



JET PROPULSION LABORATORY California Institute of Technology • 4800 Oak Grove Drive, Pasadena, California 91103

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Mr. Maxwell W. Hunter, II
National Aeronautics and Space Council
Washington 25, D.C.

Dear Mr. Hunter,

I have read your recent paper "ZENI" and would like to make a few comments about it. Since it deals with some very advanced ideas I want to preface what I have to say with a few remarks which I feel are important.

I have always believed that one of the most dangerous characteristics retarding technical achievement is simple apathy. Apathy induced by a few good willing but very pessimistic people. It was true after Aristotle and will probably always be true when bold and new ideas are born. At this time in our history we are experiencing concepts just as revolutionary as any mankind has ever known. Concepts such as manned interplanetary transportation systems covering the entire solar system surely ranks as one of the most exciting and revolutionary ideas ever existing in the mind of man. If these ideas are to become a reality, the first task to be accomplished is to demonstrate that it can be done. That given enough dedication and courage along with the necessary tools, man can build such systems. This climate must be generated from the highest levels in our country. It must come from our president and those people directly responsible for guiding major areas of research and development. We are going to the moon before 1970 because of a president who had the courage and foresight to speak his mind, to set the course, to inject into all men ideas so exciting and challenging that world totalitarianism and petty exploration can be seen naked in the light of man's true spirit.

With this philosophy I believe "ZENI" is an excellent paper. It is written with optimism not incompatible with technical feasibility. This I feel is of fundamental importance. Since you have invited me to comment on it I shall give some alternative ways of thinking about some of the subject covered in the report.

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First of all I would have liked to have seen reference 1 and this paper combined into one larger work. This I think would have eliminated the unintentional playing down of nuclear rocket engines inherent in the earlier paper. In writing a paper like "ZENI" I would have first discussed the mission then the resulting velocity requirements and thirdly the desired transportation capability. The type of propulsion system would then follow as a conclusion or solution to the given mission goals.

The simple method of calculating velocities by linear distance divided by flight time is good for missions like Earth-Pluto 500 day transfers. However I do feel that even with this capability, heliocentric clockwise trajectories still should be avoided although in some cases it will be impossible to do so.

My concept of an interplanetary space transport capable of operation throughout the entire solar system is somewhat different from yours. Instead of requiring them to land directly on a planet's surface I view them as strictly interplanetary vehicles providing transportation from one planetary space-port to another. These space-ports are very large orbiting stations which have a relation to the space transports as airports have to present day aircraft. Flights from one planetary (or satellite) space-port to another will be analogous to contemporary air travel from one airport to another. The motor trip to the airport will become a chemical rocket trip from a planetary launch complex to an associated orbiting space-port. This admitted inconvenience has obvious advantages. The ships payload/weight ratio would be greater as well as the total velocity capability. No auxiliary major chemical rocket engines would be needed. No planetary radiation contamination problems would exist. The vehicle could always operate at maximum Isp values. No re-entry design restrictions would exist. The ship configuration would be determined only by the propulsion system and crew comfort. I view these space-ports as really very large facilities complete with all the comforts of a modern airport. Several of these space-ports could be orbiting each major body of the solar system. In addition to these personal ideas I feel that special ships be designed to handle personal and cargo separately. The cargo transports could be fully automatic and require no life support equipment or radiation shielding. The resulting cost/lb of payload would be much lower. The engine unit would be the only major factor influencing the ships design.

The weight and total velocity capability of these ships seems to be conceivable (in light of today's technological level) only by some type of gaseous fission engine. I feel that the vortex method looks most promising as it is basically a problem in gas dynamics and heat transfer.

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Your suggestion of using propellants other than liquid hydrogen such as water, ammonia or methane is as attractive not only because of their higher densities and possible desirable effects on the containment problem but also because these substances are readily available on most planets of the solar system.

Finally I would like to say that the last two topics "Solar Transportation Capability" and "A Reusable Test Vehicle" requires much more than the few paragraphs devoted to them. Perhaps it would have been better to have taken them up in a new paper which would also treat human factors. However it did add some flavor to the report and in this sense I liked its inclusion.

Thank you for sending me ZENI. I enjoyed reading and thinking about it very much. I hope it will contribute to the generation of a climate of adventure and anticipation which is so vital to research and development.

Sincerely,

JET PROPULSION LABORATORY

Michael A. Minovitch

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