in mice," Baruj Benacerraf, also of Harvard Medical School, reminded the symposium audience. "Only now is it being considered for clinical therapy."

Clinical advances in heart disease also stem from biomedical research, particularly of the non-mission-oriented kind, Eugene Braunwald of Peter Bent Brigham Hospital in Boston said. One of the most dramatic advances in medicine during the past 25 years has been the development of open-heart surgery, and only the last phase was mission-oriented research: the development of the pump-oxygenator (artificial heart and lung) apparatus. However, even the original goal of the surgeon who invented this apparatus was not open-heart surgery. It was designed to keep a patient with a blood clot blocking the main artery to the lung alive long enough to remove the clot surgically.

Thus scientists, for the most part, want funds for basic biomedical research with as few goal-oriented restrictions as possible. But with increasing costs of biomedical research, the public prefers to fund research with immediate clinical spin-off. The National Cancer Act of 1971 is a prime example. "The fact that there are two sides is something that most of us in this room have been reluctant to face," Thomas admitted. "We have had so strong a preference for our side that we tend to ignore the major issues of the disagreement, on the assumption that they will go away if we are patient. They will not go away. It is a genuine argument, with two genuine intelligible points of view, and the way it comes out may well determine the course of both biomedical science and the practice of medicine for the rest of the century and beyond." □

Twin-heart patient dies

The world's first twin-heart transplant patient has died, after living four months with a spare heart. The idea of giving a man a second heart was tried by Christiaan N. Barnard in Cape Town, South Africa, under the presumption that if something goes wrong with the new heart, it can be removed and "the patient is at least no worse off than when he started." The new technique, however, does not overcome the basic problem of the body's tending to reject transplanted foreign tissue (SN: 11/16/74, p. 314).

Ivan Taylor, 58, was suffering from terminal heart disease when he received his second heart last Nov. 25 (SN: 12/7/74, p. 358). No reason was given for his death on April 11. Another patient who received a second heart on New Year's Eve was reported doing well. In all, Barnard has given 14 patients new hearts. □

Charting ocean's profile from space

A satellite destined to be "the best-tracked spacecraft ever launched by the National Aeronautics and Space Administration" has been sent into an almost perfect orbit, from which it will provide data ranging from the height of ocean waves to the shape of the world.

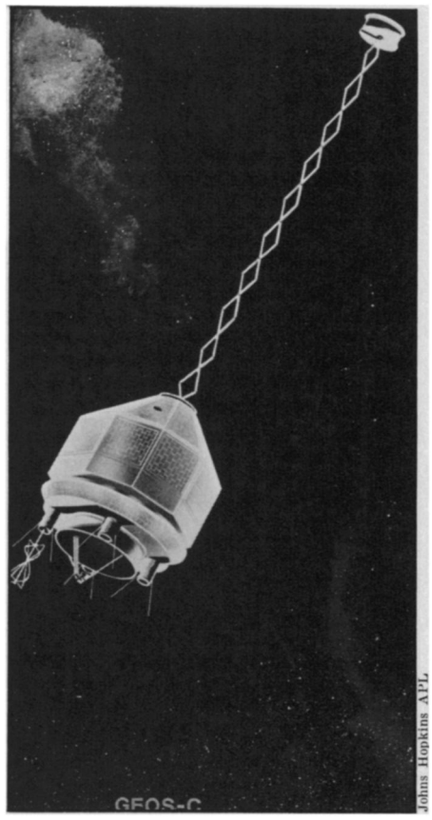
Known as GEOS-3, the third Geodynamics Experimental Ocean Satellite, launched last week, is the latest and most sophisticated in a line that goes all the way back to the second object ever put into orbit by the United States. Vanguard-1, launched March 17, 1958, made its mark by proving that the earth is not merely a flattened sphere, but pear-shaped. Since that time, satellite measurements of the shape, gravitational field and mass distribution of the planet have become increasingly precise, to the point where GEOS officials are talking about measuring the globe to within 10 centimeters.

Besides looking at the total planet, this latest GEOS is taking on a second task: mapping the ever-changing "topography" of the ocean. The primary instrument aboard the satellite is its ocean-watcher, a radar altimeter that bounces signals off the surface of the sea and times the echoes.

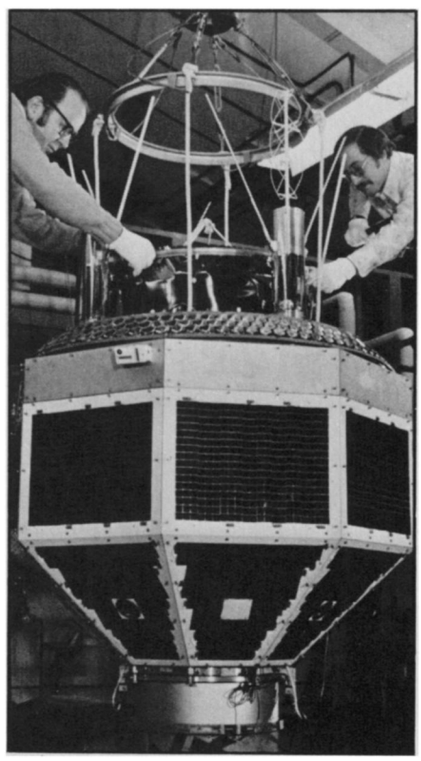
One purpose of such measurements is to refine the "ocean geoid," the shape that the ocean surface would follow in the absence of winds, currents and tides. GEOS-3's altitude reckonings are expected to be so precise that researchers plan to monitor ocean swells, waves and storms as part of a future goal of making regular "sea state" information available by satellite for shipping, weather forecasting and other applications.

The prototype of the radar altimeter was one of the instruments aboard Skylab, as part of the manned space station's earth-resources experiment package. Data gathered during Skylab, in fact, are now being used to construct models of the sea surface for comparison with GEOS-3 results.

Wave-height measurements with 10-centimeter accuracy are not quite in GEOS-3's capability, although determinations to less than one meter may be possible. Even so, to make such measurements from the satellite's altitude of about 840 kilometers requires that the probe's height and position be known to the best obtainable accuracy. To do this, it will be tracked from the ground not only by the conventional radio doppler method, but by two kinds of radar, and even lasers. A triple ring of 264 specially shaped quartz reflectors girdling the satellite will reflect ground-based laser beams to yield accuracies as fine as 10 centimeters in the probe's position. Careful positioning of the reflectors, and studies of what happens to the beams when they strike the reflectors at varying angles, should pro-



Stabilizer positions GEOS-3 in orbit.


Shroud covers altimeter before launch.

Scientific Manpower Commission

A new examination of the present and future utilization of scientists and engineers has been published by the Scientific Manpower Commission.

The Human Resources of Science and Engineering—Today and Tomorrow is a collection of 15 illustrated papers presented at a symposium at the annual meeting of the American Association for the Advancement of Science on Jan. 27, 1975. Manpower specialists examined the present utilization of manpower in each of several science and engineering fields. Past projections of supply and demand were compared with what really happened. The nature and quality of career guidance in science and engineering included a special look at guidance for girls and minority youth.

Looking toward the future, field by field enrollment information shows some of the enrollment trends that will change the relative supply of new graduates in science and engineering over the next few years.

Four speakers from academe, the professional societies, industry and Congress assessed the implications for action in these sectors to encourage policies and practices leading toward future balances in the supply of and demand for scientists and engineers.

Authors are John Alden, Donald Beem, C. Alan Boneau, Truman Botts, David Breneman, Janet Brown, Bonnie Henderson, Robert Henze, Charles Kidd, David Reyes-Guerra, Paul Robbins, Raymond Sears, Robert Stern, James Symington and Betty Vetter.

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vide greater precision than with any previous laser-tracked satellite, according to program manager Dick S. Diller. (Early next year NASA plans to launch LAGEOS, a GEOS designed to wring the most out of laser tracking, equipped with 426 reflectors and promising measurements to within as little as 3 centimeters.) It is even being tracked from orbit by another satellite, ATS-6. With so many methods in use at the same time, it is not surprising that one of the goals of the program is to see what can be gained by using the different systems to check one another out.

The ocean studies will be particularly valuable to the researchers now making plans for SEASAT, a probe scheduled for 1978, which will provide sea-state information to a wide range of users, much as LANDSAT does with crop and other earth resources data. The SEASAT office is already hearing from a wide range of potential "clients," both government and civil.

Geodetics, however, are still very much a part of GEOS-3. Major improvements are hoped for in charting earth's gravitational field, as well as investigating such solid-earth dynamic phenomena as polar motion, fault motion, earth rotation, earth tides and continental drift theory.

There is even a sort of tail-wagging-the-dog aspect to the mission, in that once the satellite's motions have been well determined by all that tracking, NASA analysts will start using it to refine their existing knowledge of the locations of their own tracking stations on the ground. Such role reversal, in fact, goes back as far as 1959, when tracking of early U.S. satellites, not necessarily geodetic ones, was used to provide positioning information in setting up the tracking network for the manned space flights of Project Mercury. □

Careers in science: Flexibility needed

Improving the methods of gathering data on manpower projections and developing better understanding of how students react to those projections are key suggestions made by an ad hoc subcommittee on manpower of the National Science Board. In a seminar slated specifically to analyze how manpower projections are made, and how accurate they are, the subcommittee agreed with Lewis C. Solmon, of the Higher Education Research Institute, who testified, "If the data collected by the different professional societies could be coordinated, and if societies and social scientists with longitudinal data sets could begin collecting comparable data, we might be able to understand why people's careers develop the way they do."

Manpower miscalculations, upon which many college students base career plans, may be responsible for four-year fluctuations in the job market. To help compensate, the subcommittee suggests that colleges help place students in training programs outside of school rather than in university labs and that they make it easier for students to transfer from one deparment to another (physics to mathematics, for example) should career plans fall through midway into a student's academic training.

Since employers are obligated to hire numbers of women and blacks, the nonminority graduate student may have to select broader career choices. Substitutability has already become an important consideration in college programs, since persons trained as specialists in research may be forced to seek nonspecific jobs. More emphasis should be placed on vocational interests—what the student actually wants to do—than on achieving academic degrees, the report says. The subcommittee's report, "Scientific and Technical Manpower Projections," was issued by the National Science Board last week.

Manpower predictions estimate at most a need for 160,000 new scientists and engineers between now and 1985, depending on pollution abatement requirements. This falls far short of the 200,000 new Ph.D.'s in science and engineering expected to come onto the job market by then. Employment prospects, coupled with anticipated salaries, may steer science majors into brighter fields—health professions, city planning, dentistry, medicine and law. Students generally are primarily interested in the lifetime income of their prospective fields, the subcommittee reports, but rarely do they accurately perceive careers beyond the first five years.

One of the fallacies in predicting job markets is overlooking the number of foreign students trained as engineers and scientists, and the students who leave the college pool to accept internal training jobs within large firms, such as Exxon. Figures on the transferability of such specialists, layoff and hiring rates and attrition predictions could lead to more accurate forecasts of the future.

Channeling the unemployed Ph.D. into sales, manufacturing production and control should begin while the student is still in school. "The real issue for scientific manpower lies in the strength and quality of the universities," the committee says. As important is strengthening university faculties, implanting young professors, and keeping qualified Ph.D.'s in education. □