THE AMERICAN MUSEUM OF NATURAL HISTORY
CENTRAL PARK WEST AT 79TH STREET
NEW YORK 24, N. Y.

RUTH NORTON,
SUPERVISOR OF PUBLIC RELATIONS

PHONE: TRAFALGAR 3-1300
EXT. 444, 311 AND 481

**RELEASED FOR**.........12 noon, Monday, October 13, 1952

# A DOWN-TO-EARTH VIEW OF SPACE FLIGHT *

by

Milton W. Rosen
Director, Viking Rocket Project
Naval Research Laboratory
Washington 25, D. C.

In many respects, the rocket capital of the United States is White Sands Proving Ground, New Mexico. Here, in the 40-mile wide basin between the San Andres and Sacramento Mountains, rocket vehicles designed and built in widely different parts of the country are tested and fired. This is where the Viking established a record altitude for single-stage rockets of 136 miles and where the two-stage Bumper Wac ascended 250 miles, the highest altitude reached by a man-made vehicle. There is a saying among the rocket technicians who meet and discuss their work at White Sands--a phrase which goes like this, "You have either just had trouble, or you are now having trouble, or you are about to have trouble." A few successful flights have received wide publicity; the public seldom learns about the many rockets which do not fulfill predictions. Nor is it explained that great odds were overcome to produce a record flight--a flight that would have been nullified by the failure of one component in several thousand. In a rocket--everything must work. It is because I have spent much of the last six years at White Sands that I have such a down-to-earth attitude toward space travel.

Why is it so difficult to go much higher than we have been? It is because the engineers have caught up with the scientists. It is because they have almost exhausted our store of basic knowledge. The time lag between the discovery of a new material, technique or principle and its utilization has become increasingly short. The public has come to expect a constant flow of products each more wonderful than its predecessor. But the engineer who has drawn the ingredients from the cupboard of basic research now finds that the cupboard is bare. He must wait for new ingredients.

(more)

* Lecture to be given at the Second Symposium on Space Travel at the Hayden Planetarium, American Museum of Natural History, October 13, 1952.

This is why plans for space traveland designs for space ships are based on a meagre store of scientific knowledge and a large amount of speculation. Now there is a place for speculation--if it is clearly labelled as speculation, and if its purpose is to stimulate interest in the subject. But I can hardly conceive of anything that would do more harm to this country's defense effort, and to the cause of space flight itself, than for the United States to undertake any one of the fantastic projects for a space ship that have been proposed in the last few years.

We can illustrate the difference between the speculative and the scientific approaches to space travel by imagining two scientists, whom we shall call "Scientist A" and "Scientist B." Scientist A is holding up a ladder which extends far into the sky. A typical American whom we shall call "Taxpayer" approaches and engages him in conversation.

Taxpayer - "What are you doing with that ladder?"

Scientist A - "Do you see that light high in the sky--that light is called space travel and I intend to climb this ladder and to reach that light."

Taxpayer - "I notice that many of the rungs are missing from your ladder."

Scientist A - "Don't worry about that--I will supply the missing rungs as I climb."

Taxpayer - "But how will you balance yourself on the ladder?"

Scientist A - "I will climb so fast that I will reach the top before the ladder topples. Then I will hang from the light and I won't need the ladder any more."

Taxpayer - "Well, let's see you climb it."

Scientist A - "I forgot to tell you--I need ten billion dollars before I can start."

And before Scientist A can finish that sentence, the taxpayer has disappeared. Now we see Scientist B, who is building an immense pyramid block by block. Construction is not far advanced--the highest block is only a few yards above the ground. The taxpayer approaches.

Taxpayer - "What are you doing?"

Scientist B - "Do you see that light --- ?"

Taxpayer - "Your friend, Scientist A, told me about it. Are you trying to reach it? Is that why you're building the pyramid?"

Scientist B - "Yes--and it's very hard work. Sometimes I have to search all day to find one block--and when I need one of a particular size and shape, it may take weeks or months to find it."

Taxpayer - "Are you going to ask me for ten billion dollars?"

(more)

Scientist B - "Heavens no! I wouldn't know what to do with that much money. But I could use a few million dollars for modern equipment. You see-- as the pyramid grows higher, it becomes increasingly difficult to lift the blocks."

Taxpayer - "I can't see any return for that investment. Your progress is too slow. I will be gone and forgotten before you get close to space travel. But don't be discouraged. If you ever get to the place where you need only a dozen more blocks, I will buy that dozen!"

Where do we stand today with respect to space travel? To answer this question let us consider the feasibility of building a manned, earth-returnable rocket on the basis of what we have done, rather than what we think we can do. A manned earth-returnable rocket is a vehicle which travels some distance away from the surface of the earth, which carries one or more human beings as passengers, and which includes provisions for ensuring the safe return to the earth's surface of these passengers. It is not considered essential that the vehicle itself return in a re-usable form.

Altitude is the primary factor in any consideration of the feasibility of a manned, earth-returnable rocket. Two altitudes, 15 miles and 50 miles, are significant because they define the boundaries of three regions that can be considered separately. These are the regions between the ground and 15 miles where feasibility has been demonstrated, the region between 15 and 50 miles wherein feasibility can be shown, and the region above 50 miles where a decision on feasibility is not possible today.

According to recent unofficial, but reliable reports, a Douglas Skyrocket has reached an altitude of 15 miles and its pilot has returned safely to the earth's surface. For an altitude of 15 miles, then, feasibility has been demonstrated. No more needs to be said.

Feasibility can be shown for a manned earth-returnable rocket that reaches an altitude of between 15 and 50 miles, even though no human has ever reached these heights. Rockets have been built which can ascend 50 miles and which can carry the necessary payload involved in transporting a human being. The significance of the 50-mile height is that parachute recovery has been successful below this altitude. Entire Wac Corporal rockets and instrument sections from Aerobees have been recovered by parachute from altitudes up to 50 miles. The accelerations encountered on the powered ascent are within the tolerance limit of human beings. The maximum velocity is sufficiently low that, for a vertical ascent, the vehicle skin temperature will not tax the capacity of known materials and techniques of

(more)

construction. The most important feature of a flight to less than 50 miles is that the duration of flight will be brief--a matter of several minutes. For this reason, many of the difficult problems that would be involved in flights to higher altitudes will be ignored when the altitude limit is only 50 miles. These problems include the effects on the vehicle and its passenger of cosmic and solar radiation, meteor collisions and free fall in a vacuum. Because the flight time is so short, it will not be necessary to make elaborate provision for the necessities of life: food, oxygen, elimination of wastes and maintenance of ambient temperature. The most important problem in this region is one of reliability.

In considering the feasibility of building a manned, earth-returnable rocket for altitudes between 15 and 50 miles the important words are man and return. The reliability of the vehicle must be weighed against the man's chance for survival. This concept of reliability must enter into the design of every component, sub-assembly and operating system of the vehicle. The factors of safety here are entirely different from those presently used in the design of sounding rockets. The probability of returning a man safely 99 times out of 100 is a very much smaller number than the probability of a safe return 1 time in 100. For the region between 15 and 50 miles, then, the important question to be answered is not whether a manned rocket can reach the required altitude, but whether the same man can make two flights.

Above 50 miles the situation is entirely different. Attempts at parachute recovery of instruments have not been successful. Depending upon the altitude to be reached, the accelerations could be beyond human tolerance limits and vehicle skin temperatures above the melting points of available materials. The Viking rocket, which reached an altitude of 136 miles, could have carried a man, but no one could have ensured his safe return--no one could have calculated the probability of his survival. If the duration of flight is sufficiently long, the effects of cosmic and solar radiation must be considered. The nature and quantity of these radiations in outer space have not been fully determined, and we are only beginning to study their effects on living cells. The probability of meteor collisions has been estimated and various schemes for eliminating this hazard have been proposed, but have never been tested. It is not possible to predict the physiological and psychological effects on a human being of a prolonged weightless state. If the flight time is long, as it will be when we speak of very high-altitude rockets, satellites, and space ships, elaborate equipment will be required to provide the human being with the necessities of life. A continuous power source will be needed for the operation of such equipment. Since the flight may impose terrific physical and psychological

(more)

strains on the passenger, it is expected that all equipment necessary to power and guide the vehicle, to provide the necessities of life, and to ensure the passenger's safe return--will have to be automatic in operation. Feasibility will have to be shown for every one of these machines--machines which will have to perform a diversity of functions with great precision. A tremendous amount of investigation, measurement and test will have to be conducted before one can assess the magnitude or importance of most of the problems involved. The discussion for altitudes above 50 miles leads to the inevitable conclusion that, at the present time, we cannot even estimate the feasibility of building a successful manned rocket, because of insufficient information.

If we cannot build a space ship today, what can we do to advance the cause of space travel? We can do much--we can discover the ingredients for future engineering--we can replenish the cupboard of basic research. Before we can attempt to transport human beings in a ship that orbits around the earth, we must produce a practical, reliable, unmanned satellite. To do this we need better, more efficient rocket power plants, and our progress in recent years has been slow. Anyone who can operate a few machine tools can build a rocket motor and make it work. It is one of the simplest engines for converting chemical energy into mechanical energy. But no one fully understands the theory of combustion in a rocket motor. This is one reason why every rocket manufacturer in the country is having difficulty in improving his product. We need more research on fuels, on high-temperature metals and ceramics, on novel methods for cooling the inner walls of rocket motors and the outer skins of high-speed airframes.

Atomic energy has been envisioned as an almost limitless power source for the propulsion of a rocket. The application is important, but its value has been overestimated. Some limitations of present-day rockets still apply. There is a practical limit on the temperature at which a rocket motor can operate and it matters little whether the heat has been generated by nuclear or molecular reactions. All rockets are propelled by the ejection of matter and our atomic rocket will have to carry a working fluid. This fluid can have lower molecular weight than the exhaust gases of a chemical combustion and herein lies the major gain to be achieved from the use of a nuclear power plant. The protection of instruments and personnel against damaging radiation is an obstacle to be overcome. Despite these difficulties, the potential use of nuclear power for the propulsion of rockets cannot be ignored. It remains to investigate the use of nuclear rocket power in the laboratory and in the test pit, before we construct the first atomic-powered rocket vehicle.

(more)

Hand in hand with rocket power gains must come progress in the field of electronics. The navigation of a space ship, communication between the ship and earth, and automatic control of the complex equipment necessary for human survival in outer space--all pose tremendous problems for the electronic scientist.

I will not attempt to list or classify the many investigations that evolve from our desire to send a human being into outer space--research that falls into the category of human engineering. Many of the problems and a few of the answers have been ably presented by Dr. Haber. This type of research can proceed, in fact must proceed concurrently with vehicle development if we contemplate human travel in outer space. Herein lies many years of research for the biologist, physiologist and psychologist. When asked what fields of scientific endeavor are embraced by the subject of space travel, a co-worker of mine replied, "It would be easier to name the fields that are not required." When pressed further he was unable to name any field of science that could be eliminated categorically.

Finally, we need more and better sounding rockets--rockets which can ascend far above the pedestrian altitudes thus far achieved. Sounding rockets are our best laboratories for space-flight research. They are, indeed, the predecessors of future space ships, but they are the remote--not the immediate ancestors.

Thus far, research contributing to space travel has been accomplished as a by-product of other projects--largely military. A better rocket motor is a better rocket motor--whether it is intended for a guided missile or a sounding rocket. Conversely, many investigations which further space travel have been supported because they also contribute to our national defense. The time has come, I believe, for someone or some group to assess clearly the problems involved in space flight and to determine what we are doing and what we could do to make further progress. Such a group should consist of able and respected representatives of government, science, and industry and could well be sponsored by the National Science Foundation recently created by Congress.

I would commend to the group the following procedure:

(1) They should make a thorough study of existing knowledge on space flight and then prepare a list of the problems which must be solved before it can be achieved. Such a list will be lengthy and far from complete.

(2) They should select from the list those problems which can be tackled with the techniques and tools available today.

(more)

(3) They should examine every project in the country which is closely allied to the field of space flight. Many of these projects are classified for security reasons and could be revealed only to a select group.

(4) They should recommend to government and industry present and future support for those projects which are making a worthwhile contribution to space flight.

(5) They should recommend the initiation, when appropriate, of investigations which are not being conducted and which could yield important results in the near future.

A large share of our scientific talent is now enlisted in the effort to resist and deter foreign aggression. We can, I hope, look forward to the time when some of this talent can be released from the task which is so urgent today. The recommendations of the proposed space-flight committee would constitute a program that could be implemented when the country can afford the manpower and money required to support the work.

Now comes the question--why do it at all? This country should not and, I feel confident, cannot be frightened into attempting space flight before it is technically feasible. The alleged military value of a space ship is as speculative as today's space-ship designs. Also we can only speculate about the material benefits that might be derived from the exploration of outer space.

I am reminded of Aesop's Fable about the farmer and his sons. A farmer, being on the point of death and wishing to show his sons a way to success, called them to him and said, "My children, I am now departing from this life; but all I have to leave you, you will find in the vineyard."

The sons, supposing that he referred to some hidden treasure, as soon as the old man died, went to work with their spades and plows and turned up the soil over and over again. They found, indeed, no treasure; but this thorough tillage yielded a firmer vintage than they had ever reaped before and more than repaid the young husbandmen for all their trouble.

Similarly with space travel; the knowledge we will have to gain, the techniques we will have to master, the machines we will have to build--will bring more material benefit to the earth's population than any gold or uranium we may find on Mars or Venus. The value of space flight is in the doing of it.

Milton W. Rosen - Biography

Milton W. Rosen was born on July 25, 1915. He was graduated with the degree of BS (EE) from the University of Pennsylvania in 1937 and did graduate work at the University of Pittsburg in 1937 and in the California Institute of Technology in 1946.

Experience: Graduate Student Engineer, Westinghouse Electric & Manufacturing Co., 1937-38; Staff Member, Naval Research Laboratory, 1940 to present. Developed radar and radio-control systems for guided missiles. In 1945, proposed and assisted in organizing a Branch to investigate the upper atmosphere with sounding rockets. Since 1947--Scientific Officer in charge of development of the Viking high-altitude rocket. Author of numerous reports on Viking and guided missiles. Vice-President Washington-Baltimore Chapter, American Rocket Society.