REVISED REVIEW OF LIFE IN THE UNIVERSE AND EXTRASOLAR PLANETS

One of the most fundamental questions we can ask is "Are we alone?" Is there intelligent life elsewhere in the universe that we might possibly communicate with? We don't have an answer to this question, but astronomer Frank Drake came up with a way to break down the question into several other questions that make more sense to address individually. The end result of the Drake Equation is an estimate of how many technologically advanced civilizations there might be in the Milky Way. Some of the questions in the Drake Equation we already have some information on. I won't list all the terms of the Drake Equation here. The first terms are more astronomical, but the later terms are more biological/sociological/technological, and are much more speculative. Ask any astronomer to estimate the terms and come up with a number, and you will get a different answer.

The first term has to do with how frequently stars form in the Milky Way, and it is the least uncertain because we have a good estimate of that. The second term has to do with the fraction of stars that have planets, and only in the last fifteen years or so, we have begun to address that by discovering planets around other stars.

We have now found over 400 extrasolar planets. Most have been found by the "radial velocity" technique: looking for the periodic Doppler shift in a star's spectrum that indicates it is being pulled on by a planet. The "transit" or "eclipse" technique is also becoming more successful: detecting the dimming of light from a star as a planet crosses its face. NASA's Kepler mission should discover perhaps 100 terrestrial-size planets using this technique. The third technique is direct imaging, and a few planets have been found this way. It is easier to find massive planets, and so most that have been found are at least as massive as Jupiter. For the radial velocity technique, it is easier to find short-period planets. Many Jupiter class planets have been found closer to their stars than Mercury is to the Sun. These "hot Jupiters" are a challenge for planet formation theories to explain as such massive planets should form much further out where there is more solid material for accretion. Inward planetary migration is probably the explanation, although the details aren't clear. Most planets found have much more elliptical orbits than in our Solar System. In such systems, it is more likely that some planets may have been ejected by gravitational encounters with massive planets on elliptical orbits. Circular orbits present a more stable configuration.

As our techniques improve, we will no doubt soon find an Earth-like planet in its star's habitable zone, and start to address the Drake equation term which is the fraction of Solar Systems that might contain habitable planets.

Another attack on the problem of extra-terrestrial life is the Search for Extraterrestrial Intelligence (SETI). Some astronomers are using radio telescopes to try to detect radio communications from possible planets around other stars, based on the fact that such communications should be detectable by another advanced civilization around a nearby star. Radio waves are probably the best way to communicate because they can travel long distances without being absorbed by gas or dust. Of course, no definitive signal has yet been detected, but the payoff from such a discovery would naturally be very high.