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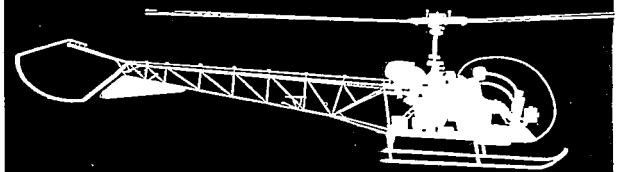
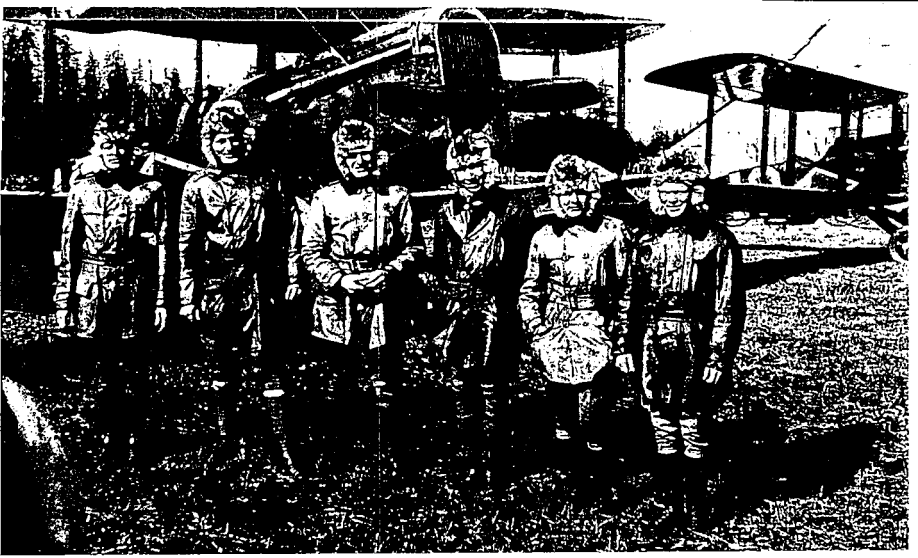
AIR ATTACK ON FOREST FIRES





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AIRPLANES, HELICOPTERS, AND THE FOREST SERVICE

Just 16 years after the Wright Brothers' historic flight at Kitty Hawk, the Forest Service, U.S. Department of Agriculture, pioneered in using aircraft in forestry. This early recognition of the role planes might play in protecting and managing forest lands led to a variety of ideas for using aircraft in fire detection and suppression.

To place credit for the practical beginning of Forest Service "air attack" ideas, we must go back to a restaurant on Market Street, San Francisco. The year—1919. Two men, who have met purely by accident, sit discussing their problems. One of them is Coert du Bois, Regional Forester, U.S. Forest Service. The other, a young Army Air Corps major in charge of a demoralized group of World War I flyers. The major wants something useful for his pilots to do. Something that "would keep them pepped up and maybe let the public know they used to have an air force." The forester needs a way to quickly spot forest fires. Their discussions lead to an idea. And the idea develops into an organized

forest fire patrol along California's Sierra Madre Mountain Range. Plans are also laid for regular aerial scouting of large forest fires. . . . This is the beginning of coordinated air-ground operations in forest fire control.

The young major's name? . . . Henry A. "Hap" Arnold, later to become commanding general of the first independent United States Air Force.

In today's modern Forest Service, airplanes and helicopters are of vital importance. You'll find them taking wildlife surveys, reseeding range and timberlands, destroying noxious plants with chemicals, controlling forest insects, and rescuing lost hunters and injured skiers. But most of all you'll find them helping to put out forest fires.

Through the progressive ideas of Coert du Bois, "Hap" Arnold, and a host of other courageous men who have worked with aircraft, the Forest Service has saved millions of acres from fire. But the Forest Service aircraft story is not over. Today Forest Service men are still pioneering with new ideas, methods, and equipment. The story is continuing—and that's what "air attack" is about. Each of the five main chapters, Platforms in the Sky, Airborne Firefighters, Attack From Above, Supply From Above, and It's Always Teamwork tells its own story of airplanes, helicopters, and men of the Forest Service.

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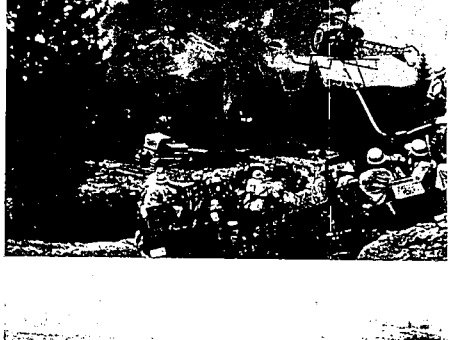

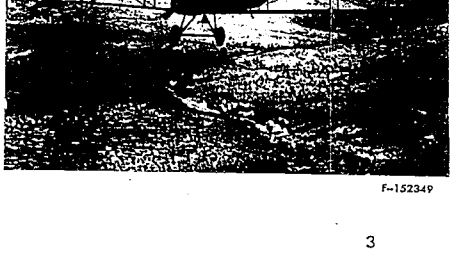

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FOREST FIRE DETECTION

Airplanes and helicopters are excellent platforms in the sky. They make it possible to spot and inspect forest fires in remote mountain areas.

From the Great Lakes to the Pacific Ocean, regular Forest Service air patrols are commonplace. They operate planned "fire looking" trips carefully integrated with lookout tower activities. Flight patterns are mapped, courses plotted and carefully noted by each pilot. A specially trained and qualified Forest Service observer usually goes along to do the actual fire spotting.

In areas where lookout towers are the primary feature of the fire detection system, aircraft still have an important role. Part of their job is to make thorough searches of forest areas hit by severe lightning storms. These patrols are continued at regular intervals to spot "sleepers" or smoldering fires that come to life when the forests dry out. Helicopters are good for this type of fire detection. Their slow speed and ability to fly close to the ground permits an intensive, methodical search.

Often fire-tower lookouts report a possible smoke in a hard-to-see valley. When exact location of the fire is uncertain, a shortwave message sends a helicopter to search. Close radio contact is maintained between the aerial observer and lookout tower until the smoke is pinpointed and the fire-fighting crews are on the way.

Aerial fire detection has come of age in the Forest Service. The Forest Fire Detection air patrol system is now a versatile unit. It can be built up or decreased to fit the needs of fire-weather conditions. Each year new aerial fire detection uses, methods, and techniques are being discovered. Old ones are continually being improved. Forest Rangers now look to their "eye in the sky" to help locate fires while they are still small and easier to control.

SCOUTING

Someone once said, "A picture is worth a thousand words." To fire bosses direct aerial views of forest fires are worth even more. Light scout planes and helicopters have proved their value by making it possible to gather firsthand, up to the minute forest fire information quickly and easily. Usually a local Forest Service man flies as observer and recorder. From the air he notes the fire's rate of spread, direction, intensity and behavior. The topography and ground cover in front of the fire is surveyed and evaluated. Access roads and trails are located. Progress in controlling the fire is sized up and reported to ground headquarters.

In the Cleveland National Forest in California, on September 9, 1946, a helicopter flew a special project mission. It carried a Forest Service engineer to scout and map a forest fire near Red Rock Mountain. Within 45 minutes a detailed map of the rugged fire area was completed and in the hands of the fire boss. Today, in many areas, aerial mapping is routine procedure.

During major fires, division and sector bosses often fly over their respective control areas before beginning their work shift. This gives them a firsthand look at how adjoining fire control jobs can be tied in with their current plans. Often the fire boss himself uses a helicopter to scrutinize portions of the fireline and personally supervise critical areas. By making several flights a day more timely information can be obtained than with a conventional ground crew of scouts working from daybreak to dark. Under new systems of coordinated attack the air operation boss does most of his directing from the seat of a plane. He controls tanker planes and helicopters, telling them just where and how to drop their water or fire retardant slurry.

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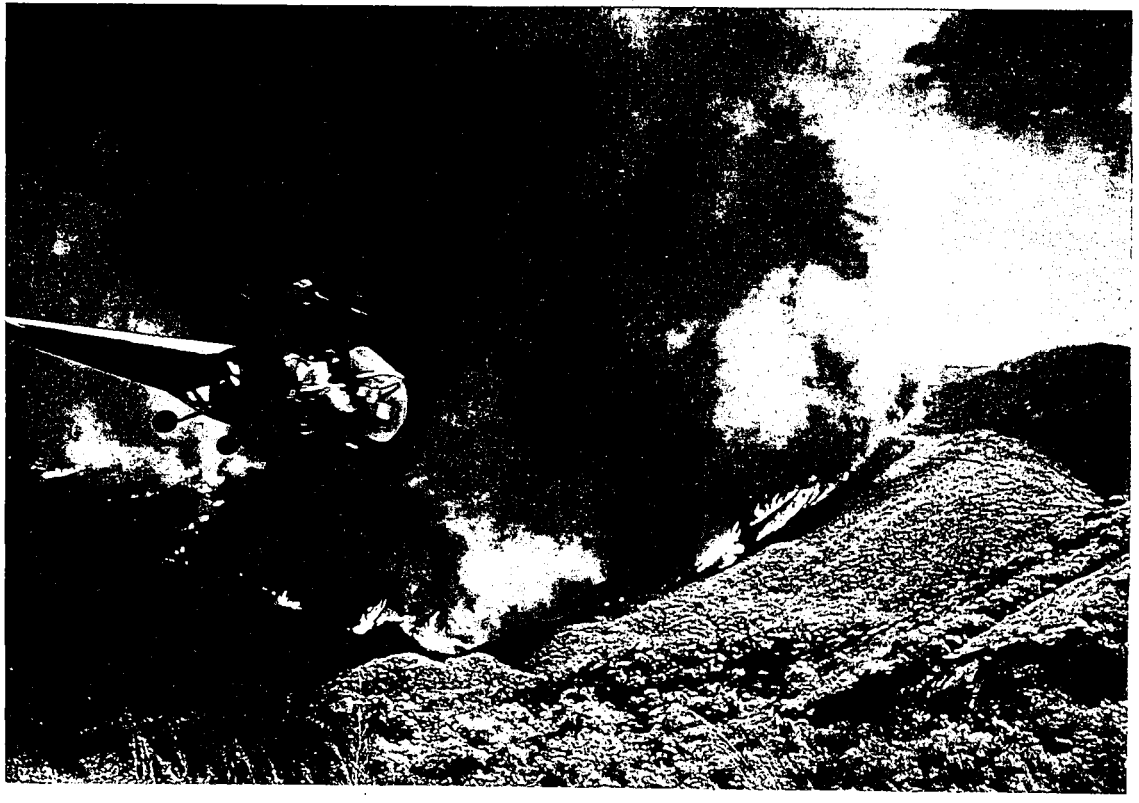

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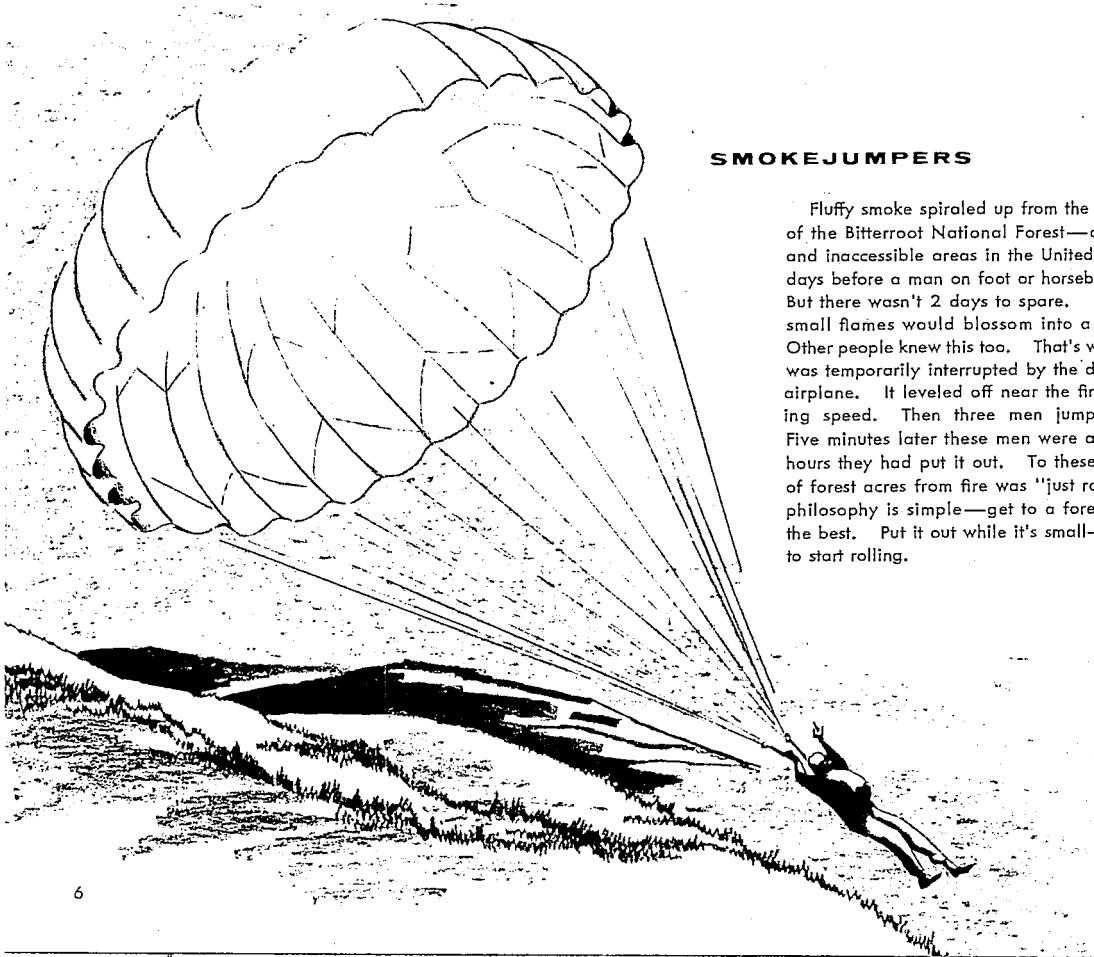
airborne firefighters



SMOKEJUMPERS

Fluffy smoke spiraled up from the Selway Wilderness area of the Bitterroot National Forest—one of the most rugged and inaccessible areas in the United States. It would be 2 days before a man on foot or horseback could reach the fire. But there wasn't 2 days to spare. In less than an hour the small flames would blossom into a full-fledged forest fire. Other people knew this too. That's why the wilderness silence was temporarily interrupted by the drone of a Forest Service airplane. It leveled off near the fire, slowing to near stalling speed. Then three men jumped rapidly into space. Five minutes later these men were attacking the fire. In 2 hours they had put it out. To these men, saving thousands of forest acres from fire was "just routine." Smokejumper philosophy is simple—get to a forest fire the quickest with the best. Put it out while it's small—before it has a chance to start rolling.

ɔrne firefighters airbor

The smokejumping idea was given birth by a few progressive minded foresters in the early 1920's. But it didn't seriously take hold until 1939 when planes and equipment had improved. That year test jumps by Forest Service men showed that airborne firefighters could land safely in all kinds of timbered areas, provided they had proper equipment and protective clothing.

The "big day" finally came for those who pioneered smokejumping. It happened on the Nezperce National Forest near Martin Creek in Montana. On July 12, 1940, for the first time, two men made a parachute jump to a forest fire.

Smokejumping proved so successful that U.S. Army staff officers visited the parachute training center at Missoula. One of these officers, Major William Cary Lee, used Forest Service ideas and techniques in organizing the Army's first parachute training center at Fort Benning, Georgia. Major Lee later commanded the Army's famed 101st Airborne Divi-

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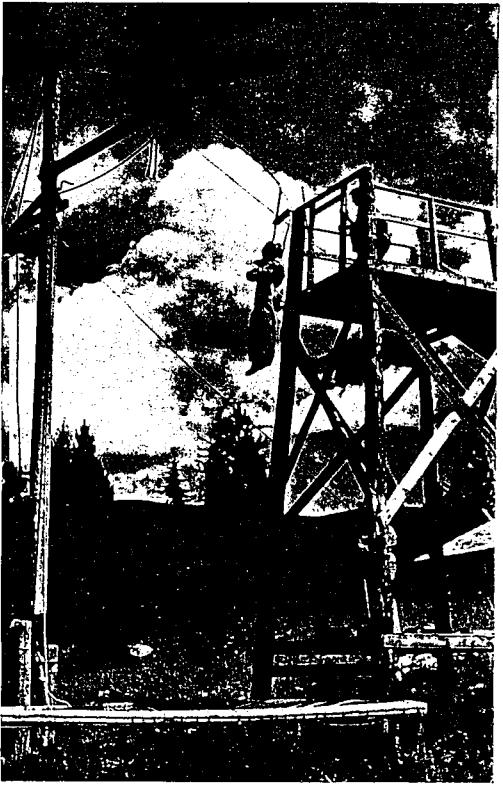
sion in World War II. The Army also relied on the Forest Service for direct training of paratroopers. The 555th Paratrooper Battalion and the original group of Air Force "paradoctors" were instructed at the Missoula training base.

Today, in peaceful times, Forest Service smokejumpers accomplish two major objectives: they replace or reinforce other back-country firefighting forces, and they place skilled hard-hitting crews on fires in the shortest possible time.

From the first smokejumper action in 1940, the organization has grown steadily. In the beginning only 12 men were employed. Though they all had previous forest firefighting experience, some had never before been in an airplane. By the end of their first season, the group had made 99 parachute jumps. In comparison, during the 1958 fire season, 308 Forest Service smokejumpers made 2,251 fire jumps totaling more than 5,000 man-days on forest fires.

Since 1940, continual research and development has made smokejumping easier and safer. New protective clothing has been developed to prevent injury from sharp tree limbs and rocks. Maneuverable parachutes have been invented and redesigned for maximum safety. Parachute openings have been made automatic by static-line ripcords. Slotted canopies and special guide lines now enable jumpers to control their direction and speed of descent. But no matter how good the equipment, the effectiveness of smokejumping depends on the smokejumper. Good men are a must.

Smokejumpers are recruited early each spring. A majority of the recruits are college students. All types of academic programs are represented, though forestry and medical students outnumber others. Usually there are many more applications than job openings. The mental and physical standards are high. Recruits must have at least one season



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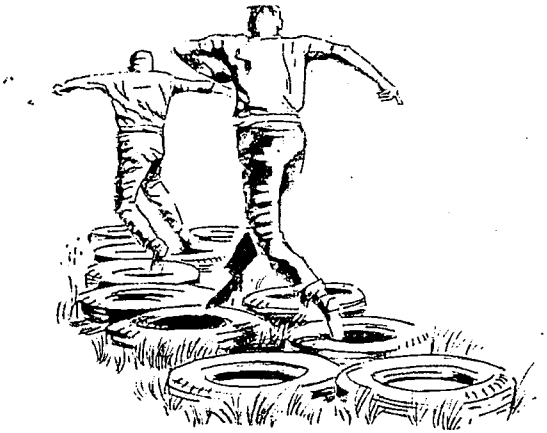
of forest firefighting experience and a good recommendation from their former supervisor. They must be self-reliant and accustomed to rugged outdoor life, be from 18 to 28 years old, weigh not more than 180 pounds, and must pass a rigid physical examination. Successful candidates are enrolled in a 4-week training course in parachute jumping and firefighting. Classes are conducted by experienced squad leaders. The methods taught and the materials used represent the safest and most efficient way of doing the job. Rigorous calisthenic exercises are included in the training curriculum. Low jumps, ground exercises, hurdles, and obstacle courses toughen the trainees' muscles, train them to be agile, and teach them how to fall safely. In addition, the men are given at least 16 hours of practical first aid instruction and 4 hours of training in stretcher bearing and related rescue work.



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airborne firefighters

A recruit makes his first practice jump only after he has successfully passed his classroom studies and ground training courses. Seven practice parachute jumps are required, each simulating conditions that might occur in actual forest fire situations. These preliminary jumps are made under the watchful eyes of instructors. The men check and recheck each other's clothing, parachutes, and harnesses. Not until the squad leader gives the final "OK" are the jumpers permitted to leave the plane. This procedure is followed on all jumps.

When training is completed the men are assigned to smokejumper bases. Each base has special maneuverable planes which enable the jumpers to reach fires often within minutes after they are reported. The smokejumpers bail out at about 1,500 feet. Two parachutes are worn for all jumps. One, a large back-pack chute, is opened automatically by a static line attached to the aircraft. The other, a standard chest-type parachute, is used only in emergencies. The number of jumpers used depends on the size and intensity of the fire, though for safety purposes never less than two men jump to any fire. Tools, food rations, radiophones, and other necessary material are dropped with the aid of special equipment parachutes. Unlike early firefighters who spent many weary hours walking to a fire, smokejumpers are fresh and alert when they arrive by air. They have had a chance to observe the fire from the plane and to judge its probable course. They know that fellow jumpers and equipment are available within the hour if they are needed.

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pecially in the leg areas. Helmets, equipped with a fine face screen to prevent injuries from heavy brush, are worn along with heavy leather gloves. A helijumper's tools usually consist of a long-handled shovel, an ax or other cutting tool, a canteen, headlamp, and food rations. This equipment is tied together in a compact free-fall bundle.

Before the jumper leaves the helicopter, several low-level passes are made to select a jump spot free of most ground hazards. First the tools are dropped. Then, on signal from the pilot, the helijumper leaps the 5 to 10 feet to the ground.

Helijumpers are usually recruited from trained fire suppression crews. They must be young men, light to medium weight, in top physical condition and with 1 or 2 years of forest fire experience. Selected recruits take part in prescribed training programs conducted by experienced helijumper instructors. At least 40 hours are spent in classroom work and an additional 75 hours in ground and air training experiences, including a series of actual helijumps. Six or more carefully supervised jumps are made—three on level ground over low vegetation, and three under typical fire conditions. When training is completed the helijumpers await fire calls requiring helijump services. Between calls they handle other jobs for the District Forest Ranger.

National-forest officers know of many documented cases where helijumpers have pinned and held small spot-sized fires that could have become large, costly, and devastating. It hasn't taken long for helijumping to progress from a firefighter's dream to a time- and money-saving reality.

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CASCADING WATER AND CHEMICALS

Roy Johnson shoved the "big cat" in reverse and backed out of the smoke. It looked like a hopeless job now. The fire had crossed the line and was roaring downhill, soon to be out of reach. Roy eased his bulldozer forward and tried to pick up the slop-over. But the heat and smoke forced him back. As he wiped the sweat from his eyes he thought to himself, "Well, here we go again. Looks like a big one's about to break loose."

Then he heard the roar of a plane overhead. Something wet hit his face. Looking up, he saw a cloud of liquid falling from the belly of a low-flying plane. A second plane dropped a load in the brush just ahead of the fire. As the flames hit the white-coated brush they cooled down. Seizing this chance, Roy pushed his "big cat" in along the edge of the fire and began to pick up the slop-over.

Dropping water or chemicals on fires is not an entirely new thought. The idea started back in 1921. The first recorded test took place in 1930. A veteran firefighter and a bush pilot teamed up with a tri-motor plane for a strange aerial experiment. Six history-making wooden barrels were loaded on the plane. A large white circle marked the target below. At 100 feet up, and traveling at 90 m.p.h. the forester pushed the barrels overboard. They scored a near miss, spattering water over a small area as they crashed. Though the results were not encouraging, it was at least a start.

Ever since that early experiment, firefighters have tried to develop practical ways of air-dropping liquids. They tried dropping uncontained water and enclosed water tanks. They dropped them from B--29's, tri-motors, and a number of other

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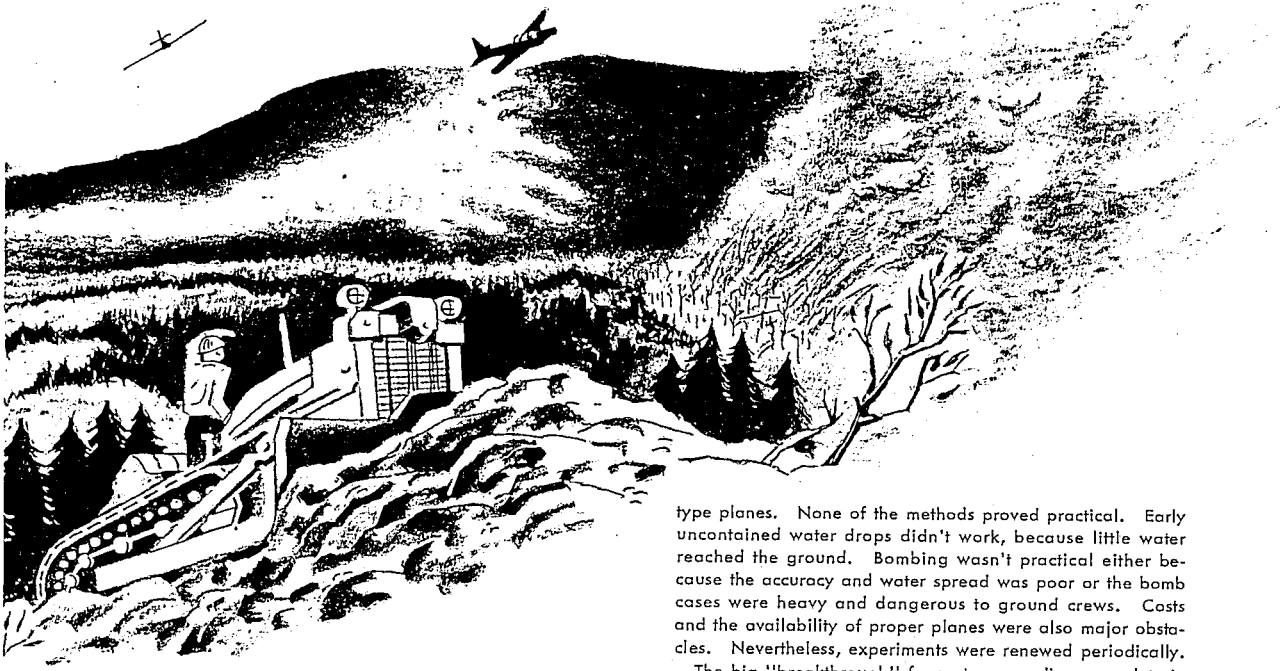
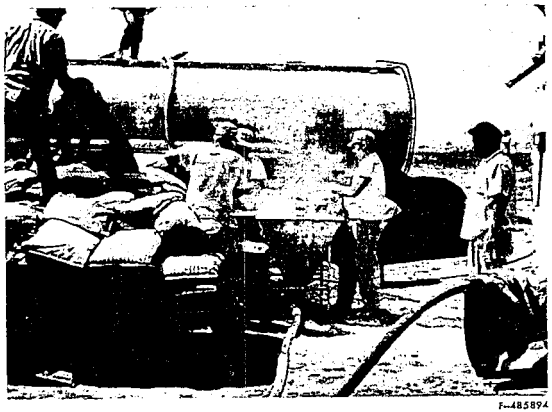


type planes. None of the methods proved practical. Early uncontained water drops didn't work, because little water reached the ground. Bombing wasn't practical either because the accuracy and water spread was poor or the bomb cases were heavy and dangerous to ground crews. Costs and the availability of proper planes were also major obstacles. Nevertheless, experiments were renewed periodically.

The big "breakthrough" for water cascading came late in 1953 from an unexpected source. An aircraft company was testing the new DC–7 over Palm Beach Airport. Flying at 200 m.p.h. at 500 feet, the crew jettisoned 1,300 gallons of water carried for ballast. In spite of the desert temperature the water drenched an area 200 feet wide and a mile long. Company engineers passed the word along to the Forest Service. On December 2, 1953, extensive tests were carried



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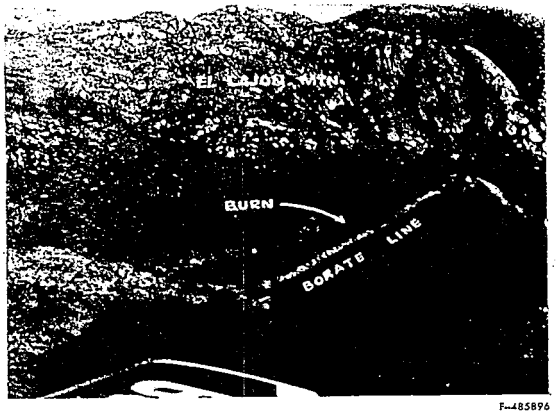

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on at Rosamond Dry Lake in the Mojave Desert. Though the gigantic DC–7 obviously was not the plane for firefighting, the free-falling water idea worked. Firefighters had an early Christmas present.

Later in March at the El Toro Marine Base, a 250-gallon napalm tank was slung under the belly of a single-engined fighter plane. As the plane flew low over the field an impulse triggered by the pilot shattered the glass and cascaded a stream of water across the ground. Once again water cascading worked.

The success of these experiments set the stage for Operation FIRESTOP—a one-year effort in which Federal, State, and private organizations pooled their resources to explore new fire-control methods which might prove practical. U.S. Forest Service scientists gave technical direction to many parts of the program. One of these was testing fire-retardant chemicals and their release from aircraft. Of the several methods tried, the Navy (TBM) torpedo bomber with a special water tank in its belly showed the most promise.

In 1956 a squadron of maneuverable agricultural spray planes, equipped with 100-gallon water tanks and special discharge gates, were used experimentally by the U.S. and State forest firefighters on 23 California fires. They dropped 123,000 gallons of water or sodium calcium borate "slurry." Because of the lasting fire-retardant qualities of borate and its ability to penetrate heavy foliage, it did a better all-around job than plain water. By the end of the fire season, air support was credited as a deciding factor in controlling 14 of the 23 fires.

Encouraging as these experiments were, they proved that planes with greater water-tank capacity were needed for large fire operations. Late in 1956 and in 1957, attention

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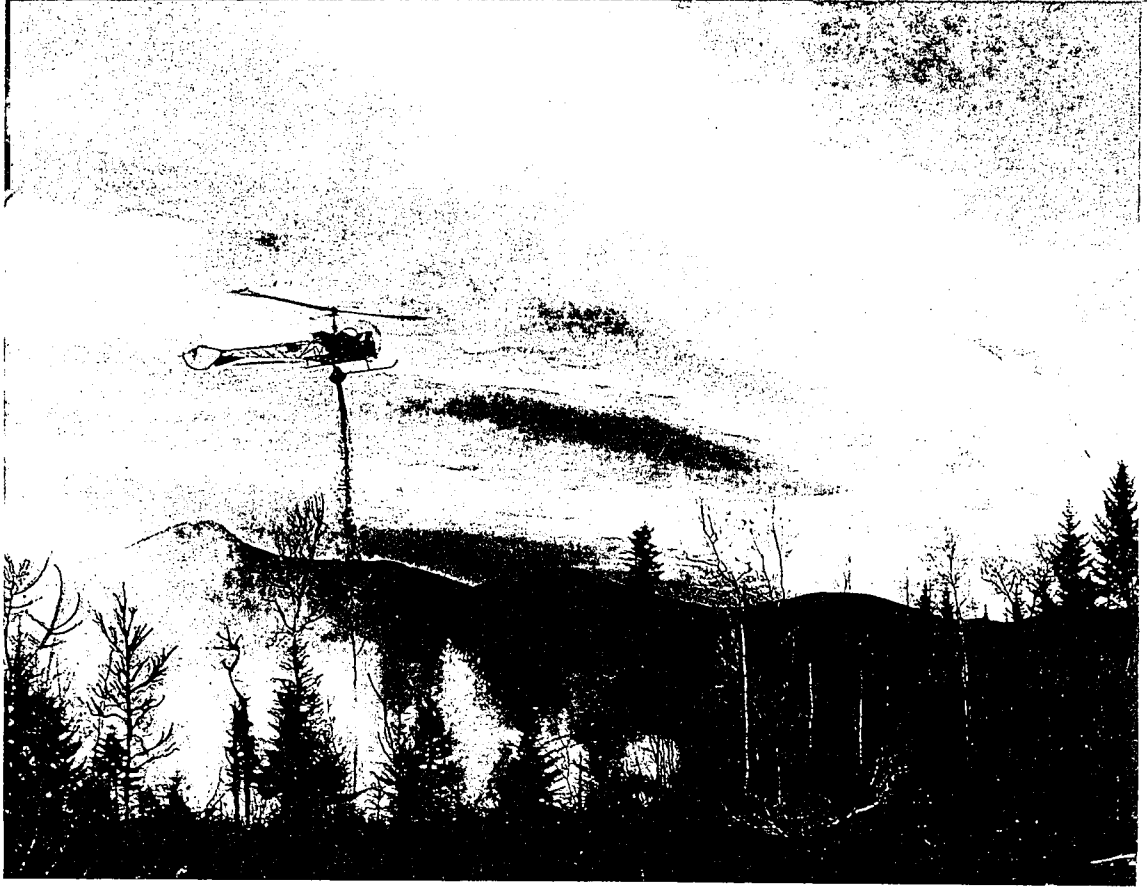

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was again concentrated on the large Navy torpedo bomber tested in Operation FIRESTOP. Eight of these bombers, obsolete for Navy use, were transferred to the U.S. Forest Service. This was the beginning of a firefighting air force. Forest Service engineers equipped several of the TBM's with special 400-gallon water tanks. Experiments on actual fires were conducted. These tests brought out several facts. First, airplanes are not a complete method of firefighting, nor are they substitutes for ground forces. However, they are excellent in providing close aerial support to ground crews. Air tankers can:

1. Hold small fires until ground crews arrive.
2. Knock down spot fires.
3. Cool down hot spots so that men can enter an area and work safely.
4. Lay a fire-retardant line in advance of a fire.
5. Reduce the probability of fire jumping into treetops.
6. Strengthen existing firelines.
7. Assist in critical fireline construction.
8. Fireproof local areas where spot fires are probable.

Studies also show that in some situations air tankers provide little or no help. Tankers cannot at this time:

1. Knock down very hot rolling brush or timber fires.
2. Make safe drops in high winds.
3. Make drops in the bottoms of steep canyons or similar places which lack maneuvering space for aircraft.
4. Cool down fires where heavy fuels are under timber stands.
5. Work at night.

Like all specialized equipment, air tankers must be closely coordinated with other fireline action. Though airplanes may reduce the need for ground crews, they do not replace them. Control lines and thorough mopup are still necessary. Gains made by fast air attack can be lost if firefighters do not take quick advantage of a knocked-down fire.

The potential of coordinated air tanker-ground crew action is tremendous. An eyewitness to the 3,500-acre Boulder Creek fire on the Los Padres Forest in August 1957 summed up the situation by saying ". . . What I witnessed was an outstanding example of controlled air attack carefully integrated with ground action, resulting in control of a very difficult fire with an awesome potential. . . . The northwest corner beyond the main ridge was heavily timbered and was being held by hand crews. The fire spotted over the ridge above them threatening their line. A borate drop was ordered. A PBY and two TBM's dropped one load each, a total of 2,100 gallons, which completely extinguished the fire, securing a critical corner.

"No one could witness such an action without feeling a sense of real promise for coordinated use of a new tactical fire tool and a sense of pride in the skill, tenacity, and aggressiveness shown by experienced wildland firefighters."

Forest fire losses in the United States and many other countries still need to be reduced. Lately the U.S. Forest Service air tanker program has received worldwide attention. New projects have developed at a startling tempo. In the 1958 fire year alone, over 2 million gallons of fire retardant were cascaded by air tankers. A new, easily mixed fire retardant called bentonite is coming into wide use. It costs substantially less than the other retardants now in use. Yes, in this age of rockets, Forest Service air-attack development and research is on the move. It is not beyond reason to explore in thought what a guided missile full of fire retardant could do when the visibility is 0–0 and the wind 60 m.p.h.

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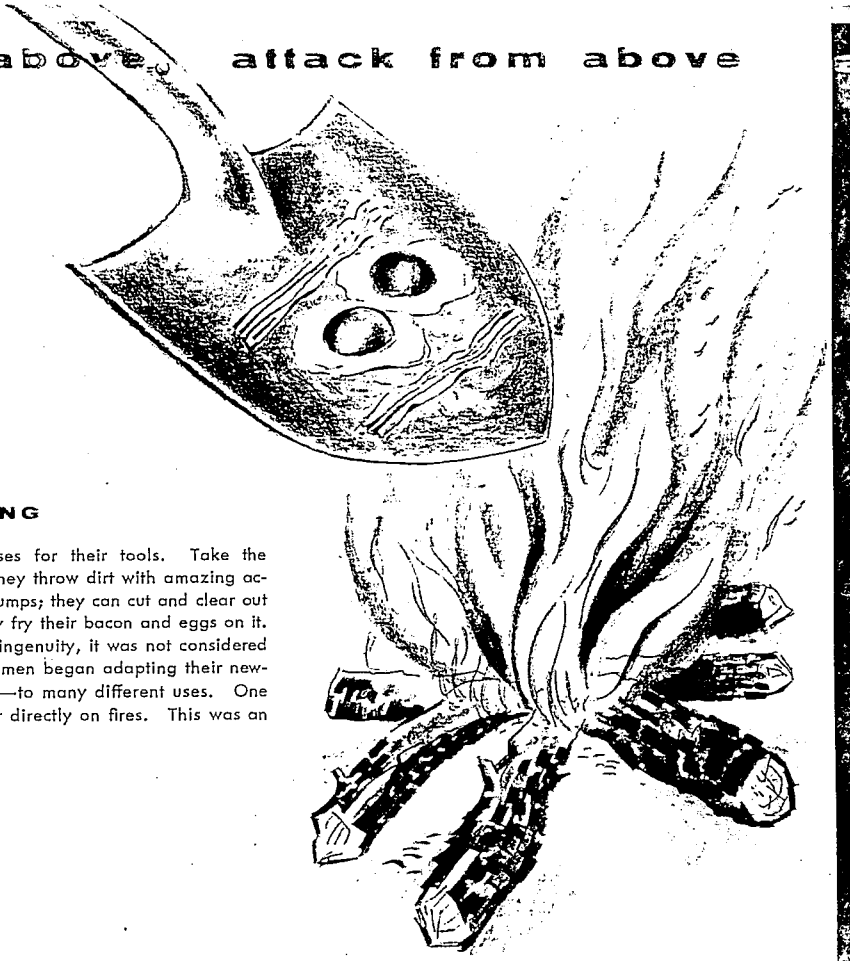

WATER DROPPING

Firefighters find many uses for their tools. Take the shovel for example; with it they throw dirt with amazing accuracy at flaming logs and stumps; they can cut and clear out firelines, and if need be, they fry their bacon and eggs on it. As firefighters are noted for ingenuity, it was not considered unusual when Forest Service men began adapting their newest fire tool—the helicopter—to many different uses. One of these was dropping water directly on fires. This was an

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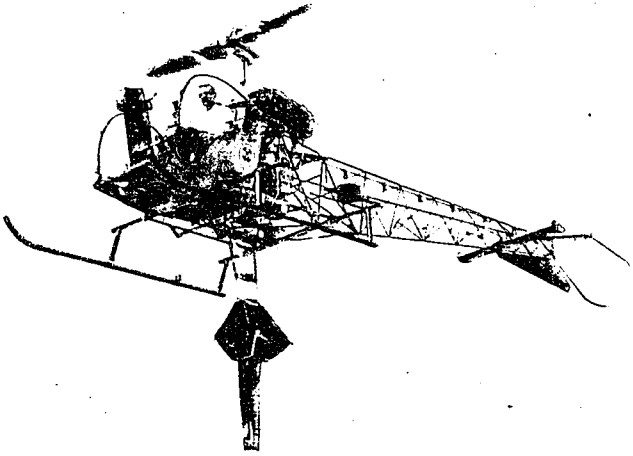

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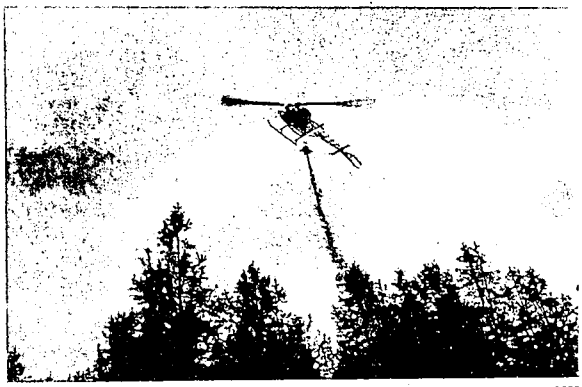

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excellent idea. It meant that spot fires, lightning-struck trees, and small ground fires could be thoroughly drenched from the air with either water or a fire retardant.

Water-dropping helicopters are called "helitankers." Their operation is simple. A 35-gallon bag, made of lightweight neoprene-coated nylon fabric, is suspended under the helicopter. When empty, the bag is so light and compact that it can be carried in a briefcase. The bottom of this pyramid-shaped water bag has a long neck which is drawn up through the bag and secured to a tripping mechanism. While the helicopter hovers over the fire the pilot, by pressing a button, releases the neck and the water drops through it directly on the flames. These water drops, like water cascading, attack forest fires in three ways. The falling liquid reduces the air temperature around the fire, raises the relative humidity, and applies a water or fire retardant coating on or around the fire area. A single water drop can cover an area 10 to 15 feet wide and from 50 to 75 feet long.

While helitankers are in action, spare bags are filled at the heliport. These loading spots are usually close to the fireline. When the helicopters return, their empty bags are easily and quickly replaced with full ones. This quick-change method enables helitankers to drop water or retardants on critical fire areas every few minutes. Though 35 gallons of water or slurry is a small volume, it can be worth 500 gallons when it's used on the right place at the right time. As an example, during 1958, 77 helitanker drops were made on a single forest fire. Over 2,600 gallons of water and fire retardant were released with pinpoint accuracy on key fire spots. In many cases it knocked the flames out of trees and cooled the fire sufficiently to allow ground crews to come in and stop the advance of the fire.

LAYING FIRE HOSE

Tugging garden hoses around your yard will give you an idea of the effort needed to stretch thousands of feet of heavy firehose up steep rocky slopes. Until recently, firefighters did this job completely by hand. But not anymore—helicopters have joined the hose-laying team.

F-485884

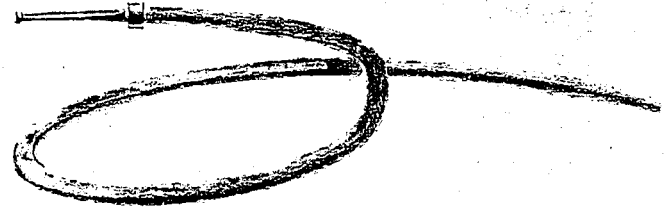
It all started in 1954 when a helicopter circled a firetruck, picked up the nozzle end of a firehose and proceeded to fly slowly away. The unreeling hose was an unusual sight. Though the basic idea was good, there were practical limitations due to the weight and length of firehoses.

Several years later Forest Service equipment engineers developed a new idea. The firehose was folded, in a horseshoe pattern, on a 4- x 8-foot plywood hose tray and mounted under the helicopter. At first, the "copter" hovered over the ground while firefighters pulled a dangling rope to start the hose lay. This was neither safe nor convenient. Soon a new system was developed. Now the pilot simply pushes a button automatically releasing a coiled length of hose. The weight of the coil starts the laying operation as the helicopter flies slowly forward at 10 to 15 m.p.h. In this way, up to 1,500 feet of 1½-inch linen hose can be laid over rugged brush or lightly timbered terrain.

If additional hose lengths are needed the helicopter returns to its base, where prepacked hose trays quickly replace the empty ones. On one large fire in 1958, 20 such hose lays were made totaling 10,000 feet of firehose. The separate sections were easily connected by ground crew members.

To judge the comparative effectiveness of ground hose-laying teams and helicopters, the Forest Service held an experiment. The results were conclusive. It took 8 ground crew members 30 minutes to lay 1,500 feet of hose up a 70 percent slope. A helicopter did the job in 53 seconds.

Though there are still limits to where and when helicopters can operate, no doubt remains that they have become a welcome member of the firefighter's hose-laying team.



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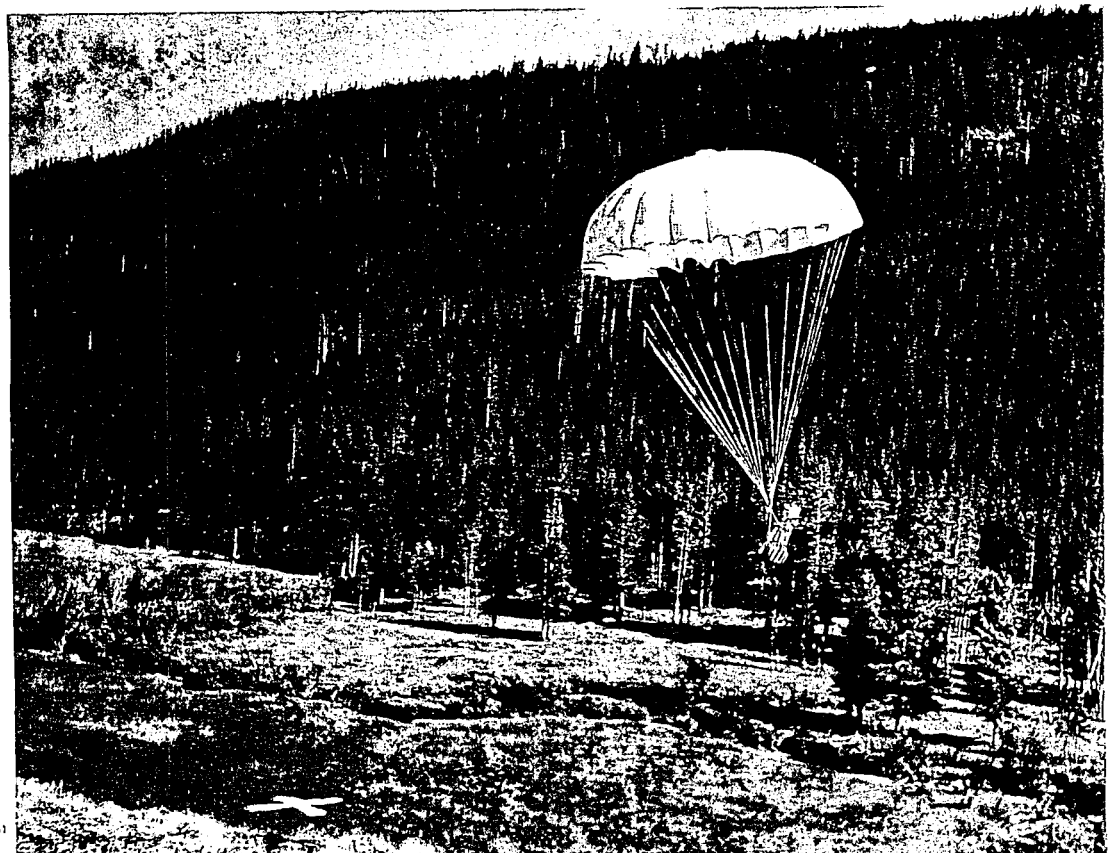

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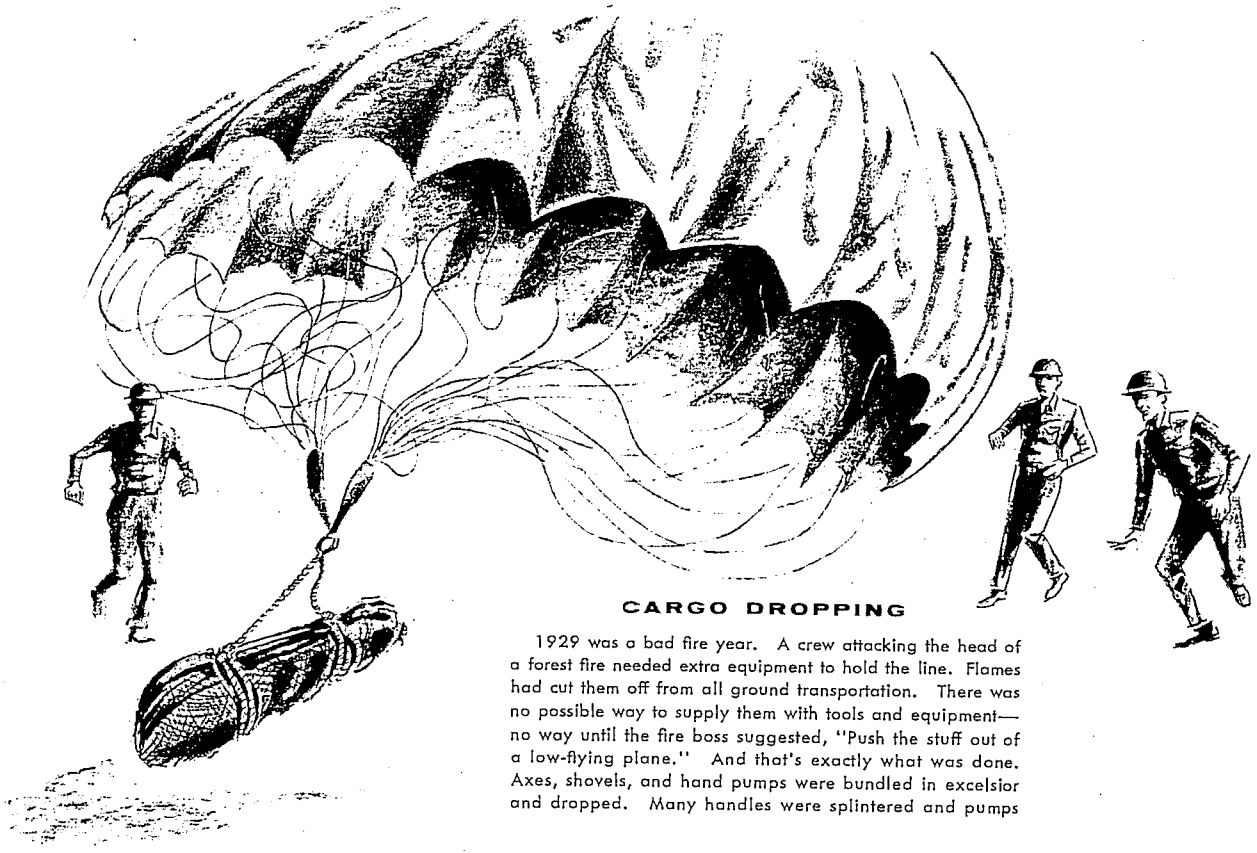

CARGO DROPPING

1929 was a bad fire year. A crew attacking the head of a forest fire needed extra equipment to hold the line. Flames had cut them off from all ground transportation. There was no possible way to supply them with tools and equipment—no way until the fire boss suggested, "Push the stuff out of a low-flying plane." And that's exactly what was done. Axes, shovels, and hand pumps were bundled in excelsior and dropped. Many handles were splintered and pumps

supply from above

smashed against rocks. But some equipment was salvaged—enough to stop the fire. The first aerial delivery of supplies direct to a fireline became part of history.

Dropping cargo bundles at treetop height continued for several years. Breakage was severe. The protective packaging was costly and bulky. Often there was more insulation than actual payload. Then, late in the 1930's a simple homemade burlap parachute solved the breakage problem. Soon surplus and condemned personnel chutes were adapted for cargo drops. They proved an excellent and economical choice. Today, cargo chutes of different colors, denoting various equipment, are commonplace in the Forest Service.

All sorts of things can be dropped safely by parachute. Construction timbers for remote lookout towers, steel girders for bridges, portable sawmills, and even hot lunches for weary firefighters.

Through experiments, the Forest Service recently found that some items could be dropped safely without parachutes. It's now common practice to release bedding and specially packaged water and fuel cans from slow, low-flying planes. Experiments such as these are constantly going on to develop new practical, economical ways of delivering cargo.

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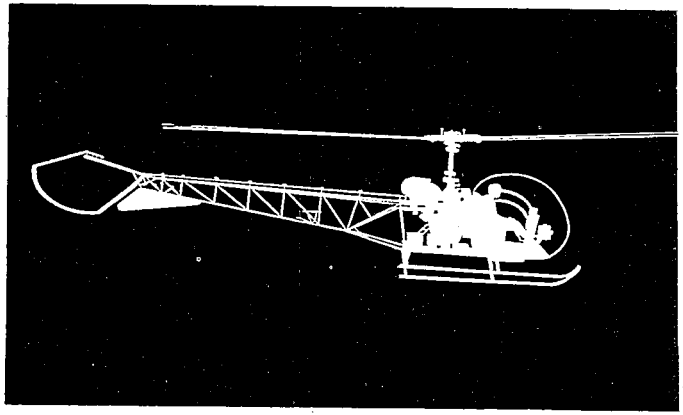
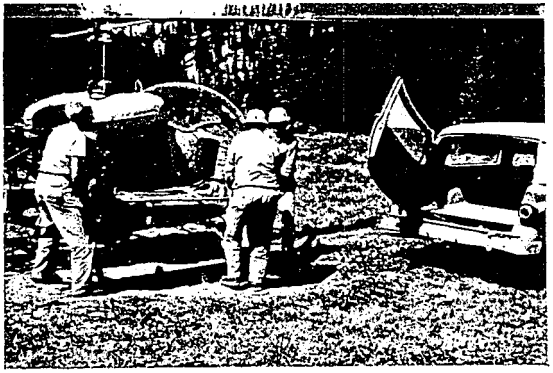
DELIVERING EQUIPMENT

Helicopters are excellent special cargo carriers. In many instances they pick up and deliver equipment without landing. One of the unique attachments developed for this type of transport is the helipumper—a lightweight firefighting unit composed of a water tank, pump, and 200 feet of hose. The whole unit can be carried to the fireline fastened to the side of the "copter," or suspended in a cargo sling beneath the landing skids.

In action, the helipumper is a little workhorse. Connect the hose to the pump, pour water in the tank, and 7½ gallons of water a minute is sprayed out the hose nozzle at 150 pounds pressure per square inch. The pumper's water supply can easily be carried in the cargo sling in disposable 5-gallon containers.

Forest Service engineers testing the helipumper also designed and built a new adapter assembly for the helicopter cargo sling. With the adapter mounted permanently on the "copter," aerial fire control accessories can be hooked up or interchanged in minutes. And in fighting fires, every second saved means forest land that will not burn.





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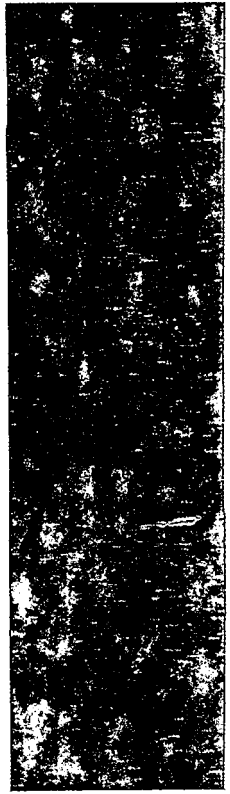
it's always teamwork it'



RESCUE OPERATIONS

Someone is badly hurt—miles from the nearest doctor or hospital. Medical help must arrive quickly or the person may die. Time is all-important. A helicopter can buy that valuable time.

Someone is injured in a wilderness area—again time is important. A crew of smokejumpers is quickly dispatched to aid him.

Though detection and suppression of fires is the main job of the air attack program, rescue operations are an important dividend. Small firefighting helicopters can carry 2 or 3 slightly injured people inside the cabin or 2 stretcher cases strapped to the outside landing struts. Some "copters" are even equipped with special winches making it possible to perform rescue operations without landing.

Forest Service planes have rescued many lost, injured, and sick hunters, fishermen, hikers, mountain climbers, downed pilots, and firefighters. It is satisfying to know that air-attack planes and helicopters can be used to defeat human tragedy as well as forest fires.

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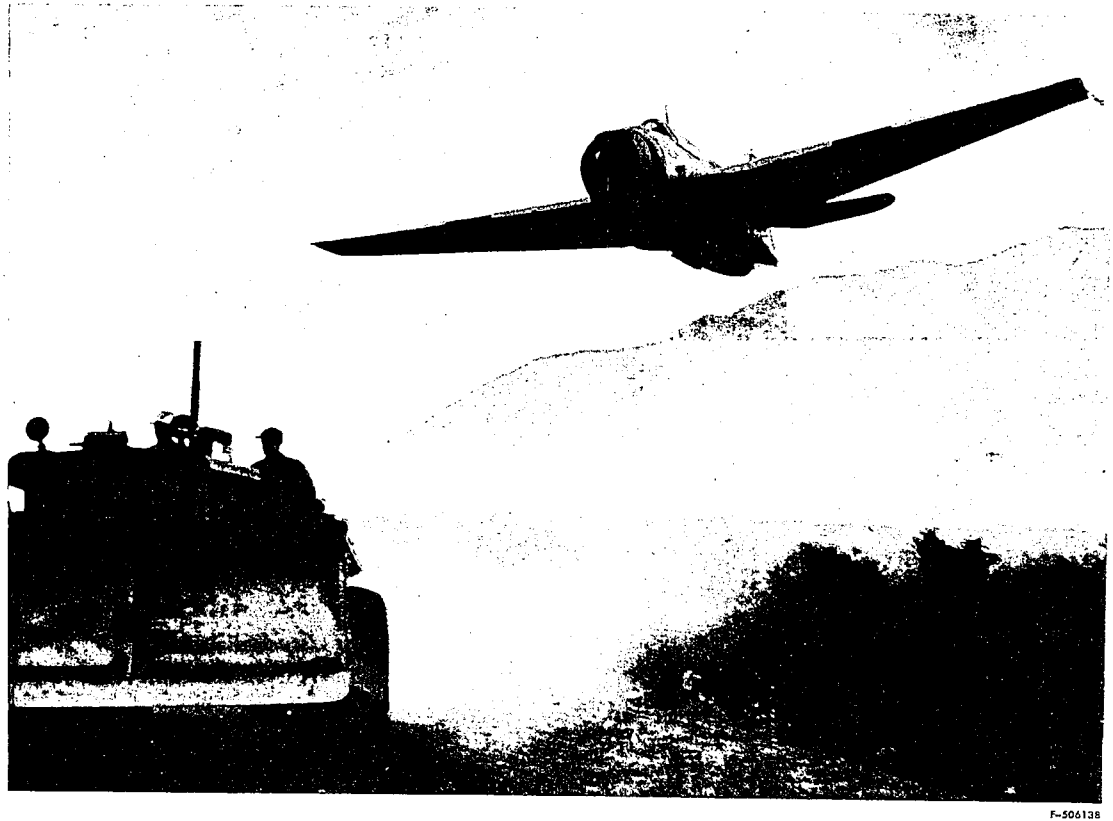

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it's always teamwork

PART OF THE TEAM

The quarterback of a football team is an important man. But his spectacular and effective aerial show can only be put on if he has the full support of his team. Forest Service air attack planes are somewhat like football quarterbacks. Though they are the spectacular part of fire control, they are only part of the suppression team. Without the other players—the ground crews, handtools, and bulldozers—air attack would be worthless.

Forest lookouts are still needed to discover fires at night or when the weather is so bad planes can't fly. Complete firelines can't be built from the air. Though air tankers make the job easier, quicker, and safer, ground forces are still needed to finish the job. After a fire is stopped, every spark must be put out. This "mopping up" is a long and tiresome job. It goes on 24 hours a day until the fire is dead out. Airplanes can play only a minor role in this important phase of controlling fire.

As in any vital task, it is not good practice to "put all your eggs in one basket." When fighting forest fires you cannot rely completely on aircraft. Sometimes fire areas are so "smoked in" that planes can't operate safely. Then men and ground machines must do the job alone. To be sure, airplanes and helicopters are wonderful new fire tools. New uses are being discovered for them each year. But they cannot lick a forest fire alone—men, tools, and teamwork will always be necessary.

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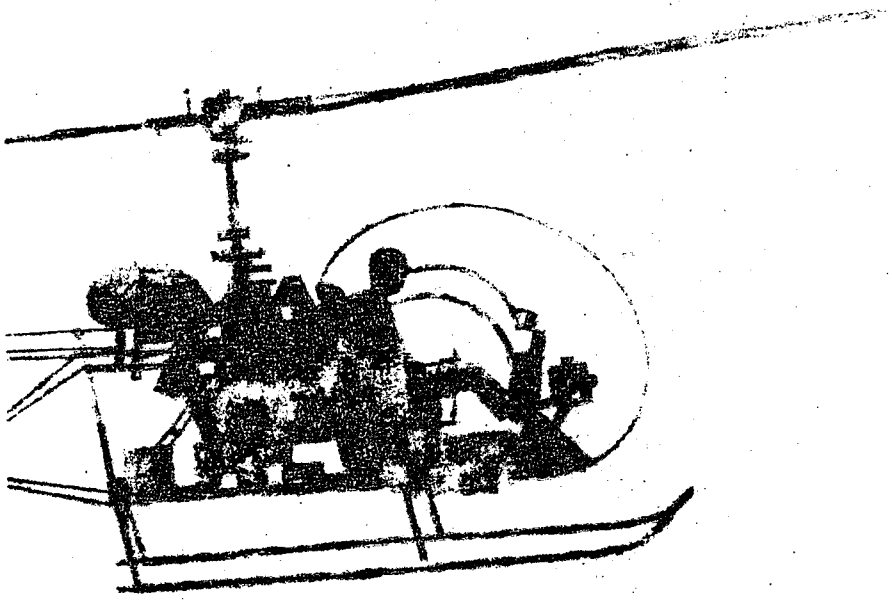

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