

## NONCONSCIOUS INTELLIGENCE IN THE UNIVERSE†

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(Received 29 November 1991)

**Abstract**—Animals lacking humanoid intelligence have evolved systems indistinguishable in function, if not in structure, from systems built by humans. Although radio communication has never been verified in animals, it is completely feasible biologically. If such systems are present in non-intelligent organisms on other planets, then our chances of detecting life in the universe by current SETI methods are greatly enhanced.

### 1. INTRODUCTION

A curious aspect of the Search for Extraterrestrial Intelligence (SETI) is that it is promoted largely by physical scientists. Most evolutionary biologists and paleobiologists have either ignored SETI or have argued actively against the proposition that there exist civilizations elsewhere in the universe with anything approaching humanoid intelligence. This negative attitude was articulated by G. G. Simpson [1] in his classic essay entitled "The Nonprevalence of Humanoids" and is still supported by the vast majority of organismic and evolutionary biologists [2].

Biologists offer two main arguments against SETI. First, that the evolutionary process is fundamentally nonrepeatable, meaning that if an organism evolves once, it is most unlikely to evolve again. Simpson stated this as follows:

"No species or any larger group has ever evolved, or can ever evolve, twice. Dinosaurs are gone forever. Nothing very like them occurred before or will occur after them. That is so not only because of the action of [natural] selection through long chains of nonrepetitive circumstances . . . [but also] . . . because . . . there is a . . . random element in evolution involved in mutation and recombination . . ."

The conclusion drawn from this is that "nothing very like" human intelligence has or could evolve elsewhere in the universe and therefore, SETI programs are futile. Simpson and other biologists have been careful to emphasize that their reasoning applies to humanoid intelligence even in the absence of the humanoid form.

Although Simpson's conclusion has been challenged by citing several apparently remarkable examples of convergent evolution—as, for example, the similarity of the eyes of organisms as different as molluscs and mammals—such cases are seen by most biologists as not comparable to the evolution of intelligence. In commenting on this, Mayr [2] states boldly that, "Those who have thus argued, unfortunately, do not know their biology." For support, Mayr notes that eyes have evolved independently at least 40 times on Earth but that humanoid intelligence has evolved only once.

The biologists' second argument is one of timing. Human intelligence appeared on Earth several billion years after the origin of life and about three-quarters of a billion years after the evolution of advanced, multicellular organisms. But there is nothing in evolutionary theory that predicts or requires this timing. Intelligence could have evolved much earlier, much later, or not at all. Furthermore, since human intelligence in its modern form originated, its development has been dominated by rapid cultural evolution, as opposed to the slower, Darwinian evolution. Intelligence as we know it thus occupies an extraordinarily small time window: one not likely to be shared by an extraterrestrial organism even granting—which the biologists do not—that comparable intelligence could evolve elsewhere.

Thus, the evolutionary biologists challenge the non-zero probabilities commonly attached to two important constants in the Drake equation: the probability of humanoid intelligence evolving on another planet and the probability of this evolution overlapping in time with our own. Regardless of the validity of these arguments, searches for extraterrestrial intelligence are a fact of the international scientific community and it is sad that more biologists are not participating in what is fundamentally a biological problem.

My purpose in this paper is to present an alternative view—one that may eliminate the major objections just discussed.

†Paper IAA-87-599 presented at the 38th Congress of the International Astronautical Federation, Brighton, U.K., 10-17 October 1987.

## 2. ALIEN INTELLIGENCE ASSUMED BY SETI STRATEGIES

Nearly all SETI reasoning is based on the presumption (or hope) that organisms in an alien biology have developed scientific and technical abilities close enough to our own for them to be able (and willing) to communicate with us *or* that they have communication systems that give off signals that we can detect in an eavesdropping mode. It is assumed that this requires something like the level of science that we enjoy, with the well-developed powers of reasoning, information storage, and tool-making technology necessary to manufacture and deploy sophisticated electronic instruments.

In view of the amount of convergent evolution called for, I find it hard to fault the skeptical reactions of Simpson and the other evolutionary biologists. The SETI proponents are asking for an intelligence so humanoid as to be incredible in the current state of evolutionary theory.

Intelligence in the absence of science and technology is not considered viable in a SETI context. Tarter [3] put it this way:

“...if the [alien] universe is teeming with beautiful worlds of water, populated by the super intelligent analogs of terrestrial dolphins and whales, *lacking manipulative organs and any technology*, then no passive search strategy will detect them directly.” (*Italics added.*)

## 3. ANIMAL ENGINEERING

It is well recognized that many animals (and plants as well) are master engineers (see von Frisch for review [4]). Examples include temperature and air quality control in termite nests, systems of bee navigation, and communication by electrical signals in fish.

Especially dramatic cases of engineering by animals relate to the use of magnetic navigational devices in birds, insects, and fish. These animals synthesize tiny crystals of the magnetic mineral magnetite and use them to sense the orientation and strength of the Earth's magnetic field. This allows them to move from place to place with reference to the natural magnetic landscape—a landscape formed by the heterogeneities in the Earth's crust and capable of being “visualized” as readily as we visualize the physical landscape. More important, these animals have developed the onboard computers necessary to process the magnetic information. Gould [5] described these organisms as “...most usefully thought of as no more than microcomputer equipped machines, programmed and then laboriously “debugged” by their genes...”

Thus, many organisms on Earth display systems which could have been the products of humanoid intelligence even though we know they are hard-wired by the evolutionary process and owe nothing to

intelligent behavior as we know it. The important element here is that the products of animal engineering are often indistinguishable in function from instruments devised and manufactured by humans. In fact, some sensory systems in animals solve problems that human engineering has not yet been able to treat. And even where humans have solved the same problems, animals have often done so far earlier in geological time.

An especially dramatic example is found in the optics of the eyes of extinct trilobites—crab-like creatures that died out 250 million years before the origin of Man. According to the interpretation of Clarkson and Levi-Seti [6], trilobite eyes were excellent approximations of aplanatic lenses and indistinguishable from designs published by Descartes and Huygens in the 17th century. In fact, the trilobite optical system was actually an improvement over the Descartes and Huygens designs in that it was modified in various ways to optimize performance under water. A modern optical engineer attempting to develop this lens system would need a thorough knowledge of Fermat's principle, Abbe's sine law, Snell's laws of refraction, and the optics of birefringent crystals (the last being because the trilobite used the highly birefringent mineral calcite as the lens material).

The message of this and countless other examples familiar to any watcher of television nature programs is that animals can do anything we can do—and they often do it earlier and better. It is impossible to prove this proposition, of course, but it may be a good approximation of reality.

The products of animal engineering rarely look anything like their human analogs, of course. Lens systems in trilobite eyes and magnetite navigational instruments in birds are not manufactured in any human sense. The animals lack our manipulative ability and obviously do not fabricate things as we do although even this generalization is weakened when one considers the manipulative fabrication that goes into the building of termite nests and other sophisticated structures.

## 4. CAN ANIMALS WITHOUT INTELLIGENCE BUILD RADIOS?

Systems of intraspecies communication used by animals are of special interest in the SETI context because of the possibility—remote though it may be—that animals have or could have developed systems of communication capable of being “heard” from great distances. Many of the currently employed strategies in the search for extraterrestrial life are predicated on the hope that signals used in intraspecies communication in an alien biology are strong enough to be detected from space. This is based in part on the knowledge that some human communication systems are leaking radiation that could be picked up at great distances. If the current listening

systems of SETI programs are successful, will we be able to distinguish intelligent from non-intelligent emissions? This reduces to the question of whether it is biologically possible for a non-intelligent species to develop something comparable to our radio?

To date, functioning radios have not been incontrovertibly demonstrated in animals. Moffler [7] published data indicating that a variety of marine fish transmit radio signals although the experiments have not been repeated. But the possibility of radio communication by animals on Earth cannot be ruled out. It is well known that many animals can detect magnetic fields and/or generate substantial electric currents (see Anderson for review [8]).

The so-called "electric fish" and a number of sharks, rays, catfish, and eels, generate and use electric fields for hunting and intraspecies communication. Pulses emitted range as high as 600 V. The electric fish discharge either pulses or waves. Wave-emitting species exhibit sinusoidal discharges with stable repetition rates from 100 to 1800 Hz although individual fish operate in much narrower ranges, often related to sex and age. That these signals are used for communication has been confirmed by experiment (see Moller for review [9]). Individual fish even shift frequency to avoid jamming by other fish (of the same or different species). Furthermore, these capabilities have evolved independently in widely separated biologic groups and the organs responsible for electric discharge differ substantially in embryonic origin from group to group. Like visual systems—but unlike humanoid intelligence—electrical systems appear to be "easily" developed in evolution.

Thus, the ingredients for effective radio communication are clearly available in the animal world and it may only be a matter of time until true radio communication is discovered in our own biosphere. Biologists have been stunned too many times in recent years by discoveries of sensory systems thought to be impossible (sonar, for example). Furthermore, the large element of chance inherent in any evolving system makes it reasonable that an alien biology could have developed systems not known on earth. The possibility of radio (or radar) evolving naturally in an alien biology would be enhanced if body size of individuals (or colonies) were larger than on Earth.

##### 5. THE NATURE OF INTELLIGENCE

The foregoing discussion suggests that what might be called intelligent behavior is not limited to intelligent organisms.

Definitions of intelligence and of intelligent behavior are critically important. We are accustomed to thinking of intelligence in human terms. Most definitions start with the obvious importance of problem-solving and then proceed to describe the abilities that make rapid, effective problem-solving possible. Minsky [10] listed the following as import-

ant ingredients: the ability "to break hard problems into simpler ones," to "understand how things change", to "allocate scarce resources," and to "organize work." Obviously, these and other mental abilities depend, in turn, on the existence of considerable reasoning power.

In the SETI context, it is assumed that for a search to be successful, the alien organisms must have reasoning power suitable to recognize problems and to solve them quickly and efficiently—and, of course, the cultural level and manipulative ability to implement the solutions through technology.

I submit that the traditional way of thinking about intelligence mixes two very different elements: the *fact* of problem-solving and the *means* by which problems are solved. Let me suggest, as an alternative, a much less restrictive definition of intelligence: *the ability to solve problems quickly enough for the survival of the species*. It follows from this that the various lists of *means* used to solve problems merely describe those used by one species, *Homo sapiens*.

All organisms on Earth (and presumably elsewhere) are effective problem-solvers. They are constantly faced with problems that must be solved if they are to survive. The problems range from avoiding lethal conditions in the physical environment to purely biological problems of food-gathering, waste disposal, reproduction and avoidance of predators. The documented history of life on Earth shows many successes and failures in problem-solving. The several million species living today are those which, with their ancestors, were able to cope with the trials of changing environments and thus must have been able to solve the problems they faced before it was too late. The several billion extinct species were not so fortunate. Some, like the dinosaurs, solved problems successfully for more than 100 million years, only to go extinct at the end of the Cretaceous—presumably because circumstances changed more rapidly than their problem-solving ability could develop solutions.

It can even be argued that problem-solving ability is the single most effective criterion to separate life from non-life, or animate from inanimate.

##### 6. ANIMAL INTELLIGENCE

Animals do not use what we normally think of as intelligence, of course. Consider, for example, the problem faced by insects at risk of being eaten by birds. Some species have evolved defense mechanisms based on camouflage, with wing coloration that looks enough like the bark of a tree to make them effectively invisible to predators. Others have developed color patterns so much like those of noxious species that predators avoid them. In both cases, the insects have arrived at solutions not unlike those that human intelligence might develop but they have done so by natural selection rather than by using any sort of reasoning ability.

Consider, purely as a thought experiment, that we were actually intelligent butterflies living in a world that came to be invaded by ruthless (but not intelligent) birds. Our scientists and engineers might devise several possible solutions and this would (hopefully) lead to a program of manufacture and deployment of effective defensive measures. Assuming we had or could generate some manipulative ability, the solutions might involve camouflage pigment applied to our wings or, if our butterfly science were sufficiently advanced, we might use genetic engineering to modify the genetic code so that future generations would grow up with natural protective camouflage. Or we could synthesize substances toxic to the birds but not to us—either to be attached to our bodies or synthesized by our own physiologies. Any of these solutions would be effective if it were implemented quickly enough to make the survival of the species possible.

The striking fact is that actual butterflies have solved the predation problem without humanoid intelligence. They have done so through the cumbersome and inefficient but highly effective method of natural selection. Any random mutation producing an alteration in color pattern or toxicity that provided partial protection from predation was favored so that frequencies of the mutant gene were enhanced in future generations—leading ultimately to the near-perfect mimicry (of tree bark or noxious species) that characterizes so many insects today. The resulting adaptation is hard-wired and does not involve intelligence in any human sense but the adaptation is just as effective as any devised by human intelligence.

In view of the foregoing, we can reasonably think of evolved adaptations in non-thinking animals (and plants as well) as being the products of intelligence although nothing like the sort we use as humans. To make the distinction, I will call the human approach to problem-solving *conscious intelligence* and contrast it with *nonconscious intelligence* for that evolved in the animal and plant worlds. The mechanisms of problem-solving in nonconscious intelligence are totally different, and operate on different time scales, but the results are often functionally identical.

#### 7. PROBLEMS OF TIMING

If a race of ordinary, non-intelligent butterflies were suddenly invaded by predatory birds, there might not be enough time to develop and deploy defensive measures without the aid of conscious intelligence. Conscious intelligence has a clear advantage over nonconscious intelligence in its power to react to problems quickly. Yet, the example of real insect evolution demonstrates that animals are able to evolve quickly enough to survive. On planetary time scales—measured in millions or billions of years—the sluggishness of problem-solving by animals using only nonconscious intelligence may not be signifi-

cantly different from the faster method used by humans.

An important element of the sophisticated engineering systems used by animals is that they usually are stable over tens or hundreds of millions of years. This is in sharp contrast to the systems developed by human intelligence, the latter being ephemeral because of the rapidity of the cultural evolution process. For SETI purposes, animal systems are more likely to overlap in time with our own technology.

#### 8. CONCLUSIONS

1. Many animals on Earth exhibit feats of engineering which are functionally indistinguishable from the technology produced by human intelligence.

2. Animal engineering is accomplished through Darwinian natural selection. Although this requires more time than its human equivalent, the time difference may not be significant on planetary time scales.

3. The kind of problem-solving used by animals may be called *nonconscious intelligence* in contrast to the *conscious intelligence* of humans.

4. Although radio communication has not evolved among animals on earth, as far as we know now, the fact that many animals can detect radio signals and/or generate strong electrical pulses suggests that radio communication in non-intelligent animals is possible. Therefore, organisms on other planets may use natural radio communication and detection from space is a possibility.

5. Radio communication developed by non-intelligent organisms in other planetary systems probably persists for much longer time spans than such systems developed by intelligent organisms. Therefore, the common SETI problem of a time match between our technology and that of alien organisms may be eliminated.

6. If we accept the possibility that non-intelligent organisms may emit radio signals, the probability of detecting life, although not necessarily intelligent life, by SETI searches is enhanced because (a) we are not dependent on the presence of humanoid intelligence elsewhere in the universe and (b) the probability of our living at a time when radio signals are being generated is increased.

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