

Memo: Thoughts for the Westex III Meeting.
Jet Propulsion Laboratory, April 21, 1959

Dear Colleague:

At the Westex II meeting it was mentioned that the Jet Propulsion Laboratory had been assigned the technical supervision of the Atlas-Vega rocket. The Vega is the next generation of deep space vehicles and will be used for a variety of purposes. The first stage is a modified Atlas ICBM built by Convair Astronautics Corporation. The second stage is a GE 405 engine or modified Vanguard first stage. The third stage is now being developed at the Jet Propulsion Laboratory and is usually referred to as the 6K because it is designed to produce 6000 pounds thrust.

The first Vega Launching will take a trajectory out past the Moon. This will occur in the middle of 1960. The second Vega will be sent in the direction of Mars hopefully missing it by no more than a million miles. This launching will take place in late September of 1960 and the probe will arrive in the neighborhood of Mars approximately 145 days later. The third Vega launching attempt will take place in January of 1961 and the probe will be sent in the direction of Venus. The trip will take approximately 90 days. This is the way the program shapes up now. It may be necessary to change it.

The gross payloads for each of these shots are:

1st	1000 lbs	Moon miss
2nd	400 lbs	Mars miss
3rd	800 lbs	Venus miss

The gross payload includes the power supply, guidance, communication systems, etc., leaving considerably less for scientific instruments. The current estimate of the scientific package weights are:

1:	100 + lbs	Moon
2:	20 lbs	Mars
3:	80 + lbs	Venus

Obviously, the Mars mission poses the most serious technical problems. It also presents an opportunity for the United States to regain some prestige in the space field.

The Soviet Union already has an ICBM rocket developed for deep space work and it is quite likely that they will again demonstrate their superiority next June when Venus and Earth approach opposition.

At the moment, the first priority experiment on the Mars probe is an infra-red optical system. Hopefully, we can obtain new information that will prove useful in planning subsequent Mars missions. For example, a 10 inch reflector 10⁶ miles from Mars has four times the radiation collecting power of the 200 inch telescope when Mars is at opposition to the Earth. We believe a 20 inch reflector is feasible for a Mars probe and that the probe may come within a half million miles. This would provide a radiation collecting factor of 64 better than what Sinton had with the Palomar telescope.

Sinton observed Mars in the 3-4 μ region. Calvin suggests that there are many organic compounds which would show the 3.43 μ dip and that some more characteristic spectrum should be looked for. He has taken a reflection spectrum of milled nylon. The peptide linkage shows a reflections peak at wave number 1532. Another reflection peak occurs at about 1611. (This is in the neighborhood of 6 μ .)

I have made some calculations on the amount of energy received from the entire Mars planet at a distance of 10⁶ kilometers. The total radiation consists of two parts, the Sun's radiation reflected from Mars, and the emitted radiation. Mars is assumed to radiate approximately like a black body at 250° K. The albedo is taken to be 0.156.

$E_r(\lambda)$ = reflected power in watts per micron at wavelength λ

$\tilde{E}_r(\lambda)$ = emitted power in watts per micron.

A_d = area of reflector in cm.² \approx 2000 cm.²

$$E_r(3.4 \mu) = 6.1 \times 10^{-10} A_d \text{ watts } \mu^{-1}$$

$$E_r(5.7 \mu) = 0.98 \times 10^{-10} A_d \text{ watts } \mu^{-1}$$

$$E_r(7 \mu) = 0.86 \times 10^{-10} A_d \text{ watts } \mu^{-1}$$

$$E_r(6.5) = 0.65 \times 10^{-10} A_d \text{ watts } \mu^{-1}$$

$$\tilde{E}_r(6 \mu) = 1.75 \times 10^{-9} A_d \text{ watts } \mu^{-1}$$

Note that in the 6 μ region the emitted radiation is 20 times as great as the reflection radiation. The opposite is true in 3 μ region.

Mars is not a black body, but a gray body. It seems likely that Calvin's reflection spikes will show up as spectrum dips.

More laboratory work is badly needed. It should not be difficult to get such work financed. Preliminary investigation indicates that there is no classified work of this nature.

Can we get the radiation into a spectroscopy aperture? If we can, detection does not appear to be a problem. If the light losses are not high, then as little as a 30th of the area of Mars can be scanned.

Pb Se may be a suitable detector in the 6μ region. At low temperatures it has a sensitivity of about 10^{-11} watts and a time constant of 10^{-5} seconds.

An infra-red telescope would also be useful on a Venus probe. Temperatures of the Cytherian atmosphere are currently estimated from radiation in the 8μ region and the $10-13 \mu$ region.

What ideas do you have for the Mars and Venus missions? There is not much time and we must make our decisions soon.

Looking forward to seeing you,

R. W. Davies