known β-galactosidase system. The enzyme β-galactosidase is synthesized in large amounts in the presence of its substrate lactose, or analogues of its substrate, but is not synthesized in the absence of an inducer, as these molecules are called. The question arises whether the inducer directs synthesis of the lac messenger or whether it activates a messenger already synthesized. Pulse-labeled RNA was extracted from wild type *E. coli* grown with and without an inducer and from a mutant having a deletion in the lac region grown with an inducer. DNA from a transducing phage, P1, which carried the lac region was extracted. Each of the RNAs was tested to see if it would form a complementary hybrid with this DNA under suitable conditions. A significantly larger portion of the RNA isolated from the induced strain hybridized with DNA containing lac gene than with either of the two control RNAs. In addition, it was found that the RNA isolated from the induced strain produced two RNA peaks in the Mandell-Hershey column eluant that the control did not have. The RNA from all of the peaks was tested for ability to hybridize with lac gene-containing DNA. Only the material from the two distinct peaks could hybridize appreciably. This RNA did not hybridize with DNA from transducing phage not containing the lac gene.

These experiments indicate that the inducer acts by controlling the synthesis of the RNA messenger rather than by controlling use of the messenger. The experimental procedure promises to provide a source of messenger RNA from a specific gene.

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Satellites: Scientific Mission and Design

The significance of scientific satellites and their growing importance in gathering basic new information about space and in support of future manned space programs were emphasized in a one-day (27 December) special astronautics symposium at the AAAS Philadelphia meeting. The president of the American Astronautical Society, Alfred M. Mayo (Chance-Vought Corporation), in his brief welcome pointed out how symposia of this type can improve communication between scientists and engineers, and thereby improve the chances for mission success.

Various techniques, such as welding to improve circuit reliability, yo-yo despin control for stabilization, and methods for solar cell control were discussed by Alexander Kossiakoff (Johns Hopkins University) in his keynote address on "Scientific satellites—a perspective."

The morning session, chaired by John E. Naugle (NASA), contained four technical papers dealing with current scientific satellites. The objectives of the NASA S-6 Aeronomy Satellite include measurement of the neutral atmospheric parameters of density, composition, pressure and temperature, and the electron density and temperature in the region of 250 to 900 km, together with variations of all these parameters with time and latitude. Various primary detectors (neutral mass spectrometers, vacuum gauges and electrostatic probes), plus the necessary engineering provisions in the satellite for power, stabilization, telemetry, programming and command response were included in a paper by R. Horowitz (NASA).

Two complementary papers treated the subject of topside sounding of the ionosphere. The Canadian "Alouette," or S-27 satellite, utilizes a swept-frequency sounding technique in the 1- to 12-mc region. The sweep frequency method, described by John H. Chapman (Defence Research Telecommunications Establishment, Ottawa), is usually preferred for measurement of vertical electron density profiles, whereas the fixed frequency method, described in another paper on NASA's S-48 program by John E. Jackson (Goddard Space Flight Center) is best adapted to the observations of height changes with time, the drift of irregularities in the ionosphere, and so forth. In the exploratory phase of topside sounding there is an obvious need to examine both methods. The Central Radio Propagation Laboratory of the National Bureau of Standards is providing scientific coordination and direction of these efforts with NASA; a joint working group on topside sounding includes representatives of the United States, Canada, and the United Kingdom.

Exploratory soundings from the topside of the ionosphere were first obtained at Wallops Island in June and October 1961; these soundings used special rocket pay-loads designed by Airborne Instruments Laboratory under the S-48 program. Results from these experiments showed the feasibility of the various design parameters, power levels, and background galactic noise levels. The Canadian S-27 satellite was successfully orbited by NASA on 29 September 1962, and became the first topside sounder satellite. Excellent data already received from the S-27 have shown a number of interesting anomalies as well as a wealth of more routine information about the variations in electron density over the entire earth's surface with time under varying magnetic and auroral conditions. The presence of distinct layer tilts in certain equatorial regions and evidence of additional "layering" at altitudes above the normal region of maximum F2 electron density has been noted under some conditions. A comprehensive picture of the upper ionosphere over the entire earth's surface will soon be provided by analysis of the data from the S-27 and the S-48.

The three satellites Injun I, II, and III were designed and built at the State University of Iowa to study the natural and artificial radiation belts, auroras and airglow, and other geophysical phenomena (Brian J. O'Brien). Injun I has already produced a vast amount of useful radiation measurements. It has shown that the primary source of auroral particles lies well above the ionosphere, and that the outer-zone is probably not a source of auroral particles (as in the "leaky bucket" model), but is perhaps a sink of unused auroral particles. For the first time it was shown that the sun exerts a strong steady-state control on the shape of the magnetosphere in which particles can be trapped. Injun I, after one year in orbit, also discovered and mapped the artificial radiation belt produced by the high altitude nuclear explosion of 9 July 1962.

In the afternoon session on the observatory generation of satellites, John W. Townsend, Jr. (Goddard Space Flight Center), who acted as chairman, pointed out that this class of omnibus satellites has been adopted by NASA as a means for economically accomodating a variety of related scientific experiments in the same vehicle. Obvious advantages exist in making a large number of simultaneous observations and in reducing the total cost for each experiment, but disadvantages and limitations resulting from mutual interference or incompatibility of experiments must also be considered. Thus, there will still be room for the individual, special purpose unmanned scientific satellite for special cases.

Three pairs of technical papers were presented, dealing first with the mission and then the engineering design aspects of NASA's current observatory satellite programs. All of these projects are still in the design and qualification stage.

The mission of the Orbiting Geophysical Observatories, discussed by Wilfred E. Scull (Goddard Space Flight Center), includes the measurement of magnetic fields, energetic particles, interplanetary dust, atmospheric structure, electron and ion densities in the ionosphere, solar monitors, astronomy surveys, and certain meterological measurements. In addition, the OGO's may be used to test planetary instrumentation, vehicle support systems, and certain biological experiments. Two major orbits are contemplated in the program—the Eccentric Orbiting Geophysical Observatory (EGO), scheduled for late 1963, and the Polar Orbiting Geophysical Observatory (POGO), scheduled for 1964 launch. The engineering design, described by George J. Gleghorn (Space Technology Laboratories), features active thermal and attitude control, and extended booms for experiments requiring isolation from the body of the satellite.

Although the first Orbiting Solar Observatory (OSO) has been successfully orbited and has yielded much useful information, NASA's Advanced Orbiting Solar Observatory program is necessary to meet more demanding requirements in the period beyond 1966. John C. Lindsay (Goddard Space Flight Center) pointed out that improved stabilization and instrumentation will enable detailed study of the energy storage phenomena in the pre-flare active regions of the sun and also the flare mechanism and manifestations of energy release from solar flares. Optical measurements from such a spacecraft also may detect solar streamers and other evidences of energy transport from the sun to earth. A. J. Cervenka's (Goddard Space Flight Center) discussion on important engineering design features of the AOSO included orbit selection, stabilization requirements, orientation, data capacity, thermal control, power supply, command subsystem, and weight limitations imposed by the launch vehicle.

Glimpses of astronomical observations outside of the earth's atmosphere have been obtained recently from balloons and rockets, but only an orbiting observatory can produce the continuous and high quality observations that are required. A flexible, highly stabilized, and controlled OAO satellite concept was described by Robert R. Ziemer (Goddard Space Flight Center). Specific objectives include a new sky map in the ultraviolet portion of the spectrum, photometric systems capable of determining stellar energy distribution and emission line intensities in the spectral region from 3000 to 800 angstroms, and absolute spectrophotometric measurements of stars and nebulae in the ultraviolet. Another experiment will observe the absorption lines of interstellar gas in the far ultraviolet region. The engineering requirements of the 3600-pound OAO satellite were discussed by Walter H. Scott (Grumman Aircraft Engineering Co.). The stabilization and control system must be capable of orienting and maintaining the satellite in a stable attitude within 15-arc seconds over a 50-minute period. Using the experiment as an error source, the fine momentum wheels will then be able to hold the optical axes to 0.1-arc second. The structural and thermal design characteristics and the usual satellite support systems were also included in this final paper.

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