Astronomy and Astrophysics for the 1980's

After 2 years of study, the National Academy of Science's Astronomy Survey Committee is publishing a report that endorses four major new programs as top priorities for the 1980's: an Advanced X-ray Astrophysics Facility (AXAF) in space; a Very Long Baseline array of radio telescopes; a 15-meter new technology optical telescope; and a 10-meter reflecting telescope to be deployed from the space shuttle.

The panel's report* also recommends a number of moderate- and small-sized new programs. One of them is an astronomical search for extraterrestrial intelligence.

This is the third time that the academy has done a 10-year review of astronomy (*Science*, 6 March 1981, p. 1033). The previous efforts were highly influential, largely because the committees were able to achieve a wide consensus within the astronomical community and because they made real choices: programs were ranked in order of priority. The 1972 report, produced under chairman Jesse L. Greenstein of the California Institute of Technology, led to the construction of the Space Telescope, the Multiple Mirror Telescope in Arizona, the Very Large Array of radio telescopes in New Mexico, and the Einstein orbital x-ray observatory.

The current committee, chaired by George B. Field, head of the Harvard-Smithsonian Center for Astrophysics in Cambridge, Massachusetts, estimates that the 10-year cost of implementing its new recommendations would be $1.9 billion in 1980 dollars. This is roughly comparable to what was actually carried out during the 1970's on the basis of the Greenstein report. Whether such funding will actually be forthcoming is anyone's guess.

The Field committee's recommendations pointedly start with "Prerequisites for New Research Initiatives." These are the unglamorous but essential items that often are shortchanged in the budgetary struggles over major programs. The committee strongly urges that substantial enhancements be made in instrumentation and detectors; theory and data analysis; computational facilities; laboratory astrophysics (molecular, atomic, and nuclear physics needed for interpreting the observations); and technical support at ground-based observatories.

The new programs themselves are grouped in three categories according to the scale of resources required. Ranking them within each category was especially sensitive, say committee members, since in the current fiscal climate, placing a given program third instead of second might delay it for years or even kill it. Nonetheless, the committee declares that its four major projects are critical to continued progress in astronomy and that the priorities in the report are unanimous:

- *AXAF* would be operated as a permanent national observatory in space, much like the upcoming space telescope. It would have 100 times the sensitivity and 10 times the resolution of Einstein, making it comparable to present-day optical and radio telescopes. It will be able to study individual x-ray sources in galaxies tens of millions of light-years distant.
- The *Very Long Baseline (VLB) Array* would consist of 10 radio antennas, each about 25 meters across, spaced from Europe to Hawaii and from Alaska to Mexico. Using interferometric techniques such an array could achieve a resolution of 0.3 milliarcsecond—the size of a dime in New York as seen from Los Angeles. This is a hundred times better than any other telescope at any wavelength. VLB could study the details of the galactic center and of stars in the process of formation. It could even study the small-scale structure in the central regions of quasars. Although complex, the array would use proven technology.
- The *New Technology Telescope* (p. 280) is given a scientific importance as high as any other facility considered, and ranks third only because the technology is not quite ready yet for building it. "The design studies needed before NTT can be constructed are of the highest priority and should be undertaken immediately," says the report.
- The *Large Deployable Reflector in Space* would extend the light-gathering power of the NTT to the far infrared and submillimeter wavelengths that are screened out by water vapor in the atmosphere. The 10-meter diameter is also needed to achieve arcsecond resolution at these wavelengths. The instrument could address problems of star formation in the Milky Way and other galaxies, the nuclei of active galaxies, and molecular activity in planetary atmospheres and interstellar clouds.

The precise ranking of the moderate- and small-sized programs is considered less critical. Some examples are:

- An augmentation of the NASA program of Explorer satellites, "a flexible and highly cost-effective means to pursue important new space science opportunities."
- A VLB antenna in low earth orbit, to extend the resolution and sky coverage of the ground-based array.
- The construction of ground-based optical/infrared telescopes in the 2- to 5-meter class. They would observe transient phenomena, conduct long-term survey programs, provide support to space astronomy, and provide a realistic environment for instrument development.
- An advanced solar observatory in space.
- An astronomical search for extraterrestrial intelligence (SETI) supported at a modest level and undertaken as a long-term effort rather than a short-term project.

This last item was given a special working group during the study. "Intelligent organisms are as much a part of the Universe as stars and galaxies," concludes the report. "Investigating whether some of the electromagnetic radiation now arriving at Earth was generated by intelligent beings in space may thus be considered a legitimate part of astronomy."

A final set of recommendations deals with the need to plan for the future. Given the very long lead time involved, the committee urged that study and development begin in the 1980's for programs that will come to fruition in the 1990's.

Meanwhile, the committee finds NASA's plans for one or more permanent space platforms intriguing. Since so much of the modern astronomy must be done from space, such platforms would allow relatively simple and low-cost instruments to be placed in space for a long time, while being serviced on a regular basis.

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