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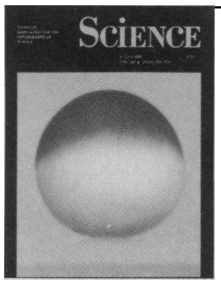

COVER An egg of the frog, *Xenopus*, previously injected with messenger RNA for the M1 muscarinic acetylcholine receptor, undergoing cortical contraction after exposure to acetylcholine. Application of acetylcholine after introduction of the receptor into the egg membrane initiates this and other responses similar to those normally initiated by sperm (×110). See page 464. [Douglas Kline, University of Connecticut Health Center, Farmington, CT 06032]

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Space Science: Past and Future

A symposium and a substantial number of recent publications have provided a basis for estimating the past performance and the prognosis for the U.S. space effort (see Research News, 8 July, p. 162). Once this country enjoyed enormous prestige for both its manned presence in space and its excellent scientific achievements. Its present position and its future status are less favorable. A crucial weakness in the NASA program has been excessive emphasis on man in space. The great adventure of visits to the moon won universal attention and admiration. But in this era and in the future, repeated travel to a space station near the earth becomes monotonous, with excitement mainly stirred by stunts and by the possibility of a tragic accident. A principal justification for the space station, then, is its potential role in scientific and biomedical research. That is not negligible, but it does not match the past accomplishments of unmanned missions or their potential if unleashed. The robotic missions are much less costly, are flexible, can be conducted more rapidly, and can probe phenomena inaccessible to the human presence. They have a superior record of leading to practical applications and will probably stir increased interest as concern about the environment mounts.

In terms of prestige and science and engineering, the planetary missions were exemplary. That was particularly true of the Voyager missions. The engineering achievements involved in the Voyagers were magnificent, including durability of the craft, their flexibility in responding to earth-borne commands, and the capability of the system to convey information to distant earth.

For the present and the future, some of the most important observations from space will relate to the earth and sun. Changes in stratospheric ozone and potential greenhouse phenomena urgently require steady monitoring. Observations of ocean currents that give rise to El Niño and related climate and weather phenomena are of practical importance. Changes in vegetation worldwide can best be followed by sensors on satellites. Phenomena in the sun and solar-terrestrial relations will be of enduring importance.

The capabilities of satellite sensors are impressive. They can be used to obtain vertical temperature profiles in the atmosphere and to determine concentrations of many important trace gases in the atmosphere and their variations with altitude. Visible and near-infrared imagery are important in weather forecasting as well as in the estimation of marine resources. A striking example of the potential of a space mission in physical science is the Laser Geodynamics Satellite, which was built at a cost of $6 million (1987 dollars). Reflectors allow ground-based lasers to track the position of the object with centimeter accuracy. This capability has led to improved knowledge of post-glacial rebound and of electromagnetic coupling between core and mantle.

In following developments regarding the atmosphere and oceans, it is desirable to maintain time series of measurements. The outlook for some of the most important observations is chancy. We are highly dependent on the Nimbus 7 satellite that has long outlived its expected usefulness. A gap in ocean color observations has already occurred, owing to termination of the coastal zone color scanner measurements on Nimbus 7. Global stratospheric ozone measurements with high spatial resolution are also likely to become unavailable. No firm plans have been made for a follow-on mission to the Nimbus 7 total ozone mapping spectrometer.

Earlier, when operation of the space shuttle was expected, our great national capability of expendable launch vehicles was destroyed. Launches of satellites were assigned to the shuttle. This led to delays and to costly extra requirements for quality control.

In the future, major U.S. earth monitoring activities will involve polar orbiters, but these have not yet been included in the budget. Present indications are that these satellites will not be launched before the late 1990s. In the meantime, other countries are proceeding with a variety of programs for earth observations, and they will provide strong competition for leadership in the field. The United States has embarked on a program of restoring its launch capabilities. That effort should be expedited, and correspondingly faster schedules of unmanned missions should be established.—PHILIP H. ABELSON