# COMMUNICATIONS FROM SUPERIOR GALACTIC COMMUNITIES

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SINCE Morrison and Cocconi[1] published the suggestion that there might be advanced societies elsewhere in the Galaxy, superior to ourselves in technological development, who are beaming transmissions at us on a frequency of 1,420 Mc./s., Drake[2] has described equipment under construction to look for such transmissions. The confidence necessary to commence actual observations is based on an opinion that planets are a common by-product of the formation of stars. One argument among others is that stars of spectral type later than $F5$ have low angular momenta, just as the Sun has; and in the case of the Sun we know that it is because the momentum (98 per cent of it) resides in planets[3]. Of the thousands of millions of planets in the Galaxy likely to be situated similarly to the Earth in relation to their star, it is hard to dismiss the possibility that some have more advanced civilizations than ours. In view of the acceleration with which technology develops, advanced societies could be incredibly more advanced.

Any simple test of this possibility would be well worth while. Drake plans to look at $\tau$ Ceti and $\varepsilon$ Eridani. Of the list of likely neighbouring stars given by Morrison and Cocconi, these two, and $\varepsilon$ Indi, are the only ones left when we eliminate double stars. Because of orbital perturbations, the planets of double stars are, with some exceptions, not expected to possess equable climates over the geological periods deemed necessary for evolution[4].

But do we really expect a superior community to be on the nearest of those stars which we cannot at the moment positively rule out? Unless superior communities are extremely abundant, is it not more likely that the nearest is situated at least ten times farther off, say, beyond 100 light years? Let us assume that there are one thousand likely stars within the same range as the nearest superior community. This makes it hard for us to select the right one. Furthermore, if this advanced society is looking for us, we can only expect to find them expending such effort as they could afford to expend on the thousand likely stars within the same range of them. It does not seem likely that they would maintain a thousand transmitters at powers well above the megawatt estimated by Drake as a minimum for spanning only 10 light years, and run them for many years, and we could scarcely count on them paying special attention to us. Remember that throughout most of the thousands of millions of years of the Earth's existence such attention would have been fruitless.

Would not this other more advanced society, on the contrary, be doing what we ourselves are now discussing and are on the point of doing, probably during this century, namely, sending probes to nearby stars. Their exploration and other activity would be intense in their immediately neighbouring planetary systems. Beyond their immediate neighbourhood, it might be feasible for them to spray some number of suitable stars, say, one thousand, with modest probes. Each probe would be sent into a circular orbit about one of the thousand stars, at a distance within the habitable zone of temperature. Armoured against meteorites and radiation damage, and stellar powered, the probes could contain durable radio transmitters for the purpose of attracting the attention of technologies such as ours.

Using this plan, our hypothetical advanced neighbours could lay down a stronger signal here than they could with a home-based transmitter handicapped by inverse-square attenuation over interstellar distances. They would also eliminate their dependence on our ingenuity in selecting the right star and the right wave-length.

For this reason we might better devote our efforts to scrutinizing our solar system for signs of probes sent here by our more advanced neighbours. In this way we would be effectively paying attention to all stars capable of reaching us. We need not expect, however, that any community other than the nearest is trying to reach us, because the superior communities throughout the galaxy are probably already linked together into an existing galaxy-wide chain of communication. They will act in concert and avoid duplication in searching. Our impending contact cannot be expected to be the first of its kind; rather it will be our induction into the chain of superior communities, who have had long experience in effecting contacts with emerging communities like ours.

For suggestions as to how the superior communities may detect us, consider what we might do to detect them. A very good first project for us, when we come to probe outside the solar system, would be to seek the presence of technological development on $\tau$ Ceti and $\varepsilon$ Eridani by means of a probe that would listen for the existence of monochromatic radio-communication, and report back by star-to-star relay. We would see whether there is in those solar systems a radio-frequency line emission spectrum such as the Earth now emits. It is possible, in fact, that the hypothetical feelers sent out in large numbers by our nearest superior community did no more than listen for this radiation. If so, a positive answer could have been on the way back to the home star several decades ago, and we may look forward in due course to the arrival of a more sophisticated mission.

However, since interstellar transfer of material things is time-consuming, and transfer of information is in any event more important, it would be commensurate with the effort of delivering a material probe into our solar system if the very first probe sent here contained a quite elaborate store of information and a complex computer, so that it could not only detect our presence, but could also converse

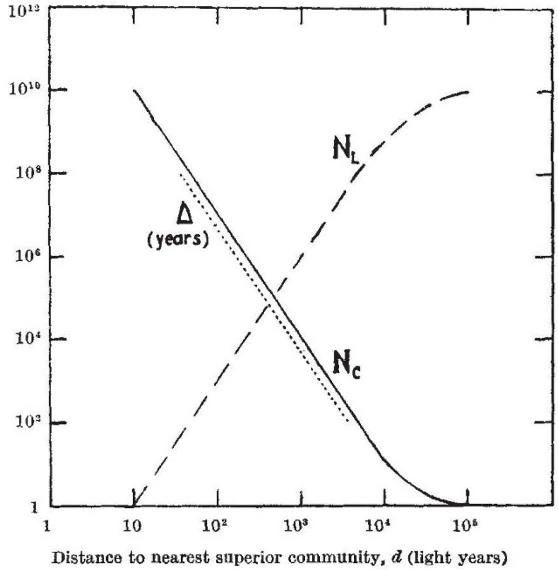


Fig. 1. $N_C$, total number of communities in the galaxy the technology of which is superior to ours; $N_L$, total number of likely stars out to a distance $d$; $\Delta$, average life-time of a superior community

with us. Such a probe may be here now, in our solar system, trying to make its presence known to us. For this purpose a radio transmitter would seem essential. On what wave-length would it transmit, and how should we decode its signal ? To ensure use of a wave-length that could both penetrate our ionosphere and be in a band certain to be in use, the probe could first listen for our signals and then repeat them back. To us, its signals would have the appearance of echoes having delays of seconds or minutes, such as were reported thirty years ago by Størmer and van der Pol[5] and never explained.

To notify the probe that we had heard it, we would repeat back to it once again. It would then know that it was in touch with us. After some routine tests to guard against accident, and to test our sensitivity and band-width, it would begin its message, with further occasional interrogation to ensure that it had not set below our horizon. Should we be surprised if the beginning of its message were a television image of a constellation ?

These details, and the matter of teaching the probe our language (by transmitting a pictorial dictionary ?), are fascinating but present no problems once contact has been made with the probe. The latter is the main problem. The important thing for us is to be alert to the possible interstellar origin of unexpected signals. We must avoid relegating them, if they are there, to the fate of the very strong emissions from Jupiter (of the order of 1,000 megawatts per Mc./s.) which were heard and ignored for decades[6].

If after a few years of careful attention we find no signs, radio or other, of such probe, we shall have to admit the possibility that our nearest superior community is beyond the range where attempts at contact with us would be assured of much certainty of success.

To survey the possibilities of there being a superior community within reaching distance of us, consider Fig. 1, which shows the number of superior communities in the Galaxy, $N_C$, plotted against the distance to the nearest superior community, $d$, in light years. This graph is obtained from the broken curve which shows a quantity $N_L$, the number of likely stars at a range less than $d$. By likely stars I mean those 5 per cent[4], here taken as $10^{10}$ in number, that cannot be ruled out at present as unsuitable to support life. The curve is based on a galactic mass distribution model and cannot be considered accurate to better than an order of magnitude.

Now consider the consequences if $N_C = 10^7$. Then $d = 100$ light years, and the number of likely stars within this range is $10^3$. The frequency of occurrence, $p$, of superior communities among likely stars, is $10^{-3}$. Although we have no evidence for intelligent life elsewhere, yet if we consider that on the average it takes $5 \times 10^9$ years for a likely star to produce one superior community, which then endures for an average life-time $\Delta$ measured in years, then $p = 10^{-3}$ implies a $\Delta$ of $5 \times 10^6$ years, assuming that we are in a state of secular equilibrium. This would seem to offer ample time to explore the $10^3$ stars out to 100 light years and establish a chain of communication.

Consider the consequences, however, if technology in our galaxy is less abundant, for example, take $N_C = 10^3$. Then $p = 10^{-7}$, $N_L = 10^7$, $d = 2{,}000$ light years, and $\Delta = 500$ years. The duration of communities which can maintain a frequency of occurrence of only $10^{-7}$ is thus, on the average, too short to permit interstellar traffic.

If intelligent life does develop on other likely systems at the same tempo as ours has developed, and if some superior community has not made contact with us, it may simply be that the mortality-rate for advanced civilizations is too high for them to become abundant in the Galaxy. Even so, it is rather striking that there would be a thousand superior communities present in the Galaxy at any time even though it takes as long as five thousand million years to produce a technological community that is viable, on the average, for only 500 years beyond the point we have reached.

Even in the event of technology being rare, there is, however, the possibility of a chain existing. Thus, in a Galaxy supporting only $10^3$ superior communities with brief expectation of life, there may be some communities that have achieved durability, even quasi-permanence, perhaps by gaining control of the circumstances that lead to short average life-times. Aided by accidental proximity due to random spacing, some of these could be in contact. Presumably such an ancient association would be very able indeed technically, and might seek us out by special means that we cannot guess. Whether they would be interested in rudimentary societies which, in their experience, would usually have burnt themselves out before they could be located and reached, is hard to say. Such communities would be collapsing at the rate of two a year ($10^3$ in 500 years), and they might already have satisfied their curiosity by archæological inspection made at leisure on sites nearer home. On the other hand, the prospect of catching a technology near its peak might be a strong incentive for them to reach us.

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