A Plan for Searching for Life at Mars and Europa. T Owen[1] and S. J. Bolton[2], [1]University of Hawaii, [2]Southwest Research Institute,.

This vision consists of a comprehensive search for evidence of extra-terrestrial life, focusing on domains where there is evidence of liquid water.

Mars sample return:
Mars remains the most likely habitat for extra-terrestrial life in our solar system. Unlike all previous searches, we will investigate places on Mars where there **is** water (ice that melts) instead of places where there **was** water. The samples will be returned to Earth for exquisite analysis in ultra-clean laboratories. We will focus on two environments: the rims of impact craters whose inner walls show evidence of recent mud slides (originating at the crater rims where sub-surface ice can be exposed) and the edges of the water ice components of retreating polar ice caps.

Strategy
Collaborate with imaging scientists to review all images of Mars to locate best places on Mars and the best times to explore them.

- Develop and test new "micro-rovers" that can navigate these difficult terrains, select and preserve samples at low temperatures.
- Test system end-to-end on analogue terrains on Earth: "find-collect-preserve-damp samples – transfer" (to Earth-return spacecraft)
- Examination of samples in ultra-clean laboratories. This step has been extensively and brilliantly executed by the APOLLO program.
- In this chain of events, the sticking point is the development of the rovers. Yet there is ample experience now of vehicle motion on Mars which will provide a huge head-start for this project.
- Sample return puts all the high-tech analytical equipment on Earth, where it can be coseted and kept up to date. Collaboration with existing laboratories using nano-technology will save heaps of money. Collaboration with foreign investigators would be encouraged, again following APOLLO.
- This approach to finding life on Mars has two fundamental improvements over previous attempts:
    a. Samples have recently been in contact with Mars water.
    b. Samples are analyzed by the most sensitive protocols on Earth.

Europa Sub-surface Ocean:
Is there an ocean of liquid water beneath Europa's icy crust? If there is, is it possible that life has begun and survived in this environment?

Given the uncertainties here it seems inappropriate to promote a highly expensive mission to look for possible microbes in this possible ocean. Instead, we propose a "slash-and burn" approach.

Strategy
Send a bomb to break a hole in the ice with a "chase plane-s/c" that follows it and takes movies of what happens. The chase plane could be equipped with a mass spec (Waite et al. at Enceladus) to analyze the plume produced by the explosion. At that point, people can assess the situation and decide on the next step. This is the bottom rung of the ladder used to detect life on other worlds.