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ESSAY

Could Extraterrestrial Intelligences be Expected to Breathe Our Air?

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Abstract — An objection sometimes raised to the Extraterrestrial Hypothesis (ETH) in UFOlogy, especially as it is applied to Close Encounters of the Third and Fourth Kinds (cases wherein UFO occupants appear), is that beings from other worlds could not find our own atmosphere compatible. Therefore all such reports are a' priori false. This paper goes beyond that simple "common sense" position to analyze whether it is scientifically defensible. It concludes that this anti-ETH position is not only indefensible but that reasonably strong arguments can be made that atmospheric compatibility might be the rule rather than the exception. Information is drawn from astronomy, planetology, biology and the history of technology.

Introduction

Research into the UFO phenomenon has inevitably birthed many hypotheses, and the ETH is the most widely and intensely debated among them. When one spends much time with UFO reports, this debate about extraterrestrials becomes understandable. Many of the outstanding cases researched by serious UFOlogists lend themselves to the ETH (in some form or another) quite naturally. (A very few examples would be: Boianai, New Guinea, June 26-7, 1959 (Cruttwell, 1971); The Betty and Barney Hill CEIV, White Mountains, New Hampshire, September 19, 1961 (Fuller, 1966); Allagash Waterway, Maine, August 26, 1976 (Fowler, 1993); Buff Ledge, Vermont, August 7, 1968 (Webb, 1994); and Roswell, New Mexico, July 4, 1947 (Randle and Schmitt, 1994). Each of the listed CEIII and IV cases are multiple witness cases.) The ETH is also a natural subject for debate because, to most individuals, educated or otherwise it is the least bizarre and incredible of the suite of so-called "extraordinary" hypotheses (see Table 1). Although some may want to debate this, the academic literature's willingness to hold forth endlessly on the likelihood of extraterrestrial intelligence all over the galaxy (vs. the dearth of commentary on other possible realities) indicates that the ETH is "closer to the skin" of establishment conservatism (it's more of a demon at the door) than the other theories. Also the ETH seems to demand a hearing, as it fits so nicely within the confines of current thoughts about what the universe should be like. If readers doubt this, I remind them of the "Fermi Paradox" (If there are

TABLE 1

The Mundane Class:

a) simple misidentification of "everyday" natural and artifactual entities;
b) puzzlement by rare natural but known phenomena;
c) mental deficiencies (hoaxes, lying, hallucinations, and psychiatric phenomena);
d) "unknown" USA or USSR secret technologies;
e) "games" played by the intelligence community.

The "well, maybe" class:

a) rare as-yet-unclassified natural phenomena;
b) (as above), combined with rare as-yet-unclassified mental phenomena;
c) "unknown" secret technologies from other goverments or hi-tech industries.

The extraordinary class:

a) The ETH in its various forms;
b) unknown natural phenomena stimulating psychic phenomena;
c) Atlantaeans, Aghartians, Lemurians, and Secret Societies;
d) Angels, Demons, Spirits, and Signs of the Apocalypse;
e) Jungian projected entities and tulpas;
f) glimpses of parallel realities;
g) insertions from multi-dimensional realities;
h) time travelers.

A partial list of hypotheses applied to UFO phenomena.

so many of them, why aren't they already here?) which arose almost immediately in the minds of persons studying SETI possibilities.

The ETH, as it is usually discussed, is neither science nor pseudoscience nor anti-science. It is merely human beings trying to make sense out of a complicated ongoing mystery. Science itself employs large theoretical "untestables" all the time (ex. Cosmic Evolution, Darwinism, Continental Drift): huge macroconcepts within which only small pieces can be tested or checked for their correlation with the larger thought. The ETH grows out of a similar urge to place a bewildering complexity into a conceivable context. It does, however, fail next to constructs like Darwinism, because whereas the latter has lots of "stuff' sitting (relatively) still to experiment upon, the ETH must make do with mere humans and their tales. Many kinds of research can be done, of course, but the conservative academics are correct to maintain a proper skeptical distance. Every so often some member of academia will venture into UFOlogical waters with what is, apparently, a deliberate attempt to sink the ETH ship with a grand stroke. In my experience, these forays are always ill-prepared and ill-conceived (even, often, ill-mannered). This paper will address arguments of one of the seemingly cleverer members of this breed: the attempt to dispense with all Close Encounter tales which involve humans and aliens co-existing in the same atmosphere. In short, no separately evolved intelligences can, unaided, co-exist. "They" could not possible breathe "our" air.

The Negative, in Brief

Commentary on this issue of breathing one another's atmosphere seems "reasonable" at first glance, but becomes more sociologically than scientifically interesting on inspection. One could expect some clever analysis of planetology, biochemistry, or physiology lying at the root of strong claims of incompatibility. No such basis has appeared. In its place are simple assertions almost of the "well, everyone knows that" type. And where is their root? Apparently, it is a combination of science fiction thinking (e.g. wow, there are all sorts of wild amazing places and weird creatures out there) and an interpretation of Darwinism which preaches that all developments are random and unpredictable (to the ignorance of the restrictions placed on organisms-which-succeed by physics, chemistry, and the rest of the environment). The negative view of atmospheric compatibility surprisingly never speaks of real atmospheres and their relationships to real planetology, physiology, and technology. It just casually assumes: well, everybody knows that it's impossible; everyone smart, anyway. The interesting sociological point here lies in the ability of persons to get away with saying such poorly defended things, which they never could get away with had they taken the opposite side of the argument. It is a common theme seen all over the literature when "academics" write on the subject of UFOlogy (Swords, 1994). They are willing to write things of such shallowness and lack-of-background work (as long as they are negative) that they could never conceive of daring in any other line of commentary.

Fire and ET

Something that a lot of academic types have forgotten or at least don't think much about is the critical importance of fire to our ancient ancestors (Singer, 1954; Campbell, 1981). Maybe it was my doctoral training in the history of technology which made me recall it in meditation on the subject of this paper, but few things were more emphasized as crucial to our human advancement. The role of fire is partly obvious, and maybe not so obvious. The "maybe not" is the necessity of fire, controlled fire, to manipulate materials and break them down into their elemental components. [Breaking materials down is the road, the only road, to establishing material technology.]

It has been suggested to me that this absolutist statement about the "only road" is at least debatable, if not wrong. Alternatives such as the addition of one substance to another (components, elements, alloys, et al) as a means to new material science ***without*** fire was broached. I am open to someone demonstrating this sort of non-fire-based materials science, but where these "components, elements, and alloys" will originally come from without fire somewhere down the road remains a complete puzzle to me. It is in the breakage, manipulation, and recombination of materials that one achieves metallurgy, much of chemistry, glass technology, polymers, et al. Without fire leading to metals technology there is no controlled electricity, no electric age, and cer-

tainly no nuclear age. All technology on a fireless world would be the simple utilization of what nature gives one, an almost passive interaction. Fire is the gate to the possibility of "high technology", the only gate. If anyone is in agony about this and wishes to protest science-fictionally, I say fine. Go and be well. But go knowing that whatever alternatives read by this author (beasts in molten lava, space fields, force beings caressing neutron star surfaces) make far less serious sense than creatures utilizing fire as a prime mover to create a technical civilization and, even should they eke out their bizarre existence somewhere, they seem unlikely candidates to build spacecraft and sail the stars.

Having made another strongly negative statement (about exotic lava-beasts and neutron-star beings), I should admit that several people balk at this point. They are sure that I am presenting close-minded terrestrial-chauvinism instead of a more imaginative and reasonable flexibility. Because this is important to try to clarify, I would like to briefly belabor a few of the previous points.

The argument in this paper is all of one piece, and it has many facets. The "ground rules" (or assumptions) upon which this is based are that we are talking about a technological civilization, which sometime in its past evolved from primitivism to a state where it could build transport vehicles and sail the universe (i.e. could an extraterrestrial arriving in a spacecraft breathe our air?). I believe that it is very difficult to imagine a creature spread out on the surface of a neutron star able to (or wanting to, even) build a three-dimensional normal-elements-using space vehicle, and flying around the universe in it. Although a non-materials-based "space-field creature may interact in some ways with normal matter and three-dimensionality, the use of such materials seems irrelevant, perhaps antithetical to such beings, if they could exist at all. And they would probably have to be able to maintain their own integrity passing in or near fires or stars to manipulate that matter to begin building up a matter technology. And do all this when such seems more a restriction to non-material fields than an aid. And as to things such as lava-creatures, the material integrities would be very difficult to maintain in such environments. As temperature rises, materials tend to homogenize and "information" tends to wash out.

These speculations could be spun out and argued eternally, and it is not my preference to do so at all, except that such challenges always arise. The most significant point is that all these "alternative lifeforms" are merely wildly speculative mind-play for which there is not a speck of evidence or even deductive support. And so, from the point of view of this paper, if a spacecrafting ET lands, what's it more likely to be: something we know can exist and which "works", or something that we just have fun musing about? I am placing strong odds on Carbon and Water-based, "historically evolved", fire-using technologists from "Life Zone" inhabiting planets. I will be happy to be shown a real alternative, but am loathe to accept a vague intuition about "other possibilities".

TABLE 2

Elements	The Galaxy	Solar System
Hydrogen	10,000,000	10,000,000
Helium	1,400,000	≥ 1,000,000
Oxygen	6,800	10,000
Carbon	3,000	5,000
Neon	2,800	2,000
Nitrogen	910	≥ 900
Silicon	300	500
Magnesium	290	300
Iron	200	300
Sulfur	100	100
Argon	42	70
Aluminum	19	30
Sodium	17	15
Calcium	17	15
Nickel	30	10
Chlorine	4.5	4
Phosphorus	3	5
Potassium	0.8	≤ I

Measurements of elemental distributions from stars, interstellar clouds, comets, meteroites, and our own Sun and planets indicate that the materials of the cosmos are the same in both type and quantity. (References with numbers like the above are common throughout the literature with but small variations.) (ex. Smith: 1981).

Oxygen

Fire in a technologically developing world demands oxygen. Really? Screams of negativist chemists might now be heard. The sentence was written as above as a test; to see if such screams of protest were induced. If any of us emitted them, we should ask ourselves why. Was it because we knew other combustion-supporters exist, and so, thank goodness, the drift of this ETH-friendly paper must be wrong? Or was it because we took the whole sentence into account, referred to a deep store of data about planetology and technical development and were rightfully outraged? Of course, I assume the great majority of readers were better behaved.

Why, then, does fire demand oxygen in such a world? It is of course true that other combustion-supporters exist: chlorine and the other halogens mainly. It is also true that none of our "cosmochemistry" indicates that these alternatives will be common in a dense planetary atmosphere (see Table 2). And none of our planet formation theory alters that conclusion. If you want a planet with a combustion-supporting atmosphere, it better have a lot of free oxygen in it. Free oxygen is a very unusual commodity in a chemically dense and reactive environment such as a planet. Some rather odd "advanced" process is needed to free it up. That itself implies a lot about its past evolutionary history vis-a-vis life (i.e. something had to free up this bulk of oxygen over *long periods* of biological development). And if you want to have someone around to use this great gift of fire and potential technology, that too will imply a great deal about our mythical planet's character and history.

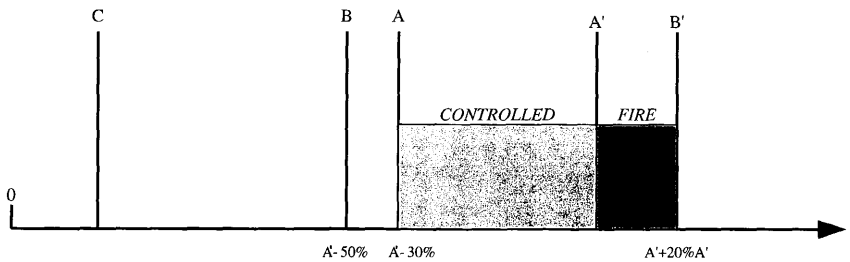
The Fire Zone

The bottleneck to materials technology requires consistent controlled fire. It's not going to happen by technological primitives running in the open with iron ore in their hands hoping to get struck by an ambient lightning bolt (or dare-devils with preternatural heat-resistance fishing ores in and out of burbling magma-pools). The technical primitives need something that's useful to them, that they can modulate, and become familiar with. Then the "accidents" and "experiments" can occur in a useable way.

Controlled fire means that you can keep a fire going at all. There is, for any reasonable and conceivable atmosphere type, a minimum density of oxygen atoms necessary to sustain a flame. This density alters depending upon how much other atomic or molecular stuff occupies this atmosphere with the oxygen (too much other "stuff' can interfere with the oxygen atoms' abilities, their free paths, to get to and keep combustion going). For "thin" atmospheres, this swamping effect of other molecules isn't important, but the 0, density is. We see this latter effect in our own atmosphere as we ascend higher and higher. There comes a place, an elevation, where 0_2 density thins below that necessary to sustain fire. "Coincidentally" human permanent high-altitude settlements cease just below this threshold as well (West, 1981). There is, therefore, on any world a minimum threshold of oxygen density required for controlled fire.

Controlled fire means that it will not rage out-of-control. Well, that seems pretty safe, doesn't it? The point is, however, that oxygen density can become too rich, even explosively dangerous once combustion begins. Nature, it turns out, seems to have at least one gross (and probably several ecologically subtle) governors to the high end of oxygen density. The gross governor is the barrier or organic wildfires (Cloud, 1989).

The existence of a planetary atmosphere loaded with bulk free oxygen requires a lot of past biology. This biology must be copious and carbon-based (Goldsmith and Owen, 1980 have a nice discussion of this issue; Chapter 11). The arguments for the latter point are also copious and shouldn't have to be recited here (despite the screams of the science-fictionists). This carbon-based world is eminently combustible, and cannot endure regular wildfires with much hope of survival. The beginnings of technical civilizations would be practically impossible. A world bearing advanced technical life (home-bred, anyway) has solved its oxygen density problems in some way (probably via intricate and subtle negative feedback, so-called GAIAN, mechanisms). For those who suggest that an alternative world, not caring about such wildfires because it was all oceanic, is a possibility for a high oxygen atmosphere, I say the idea is clever but all wet. The technological life form needs to *control* fire *where it lives*. Underwater seems a poor combustion environment. Occasional fire-seeking dog-paddling at the surface seems worse. We need a land animal. And we, therefore, need a well-behaving atmosphere with oxygen in a controlled fire zone (see Table 3).



Oxygen Density and Fire on Earth

Fig. 1. Oxygen Density and Fire on Earth. **C** = oxygen levels at beginning of the explosion of multicellular life forms on Earth (– 0.1 present level). **A'** = current oxygen availability at sea-level. **A** = current oxygen availability at highest permanent human settlements. A to **A'** represents the minimal range of oxygen adaptability of human species. This range will almost certainly extend to **A'+** levels as well. B = oxygen availability at which common organic materials in nature become difficult to combust using primitive means. Below (approximately) this level, primitive intelligences could not effectively use fire, and, consequently, their progress toward technology would essentially cease. Any ETI arriving here evolved on worlds with oxygen availability higher than B. B' = oxygen availability at which accidental fires of common organic materials in nature become uncontrollable firestorms. This is nature's natural upper limit for **O,** availability, controlled catastrophically or otherwise by Gaia effects. Any ETI arriving here evolved on worlds with oxygen availability lower than B'.

The controlled fire zone's upper limit on our Earth seems to be fairly near the current upper limit of our sea-level oxygen density. Dr. Preston Cloud of Stanford University saw evidence in the fossil record that our world may have pressed this limit sometime in the past (i.e. an age of wildfires) before finding its ecological adjustment mechanisms. This upper limit is not precisely known, of course, but it is interesting to note that humans can comfortably exist in an enriched oxygen atmosphere several percentages higher than current sea level densities. We can, therefore, breathe all the oxygen densities which our own Earth affords us, all across the controlled fire zone. But what about ET?

Alien Worlds

As we for the next few pages seek alien worlds, remember that it is only a particular type of world which we are seeking, a world which could bear a civilization capable of creating high-technology spacecraft. What are the chances that such worlds even exist? The initial step in answering this question is the familiar SETI-debate question of how prevalent are planetary systems? Since most of us haven't been out there to look, we of course aren't sure of this answer. But we're pretty sure. As amply argued elsewhere, there are about a dozen lines of evidence and decently-supported theory which all point to the

conclusion that planetary systems are common. In fact it would be one of astronomy's greatest surprises if it were to turn out otherwise. (For references to this and many other points to follow, see Papagiannis, 1989; and references in Swords, 1989; 1991).

One of the founding faiths of science is that Nature acts in uniform ways throughout its domain. This is part of this paper's view that the ET-technology-producing worlds would have much in common. One of the apparently common elements in the story is the commonality of the elements — the chemical elements, that is. As pointed out in Table 2, our measurements of meteorites and star-and-dust light indicate not only that the elements are everywhere the same, but also that they exist in approximately the same abundance ratios as we see in our own system. Equal laws working on equal materials might produce similar structures. And so it seems to be, at least with the gross physical structures of planetary systems as predicted by current theory. The systems would seem to be revolutionary disk-like structures with heavy fusing objects as the gravitational anchors (suns) and lighter, usually non-fusing objects revolving in a relative flat plane around them, obeying Kepler's and Newton's laws. The lighter objects have dense iron-dominated cores surrounded by solids and fluids whose elemental ratios reflect those of the original planetary cloud from which they came, and the Universe from which it came. The objects, the planets, are smaller near the star and larger further away (Wetherill, 1991; Hughes, 1992). This, it turns out, is the "simple" physics of the gravitational war for materials which took place between the central star and the proto-planets in their violent youth. The computer simulations spill out systems much like our own. Nature, we believe, behaves. But what if She doesn't behave? What if weird things happen? Fine. We will keep an open mind. But why proceed on the basis of what we do not believe, rather than on what we do?

Alien Earths

For our source planets for ET, the technologically advanced ET, we look close to the stars. We might, with speculators like Carl Sagan, imagine and hope for life forms in the cloud layers of distant gas giants or the strange satellites which surround them, but few would look for technology and fire there. We need a warm watery world with life-sustaining oceans and oxygen-rich skies... and land, lots of land for the technologists to dig into and grow and build upon. The necessity for the land-based fire-controlling and generally "handy" technological ET has been addressed elsewhere (Swords, 1991; 1993). I'll not belabor it here. The mere remembrance of the advantages of fire-in-air vs. fire-in-water ought to suffice for the moment. So what will our near-star alien worlds be like?

According to the computer simulations, there exists a range of sizes of terrestrial (Earth-like) bodies which show up close to the suns. Some of these are quite small, but of negligible import in our discussion. Why? Very small

planets will not effectively hold atmospheres (ex. our Moon and Mars), and so will not give birth to advanced life or ET. We are only concerned with those which may. Very large terrestrial planets are apparently impossible due to the gravitational greed for matter in their nearby sun. This leaves us with a range of probable "Earths" perhaps from one-half current Earth-mass to two-and-a-half Earth-mass in size. Objects near the lower end of the range are most common. This range in and of itself bespeaks of a great deal of commonality, and it in fact is probably even more so. This is because the elemental constituencies of terrestrial planets near the so-called "liquid water" or "life" zones are probably fairly similar, and their densities may be relatively close as well. If so, the gravitational burdens of creatures at their surfaces would be less different than the actual mass ratios of the planets might indicate; the creatures on the "heavier but bigger" planets being further removed from the gravitational center.

Note also the similarities required by the liquid water environment. Once again science-fictionists will howl, but the alternatives for liquid water are untenable by any current understanding. And the speculation of life originating and developing without any ease of mixing medium is next to preposterous. Water it is, and fluid water we must have. That means a certain temperature, which means a certain distance from the star (thus the term "life zone"). As has been pointed out many times, this probably means only certain types of stars as well (not too big nor too small), and thereby we see our little earths circling stars of a small range of energy outputs, situated at nearly equal distances from their stars, bathed in similar if not identical energy influxes. An earth-like water-world revolving about a sun-like star bathed in comfortable energies... recognizable chemical elements in recognizable universal ratios forming a planet with a similar gravity-burden at its surface... yes, the advanced life-bearing environments of the galaxy seem "wildly random" indeed. But what about the atmospheres exactly?

Alien Airs

Planetary formation theory includes the important matter of the evolution of terrestrial planetary atmospheres (Lewis and Prinn, 1984; Atreya *et* al., 1989). Is it speculative? Of course. But it is what scientists think now. The pattern of atmosphere evolution is in stages, as follows:

1. The Primordial Atmosphere, a hydrogen and helium-dominated atmosphere taken directly from the original protostellar cloud;

2. The Non-atmosphere, a naked stripped planet caused by the violent outrush of solarwinds produced by a probably common hyper-bright early condition (the T-tauri Stage) of young suns. At this point, all terrestrial world atmospheres are created equal. That is, they don't exist. Whatever differences may have existed in the protostellar cloud, as far as our ET-bearers are concerned, they're gone now;

3. The Secondary Atmosphere, an atmosphere which must emerge from the

planet itself, produced by intense subsurface heat acting upon whatever's below. This is an atmosphere produced by chemistry. It is a chemistry acting upon a set of structures determined in significant part by the relative chemical element abundances. The major gaseous molecules released by this geochemistry should be: water vapor, carbon dioxide, and nitrogen. Smaller amounts of hydrogen-containing gases plus moieties such as carbon monoxide might be present. This is the second atmosphere;

4. Clean Air, an atmosphere cleared of most of its components and left with relatively pure nitrogen. This atmospheric stage appears on future life-bearers for two reasons: first, the major components (water and carbon dioxide) must largely disappear. Water must liquify (if this is to be a water-world life-former) and rain-out of the skies. It also must do this to take with it the carbon dioxide (the prime "greenhouse gas"), which will otherwise overheat the planet by infrared retention. Water must exist originally in far greater quantities than carbon dioxide to get this greenhouse cleansing accomplished. Fortunately, according to the universal elemental abundances favoring oxygen over carbon, it should be. Then assuming proper distances from the sun, temperature should not (as on Venus) get out of control. The second, very minor cleansing should occur when life begins. The hydrogen-rich gases and other chemically active molecules should find a home in the metabolic processes of early life forms once they arise. Our terrestrial water-zone atmospheres should look pretty much the same: Nitrogen at slightly different densities and "impurities";

5. Slowly increasing Oxygen content up the Fire Control Zone. We've discussed this earlier. If the "world" is to produce a technological extraterrestrial, it must produce a combustion-facilitation atmosphere, which implies a past history of biology emitting free oxygen in bulk over many aeons. What this section of the paper has tried to accomplish is to demonstrate that it was likely that the required oxygen build-up would take place in an atmosphere and a planetary force-environment not terribly unlike our own (gravity; chemistry; radiation-inputs). The result:

Earth-sized water-worlds with atmospheres swept clean of carbon dioxide, growing life in their oceans and oxygen in their nitrogen-rich atmospheres... extraterrestrial life-seeds turning about their yellow suns... allowing fire, metals, machinery, and minds flying into the blue.

Breathing the Blue

It is this author's opinion (alas not fact; despite all my wishing, I haven't been there), that the "blue skies" of the technological extraterrestrials, at least during their developmental planet-based periods, were and are much the same as our own. Furthermore, in this extravagant opinion I believe that I have most of the best current scientific information and model-building on my side. Because we humans are so well and flexibly adapted to breathe all oxygen densities in our own fire control zone, I believe it likely that we might flexibly be

able to handle "their" fire control zone atmosphere as well. And why not vice versa? Yes, I can imagine terrestrial oxygen-nitrogen atmospheres of somewhat different densities and humidities, and I can also imagine them being astoundingly similar. What I also can imagine, *but with no scientific legitimacy whatever,* are atmospheres filled with ammonia, chlorine, sulfur dioxide — even carbon dioxide and noble inert gases — from which technological civilizations arise. I am not in a position of "belief" about this, and am quite willing to change my mind if facts and models change. But I think that if one uses the facts and models we currently have, one would suspect that it would be quite possible, even perhaps *likely,* that when *ET* steps off the UFO onto the White House lawn, the words, "take me to your leader" will be uttered without a mask and riding on good ole terrestrial air.

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