SUMMARY OF FIRST SESSION

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Next to the search for extraterrestrial life, I can think of no more exciting endeavor than the search for planetary systems. That the two are closely related is evidenced by the strong support that the effort has received from many people in this Commission. Certainly, the success of either effort will enhance interest in the other. But alas! At this conference we have heard two pieces of information that could be taken as less than reassuring.

First, we heard of a series of very effective mass extinctions of life on our own planet. The Nemesis hypotheses put forth in this session would assure us of another 10 million years or so. However, many of us are not so sure that the events are so predictable as has been suggested.

Second, we have seen new information which seems to indicate that protoplanetary systems abound! Ten or twenty percent of our nearest stellar neighbors are accompanied by clouds or rings of the very stuff from which our planet, indeed our very selves, was formed. Beckwith indicated a number of similarities between these cosmic embryos and the T Tauri stars. The numbers are impressive! We already know that fifty to seventy percent of the stellar points in the sky are binary stars. That such a large percentage of stars (many probably not binary) host planetary nurseries, could suggest the existence of a sizeable adult population. But our analogy becomes weak. Indeed, what we have found is that ten to twenty percent of our stellar neighbors are embedded in clouds of stuff. These may not be cosmic nurseries at all. Whether they are nurseries or cosmic miscarriages, or are not associated with planets at all, they are places less like the solar system than we would have hoped. They are,

M. D. Papagiannis (ed.), The Search for Extraterrestrial Life: Recent Developments, 523–526.

at best, planetary systems in a very early stage. They are certainly not planetary systems in a stage similar to our own.

Already, we know that some binaries are less than ideal for the evolution of planetary systems. Now we know that another percentage of stars are in another way different from our sun. It would be, statistically speaking, comforting to find planets forming in these clouds. Even though, at least in these instances, it would mean that humans have arrived too early for the party. If we do not find that planetary formation is a consequence of these structures, we may have a new class of objects, a class that could crowd our search space.

One of the major questions facing planetary systems science is: Do planetary systems form as a direct consequence of stellar formation? If they do, which forms first?

a) the star, or
b) the planets

In the first case, planetary systems will generally not have gas giants near their primary. In the second case, they frequently will and, as a consequence, they will be more detectable.

To date, we only have one example of a planetary system. Certainly, if we are going to understand it, we must study other examples. As for methods for detection and study:

1. We heard that ST's direct look capability may be enough to reveal a few possible very favorable configurations of planet and star.

2. In conjunction with a cooperative asteroid, ST's high-speed photometer may be able to detect some other planetary configurations.

3. The photometric approach got a boost from the suggestion that the study of the H and K lines could yield the space orientations of candidates for such a program. However, the accuracy of this technique must be improved further to become fully effective.

4. The same technique would be useful for the

spectroscopic search, where (v sin i) is a major uncertainty.

5. Most of the discussion of methods centered around the now venerable astrometric technique. This approach can be divided into 2 classes; ground based and space borne.

i) the ground based systems:

These are limited by the atmosphere to a potential accuracy of approximately 2 or 3 times 10^{-4} arc seconds per observation. This generally limits them to the detection of jovian planets around several dozen of the nearest solar-like stars, generally stars within 12 parsecs or so. Both classical and interferometric instruments are under study for this purpose, and at least one full-time program now utilizes only electronic detectors.

ii) space borne systems:

We heard that ST's astrometric capabilities resulted not from specific design but from secondary use of other instruments. Thus, ST's accuracy is like that of ground-based instruments. Generally, space borne instruments can be designed for much higher astrometric accuracy. Indeed, a two-year Lockheed study has concluded that an astrometric telescope accurate to 10^{-5} arc seconds can now be constructed (in theory, much more accuracy is possible). 10^{-5} arc second per observation instrumentation is capable of surveying thousands of stars for the effects of jovian planets, and many stars can be studied with an accuracy sufficient to detect planets similar to the Earth. A 10^{-5} arc second astrometric telescope is now under active consideration by NASA.

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In summary, the search for other planetary systems is beginning. Several new instruments may become available during the next decade. These would make confirmation of detections easier. From my point view, it is not the first detection that is important, but the first confirmation. From the astrophysical point of view, little will be known until we have a "significant" statistical sample.

If I may be permitted, I would like to add one last note; a personal observation if I may. Some at this conference have suggested that humans will evolve away from the planets; that space colonies will be built that can provide us with all of our needs. I personally find this view disturbing. Many of us tolerate the cities only when we need them. They do not provide the quality of life that we seek. I don't know how (or if) our species will ever actually travel beyond our solar system. There are certainly many technological and biological problems that would have to be overcome. But I believe that an earth-like planet will always have an appeal to humanlike beings. An alluring carrot such a place would be, a constant goal, a constant challenge. It may be that some of our descendents are destined to live in enclosed artificial planets, but to many they will never provide "all that we need".

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