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# Galactic civilizations: a reply

Ian Crawford of University College, London responds to Lazio and Cordes.

I thank Joseph Lazio and James Cordes for their comments on my article, and for their contribution to the debate. I am especially grateful to them for pointing out my misreading of Horowitz and Sagan (1993), although I note that the non-detection of Kardashev Type-II civilizations within the enormous distance of 22 Mpc places even tighter constraints on the prevalence of ET civilizations than I originally implied. Nevertheless, I agree that it is premature to draw any secure conclusions from the existing SETI results – only when a much greater fraction of the parameter space has been explored, hopefully within the next decade or so, will it be possible to use these data to place meaningful limits on the number of radio-transmitting civilizations in the Galaxy.

The main aim of my article was to draw attention to the strength (as I see it) of Hart's (1975) argument based on the absence of evidence for ET visits to Earth. Note that this argument does not rely on the non-detection of alien *artifacts*; I accept that the chances of finding these today, even assuming that past ET expeditions might have left them lying around, are infinitesimally small (although I agree that a careful search for artifacts elsewhere in the Solar System would be worthwhile). Rather, the argument relies on the fact that life on Earth has been allowed to evolve independently, without any sign of outside interference, for the past 4000 million years. Following Hart (1975), Tipler (1980) and Bracewell (1982), I argued that this single observation implies that technological civilizations must be sufficiently rare for some plausible combination of "sociological" factors to account for the absence of evidence.

I think that Lazio and Cordes have misunderstood my argument about colonization. Certainly, I never claimed interstellar colonization to be "trivial and inevitable" (how could anyone with any sense for the scale of the universe consider such a thing to be "trivial"?). Rather, I argued that interstellar colonization is physically *possible* (which is a quite different proposition), and that, if there were a large number of civilizations in the Galaxy, some fraction of them may find reasons to undertake it. Whether these reasons are instinctive (like that of the ivy rapidly trying to colonize my garden), ideological, or a rational desire to outlive the consequences of stellar evolution, isn't really important. What matters is that interstellar colonization is physically possible, that plausible motives can be identified, and that

the more independently-evolved civilizations there are, the greater the chance that, sooner or later, one of them will combine a motive with the requisite technological expertise.

I don't accept that this line of reasoning implies that "imperialism ... is the natural path for a civilization to take". For one thing, as noted above, there are many non-imperialistic (i.e. non-exploitative) motives for colonization. Furthermore, I am prepared to concede that interstellar colonization (to say nothing of outright imperialism) may be a very *unusual* path for a civilization to take. However, the more civilizations there are, the greater will be the chance of finding one or more in the expansionist tail of the behaviour distribution. Although the form of this distribution (which in principle must cover the whole gamut of behaviours from the completely sedentary to the aggressively expansionist) is unknown, there are reasons for believing that natural selection will introduce a bias (to put it no stronger) towards the expansionist side. This is self-evidently true when it comes to ivy colonizing gardens, but it may also lie at the root of some aspects of societies and civilizations.

For example, Gamble (1993) has argued that the human propensity for colonization, including the necessary cultural and ideological underpinning, may ultimately result from a genetic pre-disposition naturally-selected early in human evolution (when it was responsible for the human colonization of the entire planet from a geographically restricted region of East Africa). Thus our own tentative steps towards space colonization, while often rationalized in social, political or economic terms, may, at least in part, still be influenced by our biological inheritance. There is no reason to assume that similar considerations will not apply to other civilizations elsewhere in the Galaxy, or that some species might not have a stronger instinctive drive towards colonization than *Homo sapiens*. The simplest way out of this dilemma is to postulate that the number of independently-evolved civilizations in the Galaxy is quite small (i.e. closer to half a dozen than to tens of thousands). To my mind, this provides the most plausible grounds for believing that the expansionist tail of the behaviour distribution of technological civilizations has remained sparsely populated over the history of the Galaxy.

The remainder of my article was an attempt to reconcile this "absence of evidence" with

quite persuasive biological arguments that life, in the form of single-celled organisms, may be quite common in the universe (e.g. de Duve 1995). The key point here is the fact that it took over three billion years for multicellular animal life to evolve on Earth, which seems to imply that the evolution of complex life is, for whatever reason, a lot more difficult than the initial development of life itself (assuming, of course, that life on Earth is indigenous). This vast span of time is the main reason for doubting that there is an inevitable evolutionary link between single-celled lifeforms and complex multicelled animals. It is true that this argument would be weakened considerably if multicellular animal life had evolved more than once, and Lazio and Cordes cite the pre-Cambrian Ediacaran fauna as possible evidence for this. However, as I understand it, current palaeontological opinion favours a common origin for both the Ediacaran and Cambrian fauna (e.g. Conway Morris 1993), and that there is no clear evidence for multiple origins of animal life on Earth.

I also think that Lazio and Cordes' dinosaur discussion is a side issue here. It is true that I invoked it in the first place, but only to emphasize the fact *that even if* multicellular life evolves, it doesn't necessarily follow that a technological civilization will eventually result. I stated explicitly that, once multicellular life has appeared, all bets are off as regards its further evolution. The key point is the sheer length of time it took to reach this stage of biological complexity in the first place. This is what led me to suggest that the origin of multicellular life may provide an evolutionary bottleneck which could reconcile the lack of evidence of technological civilizations with a universe in which microbial life may be common. This evolutionary argument may be combined with Whittet's (1997) point about Galactic chemical evolution to further reduce the expectation of finding many technological civilizations at this stage in Galactic history. ●

## References

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