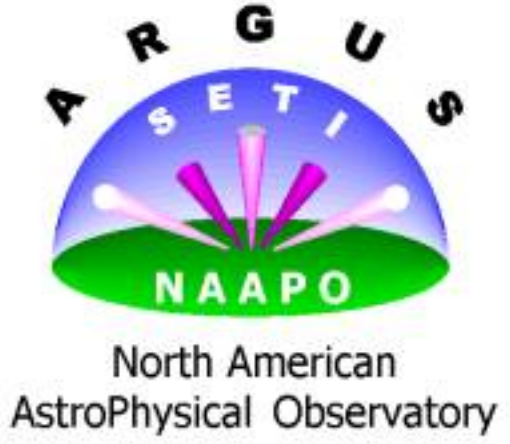

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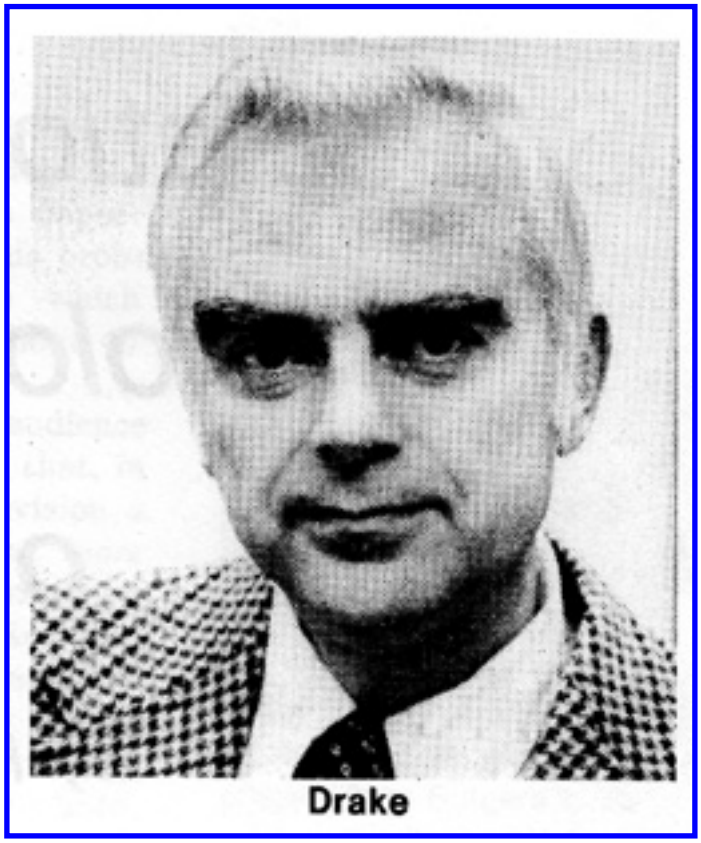
A Speculation on the Influence of Biological Immortality on SETI

By: Frank D. Drake


Drake

In designing a strategy for the radio search for extraterrestrial civilizations, we must make assumptions as to the sophistication and nature of the technology such civilizations might use to contact us. Such assumptions cannot be fool-proof, of course, in view of the fact that the creatures of other worlds may be far different from us and far more evolved biologically and sociologically. This could lead to radio transmissions which might seem to us remarkable or bizarre. So, no matter what our observational approach is, our philosophy and techniques may be "wrong", because of some technical "what ifs."

For instance, *what if* a civilization sends a radio signal our way only a small fraction of the time, say maybe a few hours a year? Then we must search every combination of direction in the sky and radio frequency many many times before hitting upon the brief interval when the signal is actually arriving here. The search could be lengthened thousands of times by this "what if?" alone.

What if a method of coding is used which escapes the net set by our computer programs? We might well receive an information-bearing message and never realize it. At this time our radio telescopes look for modulation patterns of the sort that we use here on earth, such as TV signals. Yet, it is entirely reasonable that other types of modulations would be used. These might include changing the polarization of the radiation, say, from right-handed circular to left-handed circular polarization. There are many such possibilities and we simply cannot predict or

search for all such combinations.

What if the "signal" is a myriad of weak signals? It is likely that most civilizations, like us, would broadcast very few strong signals, but a host of weaker ones. In such cases, the chances are small that any one of the strong signals are beamed our way. If our search patterns are geared to detect only these signals, then it is possible that we will not receive the other weaker ones simply because we have not used the correct techniques or built the proper instrumentation. In practice the detection of an ensemble of signals, each one by itself invisible, is possible but it requires a mathematical treatment of the observational data which is very demanding on computer systems.

To be sure, there will be many forms of intelligent life unimaginably different from ours. They will behave differently, and what is reasonable to them will be greatly different from our concepts of rationality. It could be that we cannot communicate with such creatures at all, even if we are able to detect them. There is no strategy we can now construct to cope with this plausible situation.

But *what if* they are immortal? This "what if" has come to trouble me a great deal.

Immortality is a different matter. Rather than rare, it may well be very common. By immortality, I mean the indefinite preservation, in a living being, of a growing and continouous set of memories of the experiences of the individual in which the memories reside. This could come about by the development of methods to eliminate the aging process in humans, or it could come through the discovery of means to repair indefinitely the damage caused by the aging process. It could come about through the development of the means to transfer the inventory of memories of an old brain into a young brain, perhaps even the brain of a clone, an exact copy of a person whose individuality is to be preserved. Death could still occur through the physical destruction of the human being.

Some of the steps seem not far in our future.

Just as nuclear energy and radio telescopes were inevitable steps in the technological development of our civilization, so it seems entirely reasonable to expect that in the biological realm time will bring us immortality, just as surely as it brought us a cure for poliomyelitis.

Although we can grasp some of the vast differences between our lives and those of immortal individuals, the totality of differences between a society of immortals and our own is surely beyond our comprehension. Immortals must have a fantastic obsession with safety, and every device and vehicle must be so constructed as to present no lethal hazard under any circumstance. I suspect that the use of aircraft for transportation, or indeed for any purpose, might be impossible, since a falling aircraft is a hazard to those on the ground as well as those aboard. But then, after all, who would be in a hurry anyway? Wars would probably no longer occur because no one would take the risk of fighting. One wonders how new births would be administered. Obviously after a relatively brief interval, the number of persons living would reach some optimal number which could not be exceeded. At that point, new births could be permitted only when someone died — an event which would happen rarely. So, someone would have to decide who should be authorized to contribute to the replacement of a human being.

A civilization of immortals would probably be extremely active in detecting and communicating with other intelligent civilizations for several reasons. First, such a civilization would soon use up the resources for amusement and adventure in its own limited planetary system and would want to share vicariously in the adventures of other civilizations.

More importantly, the reverence they would attach to the preservation of individual lives would drive these immortals to avoid physical threat from another planet, even over the cosmic time scale. This may seem a remote possibility, but they would have to be certain. They might in fact conceal themselves, and could prohibit transmission of radio signals detectable by other civilizations. This would not prohibit all signals, but only those so strong that they could be separated from the radio noise of the central star. But this would not stop civilizations with questionable intentions from seeking them out.

An immortal civilization's best assurance of safety would be to make other societies immortal like themselves, rather than risk hazardous military adventures. Thus, we could expect them to spread actively the secrets of their immortality among the young, technically developing civilizations. This hypothesis suggests that the numbers of their signals may well be greater than we imagine.

One practical consequence results from this somewhat muddy situation: no matter

what the immortals' philosophy, they have all the time in the world. Immortality destroys the need to do anything in a hurry. And, when it comes to radio signaling, this can be used to enormous practical advantage. For you can signal reliably to all parts of the galaxy with little power and expense by concentrating that power in a very limited frequency band.

Any signals we can now detect require such a power that it is reasonable to assume that they are created by powerful radio transmitters whose output is concentrated into a narrow beam by a large radio telescope. This creates a high power level — but only in a small part of the sky. Such a transmission is an ineffective way to proceed if you don't know the location of other civilizations. The best way to contact civilizations whose direction is unknown is to transmit through a small antenna or radio telescope which will spray the power over a much larger fraction of the sky. The resultant signal strength in any given direction is very much less. But you can compensate for this by confining the transmitted power to a much smaller band of frequencies so that the power level in each unit frequency interval is very great. In this way one can compensate for the lack of beaming by the radio telescope by narrowing the frequency bandwidth of the signal. A small transmitter can create just as great a signal-to-noise ratio, or signal detectability, in a narrow band as would be created on a wider bandwidth by a gigantic transmitting facility.

This hypothesis, which leads to the assumption that we must detect a signal of narrow bandwidth, greatly increases the number of frequency channels which must be searched. More importantly, because of the laws of physics, we must assume under this hypothesis that information can be transferred only very slowly.

To give a numerical example, if the bandwidth of the transmission channel is only 1/1,000 cycle per second, a minimim of a 1,000 seconds is required to transmit any information at all. This may seem remarkably slow to us, but to the immortals it would seem the obvious way to go. It is entirely conceivable that the premier form of interstellar message consists of an extremely narrow-bandwidth transmission, perhaps only of 1/1,000 of 1/10,000 cycle per second wide, which changes in intensity or polarization, or in some other way, only in times of the order of hours.

There are natural limitations on the minimum bandwidth of interstellar signals, the result of clouds of interstellar gas containing a few electrons per cubic centimeter meandering across the lines of sight between civilizations. As these clouds cross

the line of sight, the path of the radiation is slightly altered, with the result that the source appears to be moving toward or away from the receiver. Thus a tiny doppler effect is introduced. This changing doppler effect causes a drift in the signal frequency, limiting the minimum bandwidth. Numerically these drifts are terribly small, and they allow signal bandwidths of the order mentioned above.

All of the SETI searches so far have used bandwidths so great that their sensitivity to the signals of the immortals was probably only 1/1,000 of what is achievable with available equipment. Narrower bandwidths have not been used because the experimenters wanted to search some appreciable part of the universe within a short available time. With narrower bandwidths of the order of 1/1,000 cycle per second, the number of frequency channels which must be searched to cover a reasonable part of the radio spectrum is some ten trillion. No one has yet had the courage or the equipment to attack such a formidable number of possibilities.

I fear we have been making a dreadful mistake by not focusing all searches — including those to be accomplished by a system such as Cyclops — on the detection of the signals of the immortals. For it is the immortals we would most likely discover.

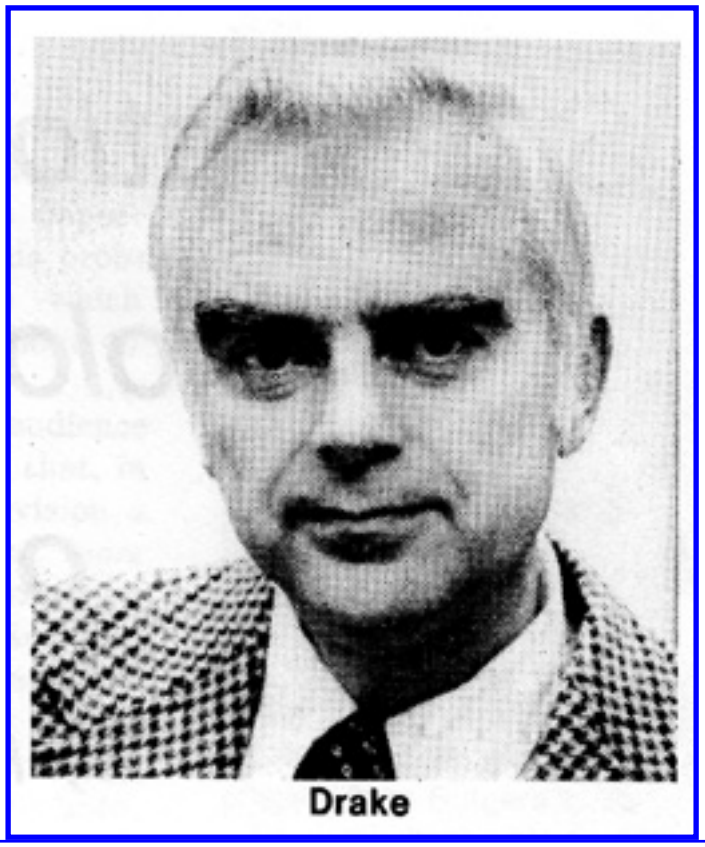
I have already given one reason why we should expect them to be abundant as message transmitters. But there is another independent argument which calls for the immortals' signals to be in the numerical majority.

It has been said that when we first discover other civilizations in space we will be the dumbest of them all. This is true, but more than that, we will probably be the only mortal civilization. Why is this?

We understand full well that our galaxy is a continuously evolving system producing new intelligent civilizations at nearly a constant rate. Indeed, the rate of production of new civilizations has been estimated at about one per year, including civilizations that remain mortal as well as those which achieve immortality. Mortal civilizations probably do not remain detectable forever, because their increasing technical sophistication enables them in time to cease the release of energy to space and thus to become undetectable. But some immortals must continue to transmit for cosmic time intervals, for the reasons given before. The number of either type of civilization at a given time is very simply the rate of appearance times the average

longevity of civilizations. We think most intelligent civilizations become immortal, but even if this were not true and immortality were achieved only occasionally, the product of that rate times a nearly infinite lifetime will give a total number of immortals far greater than the population of all detectable mortal civilizations. So it is likely that immortals will dominate space. We should therefore concentrate our search on their signals, the narrow-band signals described above. We must pour some new wine into the old bottles of those who design searches for extraterrestrial intelligent signals. Otherwise, we could very well miss the strongest, and perhaps most provocative signals of all.

A portion of the above article by Frank Drake appeared in the June 1976 issue of the M.I.T. *Technology Review*. Reprinted by permission of *Technology Review*. Copyright 1976.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