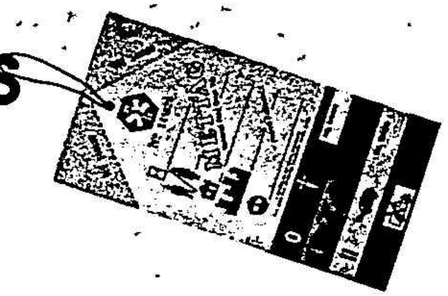
Management of Aircraft Crash Victims



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ONE OF THE earliest recorded aircraft crashes resulting in fatal injuries occurred in 1908, when a passenger of Orville Wright's was killed. Since that time, no matter what technology has been applied to the development of aircraft, the problem of injury or death producing crashes still remains.

As the payload of aircraft increases, so does the number of victims. In recent years, the size of aircraft has become so large and passenger carrying ability so vast that a modern-day air crash will tax the resources of even the most sophisticated community. Unfortunately, there seems to be an ever-increasing lag in the ability of those responsible for the development of crash management technology to face this problem.

Traditionally, the major emphasis has always been placed on the early extinguishment of post-crash fire. This is best illustrated by the way in which airport development funds have been disbursed since the adoption of Part 139 of the Federal Aviation Regulations. Over $20 million of these funds have been used towards the purchase of over 400 specialized crash vehicles primarily designed for the extinguishment of flammable liquid fires. These apparatus were used not only to upgrade existing airport fire departments, but to put many airports into the air crash business. Unfortunately, little emphasis has been placed on training. As an example, hot fire drills are recommended, but the interpretation of a hot fire drill may vary considerably.

Many crash/fire/rescue courses are based on those developed by the Armed Forces for handling crashes involving military aircraft. More time is generally spent on ejection seat dangers than on extrication; more time on handling weapons, than handling victims. We should re-evaluate our prime objectives and re-emphasize our mission priorities in the total concept of aircraft crash management. The concept of the "Aircraft Crash Fire Fighter" should be upgraded to the "Aircraft Crash Specialist."

The Aircraft Crash Specialist team should be the central community resource for the management of incidents involving aircraft. They should be highly trained and possess the necessary expertise to manage all operations at the crash site, whether on or off the airport.

The practice of refusing to allow crash equipment to respond off the airport presents serious moral, if not legal, problems.

In the U.S., there is an increasing trend toward the waiving of sovereign immunity, thereby allowing legal action against municipal governments in cases of tort liability. Consequently, there is a strong need to re-evaluate airport manuals and policies regarding the limitations placed on this equipment for off-airport use.

Jurisdictional barriers should automatically be removed in cases of major crashes. This can only be accomplished through adequate pre-planning and mutual aid, or inter-local agreements. If this is not accomplished, there may be indecision and confusion at the command level during a post-crash operation. This occurred recently at a major crash. Authority to cover bodies had to be worked out among six separate agencies because the crash was partly on, and off, the airport. Actions such as this can only create confusion and dissension at a time where maximum harmony should exist.

In reviewing major aircraft accidents, it becomes quite obvious that no two are alike. Consequently, it is difficult to adequately train and prepare personnel for a major crash. However, one fact stands out: experienced emergency personnel readily adapt to a disaster. The only necessity is to prepare them for a different operational concept from the normal daily procedures. To take individuals with backgrounds of only basic training in first aid, with little experience in handling victims with severe injuries, and expect them to operate at levels of maximum effectiveness is unrealistic.

Specialized training should be given based on victim stabilization rather than treatment. These psychological and procedural problems are best handled by conducting periodic disaster drills. However, these drills must be carefully designed, conducted and evaluated, in order to provide maximum effectiveness.

Too often, these drills are conducted with the convenience of time, ideal conditions and public relations in mind. The end-product of even the most disastrous drill is often summarized as, "All in all, the drill was highly successful; however, we did find certain areas in need of improvement..." It is far better to conduct frequent small **surprise** drills than one annual, well-publicized event of Olympic proportions. As crash likelihood is greater during adverse weather conditions, a night drill may bring out entirely different problems.

In terms of operational procedures, a crash with total fatalities does not tax a community's resources nearly as much as a crash with injured survivors. There is speculation that the inertia absorption of the largest hull mass of the wide-bodied jets may increase victim survivability. Casualty projections suggest that in the average crash of a wide-bodied jet, 25 percent of the victims will be impact fatalities, 25 percent fatalities from post-crash fire, 25 percent seriously injured, and 25 percent with injuries ranging from minor to none.

Types of crashes will also dictate the types of injuries. The impact crash occurring in a landing configuration may produce a high incidence of compressed spinal injuries, while a crash involving fire will produce a great number of thermal burns. This suggests that crash-rescue personnel be trained to the EMT level to be effective in victim care and extrication as well as fire suppression.

Generally, ambulance and rescue teams arrive on the scene a crew at a time. Where there are victims with varying degrees of injuries scattered over large areas, a plan of action must be developed immediately, usually before the arrival of the top echelon coordinators. As the rescuers arrive, they should report to a central command post to receive their assigned sectors and functions. The establishment of a central command post, then, has top priority.

The first objective of those arriving is to evaluate and stabilize the critically injured. This is best accomplished by a disaster tagging system. Such a system will prevent the time consuming duplication of victim evaluation. Through past observances of disaster drills, it has been noted that rescue teams have a tendency to follow behind one another caravan-fashion. The use of disaster tags offers immediate indication that the victim has been evaluated and categorized for treatment and transportation.

Modern concepts must establish definite priorities in the field of treatment. Arriving teams should assess and stabilize each victim to provide adequate airways and control severe hemorrhaging. Once all the victims are evaluated and stabilized, further definitive treatment can be given and they can be packaged for transportation. In the early stages of a disaster when rescue workers are sparse in numbers, this procedure ensures the most effective action.

Modern concepts in victim management should include the technology that is part of today's ALS system. Paramedics should have standing orders to start IVs wherever necessary. The average ambulance-type medical kit has the versatility to handle anything from childbirth to a heart attack. However, most of this is excess weight in the treatment of severe trauma. The same is true of the drug kits carried by ALS teams. The coronary observation radio and resuscitators can only burden the team down in the initial phases. Special trauma, or crash kits, should be provided with a back-up of MCI (multi-casualty incident) kits. EMTs and paramedics must be able to adjust to the MCI concepts of victim care.

It is a popular theory that triage centers should be established so that medical personnel can have victims brought to them for sorting. However, this may not be possible in areas where there is not an abundance of doctors. In smaller communities where medical resources are limited, doctors and nurses must report directly to the hospitals. Casualty sorting then becomes a responsibility of teams in the field. Procedures that work well in one community may not work in another.

Treatment should be divided into three phases; initial, intermediate and advanced.

INITIAL treatment is rendered to the victim at the location where first found. Stabilization and packaging fall under this category.

INTERMEDIATE treatment is rendered either at an outside staging area or in an ambulance, depending upon the situation.

ADVANCED treatment is usually provided at the hospital; or in some instances, the victim might be moved to special burn or orthopedic centers.

It may be practical to separate victims in a staging area based on their condition and priority of transportation. The critical victims could then be monitored by fewer technicians and one central location for hospital communications can be established. This staging area should be located for convenience and need not be in a building.

Each victim's location **in respect to the crash site** should be recorded before any physical transfer occurs. This information is important to the crash investigation team.

Transportation should be accomplished in an orderly manner with victims moved to *predetermined* medical treatment facilities. Past experience has shown that in times of stress, hospitals regularly used by ambulance personnel have been overwhelmed with victims of a disaster, while less commonly used facilities have received relatively few victims. This situation was noted as far back as the Coconut Grove Night Club fire in Boston in 1942 and continues to be a problem.

A transportation officer should be designated whose duties would be to maintain communications with the various medical facilities available to avoid any chance of inadvertent overloads.

Ambulances leaving the scene should be used to capacity. High priority injuries may require fewer numbers of victims per unit. Low priority victims may be included as "sit-up." The objective is to cut down on the number of trips by wise utilization of vehicles.

It is necessary that all victims leaving the scene, including the noninjured, be logged out through a registrar. This can be accomplished quickly by the tear-off section of the disaster tag. The victim can then be logged as to the unit, transported in, and the ultimate destination.

It is quite possible, if not probable, that many victims will be trapped or otherwise entangled in the wreckage. The concept of triage is used in the extrication phase. Victims who can be freed readily must be removed quickly, clearing the area for more complex extrication procedures. Care should be taken not to aggravate the victim's injuries. Caution must be used so that the wreckage is not further weakened to the point of collapse. Circular saws, cutting torches or other spark-producing tools, should be used only with extreme caution so that flammable liquids are not inadvertently ignited.

It must be emphasized, throughout all initial phases, that priority should be given to the care, treatment and transportation of the survivors. Once a victim is established as a fatality, this should be indicated on the disaster tag and nothing further done with the remains until the body identification phase is started.

Generally, the body removal and identification phase, coordinated by the U.S. National Transportation Safety Board, is not started until all lifesaving operations have been completed.

It is important that nothing be removed from the bodies such as wallets, rings, or any other personal effects; these are prime sources of identification. The area surrounding the body should not be disturbed more than necessary. The actual location of the body is marked by a body locator, usually in the form of a yellow flag having a large black number. This will mark the body's position on the final site diagram. These remain in place after the body is removed.

Prior to its removal, the body and its immediate surroundings are photographed from several different angles. The body and clothing are then described and recorded through either written form, voice or video tape. This is especially helpful where there is more than one dismembered body within a close proximity. Where possible, the parts are identified with the assigned number by a marking pen. After this, the body and all pertinent attributes may be placed in a body bag. Attention must be given to the collection of any remaining tissue found in the proximity of the victim. Keep in mind, sometimes even the smallest tissue fragment may lead to the identity or cause of death of the victim.

The bag is numbered to correspond with the locator marker, and then may be removed to the morgue. Refrigerated trucks or trailers have become popular for use as temporary morgues. The advantage is that they are mobile and often readily available.

Complete pathological examination of victims, especially the flight crew, is a necessary part of the crash investigation procedure. In some cases, the ultimate establishment of the cause of the crash has come from the autopsy table.

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Morgue procedures will include establishment of the sex, height and weight of the victim (where possible), along with further description of the body and its apparel. There may be extensive photography of the remains. Fingerprint procedures will include taking prints from the victim and matching these with either established files, or latent prints collected from articles the victim was known to have handled.

Dental identification is accomplished by matching a dental chart, made from the teeth of the victim, with one furnished by the personal dentist of the passenger in question.

In cases where victims have known bone deformities, or where there is suspicion of in-flight bombings, x-rays have been used with great success.

Laboratory evaluation is included in the autopsy procedure. This can establish blood-alcohol levels, carbon monoxide and other gas inhalation or drug usage.

Due to the extreme destruction often found in aircraft crashes, some of these procedures may not be possible. Identification may be limited to only fingerprints, dental charts, or even anthropological description. Identification of fatalities then, is a matching of the body number assigned at the crash site to the name of the passenger on the flight manifest. The legal aspects of death can then be satisfied for estate and insurance purposes. In some cases this human factors investigation may also assist in the establishment of the cause of the crash.

The investigation of a major crash may cost hundreds of thousands of dollars. The problems encountered in trying to reconstruct the scenario of the crash could be greatly alleviated through the cooperation of all involved. The final post-crash procedure should be a critique and debriefing of each individual's part in the operation. This information is then made available to the investigation team.

Today's needs should springboard yesterday's "Crash Fire Fighter" into tomorrow's "Crash Management Specialist." The "Crash Crew" should progress from its present position of an Airport Fire Department into an Aircraft Crash Management Team that functions community-wide.

Now is the time to start applying the systems approach so that costs may be cut, expertise developed, and most important of all, that human lives may be saved.

ROBERT P. HARRISON

"Ladies and gentlemen, I have a *mild* announcement to make," said Sidney Tishler, director of the Telecommunications Office at the Maryland Center for Public Broadcasting. Seated below him was a group of 250 medical, safety, police, and airport management experts, as well as some 20 members of the print and electronic media, who had assembled at Baltimore/Washington International Airport, May 12, 1978, to watch and evaluate a dramatic exercise in emergency medical management of a "simulated" mass victim catastrophe.

Speaking inside a ca(da)vernous hangar (planners of the exercise, including Tishler, allowed that this was the only time that an adjective with such macabre implications would be permitted), Tishler was winding up an explanation of how satellite technology would be tested for the first time in an airport disaster drill that for some spectators would evoke lurid memories of the 1977 air crash at Tenerife, Canary Islands.

Overhead, the hangar's permanent residents, a cast of starlings, fluttered across the oval-ridged roof and appeared to be upset with the flock of humans who had temporarily invaded their quarters. Occasionally, slight feathery pieces of insulation descended upon the audience from the heavily padded ceiling. Down below, the gathering generally ignored the sporadic and lightweight interference; they couldn't help but concentrate on the morning's heavyweight agenda.

The program appeared starkly simple. An airliner, fully loaded, would crash into a fuel truck. Explosions and fire would hurl 180 victims out of the plane and onto the runway and adjacent fields. The chaos of Tenerife would be simulated on BWI's Runway 22.

The challenge facing the airport—the reason the exercise was authorized and planned so carefully—was to learn how to deal with the carnage, disruption, and demand for services that a real-life accident of similar magnitude would require.

"What if," officials asked, "a 'mock' disaster became a cataclysmic reality? What would we do? How would we react? What kinds of resources would we need to save lives?"

Thus far, officials at U.S. airports have not had to demonstrate answers to these questions; but, as lookers-on were to attest, the issues raised by such an ominous possibility were behind the day's scenario.

Dr. R. Adams Cowley, who preceded Tishler to the platform, was responsible for providing medical answers to the problem. Founder-director of the Maryland Institute for Emergency Medical Services (MIEMS) (or the state's "shock trauma" unit), based at the University of Maryland Hospital in Baltimore, Cowley and his staff have saved hundreds of lives. They provide the most sophisticated and expeditious medical care available to patients whose hold on life is pinkie finger weak. Accident victims, heart patients, and severe burn sufferers look to Cowley and his confreres with thanks, both for saving their lives and for providing the superior treatment they need to recover.

The exercise at BWI was designed to tax the response capability of Cowley's team of medical personnel and also the reaction of dozens of "mutual aid" organizations such as local police, hospitals, fire departments, and, of course, the airport itself. Speaking from a "simulated" dais (jerry-built by using for risers two flatbed trailers backed together), Dr. Cowley cited two objectives for the demonstration: (1) to determine by computer analysis how many personnel, both medical and nonmedical, and how much equipment the "mock" victims would require if the exercise were the real thing; and (2) to investigate whether audiovisual satellite communication with distant medical specialists could help on-site management and care.

Satellite communications? Disasters? Enter Sidney Tishler, the Maryland Center for Public Broadcasting's urbane answer to Darth Vader. Four years ago Tishler was appointed the first director of MCPB's newly created Telecommunications Office. Since then he has fashioned it into an unusual information-gathering and project-producing arm of Maryland's nine-year-old state television system.

A former teacher and TV producer, Tishler is for Marylanders the counterpart to the mythical Ariadne who provided Theseus the thread by which he found his way out of the Minoan labyrinth. When the mass of information about "telecommunications" becomes a maze of confusion, the citizenry need only seek him for consultation and advice.

Under Tishler's aegis, the Telecommunications Office is an imaginative resource teeming with information about a field that seems to produce a new space age acronym every day. City and state planners use its up-to-date files to keep pace with developments within their own agencies. Representatives from hundreds of businesses, schools, libraries, and hospitals rely on it for descriptions of how radio, television, computer technology, and motion picture production are being used elsewhere.*

Even Darth Vader himself might find it a herculean labor to keep abreast of the advances in the telecommunications field, which also include changes in the way information is electronically transmitted, stored, and retrieved. That Tishler is able to accomplish this is a tribute to a successful survey technique and establishment of two-way (tele-)communication with other professionals. Like him, they are convinced that innovations in soft- and hardware, especially in satellite technology, will affect the way we live.

The BWI Airport disaster drill was the latest of several national exercises during the past two years in which Tishler has arranged for satellites to play a major role. Basically, two experimental communications satellites have been involved: the U.S.-Canadian vehicle located more than 22,000 miles above the equator in a stable orbit that places it several hundred miles west of Ecuador; and NASA's ATS-6 spacecraft circling 22,300 miles above Christmas Island in the Pacific, also in a "geostationary" or locked orbit.

In January 1977, MCPB's Telecommunications Office made its space age debut by arranging with Westinghouse Electric Corporation for a two-way satellite interconnection of a "moot court" exercise between students at the University of Maryland School of Law and Ohio Northern University. Even the planning for the two-hour debate was done through satellite "teleconferencing."

In May 1977, Tishler turned his attention from law to medicine when he arranged for doctors at the Johns Hopkins University to demonstrate via satellite three medical procedures for an international meeting of health science educators in Indianapolis. In effect, pictures and sound traveled to the conferees in the Midwest who conversed live with the Hopkins physicians in Maryland. The approximate 44,000-mile jaunt one way allowed Indiana participants, during one demonstration, to take an Alice-in-Wonderland journey down a Baltimore patient's air passages via a fiberoptic bronchoscope. The U.S.-Canadian CTS satellite transmitted the signals received from an eight-foot COMSAT Laboratories transportable earth station in Baltimore to a similar ten-foot mobile earth station in Indianapolis.

Imagine the travel and lodging costs physicians could save if the Hopkins example becomes a stan-

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*A quarterly newsletter, Telecom Update, is available free of charge by writing the Telecommunications Office, Maryland Center for Public Broadcasting, Owings Mills, Maryland 21117.

dard for medical training! In this instance, the personnel in Indianapolis did not have to wait for answers to their questions; they got them immediately.

In spring 1977, Tishler introduced Dr. Cowley and the MIEMS staff to satellite technology by having them participate in a two-way teleconference with colleagues in Ohio. There, trauma specialists, medical TV personnel, and the executive director of Ohio's ETV Network were on the agenda for a discussion with their Maryland counterparts of the potential that satellite communications posed for emergency medical care. Westinghouse Electric Corporation provided the facilities.

By summer 1977, when he announced plans for the May 1978 BWI Airport disaster exercise, Dr. Cowley was ready to test the effectiveness of sight and sound satellite technology. At his request and with Tishler at mission control, MCPB's Telecommunications Office prepared to line up a galaxy of acronymic agencies and coordinate their plans for the Brobdingnagian operation on Runway 22.

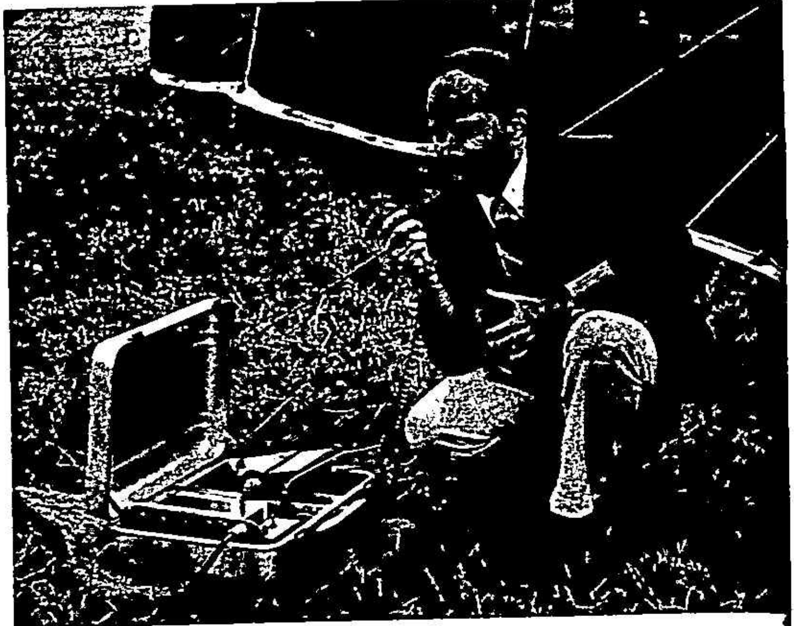
By November 1977—so fast had changes taken place in the field—a new piece of miniature technology was available for testing. The apparatus, a small briefcase the size of an executive's attache case, was designed to replace the portable earth station as the transmitter of audio signals.

Tishler arranged for Dr. Cowley to test the NASA-developed device (there are only three in existence). Speaking from Baltimore, Cowley communicated via the ATS-6 satellite to officials using a similar briefcase at the U.S. Department of Transportation headquarters in Washington, D.C. On hand in the nation's capital to vouch for the instruments' effectiveness were representatives from several organizations, including the White House Office of Telecommunications Policy.

While preparations for the airport demonstration were underway, the Maryland Center for Public Broadcasting had an opportunity to host a space age activity of its own. In February 1978, as the new copyright law was about to go into effect, MCPB and the American Library Association hosted a significant teleconference from Owings Mills, Maryland. Neither a winter snowstorm that actually disrupted land-line communications in the East nor last-minute arrivals to the Center's studios northwest of Baltimore prevented a successful satellite closed-circuit interconnect with 2,000 ALA members at thirteen receiving points across the country.

It was a space age first for the ALA made possible through the cooperation of the staffs of NASA's Goddard Space Flight Center, Greenbelt, Maryland, and NASA's Lewis Research Center in Cleveland, Ohio. They provided the mobile earth station and the satellite time that allowed the proceedings to be transmitted to the U.S.-Canadian CTS spacecraft for re-transmission to groups gathered at public TV stations of the Southern Educational Communications Association. Dr. Harold E. Wigren, the noted telecommunications consultant, designed and planned the project.

Each of these exercises brought together for the first time groups that were captivated by the long-range possibilities offered by satellite technology. The success of the experiments encouraged Tishler to solicit his telecommunications contacts for an attempt at the most ambitious test yet.



Sidney Tishler, director of the Telecommunications Office at the Maryland Center for Public Broadcasting, tests a briefcase satellite transceiver used to transmit and receive video and audio signals to Chicago and Boston via NASA's ATS-6 satellite. One of three in existence, the instrument was developed by NASA's Goddard Space Flight Center.

During the simulated mass victim catastrophe, this mobile earth terminal was used for the on-site diagnosis of the 180 "mock" burn victims at the crash site.

"What would happen," he had asked Dr. Cowley many months earlier, "if land-line communications broke down during a major medical disaster, as they did during the recent Johnstown flood in Pennsylvania? Or, what would happen if a catastrophe was so horrendous that local resources could not provide the necessary diagnosis and care? How would you handle such a situation?"

The search for answers justified the meticulous planning for the simulated disaster about to take place five miles from Baltimore at BWI Airport the morning of May 12. Dr. Cowley's staff had recruited 180 students and other volunteers to serve as "burn" victims. Their "moulage" or makeup was so real that camera crews would later wince at the sight. The "victims" would be strewn about the plane, screaming and pretending shock when given the signal.

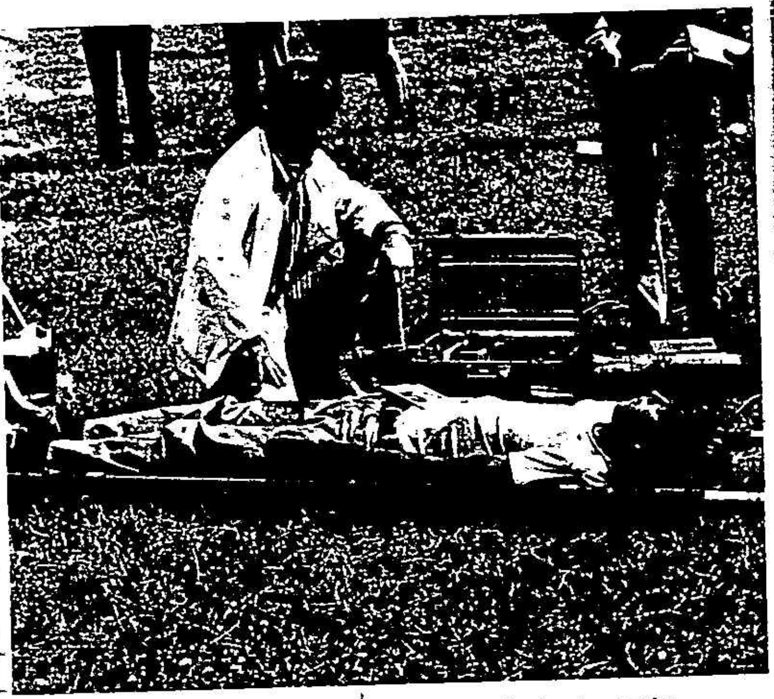
The airport administration had set aside the east end of Runway 22 for the demonstration. An old four-engine turboprop, "borrowed" from a charter service when neither the military nor the commercial airlines were able to release a plane, was parked next to a huge fuel truck. It was painted a dolorous gray, a fitting hue for the event about to take place.

Inside the hangar Tishler explained the role satellite technology would play in the experiment. Two communications satellites, one the U.S.-Canadian CTS spacecraft and the other NASA's ATS-6—both tested veterans—would enable medical specialists in San Antonio, Chicago, and Boston to assist in treating mock burn victims at the crash site. Each, however, would transmit a different kind of picture for evaluation purposes.

The ATS-6 would send a slow scan black-and-white picture. Emergency medical personnel at Chicago's O'Hare International Airport and at Boston's Logan International Airport would see the same picture—it would take about seventy-eight seconds to transmit each slow scan image—and would receive voice commentary from the Maryland emergency medical crews. Both the Boston and Chicago airports would be linked with the mock crash site by two (of the three in existence) remarkable briefcases that would receive live audio and video and transmit audio signals back to BWI.

Also, a COMSAT Laboratories mobile earth station at BWI would send full-motion color video and sound to the U.S.-Canadian satellite for transmission to Brooke Army Medical Center at Fort Sam Houston, Texas, and to the Veterans Administration Hospital in Albuquerque, New Mexico. Physicians at Brooke, using a NASA receiving station (TET, or Transportable Earth Terminal), would participate in the actual diagnosis and treatment of burn victims. The staff at the VA hospital would watch and evaluate the proceedings.

It was indeed an ambitious project that would take place on Friday, BWI's busiest day! In Maryland the 250 professionals would soon move out of the hangar to perform as a live jury from the vantage point of bleachers located a hundred yards from the action. They would see an extraordinary logistical and medical challenge met head-on by representatives of MIEMS and other local, state, and federal agencies.



Three elements in emergency medical care that were part of the simulated mass victim catastrophe: a victim made up as a "mock" burn patient; an expert diagnostician from Maryland's Institute of Emergency Medical Services; and the remarkable briefcase transceiver device.

A computer would monitor the kinds and quality of human and equipmental response. Later, experts would analyze the data to determine what services must be provided when . . . if a "mock" disaster were to become a real "shock trauma" condition. Immediately after the demonstration, the two satellites would link all participants in two teleconferences designed to evaluate the unusual event.

It was almost 10:00 a.m., the time the scheduled disaster was to begin. Several "planemates"—the futuristic vehicles used in passenger boarding and unloading—waited outside the hangar to take observers to the bleachers. In the rear of the hangar, members of the "electronic" media, unable to find a story inside (although members of the press were seen taking copious notes), chafed at waiting around.

Sidney Tishler, MCPB's telecommunications director, concluded his remarks. "I repeat," he said calmly, "we do have a mild announcement. We don't want to alarm you, but if anyone has a pacemaker, please stay away from both satellite transmitting areas. We are not certain what effect, if any, satellite transmitter radiation might have upon pacemakers, but we do suggest that you keep your distance just as you avoid walking too close to microwave ovens."

There were no pacemaker casualties, though a young woman with a bee sting precipitated a false start to the experiment. TV camera crews jumped at the chance to record the quick response of the airport rescue squad and mistakenly thought that the disaster was underway. In a few minutes it was. Both the bee-stung female and the actual simulation appeared on the nightly news.