After whole body X-irradiation with 690 R, the content was decreased somewhat on certain days after irradiation in fed mice (see figure). However, this change depends to a high degree on the irregular food intake after irradiation. To single out the effect of irradiation from the influence of irregular food intake, in a second series the citrate content was measured in the liver of mice fasted for 24 h before being killed. At the time of killing, all mice were therefore in the same nutritional state.

Under these circumstances, the content of citrate was almost unchanged for 11 days after irradiation, followed by an increase on 12th-15th day up to the value of normally fed mice (dotted line in the figure).

Discussion. The results show that the citrate content is scarcely influenced in mouse liver by the irradiation and citrate synthesis via the citratesynthetase reaction seems to be normal even after lethal X-ray doses. Changes in fed mice depends mainly on starvation effects following irradiation, since the citrate content remains almost unchanged in fasted mice over a period of 11 days after the exposure (see Figure). Therefore, neither the inhibition of phosphofructokinase nor the activation of acetyl-CoA-carboxylase by citrate is considered to be altered during this period after irradiation. It is improbable that on the first to eleventh days after irradiation any irradiation induced modifications of glycolysis or fatty acid synthesis are effected by citrate. However, the elevated citrate level in starved mice on the 12th-15th day might influence somewhat the activities of these 2 enzymes in vivo. It is difficult to decide whether the extramitochondrial acetyl-CoA content is influenced by the change in the level of citrate, because acetyl-CoA can come from anaerobic glycolysis as well as from degradation of fatty acids. Hence, the changes in acetyl-CoA content after irradiation are different from those of citrate.


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Possible Abiotic Origin of Precambrian Microfossils

Biochemical and electron microscope investigations of selected precambrian rocks have shown evidence for the existence of microfossils believed to be contemporary with the rocks. Related findings have revealed indigenous amino acids and alkanes in the samples.

Over the past decade it has been shown that a large variety of biochemicals can be formed from simple gases and liquids under the action of high energy sources using hypothetical primitive earth conditions (for reviews see reference). Recent results have also demonstrated that the transition from simple molecules to macromolecules is often accompanied by a separation of microstructures from the medium. These findings and those to be presented here support the suggestion of a possible abiotic origin of the microfossil forms found in the precambrian rocks.

As a starting material for our experiments we used ammonium thiocyanate (NH4SCN) which is a known product of juvenile volcanic gases and has been produced under simulated primitive earth conditions. In previous publications we showed that a small amount of methionine is synthesized by UV-irradiation of NH4SCN and that cell-like structures are produced in the presence of formaldehyde. In the present communication we report evidence demonstrating a resemblance between these abiotically produced microspheres and the microfossils on the basis of (a) morphology, (b) chemical composition and (c) physical properties.
We irradiated aqueous solutions of NH₄SCN (0.01–2 M) with a submerged Pen-Ray quartz lamp (Ultraviolet Products SC-1) for various times up to 315 min. All reaction solutions were first filtered with a 0.22 μ Milli-pore filter. After a few minutes of irradiation, the solutions showed a white turbidity. We placed a drop of the products on a slide and examined it with the light microscope. The size varied up to 10 μ in diameter and was an increasing function of initial reactant concentration and irradiation time.

About 10 min after the radiation had ceased (and a heavy white suspension was obtained), the microspheres began to form aggregates of larger spheres and chains. After standing for 2 h, the size of the aggregates continued to increase (up to 200 μ) and fibrillar aggregates were observed (Figure 1). After 100 h, nearly all the microspheres had formed large aggregates. Higher concentrations and aging increased the aggregating tendencies. Our observations are similar to those reported by other workers investigating the behavior of polypeptides precipitated from solution 11. In order to see how the microspheres would behave in the presence of adenosinetriphosphate (ATP), which has been synthesized abiotically 12, we added microsphere suspensions to 0.001M ATP solutions. The aggregation proceeded more rapidly and there was more surface contact between the microspheres forming the aggregates than previously. Figure 2a and c show electron micrographs of these aggregates.

The resemblance of the microsphere aggregates to precambrian microfossils is shown in Figure 2. The interior structure and dimensions appear to be similar. Since all reactant solutions were sterilized by filtration, irradiated with UV-light, and kept in closed tubes, and since these forms appeared consistently, the possibility of non-specific contamination is effectively ruled out.

Since our microstructures resembled microfossils we next investigated their stability. In tests for solubility, the microspheres were found to be insoluble in water, dilute HCl, dilute KOH, methanol, propanol, and benzene.

Fig. 1. Aggregates of microspheres in the form of a large sphere and chain.

Fig. 2. Morphological similarity between the microsphere aggregates (a, c) and the precambrian microfossils (b, d). The microfossil photographs are from 2.