TECHNOLOGY

# Pilots Given New Eyes

## Microwave radio, ending the era of blind flying, sends a picture of runway and lights to a screen inside a plane still 10 miles from the airport—By Charles A. Betts

➤ THE HAZARDS of blind flying, the fog, rain, snow and low-hanging overcasts that have plagued aviation safety and schedules since man first began to fly, soon should be overcome by modern science's use of microwave radio signals.

After a period of preliminary experimentation, the Federal Aviation Agency is scheduled to give final tests this summer to a new all-weather landing aid that lets the pilot see his runway on a special screen through any weather obstacle up to 10 miles away.

The new system, developed by the Bendix Corporation's Eclipse-Pioneer division at Teterboro, N.J., and called "Microvision," uses microwave radio signals, beamed to the plane from both sides of the landing strip, to put a picture of the runway up through fog and clouds into the cockpit of the plane.

The system has been in the development stage for about five years at Bendix. In 1965 a contract was signed with the FAA to install the electronic runway markers at the FAA National Aviation Facilities Experimental Center, Atlantic City, N.J. In addition, several FAA airplanes will be equipped to receive the signals sent by beacons.

### Runway Outlined

With Microvision, the airborne receivers convert the ground beacon signals into TV-like pictures which appear on a screen in front of the pilot in the cockpit. The pilot will see the runway outlined by electronic lights, even though the runway itself and the usual ground landing lights are not visible to him.

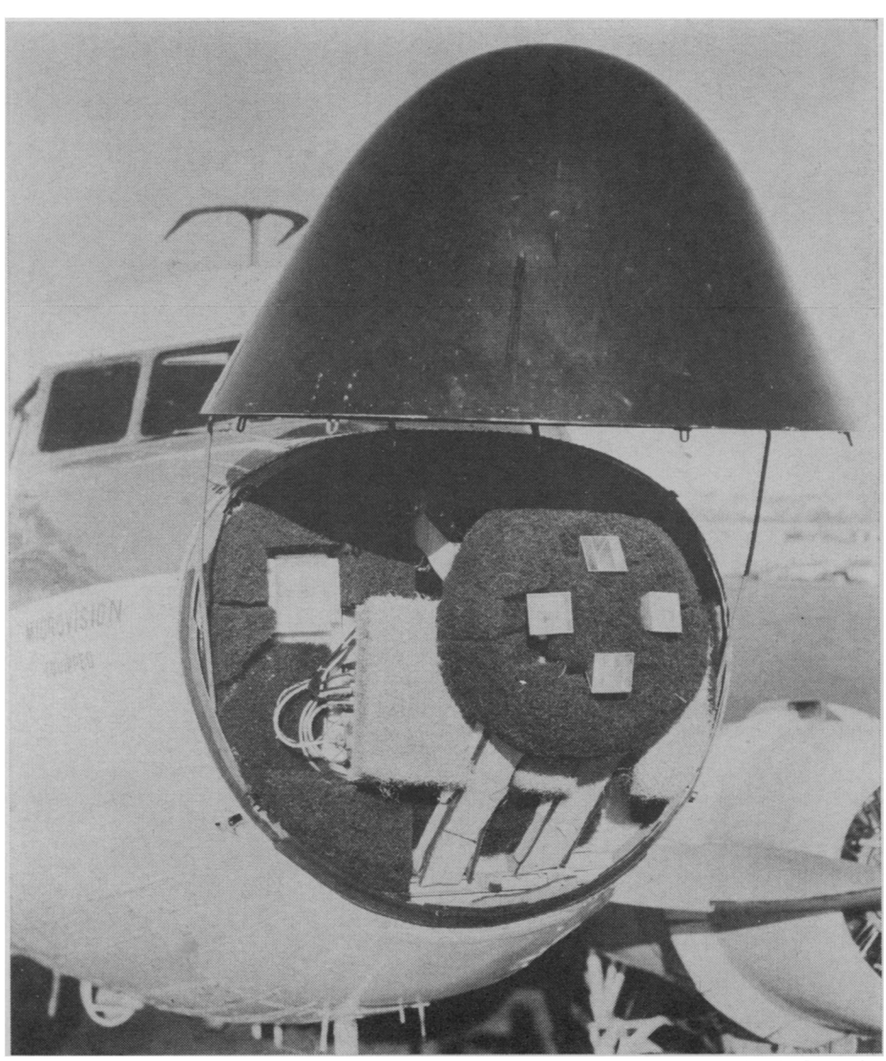
Moreover, the electronic lights may be displayed to outline not only the runway, but also to show the angle at which the aircraft is approaching the runway. Theoretically, the pilot will see almost the same picture he would see during fair weather approaches to lighted runways.

FAA and Bendix officials say that there are many possibilities of combining this microwave beacon with other landing aids to provide maximum safety to bad weather landings.

It was explained that although automatic landing systems make hands off or automatic landings technically feasible, few pilots care to be back-seat drivers to automatic systems and instrument dials during the critical moments just before landing.

A pilot wants to know how well an automatic system is taking him down the approach path, and by visual reference to the ground to decide whether he should take over manual control. Microvision gives him that visual reference. After he first picks up the runway as light patterns from 10 miles out, the runway comes more and more into focus as he gets nearer. A considerable advantage is that the pattern of lights is seen in true perspective.

Microvision consists of three essential elements—ground transmitters, an airborne receiver and a pilot's display. The ground transmitters are placed along each side of a runway in a pattern similar to conventional runway lights, and transmit pulses to the airborne receiver. The pulses, which define the angular position of each transmitter relative to the body of the aircraft, are then converted into visual images that form an outline of the runway kept in continuous relationship to the plane's position. This outline is, in turn, projected directly into the pilot's line of vision.



Bendix Corporation

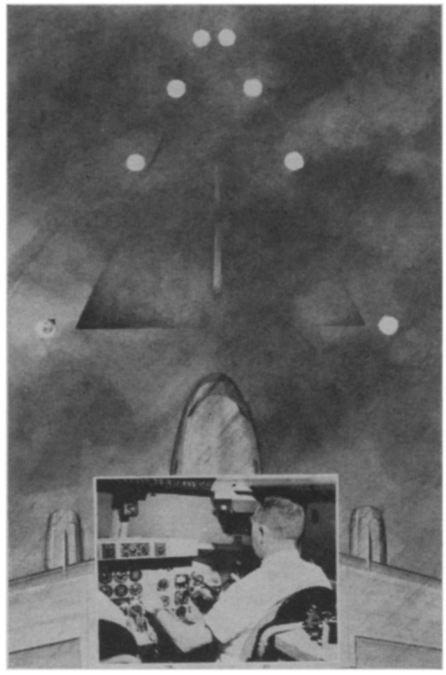
AIRBORNE RECEIVER—Microvision receivers, installed in the nose of the airplane, pick up the electronic picture of the runway and transmit it to a screen in the pilot's compartment.

The ground transmitters housed along each side of the runway transmit pulses about one microsecond in length at a rate of about 400 every second. The actual microwave equipment itself is a conventional magnatron unit such as has been employed by radar for many years. The whole assembly is packaged in weather-proof housing about the size of the larger runway border lights.

The complex airborne receiver unit weighs only 20 pounds, and Bendix engineers are currently looking for ways to reduce the weight still further.

The receiver measures the angle between the longitudinal axes of the aircraft and the bearing to each ground transmitter. The data is plotted in rectangular coordinates as bright points on the screen of a cathode-ray tube similar to that in a TV set. Such a plot results in a picture in perspective of the array of transmitters as though they were a row of lights against a dark background at night.

For all this to do any good, it is necessary to collate this technical data and give it to the pilot in usable form. It is not sufficient to present the information to him on a small screen on the instrument panel, where it becomes just one more instrument which must be interpreted. The information must be presented in such a way that, as far as possible, the pilot can actually see the runway.



Bendix Corporation

MICROVISION RUNWAY—White dots on a screen in an aircraft's cockpit outline the runway so the pilot (insert) can see it through fog or clouds.

To do this, a lens system was developed to form an image of the cathode-ray picture at great distance. Then a combining mirror, one which acts as a mirror for the Microvision picture and as a window for direct sight, was used to show the pilot the electronic image overlaid against the real scene in front of him.

He thus sees the reflected Microvision image superimposed on his normal view through the windscreen, the mirror acting as a window. By proper design and alignment of the system, the image is put in perspective, both in distance and angle.

Each Microvision ground transmitter will appear to the pilot as a runway light. Since the Microvision light dots represent actual points on the ground and not an interpretive instrument guide, they keep the pilot accurately oriented at all times. The border line between visual and instrument landings has been eliminated. With this system, the pilot sees all the time.

The airborne equipment is expected to cost about $10,000 per plane.

If the anticipated FAA approval comes through for the new system, major airlines are reported ready to go ahead with the installation of Microvision. Then at last, after more than 60 years of battling nature's barriers to vision for the air, "blind flying" will have passed into aviation history.

• *Science News, 89:222 April 2, 1966*

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# Camouflage Detection

➤ HIDING MISSILES, tanks and other objects on the ground from observers in the air has been made even more difficult by a new system that takes black-and-white pictures and then shows them in color.

Four adjacent lenses on a single camera take identical photographs, but through different colored filters—blue, green, red and near-infrared. The resulting pictures appear side-by-side on a special film that is sensitive to light from the ultraviolet end of the spectrum all the way through the visible range to infrared.

Positive transparencies made from the film are shown on a special projector, also equipped with four filtered lenses, which can superimpose any combination of the images on a screen. The result is that all the shades of black, gray and white in a normal black-and-white photo are replaced with bright colors, making the contrasts between objects more apparent.

Inventors of the system are Edward Yost and S. Wenderoth of Fairchild Space and Defense Systems, Syosset, Long Island, N.Y. They reported it to the American Society of Photogrammetry meeting in Washington, D.C.

The system works best at detecting camouflage. Vegetation such as fresh-cut tree branches, often laced into overhead netting to conceal military equipment from air reconnaissance, does not show up on ordinary infrared photos as long as the foliage is green. But, Mr. Yost told SCIENCE SERVICE, the chlorophyll content of just-cut foliage drops sharply about an hour after it is cut. The foliage then appears different to the multi-photo system.

Therefore, while a tank beneath the foliage would not be visible, the greenery used for camouflage would stand out sharply against the rest of the picture, perhaps as a bright blue area on a pink background.

Though started as a company project, the system has now aroused the interest of the U.S. Air Force. The National Aeronautics and Space Administration is also investigating the system for future use.

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TECHNOLOGY

## Computer Prints Braille Hundred Times Faster

➤ BRAILLE material is now being "written" by an electronic computer that is reportedly 100 times faster than any such standard device now in use.

Made by Honeywell Electronic Data Processing in Wellesley Hills, Mass., the electronic printer takes the place of manually-operated devices which require as long as four or five months to copy a fourth-grade text.

The printer, which produces about 300 braille letters, or "cells," a second, is being used at the University of Southern California's computer sciences laboratory, Los Angeles.

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TECHNOLOGY

## Allies Get 21-Station Portable Radio Network

➤ A SYSTEM of 21 truck-mounted radio stations that can move almost anywhere is being built for the Supreme Headquarters of the Allied Powers in Europe (SHAPE).

The half-watt microwave transmitters will be able to carry two dozen telephone and telegraph channels simultaneously, broadcasting from antennas that unfold to a height of almost 100 feet.

The network, to be delivered early next year, is being made by the Raytheon Company's Italian affiliate, Selenia S.p.A.

No tubes will be used anywhere in the system due to possible damage from traveling over rough terrain. The entire electronic system will be solid state, or transistorized.

Seven of the stations will be simple "line repeaters," which relay a signal in one electronic ear and out the other without adding any transmissions of their own. Such relays are necessary because microwave radio will only operate over line-of-sight distances.

There will be practically no time required for erecting the stations, so SHAPE's network can be put to use as soon as the trucks reach their locations.

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