

The Mars Viking Lander Biology Experiments – Harold Klein, 1977

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Gaseous Exchange Experiments		Pyrolytic Release Experiment
Humid Non-nutrient Mode	Wet Nutrient Mode	[or Carbon Assimilation Experiment]
<p><u>Premises:</u> (i) The sole limiting factor to growth of Martian organisms is water. Organisms (<i>heterotrophs</i>) would remain dormant until enough moisture became available to stir them into activity, & (ii) it was assumed that nutrients/simple organics were <i>already present</i> in the Martian soil.</p>	<p><u>Premises:</u> (i) A large fraction of Martian life is <i>heterotrophic</i>; (ii) Thus, addition of organic compounds was necessary for a metabolic response; (iii) Water was necessary for this response, & (iv) a large number of organic & inorganic compounds would not be inhibitory.</p>	<p><u>Premises:</u> (i) Martian [<i>autotrophic</i>] organisms would have developed the ability to assimilate CO₂ or/and CO in the atmosphere & to convert these to organic matter, & (ii) metabolic activity would best be demonstrated under conditions approximating the natural Martian environment. [¹⁴CO₂: ¹⁴CO ≈ 95:5]</p>
<p><u>Experimental Conditions:</u></p> <ul style="list-style-type: none"> • Martian atmosphere + additional CO₂, Kr, He; • 0.5 cc H₂O in incubation cell (sample untouched); • H₂O vapour ONLY touches sample; • Incubation temp. 8-15°C; • Incubation period is 7 days. • Atmospheric pressure 200 mbar; • Dark conditions. 	<p><u>Experimental Conditions:</u></p> <ul style="list-style-type: none"> • Martian atmosphere present for only a portion of the incubation periods, for the rest of the time being CO₂, Kr, He; • ≈ 2.5 cc nutrient solution added to 1 cc sample; • Incubation temp. 8-15°C; • Incubation periods 200 (<i>Viking 1</i>), 31 (<i>Viking 2</i>) & 116 (<i>Viking 2</i>) sols; • Atmospheric pressure 200 mbar; • Dark conditions. 	<p><u>Experimental Conditions:</u></p> <ul style="list-style-type: none"> • Two modes: water & no water. 80 µg of H₂O injected into an incubation chamber containing a 0.25 cc sample touched by H₂O vapour only; • Incubation temp. 10-18°C; • Incubation period, 5 days in the light or dark; • Wavelengths below ≈ 320 nm [UV-B, UV-C] were filtered out in order to avoid false positives; • [some samples pre-heated to as high as 175°C as a control (Mazur et. al., 1978).]
<p><u>Conclusion:</u> On the basis of the criteria developed for the experiment no data suggested the presence of biological activity.</p>	<p><u>Conclusion:</u> As for the humid, non-nutrient mode no data implied biological activity. This result, however, is said not to rule out the presence in the sample of <i>autotrophic</i> organisms, specifically, <i>chemosynthetic</i> microbes.</p>	<p><u>Conclusions:</u> Data indicated weak though significant presumptive positives. Later experiments appeared to rule out a biological interpretation. If, however, only <i>heterotrophs</i> were present in the Martian soil, i.e. no autotrophs, this negative result would not preclude the existence of life in the samples tested. There are also questions concerning the adequacy of the experimental conditions.</p>
Labelled Release Experiment		
['Gulliver']		
<p><u>Premises:</u> (i) <i>Heterotrophic</i> organisms are present on Mars, & (ii) these organisms are capable of decomposing simple organic compounds of the type produced from Miller/Urey type 'primitive reducing atmospheres' and some found in carbonaceous chondrites.</p>		
<p><u>Experimental Conditions:</u></p> <ul style="list-style-type: none"> • Mars-like conditions except for an incubation temp. ≈ 10°C & the addition of a little H₂O with a dilute solution of [seven] C-14 labelled organic substrates; • Incubation periods of about 13, 52, & 90 days; • Three samples were heat sterilized at ≈ 160°C, & later at 50°C & 44°C; • Atmosphere pressurized to about 60 mbars. 	<p><u>Conclusion:</u> Unlike the other biological experiments the LR experiment yielded data that met the criteria originally developed for a positive. In other words, by these criteria <i>alone</i> the presence of metabolizing organisms on Mars was demonstrated. Data from other experiments indicated that the LR results too might be explained chemically rather than biologically, but "it does not seem likely that the ambiguity in interpreting this experiment will be resolved on Mars by the remaining Viking experiments" (Klein, H.).</p>	<p><u>Additional Notes:</u> <i>Measurements: For the GEX experiment samples of the incubation atmosphere were taken & analysed for metabolic activity using a gas chromatograph with a thermal conductivity detector; in the LR & PR experiments the atmosphere was tested for the release of radioactive C-14 gases following metabolic decomposition or pyrolyzation respectively of organic matter. In the latter case (PR) any organic material present would be indicative though not proof of the presence of autotrophic organisms.</i></p>