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COMMENT ON LONG RANGE PLANS

NASA Space Flight Programs

In earlier representations the Exobiology Committee of the Space Science Board has formulated its suggestions for the work of the next five years. In brief, this would be mainly to lay the groundwork, by laboratory investigation, for the first planetary landfalls anticipated circa 1965. This work would consist, on the one hand, of continued observations of the planets from earthbased balloon and satellite telescopes, the chemical analysis of meteorites, and most urgently, the development of necessary strategy and instrumentation for the detection and characterization of planetary life. The Committee has concluded that the strategic effort be concentrated on the examination of micro-organisms. It is extremely difficult to see beyond the first stages of such investigation since, obviously, each experiment will depend in large measure on the results of the earlier studies. This is true to a much larger degree here than in the physical sciences since we lack the framework, perhaps even the possibility, of a rigorous theory for prediction. If organisms are detected on the early missions we should, at the same time, learn enough about them to be able to better plan the later tests. For example, a preliminary survey of a large variety of culture media may allow a decision as to which one is the best to use for the large scale cultivation of a typical organism. From such cultures more significant tests could be made of the biochemical composition and metabolic activity of the indigenous organisms. At this stage also one might contemplate the closer examination of the possible invasiveness of the planetary organisms for terrestrial life (for example, cells in tissue culture), and a general consideration of their chemistry may allow some decision as to the possible hazards of permitting their return to the earth.

For the decade of the 1970's we may anticipate the possibility of a considerable scaling up of the payloads and the question has been asked what would be the most significant experiments in space science once such very large payloads were feasible. For Biology the answer is obvious -- namely, the return of planetary specimens for examination in great detail in the terrestrial laboratory. However, we plainly cannot afford to do this until we have made the most exhaustive possible study of their existence and behavior <u>in situ</u>. It is to the latter purpose that the most effort must be spent in the preceding years.

Meanwhile, we can expect a concomitant development of procedures and information on planetary chemistry and from these to have a better understanding of the capabilities for terrestrial life to exist and propagate on the planetary surface. In some cases this may lead to a relaxation of present cautions against the contamination of the targets by terrestrial micro-organisms carried by our space craft. In others, we may have even better founded cause for deep concern. We should have to know enough about the chemistry of each planet to be able to make reasonable predictions as to the consequences of implanting various types of micro-organisms from the earth to the planetary surface. Until our assurances and concerns can thus be fortified by more knowledge, we must meanwhile make an unremitting effort to avoid an unprecedented catastrophe by inattention to the problem of space craft decontamination. As previous memoranda have noted, the presence of living man on such craft would so greatly complicate this and other problems that it is doubtful whether he can play a useful scientific function during the early stages of exploration of the solar system.

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Biological experiments on space probes

At the present time, Mars is the only planetary target for which the available physical data would encourage biological exploration. Before biological missions are planned for the moon or for Venus, chemical and physical studies should take precedence. In the long run, the planet Jupiter may be the most interesting planet from a biochemical standpoint in view of its size and abundance in lighter elements. The means of approaching its surface for detailed chemical study are a worthy challenge to the high performance vehicles of the future.

The interplanetary medium has the same interest for biology as for the other sciences: measurements of radiation and particles can improve our insight into the evolution of the solar system, and indirectly the conditions of initiation and maintenance of life within it. The one point that might be overlooked by other students concerns the chemistry of the cosmic dust, especially carbonaceous particles which are too fragile to be readily detected in the meteoritic infall to the earth. Feasible methods for capturing and analyzing such dust have yet to be devised; however, while impacting particles might not be collected intact, their fragments might be analysed as pulses of gas. Earth satellites should play an important role in these studies as well as in furnishing platforms for the telescopic study of the planets.

Comment on lunar landing mission

The Exobiology Committee has studiously reviewed the possibilities of biological experimentation in lunar landing missions. We feel that no significant biological experiment can be designed on the basis of present information of the moon's surface, and that in fact the biological interest in the moon would depend primarily on some improbable, though still possible, contradictions of our present conception of its characteristics. We have suggested that the safest policy is to avoid the possibility of irretrievable harm to later biological experiments by careless missions in the event that there should be some new finding that would then encourage a biological survey. This would depend, for example, on the detection of potentially volatile compounds beneath the exposed surface of the moon. In sum, we have therefore recommended that extensive physical and chemical experimentation should take full precedence over any biological studies. We hope, however, that such experiments will take account of the biological interest in the prevalence of carbon-containing molecules, in the temperature profile of the moon's surface, and of the possible retention of volatile materials in certain areas on the moon that is perhaps suggested by Kozyrev's claimed observations. The unique use of the moon as a storehouse of meteoritic infall, from which more insight could be obtained into the molecular chemistry of interplanetary space, has also been noted. The mass spectrometer and gas chromatograph are evidently most useful for this type of investigation. However, further developments may be needed to adapt it to the ready analysis of products adsorbed to the solid substratum.

In due course, experiments should be programmed for the search for minute residues of spores or other stigmata of extra-lunar origin to test the hypothesis of panspermia. However, it seems inadvisable to plan this experiment until after

the first studies have better defined the environment in which this search must be made. It might be contemplated at such time as we could visualize landing a detector that could screen, say, a square meter of lunar surface, to a depth of ten centimeters. Perhaps this time is not so very far off but it would be premature to go into the details of such an experiment until we had the first results on at least the texture of lunar surface. It can also be argued that this fine an analysis might more appropriately be made on samples brought back to the earth.

For early experiments, some attention should be given to general surveys, for example, the examination of surface material by a Vidicon camera at microscopic as well as other magnifications. The present development of opaque illumination for microscopy should make this enterprise a relatively easy one and it might have the additional virtue of being a preliminary test of the instrumentation intended for planetary exobiological study. This experiment is not intended to find specific biological structures in the microscopic field but mainly to give a better idea of the texture of the lunar surface down to micron size particles.