The three experimental approaches incorporated into the Viking biology instrument have yielded results that are most readily explained as nonbiological phenomena. The predominant view among investigators trying to simulate the Mars results is that the surface material of Mars contains strongly oxidizing compounds which would account for many of the more intense reactions seen on Mars. Other mechanisms are also currently being proposed and studied.

Almost two years ago, the first detailed probing of the Martian surface began. While many scientific issues were addressed in this pioneering mission, the question whether Mars contains living organisms was, perhaps, uppermost in the minds of most people. Towards this end, a number of Viking instruments provided information on this issue and a few of the more important of these are summarized here.

First we must note that, on the basis of thousands of pictures taken on the surface of Mars over the past two years, no 'little green men' or other obvious signs of living systems larger than, say a few millimeters in size have yet been noted — at least in the areas around the two landing sites (Levinthal et al., 1977). These remarks are not meant to be facetious. While many scientists — before Viking — would have been surprised to find large, complex organisms on Mars, a fair segment of the public very likely anticipated such findings. Indeed, even some scientists at that time argued that Mars might contain complex organisms and were keenly awaiting the first pictures from the surface of Mars to scan them for signs of more highly developed organisms (Sagan and Lederberg, 1976).

On the basis of the pictures from Mars, it is impossible, however, to rule out the presence of microorganisms living inside of rocks (as in the case of endolithotrophs from Antarctica (Friedman, 1976), organisms buried deep below the surface or with a gross morphology indistinguishable from inanimate Martian surface material, or organisms 'over the horizon.' Nevertheless, if the Viking Lander pictures have not ruled out the presence of organisms, they have substantially narrowed the range of possible biological types on Mars and have lowered the probability that Mars has a flourishing biology.

In quite an analogous manner, the Viking Biological experiments, which were aimed at microscopic life, have also, at the very least, substantially reduced the range of possible microbial types on the planet. The experiments themselves tested a number of different metabolic 'models' of possible Martian biology (Klein, 1977) and, within the constraints of the experimental techniques used, the evidence does not indicate the existence of these 'models' on Mars. Whether any of these metabolic types are present elsewhere on the planet, or whether other, more exotic types (Strehler, 1978) — incapable of responding in our assay systems — were present in our samples, is impossible to rule out.


In the Viking experiments, a number of different environments were presented to samples of Martian surface material, and these were incubated for varying periods of time (Klein, 1977). The experiments were all incubated at temperatures between about 8° and 18° C.*

Had there been a complex soil population approximating in diversity and adaptability that which is found in most terrestrial soils, we would have expected our experiments to light up ‘like a Christmas tree,’ since in the complex mixture of microbial populations that is normally found in terrestrial soils, at least some types would be selected for by the experimental approaches that were used. But this was not seen on Mars.

The Gas Exchange experiment which frankly was optimized to determine heterotrophic microorganisms in the soil, and which is quite sensitive to small numbers and to very slowly-growing microbes in terrestrial soils (Oyama et al., 1976), never gave any indication of a positive biological response, even in incubations of up to 7 months duration (Oyama et al., 1977; Oyama and Berdahl, 1977).

The Pyrolytic Release experiment, in tests with terrestrial soils, could detect the photosynthetic or nonphotosynthetic fixation of carbon dioxide or carbon monoxide into organic matter by a small number of organisms (Horowitz et al., 1972; Hubbard, 1976). The results on Mars indicated a very tiny amount of incorporation into organic matter in the light, and a lesser amount in the dark (Horowitz et al., 1976 and 1977). However, even these weak, presumptive positive responses are most probably not due to biological activity because similar results were obtained with material that had been pretreated with heat at 90° C for several hours and then tested.

The most controversial results have centered around the third of the biology experiments, the Labelled Release experiment (Levin and Straat, 1976a). Here, time after time, when fresh Martian surface material was incubated with a dilute mixture of simple 14C-compounds, the mixture immediately began to decompose, with the release of labelled gas (Levin and Straat, 1976b; 1977a and 1977b). The essential features of this experiment — which, in one case, lasted for 51 Martian days — are first, the immediate initiation of substrate decomposition; second, the subsidence of the reaction at a time (after one or two days’ incubation) when about 90% of the initial added radioactivity still remained; third, after this initial burst of activity, a slow, continuous further release of radioactive gas into the atmosphere persisted for weeks; fourth, each time additional fresh nutrient was added, there was no further spurt in gas release, rather, about 30% of the radio-active atmosphere appeared to go back into solution; and, finally, of prime importance in interpreting the significance of this experiment, prior heating of the ‘soil’ to 160° C for 3 hours completely inhibited the initial decomposition reaction, while heating at about 50° C substantially cut down this reaction (by about 65%), and storage

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*AAn attempt to carry out one set of incubations at -10° C was aborted late in the mission, when the sampler arm failed and a fresh sample could not be obtained. The issue of incubation temperatures as well as other potential reservations in interpreting these experiments has been discussed in Klein (1977) and in Klein, H. P.: 1976, Origins of Life, 7, 1344.