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They eat each other (4/28/97)

... Two more remarks about Von Neumann machines:

First, if there were any aliens careening around the galaxy, these would probably be they. After you get done re-engineering biological intelligences for space travel, the pilots and the ships might as well be identical. (I think Cordwainer Smith was the first to point this out; though my scholarship in this area is more than a little rusty.) — And for obvious reasons they'd better be able to live off the land: the robot Deerslayers, as it were. So that gives you the portable-Pittsburgh aspect of the idea. — The necessity of self-reproduction is a little trickier, but you can convince yourself it's logical.[1]

Second, though I don't know that many people saw it there was an amusing little volume by Francis Crick[2] published a few years ago on the subject of the extraterrestrial origins of life. Part of the argument was familiar and you've surely seen it elsewhere: evolution is fairly easy to believe once you have the rules of the game in place, but it's really difficult to imagine the genetic code originating on Earth, etcetera; updated Arrhenius, essentially. The rest of the argument was more ingenious: Crick said he thought once life had evolved somewhere there'd be a natural desire on the part of the presumably-intelligent endproducts (the Arisians,[3] I suppose) to travel the cosmos and spread themselves everywhere; but that, since physical necessity probably forbids this, the next-best thing, i.e., to transmit not themselves physically or even exact copies of themselves but (more or less) the abstract idea of themselves, the secret of life, the genetic code, would certainly be easier, might even be possible, and would be (if

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[1] Self-reproduction is just a complete capacity for self-repair; which would be necessary.

[2] Francis Crick, *Life Itself: Its Origin and Nature*. New York: Simon and Schuster, 1981.

[3] The ancient race who are masters of the cosmos in Edward E. Smith's Lensman novels.

you'd been keeping up with Crick drink-for-drink at the cocktail party where he must have made this up) just as philosophically satisfying. — So (says Crick) maybe somebody seeded the universe with bacteria, for instance. And we're all little green men.[4]

So. I'm not sure on the one hand that there is any real difference between these two ideas — I mean, a colony of bacteria (an embryo biosphere) is a Von Neumann machine, if you're casual about timescales. (And if you're going to talk about interstellar flight you have to be very casual about timescales.) — And then on the other hand if you believe this you can make one very odd but very natural prediction — namely: if the genetic code was designed by Arisian biological engineers and sent here from elsewhere, then (since they'd have wanted us to be able to figure this out) there'd be a signature somewhere, a copyright notice tucked away in one of those useless-looking sequences of codons every living creature seems to carry around and never use.[5]

I don't believe a word of this, of course. But it's funny enough that I

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[4] Crick's argument in somewhat more detail is that the uniformity of the genetic code suggests a bottleneck, i.e. that present-day life evolved from a very small set of precursors; that the earliest known forms of life resemble the forms that could be easily transported; moreover that the erratic nature of evolutionary progress — single-celled prokaryotes appeared shortly after the formation of the Earth, at least three and a half billion years ago, but eukaryotes only after two billion more years, and complex multicellular organisms only in the last six hundred million years — suggests that though the later stages of evolution are relatively easy (the canonical example of the evolution of the eye shows in fact that the characteristic innovations of the higher forms have been invented independently many times) some of the earlier steps might have been difficult and required luck — and that this luck might have been better on some other planet, and might have accelerated evolution there by billions of years. — Thus explaining why they seeded us, and not vice-versa.

[5] Much later, when Craig Venter's group created a designer organism, they did exactly this, encoding several watermarks which included the names of the authors and assorted quotations, among them "To live, to err, to fall, to triumph, to recreate life out of life" [Joyce] and "What I cannot build, I cannot understand" [a rephrasing of the famous dictum of Feynman]. See Nicola Twilley, "What's the point of streamlining Nature?", *The New Yorker*, April 2, 2016, and Gibson et al. "Creation of a Bacterial Cell Controlled by a Chemically Synthesized Genome", *Science* **329**, 5987 (2 July 2010), 52-56.

like it anyway…….

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Von Neumann machines

That requires a gloss….

These are usually pictured as industrial civilizations in a box: universal assemblers capable of self-reproduction, a kind of artificial life form that could consume energy and material resources to make copies of itself and, we know not what, eat solar systems and turn them into Dyson spheres, or whatever.

The natural assumption then is that they would be large, perhaps on the scale of a city or an asteroid to begin with, and grow to unlimited size. But the seed from which one might be grown, the essential bundle of information, the equivalent of the genetic code, could be quite compact. This would be relevant when considering how easily they might propagate from star to star.

One difficulty is that if they reproduce at fixed intervals, their numbers would grow exponentially but the spatial volume they occupied could grow at most as the cube of the time. This would entail the usual competition for resources typical of living things, which may be summarized by saying that they'd end up eating each other.

(One might object that they would naturally multiply to cooperate in organizing their immediate environment — in building the sphere, say — and this would remove the possibility of competition. — That they would function like ants in a colony, in other words. — But ant colonies go to war. with one another, so this makes no difference.)

A way around that would be to ensure they reproduce only when adequate resources are available, but that still means competition, and the war of all against all. Another would be to program a sort of

instinct into them that lengthened the time before reproduction with each generation. It isn't obvious how well that could work either, so this is definitely a problem.

Whether mutual annihilation is the reason or not, however, the Fermi question takes the same form: even at speeds a fraction of the speed of light, embryo machines or their seeds could be propelled from one star to the next in less than a hundred years, and they would saturate the galaxy in a few million years. Even at cometary speeds on the order of ten kilometers/second it would take less than a billion years. So if they actually existed, they'd already be here.

Unless, of course, Crick is right. There's something deep at the bottom of his argument. I'm not sure I have completely understood it.