

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. □