New Mexico State SAR legislation with specific volunteer provision. . . DAVE MINNICH sz Pennsylvania Nat. Guard Adjutant Gen. wants his own Search And Rescue Magazine subscription. . . SAMMY SNIDER, Pennsylvania Aeronautical Safety, is recovering from a heart attack. . . JACK HOLLEN, Montrose SAR Team Ex-President, is also recovering nicely from heart problems and his recent interview concerning the *Wall Street Journal* article on the team was heard in ten mid-western states. . . PETER JENSEN, RECRO INC., Wisconsin, sz the Defense Civil Preparedness Agency (DCPA) has begun a new movie on volunteers. Needed, are SAR movie clips. Contact Pete. . . DON CURTIS, North Carolina Wildlife Resources, sz his state has no state legislation giving SAR responsibility. . . Cmdr. BILLY CUNNINGHAM of USCG Nat. SAR Sch. sz he has photo-journalist on staff send press releases to hometown of school graduates. . . BEN SCHIFRIN, Tuolumne Co. SAR, sz his team and Yosemite SAR are doing white water rescue practices together . . . For two cowboys who hiked Grand Canyon, rim-to-rim, in one day, NASAR President RICK LA VALLA and Great Smoky Nat. Park Assist, Chief Ranger BILL WADE are sure adamant about the social implications of running. . . DON ARNER, Pres. Int. Federation of Rescue Dog Assns., sz that after over 150 failures to recruit dog handlers into SAR, it is better to get SAR people to become dog handlers. . . Maj. RAY HUFNAGEL USAF Pentagon is actg. Executive Officer for AF Undersecretary Martin. . . RAY SMUTEK, Off-Belay editor, knows what it is like to be mountain rescue victim and provides us with this insight in the Bebruary '78 issue. . . MIKE HUMFREVILLE, past Search and Rescue Magazine editor has entered the advertising agency business. . . Col. BRUCE PURVINE, USAF Inland SAR Director, sz Readers Digest is researching article on Laura Elder, "One Walked Away," Search and Rescue Magazine; Winter '76, Spring '77 and Winter '77. The NBC Today Show celebrated the 2-year anniversary of her miraculous survival with her personal recount of the plane crash, the deaths and her trek to civilization. . . NASH WILLIAMS of Jet Propulsion Lab Amateur Radio Club, is still helping with emergency communications with our Mexican neighbors to the South. . . Gen. WILLIAM WELLER, Colorado State Adjutant General, announced that as of April 1, 1978, funding has ceased for the State SAR Coordinator position formerly held by BLAIR NILSSON. The CAP and Colorado SAR Board will fulfill this function. . . TOM STAADT, NASAR Membership Committee Co-Chairman sz many NASAR members are making personal sacrifices for the benefit of the organization. . . DAN DUNLEVY, NASAR board member, is busy with his annual report to the Nat. Ski Patr Sys. . . MAC McIVER, Washington State Aeronautics, sz he is financially conservative, but not, "That Others May Live". . . TIM SETNICKA of Yosemite Nat. Park, sz BUTCH FARABEE, also a Ranger there, names his new son Adam after his favorite TV show Adam-12. . . FRANK MILLS, Harper's Ferry Nat. Historical Park Safety Officer, sz he has 300 foot cliffs above the Patomac River. . . GARY DELIUS of Tennessee is on NASAR's Finance Committee. . . JIM BRADY, NPS Albright Training Center Grand Canyon, is preparing a national fitness standards proposal for Park Service Rangers. . . THEODORE YOUNG of Calif. sz he enjoys most the Search And Rescue Magazine articles on personal survival experiences and technical how-tos. . . TONY ANDERSON, NPS Washington Hqtrs., sz his hands still sweat when he tells how he survived a fall while leading a climb of Yosemite Valley's Lost Arrow. . . BOB MARSH of Graphic Controls Corp. in Buffalo sz he hears the practice of hospitals providing ambulances and paramedics with free supplies will soon end. . . GENE FEAR, Survival Ed. Assn., has bought a mini-computer in support of the SAR 'Over-Team' concept. . . EVELYN LUNDSTROM, Washington State CAP, planned to attend the Nat. Aerospace Education Conference in Dallas, Texas. . . MALCOLM SALISBURY of Maine REACT is making a sincere effort to enhance his region's SAR capabilities. . . GERRY WELLMAN, Utah CAP, is very busy with missions and training sessions. . . MATT SUGARMAN, Pt. Mugu State Park, conducted an excellent 'sensitivity session with SAR'. . . LARRY ARNETT of Kentucky Emergency Services is into writing articles. . . PAULINE SAUNDERS, Ventura Co. Emergency Medical Board, is a big booster of SAR. . . The USCG is into a TV ad with a slogan similar to NASAR's "Help others, help yourself". . . TOM VINES, Appalachian SAR Conference, has moved again. . . LOIS KING, President, Decelomatic Inc., sz the future of mobile rescue tools is vehicle pneumatics. . . BILL DOTSON of Calif. Rescue Dog just returned from 2-weeks in Europe training. He sz he was impressed with the organization of their Civil Defense. . . Cmdr. DOUG GEHRIG, USCG Nat. SAR School reminds keepers of SAR Resource Telephone Lists to send list to listees for validation. . . DON IRWIN, Calif. OES Communications, asks the U.S. Air Force if volunteer inland ground SAR is as important to them as the CAP and if they should have exclusive SAR frequencies as does the CAP. . . WAYNE KRANIG, Director, Calif. OES Law Enforcement, has a new boss ALEX CUNNINGHAM who replaces CHARLES MANFRIED as head of Calif. Office of Emergency Services. Presently it is ex-astronaut RUSTY SCHWEICKART who is liaison between Cunningham and Governor BROWN. . . Who's-Who In The West has selected NASAR's Administrator LOIS CLARK McCOY. . .

PUBLISHER' FORUM

Dennis E. Kelley

A very real hazard to life and limb is driving Route 66 in Arizona. Savage interstate truck drivers speed, tailgate and bully their way on this public highway with little regard for others. These 'Cowboys' should be the concern of authorities.

Hospital emergency rooms are a very inhospitable place to be when sick or injured. Waiting undressed in these purposely cold or cool emergency facilities is always uncomfortable. I find this cold environment not only disquieting but seemly contributory to one's distress be it shock or vulnerability to disease.

THE WILDERNESS ACCIDENTS— WHOSE RESPONSIBILITY . . . ??

by John Wedberg
Mugelnoos,
Sierra Club's Los Angeles Chapter

Maybe we should blame it all on Holubar, Gerry, and Kelty. They were the ones who pioneered the development of comfortable, lightweight backpacking and mountaineering equipment, thus inviting the multitudes to set forth into the back country, previously the weekend abode of but a few of the hearty. Here in L.A. there were only two stores where you could purchase an ice axe (Vandegrifts and Sports Chalet) 25 years ago; now, there are dozens—maybe hundreds! Many get outfitted at one of these outdoorsman's boutiques, and venture forth into the wilderness in their spiffy new duds, guidebook and ten essentials in hand, seeking adventure or who-knows what...Some of these end up getting into some sort of trouble. Whose responsibility is it to bale them out, after they voluntarily place themselves in a high risk situation...? It is the writer's opinion that too many times it is you and I, the taxpayers, who end up footing the bill for an expensive helicopter evacuation which was either too hastily ordered, or need not be ordered at all. Too many wilderness travelers nowadays demand to be proetcted, cared for, or plucked to safety at the first inkling of trouble. Is not the challenge of pitting onself against the elements, win **OR** lose, the thing that fascinates us about climbing? Remove the possibility of ultimate catastrophe and it would seem you remove the enchantment of the risk. The same thinking that now requires motorcycle riders to wear helmets and will probably soon insist on auto air bags, is doubtless responsible for the philosophy that the taxpayer should dash to the rescue of the wilderness traveler in trouble. But maybe there is some merit to that idea, when you consider our paternalistic federal government insists upon feeding and caring for us from our cradle to our grave—maybe each hiker and climber should be labeled "Property of the U. S. Government. Do not fold, staple, or mutilate!" ■

EDITORIAL

SEARCH & RESCUE MAGAZINE INDEX

FALL 1973
◈ Washington State SAR Conference ◈ A Visit with Jon Wartes ◈ A Child is Lost, by Lena Reed ◈ Chapter 1 of Mountain Search for the Lost Victim.

WINTER 1973
◈ A Rescue Worth Mentioning ◈ The Use of String Lines for Subject Confinement, Search Area Segmentation, and Grid Sweep Control, by Jon Wartes and Bill Rengstorf ◈ Mountain Rescue Association Spring Business Meeting ◈ Fort Jackson Search and Rescue Squad, by PFC Larry Strawther ◈ Part 1, Chapter 2 of Mountain Search for the Lost Victim.

SPRING 1974
◈ Driver Survives 500 Foot Plunge ◈ National Association of SAR Coordinators Annual SAR Conference ◈ Simulated Plane Crash ◈ Heated Oxygen Hypothermia Treatment ◈ Part 2, Chapter-2 of Mountain Search for the Lost Victim.

SUMMER 1974
◈ Surf Rescue, by Bill Wagner ◈ 1st National SAR Council, by Blair Nilsson ◈ National SAR School Graduation Speech ◈ The Rescue People, by George Sibley ◈ Part 1, Chapter 3 of Mountain Search for the Lost Victim.

FALL 1974
◈ A Tribute to Hal Foss, by Dyer Downing ◈ Harold A. Foss Obituary, by Rick LaValla ◈ Land Search Organization, by Lois McCoy ◈ How State Conferences Began, by Lena Reed ◈ International Mountain Rescue Conference, by Judy Bechler.

WINTER 1974
◈ The Rescue Group Nobody Knows – SAROC, by Lois McCoy ◈ Search Theory, by Dennis Kelley ◈ The Role of the State SAR Coordinator, by Paul Koenig ◈ Developing a Search Plan, by Andrew Hutchison ◈ Caldwell Search ◈ Utah SAR Seminar, by Paul Koenig

SPRING 1975
◈ Federal Agency Roster ◈ A Visit with Peter J. Pitchess Los Angeles County Sheriff ◈ 6th Annual National Association of SAR Coordinators Conference ◈ Mt. Stuart Rescue, by Paul Williams Man-Tracking, by Lois McCoy ◈ INLAND SAR '75.

SUMMER 1975
◈ Rappelling, by Bill March ◈ Oregon SAR Conferences, by Galen McBee ◈ NASARC Advisory Council Minutes, by Paul Koenig ◈ Aerial Reconnaissance in SAR, by Lt. Cdr. Scott Ruby, USN ◈ National Jeep SAR Association Convention ◈ Anatomy of a SAR Conference, by Wes Reynolds and Lois McCoy ◈ LANTSAR '75, by Lois McCoy ◈ NASARC Awards Program.

FALL 1975
◈ How to Teach Yourself Tracking Techniques, by Jack Kearney ◈ The Dilemma of Helicopter Rescue, by Paul Williams ◈ Snowmobile Rescue Units in Northeast Support CD, by Vincent J. Tuscher ◈ The Changing Face of SAR in Baja California, by Lois McCoy ◈ Northern California SAR Seminar, by Jim Presentati ◈ Avalanche Recovery, by Blair Nilsson.

WINTER 1975
◈ National Association of Search and Rescue Coordinators 6th Annual Conference ◈ Communications – The Visible Part of Planning, by Lois McCoy ◈ Emergency Preparedness Bibliography, by Skip Stoffel ◈ Search and Rescue Dogs, by Kenny MacKenzie.

SPRING 1976
◈ Vehicle Tracking, by Gar Salzgebar ◈ Establishing Search Areas, by Robert J. Mattson ◈ Mountain Flying ◈ River Crossing, by Bill March ◈ Northwest Bloodhounds Search and Rescue, by Lena Reed ◈ Flight For Life, by George L. Seaton.

SUMMER 1976
◈ The Rumplestilskin Effect, by Lois McCoy ◈ Safety in Helicopter Operations, by Lt. Com. L. B. Beck, USN ◈ Search and Rescue in Oregon, by John Olson ◈ Uniform Map System, by Ev Lasher, NASAR Spring Advisory Council Meeting ◈ "Go the Second Mile," by Stan Bush ◈ Basic Living, by Mike Humfreville ◈ CB Radios for SAR Communications, by Lt. Col. Homer Dillow, USAF.

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JULY 15-16, 1978
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Holiday Inn North, **Lexington, Kentucky**
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JULY 24-28, 1978
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JULY 30–AUGUST 5, 1978
National SAR School for Coast Guard Auxiliary
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AUGUST 7-18, 1978
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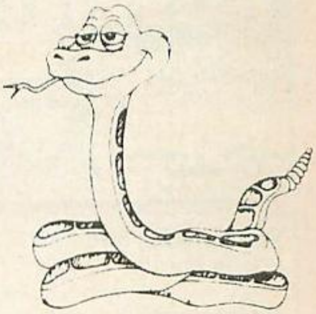

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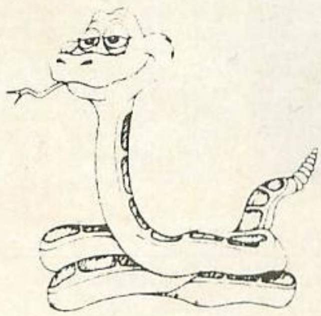

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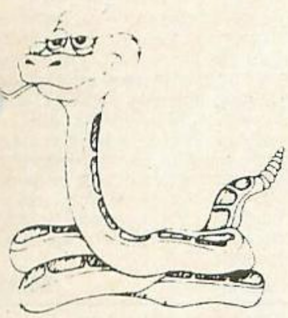

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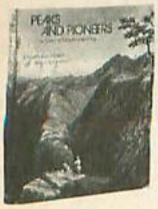

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