



Cons Sciências 2 2005

Actas do Fórum Internacional
Ciência, Religião
e Consciência



Centro Transdisciplinar de Estudos da Consciência

Incommensurability, Orthodoxy and the Physics of High Strangeness: A 6-layer Model for Anomalous Phenomena

Jacques F. Vallee and Eric W. Davis (*)

Abstract

The main argument presented in this paper is that the continuing study of unidentified aerial phenomena (“UAP”) may offer an existence theorem for new models of physical reality. The current SETI paradigm and its “assumption of mediocrity” place restrictions on forms of non-human intelligence that may be researched. A similar bias exists in the ufologists’ often-stated hypothesis that UAP, if real, must represent space visitors. Observing that both models are biased by anthropomorphism, the authors attempt to clarify the issues surrounding “high strangeness” observations by distinguishing six layers of information that can be derived from UAP events, namely (1) physical manifestations, (2) anti-physical effects, (3) psychological factors, (4) physiological factors, (5) psychic effects and (6) cultural effects. In a further step they propose a framework for scientific analysis of unidentified aerial phenomena that takes into account the incommensurability problem.

(*) Based on a presentation at the Forum on “Science, Religion and Consciousness” at the University Fernando Pessoa, Porto (Portugal) 24 October 2003.

Jacques Vallée has a Ph.D. in computer science; Eric Davis holds a Ph.D. in physics. Both are consulting members of the National Institute for Discovery Science, Las Vegas, Nevada.

The Challenge of High Strangeness

The rational study of reported cases of Unidentified Aerospace Phenomena (UAP) is currently at an impasse. This situation has as much to do with the incomplete state of our models of physical reality as it does with the complexity of the data. A primary objection to the reality of UAP events among scientists is that witnesses consistently report objects whose seemingly absurd behavior “cannot possibly” be related to actual phenomena, even under extreme conditions. Skeptics insist that intelligent extraterrestrial (ETI) visitors simply would not perpetrate such antics as are reported in the literature. This argument can be criticized as an anthropocentric, self-selected observation resulting from our own limited viewpoint as 21st century Homo Sapiens trying to draw conclusions about the nature of the universe. Nonetheless, the high strangeness of many reports must be acknowledged.

Advocates of UAP reality, on the other hand, generally claim that the Extra-Terrestrial Hypothesis (ETH) centered on interstellar travelers from extrasolar systems visiting the Earth is the most likely explanation for the objects and the entities associated with them. This argument, too, can be challenged on the basis of the witnesses’ own testimony: Ufologists have consistently ignored or minimized reports of seemingly absurd UAP behaviors that contradict the ETH, by selectively extracting data that best fits their agenda or version of the ETH. Thus the ETH, just like the skeptical argument, is based on anthropocentric self-selection (Vallee, 1990). Here we are witnessing an interesting overlap between the SETI and UAP paradigms: each excludes consideration of the other when laying claim to the legitimate search for and contact with potential non-human intelligence.

In the view of the authors, current hypotheses are not strange enough to explain the facts of the phenomenon, and the debate suffers from a lack of scientific information. Indeed, from the viewpoint of modern physics, our Cosmic Neighborhood could encompass other (parallel) universes, extra spatial dimensions and other time-like dimensions beyond the common 4-dimensional spacetime we recognize, and such aspects could lead to rational explanations for apparently “incomprehensible” behaviors on the part of visitors to our perceived continuum. As it attempts to reconcile theory with observed properties of elementary particles and with discoveries at the frontiers of cosmology, modern physics suggests that mankind has not yet discovered all of the universe’s facets, and we must propose new theories and experiments in

order to explore these undiscovered facets. *This is why continuing study of reported UAP events is important: It may provide us with an existence theorem for new models of physical reality.*

Much of the recent progress in cosmological concepts is directly applicable to the UAP problem: Traversable wormholes (3-dimensional hypersurface tunnels) have now been derived from Einstein's General Theory of Relativity (Morris and Thorne, 1988; Visser, 1995). In particular, it has been shown that Einstein's General Theory of Relativity does not in any way constrain spacetime topology, which allows for wormholes to provide traversable connections between regions within two separate universes or between remote regions and/or times within the same universe. Mathematically it can also be shown that higher-dimensional wormholes can provide hypersurface connections between multidimensional spaces (Rucker, 1984; Kaku, 1995). Recent quantum gravity programs have explored this property in superstring theory, along with proposals to theoretically and experimentally examine macroscopic-scale extra-dimensional spaces (Schwarzschild, 2000). Thus it is now widely acknowledged that the nature of our universe is far more complex than observations based on anthropocentric self-selection portend. In this respect, ufologists and SETI researchers appear to be fighting a rear-guard battle. Both suffer from identical limitations in the worldview they bring to their own domains, and to their antagonism.

Anthropocentric Bias in the SETI and UAP Paradigms

The anthropocentric biases in the SETI program are evident in the present search paradigm. Historically the founders of SETI defined the search paradigm from a series of complex arguments and assumptions that led to the creation of a "SETI orthodox view" of interstellar communication while applying the "assumption of mediocrity" to our known present technological capabilities (Oliver et al., 1973).

This approach was predicated on the notion that it was economically cheaper and technologically easier to generate and receive radio-wave photons for interstellar signaling rather than engage manned interstellar travel or robotic probes. Indeed the latter was considered economically and technologically improbable within the "SETI orthodox view". This has led to

four decades of the SETI program following a dominantly radio/microwave (RMW) oriented search scheme.

Given the failure of this initial approach, in the last two decades alternative SETI programs have been proposed. They exploit coherent laser optical/IR (COSETI), holographic signals and worldwide web detection schemes, as well as ideas to search for ETI artifacts (SETA, or astroarchaeology) and visiting probes (SETV, V=visitation) in the solar system or on Earth (Tough, 2000).

There are new proposed search schemes based on the application of high-energy (particle) physics detection, such as modulated neutrino beams, X-rays, gamma rays, and cosmic rays, etc. Other search schemes propose looking for artificially generated excess radiation emissions from astronomical bodies in space or for high-energy radiation starship exhaust trails (G. Matloff, personal communication, 1998).

These new programs have been at odds with members of the dominant RMW-SETI program, possibly because of concern over having to share scarce resources or compete with other non-RMW programs for the very limited private funding available for overall SETI research.

The community of UAP researchers is also driven by its own orthodoxy, which is only violated at great personal risk to the critic who proposes a deviant view, and by its own “principle of mediocrity” when attempting to categorize and hypothesize explanations for the phenomenon. For this reason we prefer to use the term “UAP” rather than the more common “UFO”, which is immediately associated with the idea of space visitors in the mind of the public and media. Yet a bridge could be formed between the disparate SETI and UFOlogy communities if both would only recognize a simple fact: *No experiment can distinguish between phenomena manifested by visiting interstellar (arbitrarily advanced) ETI and intelligent entities that may exist near Earth within a parallel universe or in different dimensions, or who are (terrestrial) time travelers.*

Each of these interesting possibilities can be manifested via the application of the physical principle of traversable wormholes since they theoretically connect between two different universes, two remote space locations, different times and dimensions (Davis, 2001). Traversable wormholes are but one example of new physical tools that are available or on the horizon for consideration of interuniversal, interstellar, interdimensional or chronological travel.

This leads the present authors to speculate that a new synthesis can be found by examining the full context of the UAP phenomenon -- including its apparently “absurd” characteristics -- in terms of a six-layer model. The model uses the framework of the incommensurability problem and concepts borrowed from semiotics.

UAP - The Need for a Unified Approach

What we present here is a new framework for UAP analysis that takes into account the lessons from SETI. In any scientific question it must be possible to ascertain to what extent a hypothesis, when tested and proven to be true, actually “explains” the observed facts. In the case of UAP, however, as in physics generally, a hypothesis may well be “proven true” while an apparently contradictory hypothesis is also proven true. Thus the hypothesis that the phenomenon of light is caused by particles is true, but so is the opposite hypothesis that it is caused by waves. We must be prepared for the time when we will be in a position to formulate scientific hypotheses for UAP, and then we may face a similar situation.

The framework we present here is based on such an apparent contradiction, because we will argue that UAP can be thought of both as physical and as “psychic”. We hope that it will prove stimulating as a unified approach to a puzzling phenomenon that presents both undeniable physical effects suggesting a technological device or craft *and* psychic effects reminiscent of the literature on poltergeists and psychokinetic phenomena. Here we use the word “psychic” in the sense of an interaction between physical reality and human consciousness.

The feeling of absurdity and contradiction in these two aspects is not worse than scientific puzzlement during the particle/wave or, more recently, quantum entanglement and multi-dimensional transport controversies. The contradiction has to do with the inadequacy of our language to grasp a phenomenon that defies our attempts at classification.

The Six Layers of UAP Analysis

Let us consider the characteristics of the sightings that are not explained by trivial natural causes; we can recognize six major “layers” in terms of our perceptions of these characteristics,

as they can be extracted from earlier works about UAP phenomenology (Vallee, 1975a, 1975b) or from the current NIDS database.

Layer I: First of all is the *physical layer*, evident in most accounts describing an object that:

- ∅ occupies a position in space, consistent with geometry
- ∅ moves as time passes
- ∅ interacts with the environment through thermal effects
- ∅ exhibits light absorption and emission from which power output estimates can be derived
- ∅ produces turbulence
- ∅ when landed, leaves indentations and burns from which mass and energy figures can be derived
- ∅ gives rise to photographic images
- ∅ leaves material residue consistent with Earth chemistry
- ∅ gives rise to electric, magnetic and gravitational disturbances

Thus UAP, in a basic physical sense, are consistent with a technology centered on a craft that appears to be using a revolutionary propulsion system.

Layer II: For lack of an adequate term we will call the second layer *anti-physical*. The variables are the same as those in the previous category but they form patterns that conflict with those predicted by modern physics: Objects are described as physical and material but they are also described as:

- ∅ sinking into the ground
- ∅ shrinking in size, growing larger, or changing shape on the spot
- ∅ becoming fuzzy and transparent on the spot
- ∅ dividing into two or more craft, several of them merging into one object at slow speed
- ∅ disappearing at one point and appearing elsewhere instantaneously
- ∅ remaining observable visually while not detected by radar
- ∅ producing missing time or time dilatation
- ∅ producing topological inversion or space dilatation (object was estimated to be of small exterior size/volume, but witness(s) saw a huge interior many times the exterior size)
- ∅ appearing as balls of colored, intensely bright light under intelligent control

Layer III: The third layer has to do with the *psychology* of the witnesses and the *social* conditions that surround them. Human observers tend to see UAP while in their normal

environment and in normal social groupings. They perceive the objects as non-conventional but they try to explain them away as common occurrences, until faced with the inescapable conclusion that the object is truly unknown.

Layer IV: *Physiological* reactions are another significant layer of information. The phenomenon is reported to cause

- Ø sounds (beeping, buzzing, humming, sharp/piercing whistling, swooshing/air rushing, loud/deafening roaring, sound of a storm, etc.)
- Ø vibrations
- Ø burns
- Ø partial paralysis
- Ø extreme heat or cold sensation
- Ø odors (powerful, sweet or strange fragrance, rotten eggs, sulphurous, pungent, musky, etc.)
- Ø metallic taste
- Ø pricklings
- Ø temporary blindness when exposed to the objects' light
- Ø nausea
- Ø bloody nose and/or ears; severe headache
- Ø difficulty in breathing
- Ø loss of volition
- Ø drowsiness in the days following a close encounter

Layer V: The fifth category of effects can only be labeled *psychic* because it involves a class of phenomena commonly found in the literature of parapsychology, such as

- Ø impressions of communication without a direct sensory channel
- Ø poltergeist phenomena: motions and sounds without a specific cause, outside the observed presence of a UAP
- Ø levitation of the witness or of objects and animals in the vicinity
- Ø maneuvers of a UAP appearing to anticipate the witness' thoughts
- Ø premonitory dreams or visions
- Ø personality changes promoting unusual abilities in the witness
- Ø healing

Layer VI: The sixth category could be called *cultural*. It is concerned with society's reactions to the reports, the way in which secondary effects (hoaxes, fiction and science-fiction imagery, scientific theories, cover-up or exposure, media censorship or publicity, sensationalism, etc.) become generated, and the attitude of members of a given culture towards the concepts that UAP observations appear to challenge. The greatest impact of the phenomenon has been on general acceptance of the idea of life in space and a more limited, but potentially very significant, change in the popular concept of non-human intelligence.

Possible Nature of UAP Technology

A framework for scientific hypothesis on the UAP observations can be built on the identification (admittedly very coarse) of the six major layers of UAP effects. If we must formulate a view of the problem in a single statement at this point, that statement will be:

Everything works as if UAPs were the product of a technology that integrates physical and psychic phenomena and primarily affects cultural variables in our society through manipulation of physiological and psychological parameters in the witnesses.

This single statement can be developed as follows:

- a) The phenomenon is the product of a technology. During the observation, the UAP is a real, physical, material object. However, it appears to use either very clever deception or very advanced physical principles, resulting in the effects we have called “anti-physical”, which must eventually be reconciled with the laws of physics.
- b) The technology triggers psychic effects either purposely or as a side effect of its manifestations. These consciousness phenomena are now too common to be ignored or relegated to the category of exaggerated or ill-observed facts. All of us who have investigated close-range sightings have become familiar with these effects.

- c) The purpose of the technology may be cultural manipulation – possibly but not necessarily under control of a form of non-human intelligence – in which case the physiological and psychological effects are a means to that end. But the parapsychologist with a Jungian framework may argue that the human collective unconscious is also a potential source of such effects – without the need to invoke alien intervention.

The Incommensurability Problem

The above considerations bring us back to a discussion of the SETI paradigm. Many SETI workers now realize that we cannot be so presumptuous as to assume that ET cultures, possessing a cognitive mismatch with us, will behave as humans do in the 21st century. Specifically, there is no reason to restrict them to radio-based communications technology and to exclude travel through interstellar space or the sending of automated probes. Thus the SETV/SETA program overlaps ETH-based UFOlogy. Both are dedicated to detecting non-human intelligence on or near the Earth, demonstrating a paradigm shift away from the “SETI orthodox view” and principle of mediocrity.

The view that ETs and humans may have such divergent ways of conceptualizing the world that there can be no mutual understanding is referred to as the “Incommensurability Problem” in the SETI literature (Vakoch, 1995; D. A. Vakoch, private communication, 1999). The cognitive mismatch or Incommensurability Problem between human and ET cultures will guarantee that the latter will develop communication techniques other than radio. ET cultures may be sending radio and optical signals to Earth now but they may also be sending signals in a variety of other forms such as holographic images, psychic or other consciousness-related signals, modulated neutrinos, gamma ray bursters, wormhole-modulated starlight caustics, signals generated by gravitational lensing techniques, modulated X-rays, quantum teleported signals, or some quantum field theoretic effect, etc. The Incommensurability Problem even applies to the problem of understanding UAP manifestations within the framework of the ETH.

At the core of the Incommensurability Problem is the view that no intelligent species can understand reality without making certain methodological choices, and that these choices may vary from civilization to civilization (Vakoch, 1995). If ETs and UAP entities have different biologies and live in considerably different environments from humans, they may well have

different goals for their science, and radically different criteria for evaluating the success of their science. Their explanatory mechanisms, their predictive concerns, their modes of control over nature might all be very different, and their means of formulating models of reality should be expected to differ drastically from ours (Rescher, 1985).

In this regard, there is one additional feature that needs to be mentioned in support of alternative SETI paradigms. The SETI program's encryption/decryption emphasis on pictorial images or messages is predicated on the assumption that ETs have sight like humans vis-a-vis the "SETI orthodox view" (Oliver et al., 1973). We observe that this emphasis is not so much a reflection of the primacy of vision in humans, but rather a reflection of the philosophical assumptions about the proper means of gaining knowledge. Hence, anthropocentric self-selection becomes manifest within the SETI and UFOlogy "orthodox view".

Michel Foucault asserts that human reliance on science is based on studying visible characteristics of objects (Foucault, 1966). The belief that true knowledge must be acquired from sight originated in the 17th century. This emphasis on sight led to eliminating the other senses as potentially valuable sources of scientific information.

Without even raising the question of whether ETs or UAP entities can "see", we may be wise not to overestimate the importance of pictorial representations for them. The same applies for ET/UAP transmissions to us. We can see and gain knowledge by sight, but ET/UAP signals potentially bombarding the Earth could be misunderstood, unrecognized or undetected because we are not employing paradigms involving our other modalities, such as psychic functioning. Many examples of this are found in interactions between humans from different cultures (Highwater, 1981).

Because we cannot be certain of the nature of ET/UAP recipients of our deliberate messages and they cannot be certain of our nature when sending us their messages *a priori*, it is difficult to construct pictures that will be unambiguous. To some extent, ET/UAP viewers of our pictograms may project characteristics from their own species-specific experiences onto our messages, and we certainly project our own species-specific experiences onto their messages. The former may be the cause for the lack of detected ET signals (save for those 100+ radio and optical signals which were not false positives but also not repeated by their source) while the latter can be the cause of the current impasse in the study of UAP phenomena.

Semiotics

In his analysis of the communication problem SETI Institute psychologist Doug Vakoch has advocated the application of semiotics, the general theory of signs (D. A. Vakoch, private communication, 1999), where a sign is something that represents something else, the signified. For example the words “the coin” might represent the object you hold in your hand.

In interstellar messages, in terms of classical information theory, there is no innate relationship between the form of the message and the content borne by the message. Once the information of the message is decided upon, an efficient means of encoding it is sought. In this approach, there is a purely arbitrary connection between content and form of the message. Semiotic-based messages have a wider range of possibilities for relating form and content.

Semioticians categorize signs according to the ways that the sign and signified are related to one another. In the association between the sign “the coin” and its signified object, this relationship is purely arbitrary. The sign for this object could have well been “the poofhoffer”. This is a purely conventional association. In semiotics, when the association between sign and signified is arbitrary, the sign is referred to as a symbol. With symbols, there is no intrinsic connection between the form of expression (the sign) and the content that is expressed (the signified).

There are alternatives to the arbitrary connection between sign and signified that are seen in symbols. One alternative is the icon, a sign that bears a physical resemblance to the signified. With icons, the form of the message reflects its contents. For example, the profile of the man on a modern American quarter is an icon for a specific man who was the first President of the United States. We can also represent the same man with the symbol “George Washington”. In the former case, the image of Washington is an icon because it physically resembles the signified. Icons can also be used when the signified is less concrete. For example, the scales of justice icon represents the concept of justice because there is similarity between the sign (scales that balance two weights) and the signified (concept of justice, which involves a balance between transgression and punishment).

It is also helpful to realize that icons are not specific to the visual sensory modality. It is possible to have a sign that physically resembles the signified in a nonvisual way. For example,

the fly *Spilomyia hamifera* beats its wings at a frequency very close to the wing-beat frequency of the dangerous wasp *Dolichovespula arenaria*. As a result, when one of these flies is in the vicinity of a group of these wasps, the fly gains some immunity from attack by insect-eating birds. The fly's mimicry of the wasps occurs within the auditory modality. It is not attacked by would-be predators because it sounds like the wasps. In short, the fly's defense strategy is based on producing an auditory icon, in which the fly's wing-beating (the sign) physically resembles the wing-beat of the wasps (the signified) (D. A. Vakoch, private communication, 1999).

Icons could function in any sensory modality. Given that we are not sure which sensory modality will be primary for ETs/UAP, a sign for communication that is not reliant on any particular sensory modality would be preferable. In SETI/CETI, electromagnetic radiation is used as an iconic representation, allowing a direct communication of concepts (Earth chemistry, solar system organization, human DNA, math, geometry, etc.) without encoding the message into a format specific to a particular sensory modality. In using icons, the message's recipients are pointed directly toward the phenomena of interest, and not toward our models of these phenomena.

From a more complete perspective, the sign and the signified are in a triadic with the interpreter of the relationship. Thus, the similarity that exists between an icon and its referent does not exist independently of the intelligence perceiving this similarity. Although in iconicity there is a natural connection between the sign and the signified, this connection cannot exist without intelligence to observe the connection.

Ultimately, the problem of iconicity is that similarity is in the eye of the beholder. And because we do not know what ETs/UAP are really like, we cannot be sure that what to us seems an obvious similarity will be seen as such by an intelligence with a different biology, culture, and history, possibly originating in a different universe. Thus, judgment of similarity is not purely objective, but is influenced by a variety of factors that impact conventions of interpretation.

The UAP and Abduction Problem

The aforementioned behavior of UAP is not fundamentally absurd. This apparent absurdity is merely a reflection of the cognitive mismatch or the Incommensurability Problem that exists between humans and the phenomenon.

In this particular case, UAP are sending the message and we are the recipients. The message(s) they are sending to us are icons, icons fashioned by the phenomenon and sent to us via various sensory modalities. The difference between our respective cultures, biologies, sensory modalities, histories, dimensional existence, physical evolution, models of nature and science, etc. is directly responsible for our lack of understanding of the phenomenon and its message. We cannot see what UAP believe to be (iconical) similarities in the message that is intended for us. These stated differences directly impact our conventions of interpretation in such a way as to impair our recognition of the “similarity” between the sign and the signified contained within the icons of the UAP message, further impairing our ability to “see and understand” the potential message.

The difference between the sensory modalities of UAP entities and humans is responsible for our inability to properly detect the UAP message (icons) and correspond with them. This difference may also prevent us from correctly interpreting what their icons are if we do in fact recognize them. In this regard, recall that we will project our own species-specific experiences onto their icons (messages) thus manifesting the appearance of “absurdity” during the human-UAP interaction.

UFO abduction cases may exemplify this, in the sense that the “absurd” activities (or scenes) concurrent with abduction events could merely be the iconic defense mechanism deployed by the UAP to protect itself from the victim/subject much like the way *Spilomyia hamifera* protects itself from insect eating birds by mimicry.

Kuiper (1977) and Freitas (1980) suggest that ETs/UAP visiting Earth would find it necessary to hide themselves from our detection mechanisms until they have assessed our technological layer or potential threat and hazards. They would employ an adaptive multi-layer risk program to avoid danger. Low observable stealth such as simple camouflage through mimicry, which works well in nature, may be the technique of choice for visiting UAP/ETI experienced in surveillance (Stride, 1998). Examples of mimicry techniques are UAP/ETI entering the atmosphere with either the look or trajectory of a meteor or hidden within a meteor shower, behaving like dark meteors without the associated optical signature, hiding within an artificial or natural cloud or a satellite reentry, behaving as pseudo-stars sitting stationary over certain regions, or mimicking man-made aircraft’s aggregate features (Stride, 1998). Another possibility

is mimicry techniques employed for the manipulation of human consciousness to induce the various manifestations of “absurd” interactions or scenery associated with the encounter.

Conclusion

Modern engineering has made us familiar with display technologies that produce three-dimensional images with color, motion and perspective through physical devices. We speculate that UAP are analogous to these display technologies but utilize a wider range of variables to operate on the percipients and, through them, on human culture. The long time scale and the global nature of the effects make it difficult to test hypotheses involving such cultural effects.

Science fiction has familiarized us with the concept of machines (or beings) projecting an image of themselves that systematically confuses observers. One could imagine that UAP represent physical craft equipped with the means to interact both with the surrounding atmosphere and with the senses of observers in such a way as to convey a false image of their real nature. One could argue that such an object could use microwave devices to create perceptual hallucinations in the witnesses (including messages that are heard by a single individual in a group).

Even such a complex scheme, however, fails to explain all the reported effects and the subsequent behavior changes in close-range witnesses. We must assume something more, the triggering of deep-seated processes within their personality. The question then becomes: to what extent are these effects evidence of a purposeful action of the operators? To answer this question, and to test more fully the hypothesis that UAP phenomena are both physical and psychic in nature, we need much better investigations, a great upgrading of data quality, and a more informed analysis not only of the object being described, but of the impact of the observation on the witnesses and their social environment.

References

- Davis, E.W. (2001). "Wormhole-Stargates: Tunneling Through The Cosmic Neighborhood", *MUFON 2001 International UFO Symposium Proceedings*, Irvine, CA, pp. 32-50.
- Foucault, M., (1966). *The Order of Things*, trans. by A. Sheridan, Random House, N.Y.
- Freitas, R. A., (1980). "A Self-Reproducing Interstellar Probe", *J. British Interplanetary Soc*, **33**, pp. 251-264.
- Highwater, J., (1981). *The Primal Mind: Vision and Reality in Indian America*, Meridian, N.Y.
- Kaku, M. (1995). *Hyperspace: A Scientific Odyssey Through Parallel Universes, Time-Warps, and the 10th Dimension*, Anchor Books Doubleday, N.Y.
- Kuiper, T. B. H. and Morris, M., (1977). "Searching for Extraterrestrial Civilizations", *Science*, **196**, pp. 616-621.
- Morris, M.S. and Thorne, K. S. (1988) "Wormholes in spacetime and their use for interstellar travel: A tool for teaching general relativity", *Am. J. Phys.*, **56**, no. 5, pp. 395-412.
- Oliver, B.M., et al., (1973). *Project Cyclops: A Design Study of a System for Detecting Extraterrestrial Intelligent Life*, NASA-Ames Research Center, CR 114445, pp. 177-181.
- Rescher, N., (1985). "Extraterrestrial Science", in *Extraterrestrials: Science and Alien Intelligence*, E. Regis Jr., ed., Cambridge Univ. Press, Cambridge, U.K.
- Rucker, R. (1984). *The Fourth Dimension: A Guided Tour of the Higher Universes*, Houghton-Mifflin Co., Boston.
- Schwarzschild, B. (2000). "Theorists and Experimenters Seek to Learn Why Gravity Is So Weak," *Physics Today*, **53**, no. 9, pp. 22-24.
- Stride, S. L., (1998). "SETV - The Search for Extraterrestrial Visitation: Introduction to a Heterotic Strategy in the Search for ETI", submitted *JSE* manuscript, Fall, 1998.
- Tough, A. (2000) <http://members.aol.com/AllenTough/strategies.html>, Univ. of Toronto, Canada.
- Vakoch, D. A., (1995). "Constructing messages to extraterrestrials: An exosemiotic approach", Paper IAA-95-IAA.9.2.05 presented at the *SETI: Interdisciplinary Aspects Review Meeting*, 46th International Astronautical Congress, Oslo, Norway.
- Vallee, J.F. (1975a). *The Invisible College*, E. P. Dutton, N.Y.

Vallee, J.F. (1975b). "The Psycho-Physical Nature of UFO Reality: A Speculative Framework,"
AIAA Thesis-Antithesis Conference Proceedings, Los Angeles, pp. 19-21.

Vallee, J.F. (1990) *Confrontations: A Scientist's Search for Alien Contact*. Ballantine, N.Y.

Visser, M. (1995) *Lorentzian Wormholes: From Einstein to Hawking*, AIP Press, N.Y.
