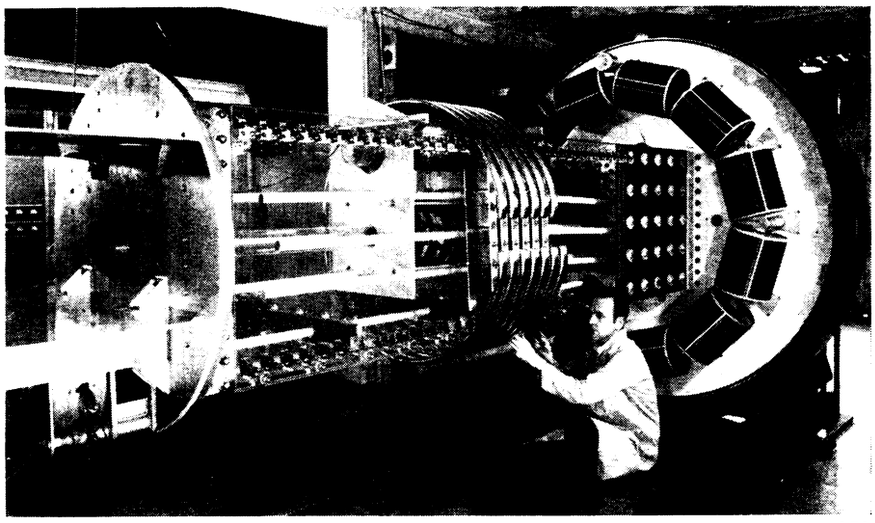

LRL

Injector for Berkeley Superhilac: The one U.S. entry will be complete by 1972.

A linear accelerator under construction at Darmstadt in West Germany, Unilac, will be able to take neon or argon to nearly 20 million electron-volts per nucleon. It will be able to accelerate ions as heavy as uranium to 10 million electron-volts per nucleon. Unilac should be finished by 1975.

Physicists at the Dubna Laboratory in the Soviet Union are building a heavy-ion cyclotron, which they hope will be ready in 1972. Its planned performance should roughly parallel Alice's.

The Berkeley Superhilac is expected to be finished by the end of this year. Its maximum energy per nucleon will be constant at slightly more than 8 million electron-volts over a range of weights from argon to uranium.

The only other American project at all alive at the moment is the wish of Dr. Milton G. White of Princeton University to convert the Princeton-Pennsylvania Accelerator to a heavy-ion accelerator. The PPA is a proton accelerator of 3 billion electron-volts energy, which the Atomic Energy Commission closed for lack of funds. Converted to heavy-ions, it could give them energies in the range of billions of electron-volts per nucleon, enough, says Dr. White, to go beyond studies of nuclear structure to laboratory imitations of cosmic rays and the behavior of nuclear matter in cosmological events. He has a promise of money for the conversion if he can find enough users for the machine after the job is done. Other American proposals, from the Argonne and Oak Ridge national laboratories and several universities, have not been taken up.

An important part of the technology of heavy-ion accelerators is the development of efficient means for stripping electrons from the ions. The higher the charge of an ion, the easier it is to accelerate. Here, too, Dr. Beringer sees the United States falling behind. "Really high charge states are needed," he says. "I hear of breakthroughs in the U.S.S.R." But in the United States, he says, physicists have to be satisfied with fairly low charges like tenfold ionized uranium.

As a result of both lack of money and lack of progress in stripping, Dr. Beringer suggests Americans concentrate on making accelerators more efficient, perhaps by using superconducting materials. A good cheap accelerator, he says, would be "just beautiful and so American and maybe not far from realization." □

SECOND SATELLITE

Chinese in space again

The launching of the second Red Chinese satellite last week came less than a year after China's space debut, April 24, 1970 (SN: 5/2/70, p. 427). Although not too impressive if compared with the Soviet Union's 81 space launches during 1970 and the United States' 28, the launch will undoubtedly add fodder to the Defense Department's Congressional arguments to move ahead with the complete Safeguard missile system of 12 antiballistic missile sites.

In his annual report to the Congress this week, Defense Secretary Melvin R. Laird predicted that between 1973 and 1975 China could develop an initial force of operational ICBMs. The North American Air Defense Command keeps track of the launching and the orbits of such spacecraft, but there is still debate about the degree of sophistication of China's booster development.

The second Chinese satellite circles the earth every 106 minutes with an apogee of 1,800 kilometers and a perigee of 269 kilometers. □

SPACE SCIENCE PRIORITIES

Some treats, some headaches

The National Academy of Sciences' recommendations for space science in the 1970's contain at least some treats for all space disciplines and a few headaches for the National Aeronautics and Space Administration. Although the priorities listed by the NAS are not likely to produce television specials or tickertape parades, they will, if followed, keep a variety of scientists busy for the next decade. In addition, and perhaps most important, the projects may help answer such existential questions as, in the report's words, "How did our home in the universe come into existence, and How did life originate?"

The report, issued this week, is sure to become the bible of various scientists and Congressmen in their yearly dialogue with NASA. It summarizes the views of 14 members of the NAS Space Science Board's executive committee. While the report emphasises this bias, it does, in addition, summarize the views of seven working groups representing various space disciplines, and ten previously published studies. At least 137 space scientists and program managers are listed as participants.

Confronted with such an awesome array, NASA will most likely fulfill all the major priorities during the next decade, but the sequence in which the missions are flown may not be according to the NAS list.

What NASA did was ask scientists, under the auspices of the academy, to examine projects they would like to see flown, if limited to a certain budget level. But it is not clear if the scientists and NASA are working with the same money figures. The report lists priorities in three groups: base, intermediate and high level. The base missions recommended are supposedly based on the 1971 fiscal year budget of $566 million for the Office of Space Science and Applications (OSSA); intermediate and high level lists would be additions to the base flights if the budget were increased by 25 and 50 percent. However, the 1972 OSSA FY request of $750 million already exceeds the intermediate budget level priorities.

Among the priorities at the base level are projects such as small planetary probes, orbiters and flybys (concentrating on Venus), astronomical observatories and telescopes and an earth-orbiting gyroscope. The report recommends an increase in earth observation satellites, sounding rockets and atmospheric balloons and a doubling of funds for data analyses of the tons of information already collected but not analyzed from previous space flights.

One controversial issue is the executive board's lack of support for the Grand Tour (SN: 1/30/71, p. 77), a mission to outer planets during the years of favorable alignment later this decade. Previous scientific studies have placed a high priority on such flights as did the President's space message of last year. But the report emphasizes the fear that such a relatively large program (about twice the estimated cost of the recommended High Energy Astronomical Observatory) would crowd out the multitude of smaller projects. In addition the report reflects doubt that the state of technological development will insure that the spacecraft survive throughout its seven-year trip past the planets. NASA has been developing an advanced spacecraft to fly on the Grand Tour.

While the manned Skylab program is supported because of the extensive solar telescopic array aboard, there is a noted absence of evaluation of other aspects of the proposed manned space program for the next decade—the shuttle and space stations and laboratories. The report notes this absence: "We found the concepts too vaguely defined with respect to costs and engineering difficulties to permit any realistic assessment of the potential values to scientific research and applications. Nor was the study able to evaluate the economics of the shuttle, because it depends so strongly on the volume of space traffic, which in turn is dependent upon many user activities. . . . It is clear that space science and applications by themselves are insufficient to justify the cost of developing the shuttle."

Both the shuttle and space station study programs are managed by the Office of Manned Spaceflight, and as such, did not fall within the study area, which was largely concerned with OSSA.

NASA is not unaware of the diverse desires of the scientific community or of its own problem with selection of projects. Dr. John E. Naugle, Associate Administrator for OSSA, summarized the agency's dilemma this week before the House Science and Astronautics Committee as a problem of selecting "from the enormous and growing catalog of human needs and interest those that only space can serve best, those that offer the greatest reward for their investments and those that make fundamental contributions to our nation and to humanity."

Detailed hearings before the Subcommittee on Space Science and Applications are scheduled to begin next week. The committee's chairman, Rep. Joseph E. Karth (D-Minn.), is a strong supporter of an increased program of earth resources observations in the NASA budget. □

MANTLE CONVECTION

Hot spots and crust motion

Few scientists now dispute the view that the earth's crust is composed of rigid plates that move about horizontally. But the driving force that moves them is still a mystery. Most theories of plate motion involve some form of thermal convection in the underlying mantle (SN: 7/25/70, p. 74), but the exact process is the subject of considerable speculation.

Dr. William J. Morgan of Princeton University now proposes that so-called hot spots observed in the mantle are manifestations of convection in the lower mantle. Convection at these spots then provides the motivating force for continental drift. Crustal plate motion over mantle hot spots had previously been advanced to explain the origin of the Hawaiian and other island chains, but no one had suggested that hot spots are actually involved in moving the plates.

Dr. Morgan proposes that there are about 20 convection plumes in the lower mantle that bring heat and primordial material up to the asthenosphere (the fluid area of the mantle) and spread horizontally in all directions from the top of the plume in a sort of umbrella shape. The return flow, he says in the March 5 NATURE, would be uniformly distributed throughout the mantle. "The currents in the asthenosphere spreading radially away from each upwelling will produce stresses on the bottoms of the lithospheric plates," he says. These stresses, together with others generated by the plate-to-plate interactions at rises, faults and trenches, "will determine the direction in which each plate moves."

One basis for Dr. Morgan's theory that hot spots provide the driving force for plate motions is that neither rises nor trenches seem to him to be integrally involved. The symmetric magnetic pattern and the mid-ocean position of the rises indicate, he says, that they are passive. As two plates are pulled apart, material from the asthenosphere would rise to fill the void. But if the upwelled dikes on the ridge axis are what push the plates apart, says Dr. Morgan, "it is not clear how the symmetric character of the rises could be maintained."

If the sinking lithospheric plates provided the main motivating force, the geophysicist continues, small trench-bounded plates would move faster than the large Pacific plate. But this is not the case.

This process of elimination leaves currents in the mantle as the driving force. The next question is whether these currents are great rolls that rise at ridges and descend at trenches or are localized upwellings or hot spots.

The gravity pattern and high topography around the hot spots suggest that they are more than just surface volcanism, Dr. Morgan points out. A recent map of the earth's gravity anomaly pattern shows isolated areas of greater-than-average gravity over most of the hot spots. Such highs are symptomatic of rising currents in the mantle, he says.

Further, almost all the hot spots are near rise crests and there is a hot spot near each of the ridge triple junctions, which is consistent with the notion that asthenospheric currents are pushing the plates away from the rises, says Dr. Morgan. Finally, he points out, there is evidence of past hot spot activity in the lands bordering the Atlantic, such as the volcanic activity in Patagonia in the Jurassic Period (135 million to 180 million years ago). The hot spots along the Atlantic coasts of North and South America, Dr. Morgan claims, produced currents in the asthenosphere that caused the continental breakup leading to formation of the Atlantic. □

AEROSPACE RETRAINING

Switch to urban problems

Unemployment among scientists and engineers is one of the severe side effects of cutbacks in the nation's aerospace budget (SN: 2/20/71, p. 128). This week the Departments of Labor and of Housing and Urban Development announced a joint pilot program to retrain some of these unemployed specialists for work on urban problems.

The initial program, which will cost an estimated $1.2 million, will employ from 400 to 600 persons. If it is successful, the program will be expanded to over 2,000, officials said. The organization of the program will begin at once. Recruitment will begin in four to six weeks.

Candidates will undergo an intensive course lasting from 30 to 40 days at one of two as yet unchosen educational institutions, one on the East Coast (possibly the Massachusetts Institute of Technology), the other on the West Coast. The purpose will be "not to reeducate them but to teach them the new language of urban affairs, the problems of the cities, their governmental structures, and to give the candidates an overview of the social, economic and physical problems of urban areas."

State, county and city officials will then be expected to assist in finding jobs for the re-oriented aerospace personnel. The program will be headed by Floyd H. Hyde, HUD Assistant Secretary for Community Development and Malcolm R. Lovell, Jr., Assistant Secretary of Labor for Manpower. □