Space Applications: Earth-Oriented Applications of Unmanned Satellites

Paul Rosenberg

An orbiting satellite, hundreds or thousands of miles high, can command a view of large areas of the earth's surface and its atmospheric envelope, and can examine the entire globe in a matter of hours. From this vantage point, the satellite also has direct lines-of-sight simultaneously with all points and vehicles in its large viewing area. Never before the space age could so few observing stations examine so much of the earth simultaneously.

This capability to establish instrumented platforms at orbital altitudes offers exciting possibilities for scientific observation and study of the earth and its atmosphere; but it has even greater possibilities for bringing practical benefits to mankind.

Two practical applications of earth satellites are already being exploited successfully, namely, communications and weather observation. The United States has successfully launched and operated several series of active communications satellites beginning with Project Score in 1958, and continuing with the Courier, Oscar, Telstar, Relay, Syncom, and Intelsat series. The Soviet Union has launched and is using approximately six Molniya communications satellites of its own. Television and radio communications via satellite are becoming commonplace.

The practical applications of satellites for meteorological observations are likewise being exploited successfully. The Tiros, ESSA, and Nimbus series of satellites launched by the United States and some of the Cosmos satellites launched by the Soviet Union are now providing worldwide data for weather forecasting.

The author heads the firm of Paul Rosenberg Associates, consulting physicists, Pelham, New York 10803. He is chairman of the Engineering Section (M) of the AAAS.

In addition to the direct benefits from communications and weather satellites, these satellite programs have engendered international cooperation between the United States and other countries including the Soviet Union. More than 50 nations have joined in a consortium called Intelsat, "to establish a single global communications satellite system as part of an improved global communications network." The Communications Satellite Corp. (Comsat) of the United States is Intelsat's manager for the space portion of the global system. Working through the World Meteorological Organization, the United States provides APT (automatic picture transmission) data to 29 nations who thereby receive cloud pictures of their local areas from U.S. satellites. The United States and the Soviet Union exchange satellite cloud pictures and infrared data over a "cold line" between Washington and Moscow.

The applications of satellites to meteorology and communincations are obviously of great benefit and have been shown to be cost-effective. However, there are other applications of satellites which are less obvious but potentially of equal or greater benefit.

One important class of these possible applications is the use of satellites to acquire real-time data concerning the earth's resources, globally as well as locally. This includes data for forestry, agriculture, geography, land-use study and development, hydrology, oceanography, and pollution studies. Another class of possible applications, related to the earth resources applications, are the applications of satellites to photogrammetry, cartography, and geodesy. Finally, there are the uses of satellite systems for navigation and traffic control of aircraft and marine vessels.

The key to these applications (except navigation and traffic control) lies in multi-spectral photography and multi-spectral sensing techniques, which have been developed for use from aircraft. There is no fundamental reason why extensions of these remote sensing techniques cannot be used from satellites. Certainly the applications of satellites to photogrammetry, cartography, and geodesy are obvious extrapolations of the well-known applications of aircraft to these fields. With satellite-borne sensors, reflectivities in various bands of the visible, infrared, and radar portions of the electromagnetic spectrum could be used to distinguish certain kinds of crops, crop diseases, trees, geologic structures, urbanized areas, bodies of water, and ocean currents.

The problems of interpreting and processing the data from satellite-derived photography and satellite-borne, multi-spectral sensors may be as difficult as the problems of acquiring the data. Large quantities of data will be furnished by the satellite in relatively brief periods. The value of the data in many applications will depend upon the rapidity with which the data can be processed, interpreted, and disseminated for use.

Navigation and traffic control satellites can be used for determining the positions of aircraft and ships at sea, for surveillance of air and marine traffic, and for traffic control of these vehicles. Satellite navigation and traffic control is particularly applicable to transoceanic air traffic and to surface vessels on the high seas and in confluence waters. The economic benefits of these applications appear greater than the costs. Not the least of the benefits to be derived from navigation and traffic control by satellite are increased safety, increased efficiency of search and rescue operations, and the saving of lives.

All satellite applications mentioned above have international as well as national implications. International agreement and cooperation will be needed to derive the full potential and benefits of these space applications, the development of which will foster international cooperation analogous to the cooperation engendered between nations by the communications and weather satellite programs.

A 2-day AAAS General Symposium entitled "Space Applications: Earth-Oriented Applications of Unmanned Satellites" has been arranged

by the Engineering Section (M) of the AAAS for 28–29 December 1968 during the 135th meeting of the Association in Dallas, Texas. The symposium will consider the satellite applications discussed above, their scientific and engineering problems, their economic and social benefits, and their international implications. The concluding panel on the afternoon of 29 December will summarize the symposium and will discuss in particular the social, economic, and international aspects of the satellite applications.

This symposium focuses attention upon the practical contributions which unmanned earth-orbiting satellites can make to human welfare. The symposium is confined to unmanned satellites, upon the hypothesis that unmanned satellites will be more cost-effective than manned satellites in these applications for some time to come.

References and Notes

1. "A Survey of Space Applications," *NASA (Nat. Aeronaut. Space Admin.) SP-142* (April 1967).
2. "Space Applications Summer Study, 1967 Interim Report," Vol. 1, *Nat. Acad. Sci. Nat. Res. Counc. Publ. O-287-327* (order from U.S. Government Printing Office, Washington, D.C., 1968).
3. Almost all the speakers, panel members, and chairmen of this AAAS General Symposium on Space Applications were members of the 1967–1968 Woods Hole Space Applications Summer Study, under the chairmanship of Dr. W. Deming Lewis. The Summer Study was organized and conducted by the National Academy of Sciences and National Research Council under sponsorship of the National Aeronautics and Space Administration. Nevertheless the opinions and conclusions expressed in this AAAS Symposium by the speakers, panel members and chairmen are their own individually, and are not necessarily the conclusions or opinions of the Woods Hole Summer Study, the National Academy of Sciences, the National Research Council, or the National Aeronautics and Space Administration.

Speakers and Topics

Arranger: Paul Rosenberg (Paul Rosenberg Associates, Pelham, N.Y.; Vice President, AAAS; Chairman, AAAS Engineering Section)

28 December (morning)

Earth Observation

Chairman: Paul Rosenberg.

Sensors and Data Systems, David A. Landgrebe (Purdue University).

Photogrammetry and Cartography, Arthur J. McNair (Cornell University).

Geodesy, Charles A. Lundquist (Astrophysical Observatory, Smithsonian Institution).

Meteorology, Verner A. Suomi (University of Wisconsin).

28 December (afternoon)

Earth Resources

Chairman: J. Ralph Shay (Oregon State University, Corvallis).

Hydrology, Paul Bock (University of Connecticut, Storrs).

Oceanography, Gifford C. Ewing (Woods Hole Oceanographic Institute).

Forestry, Agriculture, and Geography, R. Keith Arnold (University of Michigan, Ann Arbor).

Geology, William W. Rubey (University of California, Los Angeles).

Systems for Remote Sensing Information and Distribution, Arthur G. Anderson (International Business Machines Corp., Armonk, N.Y.).

29 December (morning)

Space Science–Communications, Navigation, and Public Policy

Chairman: Beardsley Graham (Columbia Plaza, Washington, D.C.).

Communications, Richard B. Marsten (RCA, Princeton, N.J.).

Navigation and Traffic Control, Henri G. Busignies (senior vice president and chief scientist, International Telephone & Telegraph Corp.).

Domestic Issues, Beardsley Graham.

International Implications, Thomas F. Malone (Travelers Insurance Co., Hartford, Conn.).

29 December (afternoon)

Summary and Panel Discussion

Chairman: W. Deming Lewis (Lehigh University).

Panel Members: Beardsley Graham, Thomas F. Malone, Allen Puckett (Hughes Aircraft Co., Culver City, Calif.), Paul Rosenberg, J. Ralph Shay, and Eric A. Walker (president, National Academy of Engineering; president, Pennsylvania State University).

General Program Notes on the AAAS Annual Meeting (26–31 December 1968) appear in the 4 October issue of Science. *Hotel reservation forms and meeting and tour registration forms appear in the 15 November issue of* Science *and will appear in alternating issues. Reports of symposia at the Meeting appear in the following issues: 13 September, "Sport and Its Participants"; 20 September, "The Control of Fertility"; 27 September, "Unanticipated Environmental Hazards"; 11 October, "Continuing Education for Engineers"; 18 October, "Antarctic Research"; 25 October, "Water Importation into Arid Lands"; 1 November, "Jupiter and the Outer Planets"; 8 November, "Use of Space by Animals and Men"; and 15 November, "Environmental Geochemistry: Health and Disease."*