David Landen
Technical Tours Committee
1974 FIG Congress
ASP, Falls Church, Va. 22046

Remote-Sensing FLY-IN

Eighteen aircraft were displayed at Andrews Air Force Base.

One of the most interesting events of the XIV International Congress of Surveyors (FIG) held in Washington, D.C., was the Remote Sensing FLY-IN held at Andrews Air Force Base, Maryland, on September 13, 1974. Approximately 800 registrants and guests attended the FLY-IN, the first one of its kind held in Eastern United States. The FLY-IN was co-sponsored by the American Society of Photogrammetry and the American Congress of Surveying and Mapping, in addition to the FIG.

The Remote-Sensing FLY-IN consisted of a static display of 18 of the latest types of remote-sensing and photomapping aircraft from military and government agencies, and from commercial firms. The display included a large variety of optical, photographic, and remote-sensing instruments and demonstrations of equipment and techniques which utilize remote-sensing technologies, such as the use of multispectral aerial photography for earth resources studies. The aircraft ranging from small, light photographic to the most ultrasophisticated were available for inspection in the following fields of interest:

- Aerial photography
  - Color
  - Color-Infrared
  - Multispectral
- Thermal infrared imagery
- Multispectral additive color
- Multiband camera
- Radar
  - Side-looking
- Radar altimeter
- Laser altimeter
- Remote-sensing instrumentation

The participating organizations were as follows, together with the aircraft that they exhibited:

- Aero-Marine Surveys, New London, Conn. — Piper STOL (PA-12-150-S).
- Aero Service Corp., Philadelphia, Pa. — Aerospatiale Caravelle.
- Atlantic Aerial Surveys, Huntsville, Alabama — Cessna 411.
- Black, Crow & Eidsness, Clearwater, Florida — Aero Commander 680 E.
- Calspan Corp., Buffalo, N. Y. — Piper Aztec, Model C.
- NASA, Johnson Space Center, Houston, Texas — RB-57C.
- NASA, Ames Research Center, Moffett Field, Calif. — Lockheed U-2.
- National Air Survey Center Corp., Washington, D. C. — Aero Commander, Cessna 310 Riley Rocket, Cessna 320 Skyknight.
- National Ocean Survey (NOAA), Rockville, Md. — De Havilland Buffalo (DH-5), Aero Commander (690 A).
- Ohio Dept. of Transportation, Columbus, Ohio — Beechcraft C-45-H.
- Pennsylvania Dept. of Transportation, Middletown, Pa. — Cessna 206 Super Skylane.
- Photo Science, Inc., Gaithersburg, Md. — Cessna Queen Air.
- USGS Water Resources Division, Prescott, Arizona — De Havilland Beaver.

Heightened world interest in such areas as a healthy environment, energy sources, and ecological studies are extending the role of the surveyor far beyond his traditional role of boundary surveys and conventional mapping. Economic considerations and speed today require that large or remote areas be mapped by aerial survey methods. These methods today include extensive use of conventional and unconventional aerial photography, photographic interpretation, and remote-sensing techniques. The United States has taken a leading role in these fields.

As the United States was the host country to the XIV World Congress of the FIG, holding its first American meeting in Washington, D.C., and some 4,000 registrants and delegates from 41 member countries were expected to attend, the planned display became of interest to both civilian and military personnel.

In view of the large number of foreign visitors, the display became of national interest,

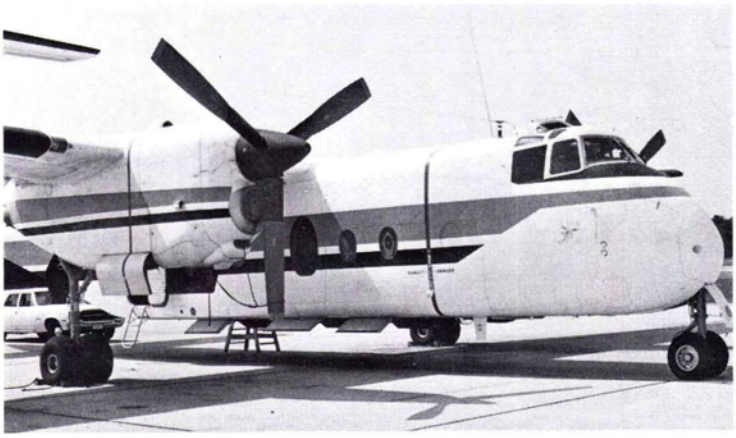

FIG. 1. National Ocean Survey — De Havilland Buffalo (DH-5) used for coastal mapping.

and the cooperation of the U.S. Air Force in the use of Andrews Air Force Base was obtained. Of considerable assistance was the help of Colonel James M. Hines, USAF, Deputy Chief, Base and Unit Divisions, Directorate of Programs, who arranged for a cooperative effort by personnel of the Andrews Air Force Base under Lt. Colonel John P. Diener.

Two events provided an important initial impetus to the event. One was the offer of Allen L. Powell, Rear Admiral, NOAA, and Director of the National Ocean Survey to display two remote-sensing aircraft, a DeHavilland Buffalo (DH-5) (Figure 1) and an Aero Commander 690A used for coastal mapping and remote sensing.

Another was the interest and support of the largest operator in remote sensing, the National Aeronautics and Space Administration. With the help of Dr. James C. Fletcher, Administrator for NASA, and Charles W. Mathews, Associate Administrator for Applications, it became possible to obtain two of the most important remote-sensing platforms, the RB57C (Figure 2) and a Lockheed U-2 (Figure 3). These aircraft were operated under Mr. Bernard T. Nolan, Manager of NASA's Earth Observations Aircraft Program. NASA's aircraft, the RB57C, was flown in by Leon Ballinger from the NASA Johnson Space Center at Houston, Texas, and the Lockheed U-2 by Martin Knutson from NASA-AMES Research Center at Moffett Field, California. Since 1971, when they were transferred from the U.S. Air Force, the two aircraft have been used in important scientific projects for government and private

FIG. 2. NASA Lockheed U-2 showing VINTEN RC-10 camera package for multispectral use.

FIG. 3. NASA-RB-57E aircraft sensors include metric and multiband cameras, and the infrared system shown consisting of a scanner and a spectrometer/radiometer.

research agencies. They included a program of high-altitude orthophotography flown at over 65,000-feet altitude. The high-altitude orthophotographs are processed by special photogrammetric restitutors to produce photographic reproductions without distortions caused by terrain relief variations. Thus, high-altitude orthophotographs and orthophotomaps combine the desirable planimetric features of traditional maps with the literal detail and accuracy of aerial photographs.

NASA's aircraft have been used in monitoring land-use patterns so that regional and state planners can accurately predict the future demands for water, energy and public services, thus helping to guide resources development and assuring compatibility with the environment. Another use of the aircraft is in disaster assessment. As an example, in 1973 extensive flooding of the Mississippi River occurred. The Earth Resources Survey Aircraft conducted flood assessment flights using color-infrared photography taken at 65,000 feet with the Wild RC-10 six-inch focal-length camera. Inundated land and older river channels and oxbow lakes become clearly visible in the new photographs. Seven display boards arranged near the NASA aircraft illustrated these applications.

The Lockheed U-2 displayed at the FLY-IN was equipped with a four-couple multispectral camera system, and featured the Vinten RC-10 camera package. This package consisted of four matched 70-mm Mitchel-Vinten cameras with 1¾-inch focal-length lenses. The cameras are spectrally filtered to match the return-beam vidicon aboard the Earth Resources Technology Satellite (EROS) which produces images in the green, red, and infrared portions of the spectrum. The fourth camera of the Vinten package normally is flown with infrared film.

NASA had acquired two U-2's from the U.S. Air Force in 1971 for high-altitude photography and research in mapping. The photography was intended to support the two earth-resources flight programs, the Earth Resources Technology Satellite (EROS) and the manned orbiting station, Skylab. The Wild RC-10 camera is a metric camera equipped for either six-inch or twelve-inch focal-length photography. For most satellite support flights, color-infrared film is utilized. The U-2's are being used today for very high-altitude aerial photography in the production of quadrangle-centered orthophotoquads. Production of these maps are speedy and inexpensive as compared with line-map production and this work is becoming more widely used.

The U.S. Geological Survey aircraft — DeHavilland Beaver (Figure 4) — featured a modified AN/AAS 24 thermal infrared imager used for remote-sensing scanning. It produces a rectilinearized image. A Sonne Strip camera may also be carried; it is used to produce continuous strip photography, either in black-and-white or in color for photographing such areas as shorelines, rivers and pipelines.

Of special interest in highway route surveying, highway design and construction surveys were the exhibits provided by the Pennsylvania Department of Transportation and the Ohio Department of Transportation. These departments provided examples of aerial photography used in highway planning and engineering. The pictures were flown with the new Wild RC-10 aerial camera in the

FIG. 4. U.S. Geological Survey De Havilland Beaver with the AN/AAS 24 Thermal Infrared Imager.

Pennsylvania's Cessna 206 Super Skylane and Ohio's Beechcraft Model C-45H.

The Aero Service-Goodyear Aerospace display featured a French Aerospatiale Caravelle twin-jet aircraft (Figure 5). The aircraft can be organized and equipped to provide a diversity of remote sensors, sophisticated instrumentation, and positioning systems for aerial resources surveys. The aircraft at the static display featured the Goodyear Side-Looking Electronic Mapping System. The aircraft had returned from approximately three years of service in South America engaged in radar mapping of portions of Brazil, Venezuela, and Peru. In these countries, clouds and other poor photographic flying conditions have often prevented aerial photographic coverage in the past. One of the unique capabilities of Side-Looking Radar lies in its ability to *see in the dark*, i.e., its capability of operating through clouds and in total darkness. The photographic radar map is produced in strip form, as fast as the plane can fly.

Lockwood, Kessler & Bartlett, Inc., displayed a Turbocharged STOL (Short Take Off and Landing) Cessna 206 aircraft, equipped with a Spectral Data Model 10 Multispectral Camera with individually focusing lenses and an image-motion compensation magazine. A Spectral Data Model 76 variscale multispectral viewer/projector with a film recording head, was stationed near the aircraft to illustrate the variety of additive-color renditions used for crop, forest and wetland vegetation speciation, geological interpretation for structure, rock types and mineralization, and hydrological investigations of flooding, sedimentation and pollution.

FIG. 5. Aero Service Goodyear Aerospace Aerospatiale Caravelle with pod containing Side-Looking Radar antenna under the aircraft.

A three-panel display of multispectral renditions prepared from ERTS, Skylab and Model 10 camera underflights illustrated practical applications including coastal wetlands classification and mapping, pre-visual detection of diseased marsh and woodland vegetation, monitoring of coastal-zone alterations, and updating of submerged features on hydrographic charts. Chuck Woodward and Phil Guss of Lockwood, Kessler & Bartlett, Inc., and George Brennan of Spectral Data Corp. were available to demonstrate the equipment and to respond in detail to the questions of the numerous visitors.

Many of the private companies displaying smaller aircraft offer integrated mapping and surveying services including aerial photography, both black-and-white, color and infrared, and have remote-sensing capabilities for monitoring air pollution, water pollution, thermal mapping of the terrain for geothermal reconnaissance and a wide variety of passive and radiant remote-sensing equipment. These smaller companies, such as Photo Science, Inc. of Gaithersburg, Maryland, provide photogrammetric engineering services, image analysis and special applications of remote sensing. (Figure 6).

Aero Marine Surveys of New London, Connecticut, provided two aircraft. The Piper Apache carried a Wild RC-8 camera, and is equipped to carry a multicamera system, a thermal-infrared line scanner, a multispectral line scanner, radiometer, and small-format cameras. The Piper STOL aircraft also has mounts for line scanners (thermal-infrared, ultra violet and multispectral) and including radiometric and small format cameras.

The National Air Survey Center Corporation displayed three aircraft — an Aero Commander, a Cessna 320 Skyknight, and a Cessna 310 Riley Rocket. Both the Aero Commander and the Cessna Skyknight are equipped with a single metric camera installation and remote-sensing capability. The Riley Rocket has a higher ceiling capability — 35,000 feet — and has a twin-camera installation, and is equipped for multispectral photography. The company also operates the airport at Warrenton, Virginia.

The cooperation of the Secretary of the Air Force, U.S. Air Force, and the use of Andrews Air Force Base was obtained through ASP Executive Director, Lawrence P. Jacobs. The cooperation of all who participated in the Remote Sensing FLY-IN is sincerely appreciated. Special thanks due to the Community Relations Office of the USAF and to Lt. Col. John P. Diener, Captain Maher, and Miss Shirley Rico of the Base Operations Office at Andrews Air Force Base.

The FLY-IN served its purpose well — that of contributing to the exchange of technical information and to international good will.

FIG. 6. Photo Science, Inc., Cessna Queen Air and display of worldwide applications of remote sensing.