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JOURNAL OF SCIENTIFIC EXPLORATION

A Publication of the Society for Scientific Exploration

AIMS AND SCOPE: The *Journal of Scientific Exploration* publishes material consistent with the Society's mission: to provide a professional forum for critical discussion of topics that are for various reasons ignored or studied inadequately within mainstream science, and to promote improved understanding of social and intellectual factors that limit the scope of scientific inquiry. Topics of interest cover a wide spectrum, ranging from apparent anomalies in well-established disciplines to paradoxical phenomena that seem to belong to no established discipline, as well as philosophical issues about the connections among disciplines. The *Journal* publishes research articles, review articles, essays, commentaries, guest editorials, historical perspectives, obituaries, book reviews, and letters or commentaries pertaining to previously published material.



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EDITORIAL

In these editorials I prefer not to revisit issues I've covered before, much less recycle previous editorials. But the recent Michigan conference of the SSE has convinced me that the time may have arrived. What provoked me was this. On several occasions I happened to overhear attendees making confidently dismissive remarks about what they took to be the extreme or outlandish views and presentations they'd encountered during the conference. And I was reasonably certain that many of those expressing these opinions did so with little or no justification for the certitude they displayed. With that in mind, I submit again, with a few suitable updates, some remarks I made back in Volume 23.

It's not often that I get to feel like a spokesperson for empirical conservatism. But that happened when I was invited to give a talk at the 50th Annual Conference on Anomalous Phenomena sponsored by the International Fortean Organization (INFO). The occasion provided several healthy illustrations about what I suppose we can call boggle relativity. The conference was stimulating, challenging, and professionally run, and I was happy to meet quite a few very smart and pleasant attendees.

But one thing that struck me especially was the difference I frequently noticed between the phenomena I was (more or less) comfortable incorporating into my worldview and the phenomena others there were equally prepared to accept. Often enough, that difference felt to me like a gaping chasm. For example, I was chatting with one clearly bright and well-read man about the evidence for remote viewing. Initially, we seemed to be very much on the same page. We apparently agreed on what the evidence was, we agreed that the phenomenon was genuine, and initially at least I thought we also agreed on the implications of the data and what they suggested about the place of human beings in nature. But then, in what struck me as a dazzling and swift series of unfounded assumptions and apparently unjustified inferential leaps, my interlocutor started asserting—with the same degree of assurance he'd lavished on the experimental evidence for remote viewing—that remote viewers were having out-of-body experiences in which they traveled to distant parts of the universe and communicated with rocks and other apparently inert objects. And he interpreted OBEs literally, insisting that OBE-ers were in fact leaving their bodies—rather than, say, having imagery-rich clairvoyant episodes while remaining thoroughly embodied.

Perhaps some *JSE* readers will be more sympathetic to these claims

than I was. Nevertheless, they were moves I was not ready to make. Still, I had to be careful not to fall instinctively into the sort of knee-jerk skepticism I frequently encounter and about which I've often complained in print. I had to remember that at one time I was equally ready to dismiss—no doubt with a disdainful flourish—any sympathetic claim regarding the evidence of parapsychology. I also had to recall that, even after coming to terms philosophically with the experimental evidence in parapsychology, I was still contemptuous of the non-experimental evidence—that is, until I studied that evidence carefully and eventually documented my conceptual evolution (Braude 1997). In fact, I couldn't help but remember that, much more recently, I had to re-evaluate my dismissive attitude toward astrology in the face of my wife's astonishing virtuosity (see Braude 2007:Chapter 8).

Don't get me wrong. I still have my dismissive attitude toward what I considered to be the extreme positions of my interlocutor. Whether I like it or not, that attitude is a fact about my current intellectual and emotional life, and I can't simply make it disappear with a cunning and quick bit of ratiocination. So for now at any rate, I'd be surprised (to say the least) if I later came to believe that we can communicate with alien (or terrestrial) sticks and stones. But I felt and continue to feel that it would have been inappropriate and unwarranted for me to have expressed my attitude and to have attached any great importance to it. I felt that if I'd done that, I'd have been every bit as contemptible as the glib and condescending skeptics whose attacks on parapsychology I've often tried to expose. After all, I couldn't pretend that my skepticism was rooted in a command of the relevant material. In fact, I hadn't even read the works to which my interlocutor was referring. So although I realized I wasn't a total ignoramus about the topics under discussion and was arguably entitled to at least some degree of skepticism, I knew also that I probably hadn't identified and thought through all the relevant issues. As far as I knew at that moment, my dismissive attitude was grounded mostly in my smugness about what I thought I knew. I also knew that if the history of science has taught us anything, it's shown that humankind is a very poor judge of the empirically possible. So the only thing I felt I could honestly and appropriately do at the time was to confess both my doubts and my ignorance, and not pretend that my judgments on the matter were delivered from a privileged post atop Mt. Olympus.

What continues to disturb me, though, is how easily I lapsed into a kind of superciliousness I've worked hard to combat in both myself and others. Maybe it's one of those demons in life that can never be fully vanquished and which will forever demand our vigilance. So it occurs to me that perhaps the time is right to remind *JSE* readers and others working in the area of anomalistics or frontier science that there's no lawlike correlation

between certitude and certainty, and, thus, that we need to remain both humble and collegial.

The *JSE* exists for the purpose of examining carefully empirical and theoretical claims about which many people, including regular readers of the *Journal*, have very strong opinions, both pro and con. The community of *JSE* subscribers is hardly uniform. It's a collection of individuals from different educational and scientific backgrounds, with different interests and assumptions, and of course with different boggle thresholds. I know that some readers of the *Journal* discount the interests of others, and I consider that state of affairs unfortunate. I'd like to think that *JSE* authors and readers have all been somewhat chastened about reacting quickly and negatively to empirical claims that strike them as beyond the pale. I would imagine that most of them have been stung at some time by others' negative and seemingly ignorant or hasty reactions to their own beliefs, and probably many have experienced changes in their own boggle thresholds similar to those I've mentioned from my own life.

I share the view of C. S. Peirce that of all earthly creatures we seem to have a distinctive knack for understanding the world around us. But that knack is merely what allows us to make scientific and intellectual progress and to frame increasingly successful theoretical frameworks. However, our faculty of understanding at no time provides a guarantee that we're making *steady and unimpeded* scientific progress and have managed to avoid getting off track—much less that we've arrived at a kind of timeless truth beyond mere warranted assertibility.

So when I now reflect back on the INFO conference, what stands out for me is how refreshingly tolerant and warm the participants were. I know that open-mindedness comes in degrees and that it shades gradually and eventually imperceptibly into credulity. But that's no different from the way cognitive caution or skepticism shades into intellectual rigidity and closed-mindedness. Despite the differences between my beliefs or theoretical orientation and those of some other conference attendees, in important ways I felt I was among kindred spirits. What I particularly admired about those I met was their respect for data, their recognition that data are always subject to varying interpretations, and their willingness to question not only received opinions but their own opinions as well.

Stephen E. Braude

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RESEARCH ARTICLE

Psi Effect or Sensory Leakage: Scrutinizing the Ball Selection Test

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Abstract—The Ball Selection Test (BST) (Ertel 2004) is a simple, entertaining, forced-choice test for assessing psi ability. Fifty ping-pong balls, each with a number from 1 to 5 written on its surface, are used as targets. After the balls are shaken in an opaque bag, a participant blindly draws out one ball while attempting to call out the number written on it. If the number on the ball matches the participant's call, the trial is scored as a "hit." Because the numbers are equally distributed across the 50 balls, the mean chance expectation (MCE) for a hit is 20%. Two earlier experiments had suggested that sensory cues such as tactile cues from the written numbers or temperature cues from recently selected balls could not account for successful BST performance. The experiment reported in this article further examines this artifactual concern by comparing hit rates on the standard BST procedure with those on a modified version of the BST that required participants to wear blindfolds and gloves. Hit rates were significantly above chance on both procedures and virtually identical to each other, strongly confirming that sensory leakage cannot account for above-chance performance on the BST. The BST has several other features that make it uniquely suited for screening psi abilities.

Keywords: Ball Selection Test—paranormal—psi—sensory leakage—ESP

Introduction

Over the years, laboratory methods for testing psi have become increasingly well-controlled in order to rule out non-psi artifacts and explanations for positive findings. These increased controls may have been purchased at a price, however: Several psi researchers have suggested that artificial technical precautions introduced into psi testing can promote tense mental sets on the part of participants that can inhibit psi performance (e.g., Braud & Braud 1974, Braud 1975, Honorton 1977, Schmeidler 1977). To remedy this problem, the Ball Selection Test (BST) was developed to establish

simple, concrete, and entertaining psi-testing conditions that would encourage participants to behave with the freedom and confidence they display in everyday life settings (Ertel 2004, 2005a, 2005b, 2009, 2010).

In the standard BST procedure, an opaque gymnastics bag is filled with 50 ping-pong balls, each one with a number from 1 to 5 written on it with a felt-tip pen. Each number appears on ten balls. The participant is instructed to place a hand into the bag, to announce a number aloud, and then to withdraw one ball. If the number on the ball matches the participant's call, the trial is scored as a "hit." The mean chance expectation (MCE) for a hit is 20%. The participant is free to approach the task in several ways. He or she can first grasp a ball and then guess the number on it or announce a number first and then attempt to select a matching ball. The participant is also free to feel among the balls or to grasp the first one that comes to hand. After each trial, the selected ball is put back into the bag and the bag is shaken. Care is also taken to ensure that the participant cannot see into the bag before or during the test trials.

Potential participants in a BST study are generally prescreened by having them first conduct a BST session in their home without supervision. They fill out recording sheets for six runs of 60 trials each for a total of 360 trials and then deliver the sheets to the experimenter. Participants whose hit scores are significantly above chance are then invited to the laboratory for formal BST testing. This prescreening has successfully identified samples of participants who reliably and repeatedly show above-chance performance on the task.

Because participants actually touch the numbered balls in the BST, it is important to rule out the possibility that successful performance might be due to the detection of sensory (tactile) cues. Although a comprehensive overview of research on the psychophysics of tactile perception contains no studies of tactile pattern discrimination (Cheung, van Erp, & Cholewiak 2008), Lee, Tang, Chen, and Fang (2002) claimed that Chinese children were able to distinguish two-digit numbers or a complex Chinese character in four different colors printed on paper. This finding, however, failed to replicate under sounder methodological conditions (Shiah 2008).

In previous research with the BST, Ertel (2005a) tested the possibility that tactile cues might account for successful BST performance by examining the sequence of hits across trials. Because participants receive trial-by-trial feedback, they can be expected to improve their performance across trials if they are using tactile cues. Ertel tested this on the BST standardization sample of 234 participants. There was no evidence of any improvement across trial runs of 60 trials: The correlation between hits and trial number was nonsignificant, $r(58) = .09$. Moreover, this was true both for participants

who scored below the median as well as for those who scored above the median—whose BST performance would be the most likely to reveal cross-trial improvement if they were learning tactile cues as they proceeded.

Ertel (2005a) tested a second artifactual possibility on the standardization sample. Because each selected ball is placed back into the bag after the trial, the returned ball might be temporarily warmer than the remaining balls in the bag after being handled by the participant. To test this, Ertel calculated the difference between hit scores for more recently selected numbers and hit scores for earlier selected numbers for each of the 238 participants. If hit rates are boosted by the perception of temperature differences, then these difference scores should correlate significantly with their overall hit scores. They did not, $r(236) = .05$, *nonsignificant*.

Finally, Ertel (2005a) tested for memory effects. If the scrambling of the balls after each trial is insufficiently thorough, then a participant might be able to remember the relative placement of previous selections (consciously or unconsciously) to correctly identify previously called numbered balls. This effect would be enhanced if a participant tended to call the same number repeatedly across successive trials.

To test this, four female participants who had demonstrated repeated success on the BST were recruited to complete 960 trials each. These women all were members of a Ukrainian family who had participated in BST experiments over several years. On half the trials they were challenged to select a sequence of balls all with the same number. For example, within a run of 60 trials, they were first challenged to select a ball with a “1” on 12 successive trials, then a “2” for the next 12 trials, and so forth. For the other half of the trials, they were challenged to select balls in the sequence “1234512345...” in each run of 60 trials. If memory of ball placements in the bag is playing a role in successful BST performance, then participants should have a higher hit rate on the repeated trials (“11111..22222..33333..”) than on the non-repeated trials (“12345123...”).

The results showed, first, that this selected set of participants continued to replicate their earlier superior BST performances. In a total of 3,840 trials, they correctly selected the numbered ball on 30.1% of the trials, where 20% is the MCE ($z = 15.6$, $p = .000001$). The critical finding was that the difference between the two test conditions differed by only 1 hit (1157 vs. 1156). In short, memory artifacts appeared to play no role in their successful performance on the BST.

The experiment reported below returns to the issue of sensory feedback, testing whether a sample of gifted participants can continue to obtain significant BST scores while wearing both blindfolds to preclude visual leakage and gloves to preclude tactile and temperature cues.

Method

Participants

Seven women with a previous record of high performance on the BST participated in this experiment. Three of them were members of the Ukrainian family who had participated in the memory experiment described above. The other four participants were students at the Psychology Institute of Göttingen University who had previously displayed superior BST performances in both home and laboratory settings.

Procedure

As noted, all seven of the participants had previously been tested on the standard BST procedure. For the present experiment, the participants wore both blindfolds to block any visual cues and silk gloves to block both tactile and temperature cues. The sessions with the three Ukrainian women were conducted by their fourth family member serving as the experimenter; sessions with the four student participants were conducted by the author. Because the standard and glove trials were conducted at different times with the Ukrainian sample, the two conditions comprised different numbers of trials.

Results and Discussion

The results show that the participants achieved nearly identical, significant hit rates under both the standard BST procedure and the procedure in which they were required to wear blindfolds and gloves: Under the standard procedure, they obtained 2,293 hits out of 7,740 trials for a hit rate of 29.6%, which is significantly above the MCE of 20%, $z = 21.16$, $p < .000001$. Under the blindfold/glove modification, they achieved 994 hits out of 3,420 trials, a hit rate of 29.1%, $z = 13.23$, $p < .000001$. In fact, all but one of the participants achieved a hit rate of at least 27.5% ($p < .00003$) under this procedure. The difference between the two hit rates is not significant, $z = 0.599$, two-tailed $p = 0.55$.

It was noted in the Introduction that artificial technical precautions introduced into psi testing can produce mental sets that might well inhibit psi performance. It is thus pertinent to note that the only participant who failed to show a significant BST effect in the modified procedure remarked in a post-experimental interview that the gloves made her feel uneasy.

It is concluded that the results of this experiment, in conjunction with results from the earlier validating experiments discussed in the Introduction, provide persuasive evidence that enhanced performance in the

BST protocol cannot be accounted for by sensory-leakage artifacts. Instead, its ecological characteristics appear to be validly psi-conducive, rendering it uniquely suitable for screening psi abilities. The BST is an objective procedure that appears to be more reliable and valid than the pencil and paper questionnaires frequently used to identify suitable participants for psi investigations. The fact that the BST requires considerably less effort and cost than other psi-screening procedures is an additional benefit.

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RESEARCH ARTICLE

The Sheep–Goat Effect as a Matter of Compliance vs. Noncompliance: The Effect of Reactance in a Forced-Choice Ball Selection Test

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Abstract—According to Reactance Theory (Brehm & Brehm 1981), when an individual's freedom is threatened through some form of coercion, *reactance* usually sets in. Reactance is “a motivational state aimed at restoring the threatened freedom” (Silvia 2005:277), which may explain the tendency for believers (‘sheep’) to psi-hit and non-believers (‘goats’) to psi-miss. In this study, the effect of reactance on psi performance was investigated using Ertel's (2005a, 2005b) Ball Selection Test. It was hypothesized that goats are more reactant than sheep in psi tests because goats are predisposed to *disproving* the psi hypothesis which requires noncompliance. In a laboratory setting, participants completed up to four runs (60 trials/run) of paranormal target-seeking (trying to predict the numbers on table tennis balls). Hit rate for the whole sample ($N = 82$) was significant, 21.06% ($p = .002$), where $P_{MCE} = 20\%$. Participants were randomly assigned to a control condition ($n = 42$) or treatment condition ($n = 40$) requiring them to read a statement that induced reactance. A significant reactance effect was found. There was no significant sheep–goat effect, but the relationship between psi-hit rates and sheep–goat scores was significant. Reactant goats scored significantly lower than control sheep, as expected, but not significantly lower than control goats. Pre-test scores on Tension and Confusion, as measured on The Profile of Mood States—Short Form (POMS-SF) (McNair, Lorr, & Droppleman 1971), predicted psi outcomes.

Keywords: Ball Selection Test—ESP—PK—reactance—psi—sheep–goat effect

Introduction

The Sheep–Goat Effect

Schmeidler (1943, 1945) categorized participants in paranormal experiments as either those who think that ESP is possible under a given experimental condition (‘sheep’), or those who reject this possibility (‘goats’). The

definition has been extended to include sheep as those who “believe that ESP exists as a genuine phenomenon” (Thalbourne 2003:114), thus excluding goats from this belief. Based on pivotal studies (Lawrence 1993, Palmer 1971, 1977, Schmeidler & McConnell 1973), paranormal belief as measured on sheep–goat scales tends to be a predictor of psi outcomes, with sheep producing significant hit rates (i.e. psi-hitting) and goats producing significant miss rates (i.e. psi-missing). For example, Lawrence’s (1993) meta-analysis of 73 studies (totalling 685,000 trials by 4,500 participants) dating back to 1947 demonstrated an accumulative sheep–goat effect that was moderate in size and highly significant—sheep consistently scored better than goats.

As consistent as the sheep–goat effect may be, psi-hitting is assumed to be the product of attempts on the part of sheep to ‘prove’ the psi hypothesis, but it is also assumed that psi-missing results from goats attempting to ‘disprove’ the same hypothesis (Palmer 1971, 1972, Schmeidler & McConnell 1973). This principle is captured in Palmer’s (1972) ‘vindication’ theory. Thus, the understanding is that goats have only one agenda (i.e. target avoidance), whereas sheep aim to identify the target. We concur with this premise. While the sheep–goat literature generally indicates that sheep can be successfully encouraged to psi-hit, this evidence comes as a corollary of the fact that sheep have complied with the experimenter’s instructions to seek a psi target. Most psi experiments, therefore, are designed to get ‘good’ performances out of sheep, but they are not designed to get ‘bad’ performances out of goats. In other words, goats are usually treated like sheep and are instructed to psi-hit; not to psi-miss. Ironically, experimenters then expect a majority of goats to avoid the target, and they even hypothesize psi-missing in goats. What we discovered is that a review of forced-choice studies by Schmeidler and McConnell (1973) showed consistently larger deviations from mean chance expectation (MCE) in sheep compared with goats, with sheep frequently psi-hitting, but goats not as often psi-missing. Although Palmer (1977) reported that 13 out of 17 sheep–goat experiments (76%) from 1947 to 1970 “were in the predicted direction” (p. 193), he did not make any reference to the asymmetrical scoring differences between sheep and goats; a point Steinkamp (2005) later made about Lawrence’s (1993) meta-analysis in her review of forced-choice studies. She stressed that Lawrence did not tell us “whether the [sheep–goat] difference is due, for example, to goats tending to perform significantly badly, with sheep scoring at chance, or to sheep performing significantly well with goats scoring at chance (or something in between these two alternatives)” (pp. 152–153).

To validly test the counter-position of goats, experimenters should not

simply instruct goats to psi-hit and then measure the shortfall in hits—they must either encourage goats to psi-miss, or *discourage* them from psi-hitting. However, these attempts are likely to fail, which is probably why no experimenter does it, because goats do not seek to ‘prove’ the psi hypothesis in any of its forms, as psi-hitting *or* psi-missing. Clearly, seeking any kind of compliance from goats will not succeed.¹ When asked to comply in any manner, goats will probably perceive the request as a threat to their freedom, which may cause so-called ‘boomerang effects’ (i.e. noncompliance and its consequences). For that reason, we regard the motivation of goats as being a special case of reactance behavior (a kind of resistance or refusal to cooperate—see next section) distinct from the kind of motivation that impels sheep to comply. While Schmeidler and McConnell (1973) intimated a sheep–goat distinction, they only ever ‘supposed’ the causes, nor did they adequately explain the asymmetrical deviations around the MCE of sheep and goats (the very same point to which Steinkamp drew our attention, as mentioned above). If psi-missing in goats is the effect parapsychologists are looking for, we argue that experimenters must manipulate goats’ behavior and thus produce psi-missing, and one way to do this is to induce reactance in goats. If this manipulation is successful, then the assumption is demonstrated that goats have a motive that is antithetical to that of sheep. These ideas are developed further in the next section.

Reactance Theory and Goats’ Behavior

In the field of social psychology, it is found that if a person’s attitudinal or behavioral freedom is threatened or reduced, the person becomes motivationally aroused (Kraus 1995, Smith 1978, Worchel & Brehm 1970, Wright 1986). This arousal generates psychological *reactance* that even takes the form of ‘boomerang effects’ where the individual adopts a noncompliant attitude, or engages in noncompliant behavior on the assumption that freedom will be restored. Considerable work has been done testing *reactance theory* (Brehm 1966, Brehm & Brehm 1981, Dillard & Shen 2005, Miller, Burgoon, Grandpre, & Alvaro 2006, Miller, Lane, Deatrck, Young, & Potts 2007, Silvia 2005, 2006). For example, Silvia (2005) showed that reactance was highest in the group that felt the most threatened by the content of an opinionated communication (i.e. a reactance prime). Opinionated communications are the most widely used threat manipulations in reactance research (Brehm & Brehm 1981). In a follow-up study, Silvia (2006) found that disagreement directly motivated by a threat declined when the threat was removed.

To test reactance theory on goats, parapsychologists would also need a reactance treatment (i.e. reactance prime) in the form of an opinionated

communication. According to theory, the treatment will raise reactance, which will remain high if no outlet is provided, and since there is a relationship between attitude and behavior (Ajzen 1985, Kraus 1995), we can expect increased noncompliant behavior in goats under threat, which may thus yield increased target *avoidance* and therefore shifts from chance-scoring to psi-missing.

While there have been no parapsychological studies on reactance *per se*, Lovitts (1981) did investigate the sheep-goat effect in a related way. He divided participants into two groups—one comprising participants who were told they were in an experiment to demonstrate ESP ability, and another which was told subliminal perception was a legitimate (non-paranormal) theory of ESP. A significant interaction effect was found indicating that the effects of the two conditions on psi-scoring were not the same across levels of paranormal belief (i.e. sheep appeared to have been manipulated to score like goats, and vice versa). The problem with Lovitt's design was that the second (subliminal perception) group did not know they were in a psi experiment. Lawrence (1990–1991) also designed an experiment that was an explicit attempt to manipulate psi outcomes by expressly telling participants that the test was designed to prove ESP, or disprove ESP, depending on random assignment. Lawrence failed to replicate the effect, but at least both groups knew they were in a psi experiment.

Evidence that goats can be manipulated into changing their psi performance comes from a study by Storm and Thalbourne (2005). Storm and Thalbourne's objective was to see if skepticism in some number of goats could be manipulated to such a degree that they would 'convert' from a psi-dismissive disposition to a psi-supportive disposition. It was hypothesized that naïve goats, after having the implications of significance testing explained to them, would thereby adopt a newfound belief in psi, so that psi outcomes would shift from chance-scoring (or psi-missing) before the manipulation to psi-hitting after the manipulation. The hypothesis was supported—in a symbol identification task, goats shifted from chance-scoring (20%, where $P_{MCE} = 20\%$), to psi-hitting (30%, $p = .047$). The significant change in performance was referred to as a 'conversion effect'.

So far, however, there have been no studies that directly test the manipulation of reactance in goats. In alignment with the conventional view in parapsychology, we advocate the position that goats show an aversion to psi-hitting. In order that reactance effects can be tested in sheep and goats, the Australian Sheep-Goat Scale (ASGS) (Thalbourne 1995) was used in the present study to differentiate sheep from goats. The psi test used was Ertel's (2005a) Ball Selection Test. We chose this test because it offers a degree of ecological validity not found in most laboratory psi tests, and the

highly physical nature of its procedure may be particularly motivating of reactance effects not only in attitude but also in behavior. The Ball Test is now described.

The Ball Selection Test

In Ertel's (2005a, 2005b, 2010) standard Ball Selection Test, participants are handed an opaque bag containing 50 table tennis balls on which one of the numbers 1 to 5 are written, each number on 10 balls. A participant's trial consists of shaking the bag, blindly selecting (i.e. drawing out) a ball from the bag by hand through the small opening of the bag, checking the number, and putting the ball back in the bag. They are told to look away from the bag when they select a ball, and they are under observation by the experimenter during all trials to make sure they are not looking into the bag to see the balls. On each trial, the number is guessed in advance and recorded. In the same trial, the number on the ball that is selected is also recorded.

Studies by Ertel (2005a, 2005b) have produced significant results using the Ball Test. In a sample of 231 students (Ertel 2005b), the average hit-rate deviation was 9% above the MCE, which is extremely significant, $z = 12.07$ ($p < 10^{-15}$). In a follow-up study (Ertel 2005a), a number of tests were run. One test unit consisted of six or eight runs comprising 60 trials each (total: 360 or 480 trials). Sixteen high-scoring participants of Sample 1 were also tested under laboratory control, again using the Ball Test procedure (Version I). Sample 2 took the Ball Test (Version II) which is essentially the same as Ball Test Version I except that green or red dots are sprinkled over the balls, and participants guess numbers (five targets) *and* colors (two targets), where P_{MCE} is thus 10%. Thirteen high-scorers of Sample 2 were also tested under laboratory control using the bead-selection test where each participant selected one of five colors (no numbers, $P_{\text{MCE}} = 20\%$). As hypothesized, hit-rates of high scorers under laboratory control were significantly above chance.

In the latest study (Ertel 2010), using the Version II design, nine selected participants retested in a laboratory achieved a highly significant hit rate of 17.3% ($P_{\text{MCE}} = 10\%$). Also, a replication of the laboratory procedure was conducted by two graduating students working under the guidance of a skeptical professor at the Anomalistic Psychology Research Unit (APRU) at Goldsmiths College, London University. Their 40 unselected APRU participants achieved a hit rate of 10.8% (where $P_{\text{MCE}} = 10\%$), which was significant ($p = .002$). It is important to note that Ertel (2005b, 2010, 2013) has gone to considerable lengths to demonstrate that psi-hitting using the Ball Test design is not an artifact of sensory leakage, memory leakage, or randomization failure (see especially Ertel 2013).

Mood States, Enthusiasm, and Psi

There has been little research on the effect of mood states on paranormal performance (e.g., Carpenter 1991, Crandall 1985, Schmeidler 1988). This oversight may stem from the fact that most psi researchers have focused on the broader issues of psi-modifying effects of attitude and personality (for an early review, see Palmer 1977), or the psychopathological aspects of paranormal belief and experience (e.g., Thalbourne & Delin 1994; see also Irwin 2009 for a review). However, it follows that a participant's enthusiasm and motivation for a psi outcome is bound to be reflected in his/her mood, and parapsychologists have acknowledged this relationship (Carpenter 1991, Stanford 1977).

Some researchers (Stanford 1977) note that motivation is a broad concept, difficult to specify, since it can refer to psychophysiological factors such as "emotional arousal," or cognitive factors such as "attention-focusing" (p. 842). At least one parapsychologist (Carpenter 1991) saw no difficulty in measuring mood, though he worked on a succession of scales, each one being an improvement on its predecessor. Ultimately, he found that psi-hitting was associated with moods whereby the participant felt strong-willed, detached, and agreeable, whereas psi-missing was associated with anxiety. He also found that large run-score variance was associated with carefree moods, whereas small variance was related to annoyance.

Since 1971, the Profile of Mood States (POMS) assessment has been shown to be an excellent measure of the mood states Tension, Depression, Anger, Vigor, Fatigue, and Confusion, plus an aggregate scale, Total Mood Disturbance, which is a combined score of five scales (Tension, Depression, Anger, Fatigue, and Confusion) minus the score for Vigor (McNair, Lorr, & Droppleman 1971). Although the POMS is applied mostly in clinical and therapeutic situations, it is suitable in research where experimental manipulations are required and mood changes might need to be assessed in order to understand the nature of the effects under investigation. We did not find any parapsychological studies that employed the POMS. However, since we are interested in the influence of the psychological state of reactance on psi performance and its related psychological effects, we planned to extend our inquiry by including measures of the six moods listed above, as well as enthusiasm, to determine any differences between the reactance treatment group and the control group on these variables. We expected negative shifts in mood due to the reactance treatment.

We were also interested in whether enthusiasm scores and the six mood scale scores predict psi performance, and whether there are sheep-goat differences in mood. In addition, we assessed participants' opinions and perceptions of the Ball Test by asking them two questions: "Do you think

your result will prove that psi exists?”, and “Assuming psi exists, is this test suitable for psi assessment?” These questions are different ways of looking at paranormal belief. The ASGS (mentioned above) is a broader measure that takes into account a number of factors about psi beliefs and/or psi experiences, whereas the two (‘prove psi’ and ‘suitability’) questions pertain to the experimental design. Our two questions actually reflect Schmeidler’s (1943, 1945) original definition, so it was of interest to determine if scores on the ASGS would be related to participants’ attitudes toward the experimental design.

Hypotheses

1. Main Effect: There is a psi-scoring difference between the reactance treatment group (‘reactants’) and the control group (‘controls’), where the reactance group scores lower than the control group.
2. Main Effect: There is a sheep–goat effect on psi-scoring, where sheep score higher than goats.
3. Interaction Effect: There is an interaction effect, where the effect on psi of the reactance treatment is not the same across levels of belief (i.e. between sheep and goats). Specifically, reactant goats have the lowest psi scores, and control sheep have the highest psi scores.
4. There is a positive relationship between psi-hit rates and Rasch-scaled Australian Sheep–Goat Scale (RASGS) scores.
5. There are mood changes (i.e. differences between pre-POMS and post-POMS scores) in POMS Tension, Depression, Anger, Fatigue, Confusion, and the aggregate scale Total Mood Disturbance, due to the reactance treatment, with greater reductions for controls compared with reactants (Vigor was excluded in the analysis).
6. Pre-test scores on POMS Tension, Depression, Anger, Vigor, Fatigue, Confusion, and Total Mood Disturbance correlate with psi-hit rates.
7. Pre-test scores on POMS Tension, Depression, Anger, Vigor, Fatigue, Confusion, and Total Mood Disturbance are different between sheep and goats.
8. Level of Enthusiasm is lower for reactants compared with controls.
9. Psi-hit rates correlate positively with (i) answers to the Psi Proof question; (ii) answers to the Ball Test Suitability question; and (iii) Enthusiasm.
10. RASGS scores correlate positively with (i) answers to the Psi Proof question; (ii) answers to the Ball Test Suitability question; and (iii) Enthusiasm.

Tests used include the Binomial test, ANOVA, *t* test, and Pearson’s *r*.

Method

Participants

The sample mainly comprised students from Deakin University, Melbourne, Victoria. Students did not participate as part of their course requirement, or to gain course credit. Participants were ‘unselected’ with the aim of recruiting an even number of sheep and goats. A total of 82 participants were laboratory-tested. Mean age for a reduced sample ($N = 79$), since three participants did not give their age, was 29 years ($SD = 13$ years). Fifty-four percent of the sample were females ($n = 44$; males: $n = 38$, 46%).

Materials

Eight forms and measures were used in the study: (1) *Instruction Sheet*; (2) *Consent Form*; (3) *Score Sheet* (comprising four grids, 15×4 cells, = 60 trials); (4) Thalbourne’s (1995) 18-item Rasch-scaled *Australian Sheep–Goat Scale* (RASGS) (Lange & Thalbourne 2002). An 18-item scale measures belief and alleged experience of paranormal phenomena. Each item scores 0, 1, or 2 points, where 0 = *False*, 1 = *Uncertain*, and 2 = *True* (Raw range is 0 to 36; Raw $M = 18$). The ASGS data are then top-down purified (two items are removed; items #9 and #10) to eliminate age and gender bias from the scale (Lange & Thalbourne 2002), and this procedure alters the scoring range and mean; (5) The Profile of Mood States—Short Form (POMS-SF) (McNair, Lorr, & Droppleman 1971) is a 30-item self-report measure of positive and negative mood states. Each item represents an affective state (e.g., Shaky, Grouchy, Annoyed, Lonely, Weary, etc.), and respondents are required to indicate how much each item represents their present state on a scale from 0 = *Not at all* to 4 = *Extremely*; (6) The single-item rating-scale on psi proof: “Do you think your result will prove that psi exists?” Participants respond on a 5-point Likert scale ranging from 0 = *Definitely-No* to 4 = *Definitely-Yes*; (7) The single-item rating-scale on the Ball Test Suitability: “Assuming psi exists, is this test suitable for psi assessment?” Participants respond on a 5-point Likert scale ranging from 0 = *Strongly Disagree* to 4 = *Strongly Agree*; and (8) The single-item Enthusiasm (before every run): “On a scale of 1 (‘low’) to 5 (‘high’), my enthusiasm is ___”.

Apparatus

An opaque bag (30 cm \times 40 cm) containing 50 table tennis balls was used. One of five digits (1, 2, 3, 4, or 5) is written on each ball, evenly spread on its surface. There are 10 balls bearing each digit (Total: 50 balls).

Procedure

All participants ($N = 82$) read the Instruction Sheet, and they signed the Consent Form if they decided to continue with the experiment. They completed the ASGS, and the POMS (for pre-test scores), and then read the opinionated communication—a modified version of the one used by Silvia (2005). The communication was presented surreptitiously as basic information about participating in a psi study:

This short communication was written by a university professor: This Ball Test has been developed in Germany and I claim that it is the best of all procedures that have hitherto been applied in parapsychology. I am utterly convinced that psi exists and that participants cannot avoid letting their psi power come to the fore when they make number predictions and then select the numbered balls. Every person, I claim, is expected to display such power. I know I have persuaded you about this. I know you agree with my opinion. In fact, you're really forced to agree because university students can't have differing opinions on this issue.

The additional italicized sentences were intended to function as the threatening elements; they were not italicized in the study. In the control condition, participants received the same communication without the italicized sentences. Allocation to control or treatment group was random. The two types of questionnaire, control and treatment, were originally stacked in two piles and then, using a random number table, randomly stacked one by one into a single pile. The participant was automatically and randomly assigned to a group according to the questionnaire that was drawn from the top of the pile. The questionnaire cover page did not identify whether it was for a 'control' or 'treatment' participant.

Participants rated their enthusiasm just prior to starting the Ball Test, and then they were shown how to shake the bag, and how to select the balls (on behalf of participants, the experimenter [LS] recorded the outcomes directly onto the Score Sheet). Enthusiasm was rated prior to every run so up to four enthusiasm ratings were taken for participants who completed four runs.

Each participant completed up to four runs of 60 trials in one laboratory session, though many did not complete four runs. According to Deakin University's Human Research Ethics Committee policy, participants must be given the option to withdraw at any stage. Accordingly, the number of completed runs varied among participants. Some participants did not have time for four runs; others got bored. Most reasons for withdrawal were of that nature. It is well understood in parapsychology that it is better to let participants withdraw if they feel bored, disinterested, or unmotivated, as

these attitudes allegedly undermine psi processes and can result in chance-scoring or psi-missing (see Broughton 1991, Schmeidler 1988, Stanford 1986). These withdrawals could not be considered feedback-based optional stopping because feedback was given to participants only after their last run was completed by which time they had already made it clear that they did not want to start another run.

The total testing time for 4×60 trials = 240 trials, spread over one session, amounted to approximately one hour. The MCE for a run of 60 trials is 12 hits because with five numbers of which participants guess one number, 12 hits (i.e., $60/5$) will be drawn on average. For 240 trials, the MCE = 48 hits (i.e. $360/5$).

At the end of psi testing, participants completed the POMS again (for post-test scores), and they answered the two questions: “Do you think your result will prove that psi exists?” and “Assuming psi exists, is this test suitable for psi assessment?”

Participants were told that when the test was done and the data analyzed, they would receive feedback in the form of a general information flyer distributed in the Deakin University library (no confidential information was provided).

Results

Descriptive Statistics

The Ball Test. There were a total of 12,016 trials of which there were 2,531 hits (21.06%). A total of 82 participants completed 224 runs of 60 trials each. Of the 81 participants who completed at least one run, 28 participants (35%) completed 4 runs; 11 participants (13%) completed 3 runs; 13 participants (16%) completed 2 runs, and 29 participants (36%) completed 1 run. One participant did not complete the first run (only 16 trials were attempted).

As a preliminary test on participation rates for the control ($n = 42$) and reactance ($n = 40$) groups, we found that the fewest number of runs were completed by the reactants (91 runs), whereas the control group completed 109 runs. However, the difference was not significant, $\chi^2(1, N = 82) = 4.86$, $p = .183$ (two-tailed).

Rasch-Scaled Australian Sheep-Goat Scale (RASGS). The mean score for the raw-score version of the ASGS was 15.00 ($SD = 8.21$). The skew of the distribution of scores was normal (skew = -0.22 , $SE = 0.27$). The mean score for the Rasch-scaled version (i.e. RASGS) was 24.46 ($SD = 6.64$). The theoretical range and observed range were the same, 8.13 to 43.39. Reliability of the ASGS was high: Cronbach’s alpha = 0.93 (Cronbach’s

alpha was also 0.93 for the RASGS). Neither of the two demographic variables, Age and Sex, correlated with RASGS. The median score (26.10) was used as the cut-off point between sheep and goats, with goats scoring 26.10 or lower ($n = 42$), and sheep scoring above 26.10 ($n = 41$). Goats' mean RASGS score = 19.72 ($SD = 5.23$) and sheep mean RASGS score = 29.57 ($SD = 3.44$). The difference was significant, $t(71.43) = -10.08, p < .001$.

Profile of Mood States (POMS). The POMS measures seven variables: Tension, Depression, Anger, Vigor, Fatigue, and Confusion, plus a composite measure, Total Mood Disturbance. Pre-test and post-test scores are presented in Table 1. Note that scores on all seven measures decreased pre- to post-testing, but the causes for these decreases are considered below (see Hypothesis 5). For the whole sample, there were significant differences between pre-test and post-test scores on (i) Tension, $t(65) = 3.08, p < .003$ (two-tailed); (ii) Depression, $t(65) = 3.04, p < .003$ (two-tailed); and (iii) Confusion, $t(79) = 2.28, p < .026$.

TABLE 1
Mean Scores and SDs for Profile of Mood States
Seven Variables ($N = 66$)

POMS Variables	Pre-Test		Post-Test	
	Mean	SD	Mean	SD
Tension	3.32	3.22	2.36	3.72
Depression	2.71	3.62	1.92	3.20
Anger	1.39	2.19	1.08	2.06
Vigor	7.37	4.13	7.04	4.38
Fatigue	5.55	4.82	5.29	4.74
Confusion	3.87	2.56	3.37	2.71
Total Mood Disturbance	9.46	13.05	6.98	12.04

Enthusiasm. Scores ranged between 0 and 5, which is also the theoretical range, mean score = 3.47 ($SD = 0.89$); median score = 3.50. Neither Age nor Sex correlated with Enthusiasm.

Psi Proof Question. Scores ranged between 0 and 4, which is also the theoretical range; mean score = 1.73 ($SD = 1.04$); median score = 2.00. Neither Age nor Sex correlated with the question.

Ball Test Suitability Question. Scores ranged between 0 and 4, which is also the theoretical range; mean score = 2.53 ($SD = 1.04$); median score = 3.00. Neither Age nor Sex correlated with the question.

Planned Analyses

H1: There is a psi-scoring difference between the reactance group and the control group, with the reactance group scoring lower than the control group. Table 2 shows numbers of hits and trials, and hit rates as proportions for the whole sample ($N = 82$), the reactance group ($n = 40$), and the control group ($n = 42$). The overall hit rate for the whole sample was significant, 21.06% (binomial $z = 2.90$, $p = .002$; $ES = .03$). There was a significant reactance effect on proportion of hits, with ‘reactants’ (mean percentage = 20.26%) scoring significantly lower than ‘controls’ (mean percentage = 21.74%), $F(1, 77) = 2.75$, $p = .05$ (one-tailed). Table 2 also shows that the controls produced a significant hit rate ($p < .001$), but reactants did not ($p = .323$). The hypothesis was supported.

It may be hypothesized that decline effects might have occurred, with low scores predominating in the reactance condition relative to the control condition, so we also conducted analyses for first-run data only (tests on first-run data were also conducted for *H2* and *H3*). There was a significant reactance effect on proportion of hits, with reactants (mean percentage = 19.92%, $p = .468$) scoring significantly lower than ‘controls’ (mean percentage = 22.03% $p = .006$), $F(1, 77) = 2.93$, $p = .04$ (one-tailed). The hypothesis was again supported.

We also looked at participant-based outcomes in the form of z scores and ES values. The mean z score for the whole sample was very weak at $z = .0002$ ($ES = 0.03$). The sheep z score was 0.08 ($ES = 0.01$), and goats’ z score was 0.039 ($ES = 0.03$).

H2: There is a sheep–goat effect on psi-scoring, with sheep scoring higher than goats. Table 2 also shows that sheep and goats both produced significant hit rates. The sheep hit rate (21.26%) was higher than the hit rate for goats (20.89%). Though hit rates were in the direction hypothesized, with the sheep hit rate higher than goats, there was no significant sheep–goat effect, $F(1, 77) = 1.07$, $p = .152$ (one-tailed). The hypothesis was not supported. This nonsignificant sheep–goat effect may be due to low power as four groups had to be formed for the univariate ANOVA test based on two dichotomous variables: (i) reactance/control and (ii) sheep/goat (see the contrasting result for Hypothesis 4 below).

Once again, when we restricted the analysis to only the first-run data, the sheep hit rate (21.45%, $p = .042$) was higher than the hit rate for goats

TABLE 2
Number of Trials, Hits, and Hit Proportions:
Reactants and Controls, and Sheep and Goats

Group	Trials	Hits	Hit Proportion	<i>p</i> (one-tailed)
Reactance (<i>n</i> = 40)	5460	1106	20.26%	.323
Control (<i>n</i> = 42)	6556	1425	21.74%	< .001
Total (<i>N</i> = 82)	12016	2531	21.06%	.002
Goats (<i>n</i> = 42)	6060	1266	20.89%	.042
Sheep (<i>n</i> = 39)	5940	1263	21.26%	.008
Total (<i>N</i> = 81)*	12000	2529	21.08%	.002

* One participant did not complete the ASGS.

(20.55%, $p = .251$). Though hit rates were in the direction hypothesized, with the sheep hit rate *higher* than goats, there was no significant sheep-goat effect, $F(1, 77) = 0.71$, $p = .201$ (one-tailed). The hypothesis was not supported.

H3: There is an interaction effect, where the effect on *psi* of the reactance treatment is not the same across levels of belief (i.e. between sheep and goats). Specifically, reactant goats have the lowest *psi* scores, and control sheep have the highest *psi* scores. There was no significant interaction effect, $F(1, 77) = 0.003$, $p = .959$ (one-tailed). However, at 19.42%, reactant goats ($n = 19$) did score the lowest of all four sub-groups. Control goats scored at 21.01% ($n = 23$), reactant sheep scored at 20.40% ($n = 21$), and control sheep scored at 22.09% ($n = 18$), which was expected according to reactance theory applied to goats. Mean hit rate for the reactant goats, however, was not significantly lower than for any other group, $F(3, 80) = 1.18$, $p = .161$ (one-tailed). Also, control sheep scored the highest. The difference between reactant goats and control sheep was significant, $t(35) = -1.76$, $p = .034$ (one-tailed). The hypothesis was partially supported.

Again, when we restricted the analysis to first-run data, there was no significant interaction effect, $F(1, 77) = 0.003$, $p = .477$ (one-tailed). However, at 19.39%, reactant goats ($n = 19$) did score the lowest of all four sub-groups (control goats scored at 21.52% [$n = 23$]; reactant sheep scored at 20.40% [$n = 21$]; and control sheep scored at 22.69% [$n = 18$]), which was expected according to reactance theory applied to goats. The mean hit rate for reactant goats, however, was not significantly lower than for any other

group, $F(3, 80) = 1.14$, $p = .170$ (one-tailed). Also, control sheep scored the highest again. The difference between reactant goats and control sheep was again significant, $t(35) = -1.80$, $p = .040$ (one-tailed). The hypothesis was partially supported. These tests on first-run data only in Hypotheses 1, 2, and 3 indicate that decline effects do not explain the differences between the two groups, reactance and control.

H4: There is a positive relationship between psi-hit rates and RASGS scores. The relationship was positive and significant, $r(79) = 0.20$, $p = .036$ (one-tailed). The hypothesis was supported.

H5: There will be mood changes in POMS Tension, Depression, Anger, Fatigue, Confusion, and Total Mood Disturbance, due to the reactance treatment, with greater reductions for controls compared to reactants. Difference scores between POMS 'pre' and 'post' psi testing were calculated for reactants and controls (Vigor was excluded). To minimize error variance, we used a mixed-model ANOVA with the sheep-goat group added as a between-subjects variable. There was only one effectively significant difference: Anger, $F(1, 62) = 2.64$, $p = .054$ (one-tailed), but given that this test is only one of six tests that were run, the outcome may be a chance effect. The hypothesis was not strongly supported.

H6: Pre-test scores on POMS Tension, Depression, Anger, Vigor, Fatigue, Confusion, and Total Mood Disturbance correlate with psi-hit rates. Psi-hit rates correlated positively and significantly with Tension, $r(80) = .29$, $p = .009$ (two-tailed); and Confusion, $r(80) = .33$, $p = .002$ (two-tailed). Two tests out of seven (29%) is well above the MCE (following the 5% rule), since we would only expect about one test in seven to be significant by chance alone (note that applying a Bonferroni correction, given that there were seven tests, still yields p values less than .05). Although the hypothesis was partially supported, it is not clear why these two negative moods would facilitate the psi function (see the Discussion for comments on this issue).

H7: Pre-test scores on POMS Tension, Depression, Anger, Vigor, Fatigue, Confusion, and Total Mood Disturbance are different between sheep and goats. There were no significant differences between sheep and goats. The hypothesis was not supported.

H8: Level of Enthusiasm is lower for reactants compared to controls. Although the reactance group did have a lower mean Enthusiasm score ($M = 0.98$) compared with the control group ($M = 1.02$), Enthusiasm in

TABLE 3
Enthusiasm Ratings (First Run): Reactants vs. Controls

Group	Enthusiasm Score for First Run					Total	Mean Score
	1	2	3	4	5		
Reactance ($n = 40$)	1	3	16	14	5	39	0.98
Control ($n = 42$)	1	1	18	18	4	42	1.02

the reactance group was not significantly lower than in the control group, $t(80) = 0.69$, $p = .248$ (see Table 3). The hypothesis was not supported.

H9: Psi-hit rates correlate positively with (i) answers to the Psi Proof question; (ii) answers to the Ball Test Suitability question; and (iii) Enthusiasm. The Psi Proof and Ball Test Suitability questions were asked at the end of psi testing. Enthusiasm was measured before each of up to four runs, though not all participants completed four runs. The number of participants rating Enthusiasm prior to Run 1 was much larger than on the other three runs, so only Enthusiasm data for the first run was used. Results of the three-part hypothesis are as follows: (i) The Psi Proof question: The relationship was positive, but weak and not significant, $r(80) = 0.03$, $p = .382$ (one-tailed); (ii) The Suitability question: The relationship was positive and significant, $r(80) = 0.45$, $p < .001$ (one-tailed); (iii) Enthusiasm: The relationship was positive but only approached significance, $r(80) = 0.17$, $p = .063$ (one-tailed). The hypothesis was partially supported.

H10: RASGS scores correlate positively with (i) answers to the Psi Proof question; (ii) answers to the Ball Test Suitability question; and (iii) Enthusiasm. Results of the three-part hypothesis are as follows: (i) The Psi Proof question: The relationship was positive and significant, $r(78) = 0.38$, $p < .001$ (one-tailed); (ii) The Suitability question: The relationship was not positive, nor was it significant, $r(78) = -0.12$, $p = .137$ (one-tailed); (iii) Enthusiasm: The relationship was positive and significant, $r(79) = 0.26$, $p = .009$ (one-tailed). The hypothesis was partially supported.

Discussion

Using the Ball Selection Test as a means by which psi effects might be elicited, the present study sought to gain insight into the psi performance differences between sheep and goats after a reactance manipulation. The

conventional understanding is that sheep are compliant toward psi-hitting, whereas goats are noncompliant and try to avoid targets, and thus may psi-miss. This conventional design means sheep are encouraged to do their 'best', but goats are not encouraged to do their 'worst'. Following the principles of reactance theory (Brehm & Brehm 1981), we deemed it possible that psi activity in goats could be changed by manipulating their reactance with an opinionated communication, resulting in even worse psi performances than would be expected of them under normal (control) conditions.

We showed that reactance does have an effect on psi performance, with the treatment clearly showing adverse effects on psi-hitting (Hypothesis 1). The mainly non-significant results for Hypothesis 5 suggest that reactance was the causal factor underlying the psi performance change, given that the consensus in the social sciences is that the treatment is the *cause* of performance differences, all things being equal. We therefore claim that the reactance treatment caused a change in psi performance. Our study is the first parapsychological study to contribute to the literature which finds that threatening communication treatments affect reactance, which then affects task performance (Brehm & Brehm 1981, Silvia 2005, 2006, Smith 1978).

Another of our primary aims was to show that the treatment would have more of an effect on psi-scoring by goats than psi-scoring by sheep (Hypothesis 2). This effect was not shown directly, although scoring was in the direction hypothesized (we attribute this non-significant difference to low power in the univariate ANOVA test, since we did find a significant sheep-goat effect when we tested Hypothesis 4). With no other explanation for the failure, and assuming our hypothesis is true, we surmise that 'trait' reactance may be relatively high in goats at the pre-experimental stage (i.e. before testing began, which is before reading the communication) compared with sheep (i.e. there may be a ceiling effect on reactance for goats). If there is less latitude in goats to increase reactance compared with sheep, it makes good sense to control for trait reactance. In future psi tests on reactance, it is advised that the covariate of trait reactance at the pre-experimental stage be measured so that it can be controlled in statistical tests. To that end, a replication study is planned that will feature the Hong Psychological Reactance Scale (Hong & Faedda 1996).

Note, however, that we twice found a significant scoring difference between control sheep and reactant goats (Hypothesis 3), with reactant goats scoring lower than control sheep. Also, psi-scoring for reactant sheep and control sheep was not significantly different, and scoring for reactant goats and control goats was also not significantly different. The only significant difference was between reactant goats and control sheep, which is a sheep-goat effect modified by reactance.

Although we did not find a significant difference in psi-hit rates between sheep and goats (Hypothesis 2), we did find a significant positive relationship between RASGS scores and hit rates (Hypothesis 4). This latter effect is very much expected as it is another way of looking at the sheep-goat effect, and the correlate is quite often tested in psi studies. Thus we report that a sheep-goat effect has been demonstrated using a more sensitive (continuous) measure of the full RASGS scale rather than a discrete sheep-goat dichotomy based on an arbitrary split into two groups (i.e. sheep and goats) based on a median score.

In Hypothesis 5, we tested the psychological effect of reactance on six mood states as measured on the POMS: Tension, Depression, Anger, Fatigue, Confusion, and Total Mood Disturbance (Vigor was excluded). There was some evidence that the reactance treatment hampered reductions in Anger, suggesting that reactants were as stable as controls over the duration of the experiment. At this early stage, it is still feasible that the opinionated communication has effects on factors other than psi-hitting since reactance is a psychological response, and multiple psychological responses are usually elicited even though only one stimulus is presented. This assumption is borne out by the findings of Hypothesis 6, which indicate that psi-scoring is related to levels of tension and confusion. In that instance, psi-hit rates correlated positively and significantly with the variables Tension and Confusion. Two tests out of seven (29%) is well above the MCE (following the 5% rule), since we would only expect about one test in seven to be significant by chance alone (note that applying a Bonferroni correction, given that there were seven tests, still yields p values of less than .05).

Although Hypothesis 6 was partially supported, it is not clear why increases in these two negative moods, Tension and Confusion, would facilitate the psi function. As we used pre-psi test scores of the mood measures, it may be that participants had doubts, expressed as tension and confusion, as to what was expected of them during the experiment, even though the Instruction Sheet and experimenter's subsequent explanations were intended to make it clear. If it is thought that these results might suggest a sheep-goat effect, we did not find any pre-test differences between sheep and goats on any of the POMS variables (Hypothesis 7). These null findings are useful as they indicate that sheep and goats were essentially matched on these POMS variables at the start of the experiment, thus rendering redundant the claim that findings of tests of Hypotheses 5 and 6 are artifacts of psi belief. However, resolving this issue may be problematized by Carpenter's (1991) finding that psi-missing tends to be associated with anxiety, which may be similar to tension—note that we found a significant correlation between POMS Anxiety and Tension

before the psi test, $r(80) = .44, p < .001$ (two-tailed), and after the psi test, $r(64) = .53, p < .001$ (two-tailed). We note that Tension can be a measure of motivation rather than dysfunctional anxiety.

We found no significant difference between reactants and controls on enthusiasm (Hypothesis 8); the correlation of psi-hitting with enthusiasm approached significance (Hypothesis 9); and enthusiasm correlated with RASGS scores (Hypothesis 10). Recall also that psi-hitting correlated significantly with RASGS scores (Hypothesis 4). Thus, those participants who were more enthusiastic tended to be sheep, and also tended to score better on the psi task, though we only have suggestive evidence that sheep scored better than goats, since we found no differential sheep–goat effect (Hypothesis 2), only a relationship with RASGS scores and psi-hitting (Hypothesis 4).

Psi-hitting did not correlate significantly with ‘psi proof’, but it did correlate significantly with ‘suitability’ (Hypothesis 9), so the higher the psi score, the more participants thought the Ball Test was a suitable test of psi. Note, however, when the sheep–goat measure is considered, we find a reversal of effect. RASGS scores correlated significantly with ‘psi proof’, but did not correlate significantly with ‘suitability’ (Hypothesis 10). Sheep, as believers, would be more inclined than goats to accept that psi-hitting scores ‘prove’ psi, but it is ironic that psi scores did not predict ‘psi proof’ as it is likely that psi-hitters were mostly sheep (perhaps sufficient numbers of sheep with high scores were too modest to say ‘Yes’ to the ‘psi proof’ question, and most goats are likely to say ‘No’ anyway). It is important to note that most participants had prior knowledge of their psi scores having been given feedback after each run, and then they answered the two (‘psi proof’ and ‘suitability’) questions. We point out, however, that getting feedback of a total score out of 15 for each and every run is one thing; being told that a score was significantly above the MCE or not above the MCE is another, and we stress that participants were never told whether or not they psi-hit. Nevertheless, the test results for Hypotheses 9 and 10 may be spurious, if not ambiguous, with the only way of validly testing these relationships being to keep participants blind to the scoring component until the end of the experiment when all questions are answered. This protocol, however, is inadvisable. For example, Honorton and Ferrari (1989), in their meta-analysis, showed that the largest psi effects were found in forced-choice studies where feedback was given. We must also allow for the fact that our single-item questions by their nature (i.e., ‘psi proof’ and ‘suitability’) may be unreliable and cannot be treated with the same regard as our other two measures, the RASGS and the POMS, both of which have good psychometric properties. The same assumption may apply to the

Enthusiasm question. For that reason, findings and conclusions based on test results on Hypotheses 8, 9, and 10 must be treated with due caution.

Conclusion

The findings in this study show that reactance does influence psi in a mixed sample, but there are differential effects when we consider sheep and goats separately. Although reactant goats performed significantly worse than control sheep, it may not suffice to manipulate state reactance in order to elicit a reactance-related psi effect in goats, because goats may have a higher mean level of pre-experimental 'trait' reactance compared with sheep. It is planned to measure trait reactance in a follow-up study so that pre-experimental reactance can be controlled.

We also found that the reactance treatment may have hampered reductions in Confusion and Depression over the course of the experiment, but we also found that Tension and Confusion predicted hit rates. Finally, we note that the reactance treatment did not affect Enthusiasm—that being said, we did find evidence that the more enthusiastic participants also tended to be sheep, who also tended to score better on the psi task.

Note

¹ Of course, some proportion of goats might try to comply, which still suggests that other goats (probably the majority) are noncompliant, and will then try to avoid the target. In the same sense, the majority of sheep would be compliant.

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RESEARCH ARTICLE

Unidentified Aerial Phenomena (UAP) A New Hypothesis toward Their Explanation

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Abstract—For six decades now luminous and other unidentified aerial phenomena (UAP) have been sighted worldwide in large numbers. Extensive scientific unidentified aerial phenomena observations have been made over the last 26 years in Hessdalen, Norway. The optical properties of luminous UAPs have been described in detail, but all efforts to explain them by terrestrial causes have failed. Earlier scientific attempts to explain UAPs by extraterrestrial visitation (ETV) have failed as well. A new ETV hypothesis is proposed which aims at causally explaining all luminous UAP sightings in Hessdalen and most elsewhere. To this end a galactic neighborhood scenario and model is defined. It explains why a stealth ETV probe equipped with artificial intelligence (AI) has been built by an exo-civilization and sent in a historical past into our solar system. It states that this extraterrestrial visitation probe (ETVP), now orbiting the earth, occasionally sends a stealth electromagnetic beam (SEMB) down into the atmosphere. It explains in detail how such an SEMB produces luminous UAPs by means of a nonlinear photonic mechanism which, as such, has been known and investigated since 1995 as a branch of current femtosecond physics. This photon mechanism is further developed into a UAP-A and a UAP-B model. Together the two models explain all optical Hessdalen observations.

Keywords: UAP—UFO—extraterrestrial probe—femtosecond—laser filamentation

Introduction

Unidentified aerial phenomena, UAPs, are one of a few subjects that have not been elucidated for more than 60 years. This was still the case in 2012 despite tens of thousands of reliable UAP sightings and observations compiled around 2005 into several, governmentally supported, comprehensive reports (Defence Intelligence Analysis Staff 2000, COMETA 2003). The objective of this article is to explain all luminous UAP sightings in a scientific–technical way, analogous to explaining polar lights in the ionosphere or

stern waves behind a moving ship. In what follows, major known properties of luminous UAP are listed. A 25-year-long program of reliable UAP observations in Hessdalen, Norway, is used as a database (Hauge 2010). Existing hypotheses to explain UAP sightings are reviewed and found unconvincing.

A new local SETI (search for extraterrestrial intelligence) hypothesis is presented. It postulates a stealth extraterrestrial visitation probe (ETVP), located in a high earth orbit. Such a probe presupposes the existence of a space-faring exo-civilization. This leads to investigating an exo-civilization scenario that includes a novel process of identifying the earth as a suitable destination for sending an ETVP. A galactic neighborhood model is set up to estimate the likely lifetime of an extraterrestrial civilization that could have sent an ETVP. Existing ETVP hypotheses and searches to detect various objects in near-earth space are reviewed. It is concluded that the presence of a stealth ETVP is a plausible premise for a hypothesis to explain UAPs.

A characterization of the ETVP is attempted and its required properties evaluated. It orbits the earth without public knowledge. An SEMB, defined as a stealth electromagnetic beam emitted by the ETVP, is further postulated. It is explained how the SEMB produces UAPs by means of a nonlinear photonic mechanism. This mechanism has been known and investigated in detail since 1995 in the context of femtosecond physics (Braun, Korn, Liu, Du, Squier, & Mourou 1995). It appears capable, after some extensions, of providing a causal explanation for all optical properties of all kinds of luminous UAPs as observed in Hessdalen and elsewhere.

Major Known Properties of Luminous UAP

Several large compilations of UAP sightings have been published over the last few decades (Defence Intelligence Analysis Staff 2000, COMETA 2003). Alternative terms in use are: UFO for unidentified flying objects, UER for uncorrelated event reports, and OVNI for objets volants non identifiés. Some 25 different UAP properties observed in Hessdalen (Teodorani 2004) and/or elsewhere are summarized in List 1. The list is not yet complete; it should be worked out in more detail and also be extended to include electromagnetic and chemical properties of UAPs.

List 1: Known Properties of UAPs

Shape Properties

- A1 Diameter approximately 0.3 to 30 m
- A2 Single dots or balls; disk, triangular, rectangular, airship shapes
- A3 Clustered dots in grape, chain, detached formation
- A4 Worm, rod, hook, spiral, irregular shapes

Surface Properties

- B1 Estimated 0.1 to 100 KW light output if isotropic light emitted
- B2 Color mostly white, occasionally blue, amber, or red
- B3 Small white or colored lights superimposed on a larger dark UAP

Dynamic Properties

- C1 Sudden appearance and disappearance
- C2 Visible for typically 0.01 to 1 hour
- C3 Diffuse overhead flashes, localized UAP
- C4 Steady lights, semi-regular intensity changes at a few Hertz
- C5 Immobile, moving at various speeds in both lateral and axial directions
- C6 Moving on a smooth curve, taking sharp turns, accelerating suddenly
- C7 Tracked by radar at speeds of up to approximately 10 km/sec

Reaction Properties

- D1 Reacting to a laser beam with a doubling of blinking frequency
- D2 Carrying out avoidance maneuvers with respect to airplanes
- D3 Changing flight path in reaction to radar beams

Acoustic Properties

- E1 Mostly silent when moving at a sub- or super-sonic speed
- E2 Rarely emitting a hissing noise

Sighting Properties

- F1 In many places, on all continents, at all latitudes to above 60°
- F2 Over all months, year after year
- F3 From ground, ships, airplanes, and spacecraft
- F4 Everywhere low or high up in the sky, and just above ground
- F5 Under blue sky, clouds, with land as background
- F6 Under high air humidity conditions, in dry air

Existing Hypotheses Concerning UAP Sightings

The deluded viewer hypothesis has always been and is still invoked in the context of UAP sightings (Defence Intelligence Analysis Staff 2000, COMETA 2003). Deluded viewers are said to have in reality seen balloons, flares, satellites, lenticular clouds, birds, the planet Venus, etc. There is a consensus that 60% to 80% of all alleged UAP sightings reported worldwide belong to this category. The remaining 20% to 40% of sightings reported are accepted as genuine UAPs. They justify the search for a scientific explanation. During the period 1950 to 2000 approximately, genuine UAP sightings were mostly interpreted as unidentified flying objects (UFOs).

They were thought of as solid crafts with an inertial mass and a volume that causes the displacement of air (Hill 1995).

UAPs are capable of extraordinary flight performances, controlled maneuvers, and various kinds of interactions with aircraft (Weinstein 2010). This has led to the hypothesis that UAPs are piloted, extraterrestrial vehicles, visiting the earth. However, such an extraterrestrial visitation (ETV) hypothesis faced several unsolvable problems. A first question concerned the extreme flight performances and lack of downwind of the supposedly massive UFOs. The only answer was to postulate the use of an as-yet-unknown force field (anti-gravitation), which does not exist within the realms of generally accepted physics (Hill 1995). A second problem concerned the energy source that could provide the power necessary to hover and repeatedly accelerate massive UFOs. Further questions such as: "How could an antigravity UFO function? Would it have an inertial mass or not? Would Newton's mechanical reaction principle remain valid?" remained without answers. A third problem concerned the silence with which UFOs move at both sub- and supersonic speeds. It is incompatible with a turbulent airflow and a conical pressure wave built up around a moving, air-displacing body. A fourth problem has been, until recently, the lack of any scientific basis to assign a non-zero probability to the existence of advanced exocivilizations, capable of interstellar travel (Forgan 2009). Because of these four major and several other problems, notably the sudden appearance and disappearance of UAPs, no ETV hypothesis could be developed that would explain a majority of all UAP observations in a scientifically acceptable way.

Systematic observations by scientists in Hessdalen, Norway, starting in 1985 (Hauge 2010) showed that nearly all of their UAP sightings were genuine. The deluded viewer hypothesis that, elsewhere, had always been evoked as an explanation for a majority of all UFO or UAP sightings, could thus be eliminated. Moreover, all UAPs that were visually and instrumentally observed in Hessdalen could be interpreted as thermal plasma balls (Teodorani 2004) rather than as massive UFO crafts. The interpretation of UAPs as balls of ionized air with a density comparable to that of the surrounding atmosphere solved the problem of their hovering without creating any downwind and aerodynamic noise. It also avoided the problem of having to introduce a highly hypothetical antigravity lift force. However, the thermal plasma ball interpretation neither explained the erratic flight movements of UAPs nor their sudden appearance and disappearance. It also did not explain where the energy came from that heated them up to a plasma temperature of several thousand degrees.

Trying to explain the Hessdalen plasma balls by ETV thus remained nearly as problematic as trying to explain solid UFOs by ETV. Interpreting

erratically moving plasma balls in the earth's atmosphere as intelligent ET visitors contradicted the common sense of most scientists, whether they worked in physics, exobiology, or space technology. To interpret the Hessdalen plasma balls other than by means of an ETV hypothesis seemed, therefore, the only possible way to go. Several terrestrial hypotheses were proposed with a view to elucidate the plasma ball enigma. A successful hypothesis would have to explain how such balls can suddenly form near the ground or up in the atmosphere, how they can hold still, move about, emit light, and disappear. It would have to explain the functioning of UAPs with an estimated light output of 20 KW and a diameter of 10 m (Teodorani 2009a).

The ball lightning and the earth light hypotheses appeared to be the most promising. Ball lightning must always be associated with strong atmospheric electricity as caused by thunderstorms. It can explain only slowly moving plasma balls of perhaps 20 to 50 cm in diameter, with a lifetime of a few seconds. However, most Hessdalen observations were made under quiet atmospheric conditions and could not be explained by ball lightning. Such observations were called earthlights to express the hypothesis that they appear for ground-related reasons. An entire range of partly sequential and partly simultaneous interactions of mechanical, electrical, thermal, chemical, optical, and/or biochemical forces in rocks, soil, or vegetation and in aerosols were combined in an attempt to formulate a credible earthlight hypothesis (Teodorani 2004). It conjectures that large-scale piezoelectric voltages are built up in compressed underground rocks and that they transform the soil into a powder with internally stored chemical energy. The powder is then supposed to rise up from the ground as an invisible aerosol ball or cluster without deforming into a plume. Once up in the air, it is supposed to start releasing its stored chemical energy into one or several, non-expanding balls of white light with a nearly flat radial luminosity distribution that may last for up to 30 min.

UAPs have also been observed in Hessdalen in wintertime when the ground is wet or frozen. It is difficult to imagine under these circumstances how a piezoelectric voltage could build up, how a fine powder could be formed without hydrating and agglutinating, and how such a powder could raise up in the air to suddenly form a luminous UAP aerosol ball. As a matter of fact, no UAP earthlight hypothesis has yet been formulated that would provide a parametric model description that yields acceptable estimates for the generation and sustenance of bright, large, long-lived, and also often erratically moving plasma balls such as observed in Hessdalen and elsewhere. Some hypothetical astronomical influences on UAP sightings have been investigated as well. They were checked by screening a large

number of UAP sightings for possible, statistically significant daily variations as caused by an object in the daily rotating stellar background and/or by a slowly varying solar radiation influx. Neither investigation showed any significant correlation (Teodorani 2009b).

To sum up the present situation: Over the last 60 years there have been tens of thousands of genuine UAP sightings, and over the last 25 years hundreds of instrumentally recorded UAP observations. However, up to now, no hypothesis has been formulated that would explain a majority or all UAP sightings and observations. Not one based on atmospheric electricity, or one based on earthlights, or one related to astronomical influences has offered a scientifically satisfactory explanation. This situation leads to considering local SETI (search for extra-terrestrial intelligence) as the only path toward an understanding of UAP sightings (Teodorani 2006).

Stating the New Local SETI Hypothesis

The new local SETI hypothesis, first part, states that a stealth, automated extra-terrestrial visitation probe (ETVP) has been sent by an advanced civilization in the galactic neighborhood. This ETVP has been residing in our solar system for at least as long (decades or centuries) as UAPs have been sighted. It is deduced from UAP observations that the ETVP must orbit the earth, albeit still undetected. The hypothesis, second part, states that the ETVP occasionally emits an invisible electromagnetic beam (SEMB). It is deduced from photon physics that the SEMB, when interacting with the earth's atmosphere, is capable of creating a luminous UAP. The hypothesis, first and second part together, explains all Hessdalen UAP observations and probably all genuine UAP night-time sightings worldwide. It is surmised that most daytime UAPs could be explained by an extension of the same hypothesis. The new local SETI hypothesis does not apply to allegedly grounded, solid alien aircraft such as described in the Roswell incident in 1947 (Corso 1998).

New ETVP Hypothesis, General Exo-Civilization Scenario

In order to be scientifically acceptable, the new local SETI-ETVP hypothesis, beyond explaining UAPs, must also fit into a general exo-civilization scenario that is credible from an astronomical, exo-biological, and technical point of view.

Exo-Civilizations

A first point concerns the probability that advanced exo-civilizations exist, in parallel to our own, somewhere in other solar systems. Before 1995,

exoplanets were essentially speculative objects. Between 1995 (Major & Queloz 1995) and mid-2011 some 550 exo-planets have been discovered and characterized, several of which closely resemble our earth (Schneider 2011). In 2011 the probability that at least one advanced exo-civilization exists in our stellar neighborhood was rated higher than before 1995. Consequently, explaining UAPs by an ETVP hypothesis cannot be rejected anymore on grounds of being too improbable.

Probe Propulsion

A second point concerns the technical feasibility of a propulsion system capable of accelerating and decelerating an interstellar space probe. This question has been addressed in several theoretical engineering publications (Project Daedalus Study Group 1978, Beals, Beaulieu, Dembia, Kerstiens, Kramer, West, & Zito 1989, Long & Obousy 2011). They assume an interstellar cruising speed of about 0.1 c, i.e. 0.74 astronomical units per hour. This speed appears attainable on the basis of emerging power- and space-propulsion concepts. Taking our human civilization as a baseline leads to the following likely sequence of developments: The first ground-based fusion reactors should operate before 2050. The first fusion-powered space probes reaching a speed of 10^{-4} to 10^{-3} c should become operational around 2100. Fusion-powered space lasers that accelerate interstellar probes to a speed of 0.1 c can be thus expected around 2200. An interstellar neighborhood voyage would then take several centuries or millennia, depending on the distance between the exo- and our earth-based civilization.

Interstellar Voyage

A third point concerns the type of interstellar voyage that is the most likely to be chosen by an exo-civilization. Taking again our earth civilization as a baseline, three major scenarios can be envisaged. Scenario S-A entails a voyage with human astronauts, S-B one with cyborg entities, and S-C one with an artificial intelligence (AI) subsystem only. What is needed in all three scenarios is an autonomous, highly flexible, and intelligent sensing, interpretation, guidance, and control capability, active during the exo-earth visitation phase of the probe. Any remote control seems excluded as each signal roundtrip would take many years. Scenario S-A would require an extremely large and complex spaceship, since our astronauts' physiological and psychological well-being and their security during a multigenerational voyage would have to be assured. Scenario S-B would entail a few intelligent, non-reproducing cyborgs. They would hibernate during the long voyage to become active during the exo-earth visitation phase only. They

would function with a support system that could be at least an order of magnitude simpler than necessary for human astronauts. Cyborgs would thus fit into a much smaller, less costly spaceship. Developing cyborgs could be cheaper than investing in an extremely large spaceship suitable for a multigenerational astronaut crew. S-C, an automated visiting probe, appears as the most realistic scenario. It represents a direct, although far-out extrapolation from presently operational autonomous spacecraft, which are exploring the various planets of our solar system. It is the only interstellar vehicle scenario that has already been subject to scientific exploration (Tough 1998). The AI capability, necessary to guide and control the spacecraft, would be part of its information processing system. The mass and complexity of such an S-C spacecraft should again be an order of magnitude lower than that required for an S-B spaceship with cyborg entities. Only scenario S-C will be retained here, in accordance with Occam's razor.

Telescopic Prior Knowledge of Earth

A fourth point concerns the probable knowledge acquired by an exo-civilization about our planet, previous to their launching of an ETVP. Taking again our earth civilization as a baseline leads to the following likely development sequence: A Darwin-type space telescope array (Cockell et al. 2009) will be operational around 2020 and produce the first information on the atmospheres of earth-like exoplanets. By 2100, the third or fourth generation of progressively larger synthetic aperture space telescope arrays will lead to a detailed physical and chemical characterization of many interesting exo-earths in our stellar neighborhood. Between 2100 and 2200 these exo-earths will be closely monitored for signatures of an active biosphere. At the same time, numerical models that describe their physical, chemical, and biological evolution will be developed. It is concluded that as soon as an ETVP can be built, i.e. after 2200, the biosphere of any exo-earth considered for a visiting probe will have been characterized in considerable detail. A similar telescopic observation sequence should hold for an exo-civilization that studies our earth biosphere before sending an ETVP.

Prior Detection of Human Civilization on Earth

A fifth point concerns the reason why an exo-civilization could have decided, several centuries or millennia ago, to launch an ETVP that produces UAPs in our earth atmosphere. It makes no sense to display strange UAPs over a planet with a plant/animal biosphere only. It is thus probable that the exo-civilization knew about the existence of our human civilization prior to their equipping and launching an ETVP. UAPs have been sighted at least

since 1947 (Bourdais 1997) and probably several centuries earlier (Zeller 2006). At the time prior to launching an ETVP, i.e. still centuries earlier, our civilization had no electric streetlights, no TV, no radio emitters, etc., to reveal its existence. It must have revealed itself by other anomalies in the electromagnetic spectrum of the earth. These anomalies have probably been caused by agricultural activities and perhaps by winter heating of dwellings. Trace gases released from cattle herds, from ore processing, etc., may have been further indicators. It is probable that such early, civilization-revealing changes in our earth's spectrum can be detected over interstellar distances. They are all tied to the development of large-scale human settlements which started about 5000 years ago.

An ETVP, cruising for 5000 years at a speed of 0.1c, bridges a distance of 500 light years. This leads to the estimate that an ETVP-launching exo-civilization is located less than 500 light years away from our solar system. The telescopic study of our earth, which had led them to the decision to send us an ETVP, must have been carried out less than about 5000 years ago. If the exo-civilization is very near, for example only 20 light years away, then their ETVP launching decision could have been made in the 18th century.

Purpose of the Exo-Civilization's Probe Visitation

A sixth point concerns the objectives the exo-civilization wanted/wants to achieve with their ETVP. One obvious objective is to gather information about our human civilization. Another objective must be to inform us about their existence. This is inferred from the probe's persistent production of well-visible, but rather enigmatic UAPs.

Taken together, the answers given to the six points addressed above show that the proposed exo-civilization—and ETVP hypothesis—is internally consistent and credible.

New ETVP Hypothesis, Galactic Neighborhood Model

In order to be scientifically viable, the new ETVP hypothesis, beyond fitting into a general exo-civilization scenario, should also fit into an accepted probabilistic galactic neighborhood model. To clarify this issue, the Drake equation (Drake & Sobel 1992) is evaluated for a neighborhood sphere with a radius of 500 light years around our solar system. This sphere represents some 10^{-5} of the entire galactic volume, contains about one million stars, and allows for visits by ETVPs between neighboring exo-civilizations. The rate of star formation in the galaxy has been estimated to be $R = 10$ per year (Drake Equation 2011); in the sphere it is about 10^{-4} per year. It is assumed that the probability f_p for a star to possess a planetary system and, if so, to

possess n_c earth-like planets is about $f_p \cdot n_c = 1$. The probability for such an earth-like planet to develop life, f_l , and then intelligent life, f_i , which forms an advanced civilization, has been estimated at $f_l \cdot f_i = 10^{-2}$ (Rose & Wright 2004). The product of the three probabilities leads to a rate of formation of new, advanced civilizations within the sphere of 10^{-6} per year. Any two such civilizations in our galactic neighborhood are, therefore, on an evolutionary stage that differs on average by about a million years. It is concluded that our civilization is, with a probability of 99.9%, not a historic contemporary (evolutionary difference of 1000 years or less) of any other galactic neighborhood civilization.

The Drake equation introduces a further probability f_c which expresses the possible inability or unwillingness of an advanced civilization to send out SETI-type radio signals; it has been estimated to 0.01 (Drake Equation 2011). This low probability supposes that an exo-civilization cannot identify in advance any solar system that harbors another civilization. Its SETI signals would thus have to be sent at random to many different stars. They would reveal the exo-civilization to its entire, yet unknown, galactic neighborhood. In the present article, the communication strategy assumed for exo-civilizations is entirely different. It starts with a covert, telescopic search for possible emerging civilizations living on candidate planets in suitably identified solar systems within the stellar neighborhood. Only once such a fledging civilization has been found, is an ETVP assembled and launched. The probe is smart, stealth, and, if required, withholds the identity of the exo-civilization that has sent it. With this newly proposed strategy, an exo-civilization sending an ETVP remains protected. It wastes no effort in launching useless SETI signals or ETVPs. The width of the communication channel established by means of an ETVP is much broader than with SETI (Rose & Wright 2004). Based on these three major advantages, the communication probability is now estimated to be $f_c = 1$.

The Drake equation finally introduces L , the probable lifetime of an advanced civilization. It has originally been estimated to be 0.01 million years (Drake Equation 2011). As our stellar neighborhood produces a new exo-civilization only about once every million years, it would, for 99% of the time, not harbor any advanced civilization at all. If, however, exo-civilizations had a probable lifetime of 10 million years, then our own civilization could, right from its beginning, have had about 10 much older exo-civilizations in its stellar neighborhood. Should L be evaluated to 0.01 or rather to 10 million years? It is noted that the first figure is an extremely short period in a planet's biosphere evolution. If, on earth, all Lucy-type creatures, 4 million years ago, after practicing biped locomotion for just 0.01 million years, had become extinct, then hominids would have been

an evolutionary failure. This did not happen; the combination of a large brain, biped walking, and free hands was an enduring success. By analogy it is predicted that, on earth, the combination of a still larger brain, free hands, and technology-promoting social behavior will again be an enduring success.

At present, there are nearly 10^{10} living humans, a majority using technology products and services. It is probable that even the worst nuclear war or epidemic, etc., imaginable would not lead to a total extinction of the human species. It could ultimately force humanity to go a second time through the last 1000 years of its history of civilization. In this and in all other less dramatic cases it is foreseeable that humans, including their genetically modified descendants, cryogenic bodies, cyborgs, androids, etc., will go on striving for a similarly long period as the great apes have already been striving on earth. Taking this forecast for our earth civilization as a galactic baseline leads to a probable civilization lifetime of $L = 10$ rather than 0.01 million years.

According to the above-given probabilities for the Drake equation, our stellar neighborhood harbors, as an order of magnitude, 10 mature or aging civilizations. Their likely age of for example a million years is vastly different from that of our own civilization. Mature exo-civilizations must have gone through hundreds of historical epochs, each with their societal, technological, environmental, etc., ups and downs. This includes epochs of rapid technology advancement followed by epochs of technology stagnation, periods of population expansion followed by contraction periods resulting from partial self-destructions, epochs of biological and ecological transformations, migrations to other planets, and perhaps retreats back to the home planet, etc. Mainstream exo-civilizations are also likely to have a long history of mutual interstellar observation, communication, and traffic within the wider galaxy. According to the proposed hypothesis, one of these neighboring exo-civilizations has recently, i.e. less than about five thousand years ago, noticed the emergence of our civilization. It has launched a stealth ETVP that has now been residing for a historical period in earth orbit. It is equipped with a communication link that has been down-engineered to correspond to our past and present level of comprehension, both socio-psychologically and technologically. This communication link is identified as a stealth SEMB (structured electromagnetic beam) which produces UAPs, visible in various places on earth.

Previous ETVP Hypotheses and Searches

R. Bracewell in 1960 was the first to describe a hypothetical automated messenger probe (Bracewell 1960). His ETVP would have been launched

centuries ago by a superior intelligent community. After arrival and slowdown in our solar system, it would have stayed in a local orbit for a long time. It would have first functioned in a silent, radio signal–receiving mode and then in a delayed radio signal–re-emitting mode and would have finally exchanged time-coded information with human radio engineers. A Bracewell ETVP would have revealed itself only to professionals equipped with a suitable transceiver system. Before Marconi’s and Tesla’s inventions, such a probe could not have carried out any messenger mission. Following R. Bracewell’s publication, some experimental searches to detect an ETVP by its delayed return radio signal were carried out in 1974; the results were negative (Ridpath 1974).

R. A. Freitas described in 1980 a probe according to the J. von Neumann concept (Freitas 1980). Such an ETVP would replicate itself infinitely by using material collected in each of the solar systems visited. It appears to be at least one order of magnitude more complex than a Bracewell probe. The designers of a von Neumann probe would have to make sure that their ETVP does not produce unreasonably large numbers of clones in every solar system in the Galaxy. On earth, bacteria come close to micron-sized von Neumann probes; they fill up every ecological niche in every plant, animal, and soil.

Rose and Wright (2004) have shown that if interstellar messages are long and archival and if their transmission time is of secondary importance, then a probe with inscribed matter is in general a more energy-efficient vector than a SETI type beam of electromagnetic radiation. Their result further supports the present hypothesis of a material ETVP residing in our solar system.

Following the conclusions drawn in the sections “New ETVPHypothesis, General Exo-Civilization Scenario” and “New ETVP Hypothesis, Galactic Neighborhood Model,” it is probable that the ETVP, equipped with a communication interface adapted to our civilization, has been and remains located in near-earth space. The discovery of such a messenger ETVP is not assured, however. It requires, firstly, that the ETVP is designed to be detectable by our present-day space observation instrumentation; secondly, that this instrumentation is actually used to search for an ETVP; and thirdly, that a positive search result is published for everyone to know about.

In 1981/1982 a telescopic–photographic search was carried out to detect possible natural or artificial objects in the earth–moon libration points; the result was published and is negative (Valdes & Freitas 1983). In 2001 an automated instrumental optical search for a possible ETVP, resident in a solar or an earth orbit, was proposed, but apparently not implemented (Stride 2001).

In 1998 NASA formally embraced the goal of finding, tracking, and

cataloguing by 2008 some 90% of all near-earth objects (NEOs), such as asteroids and comets with a diameter of 1 km or larger which, sometime in the future, may come dangerously close to the earth (Yeomans 1999). Several wide-field telescopes with mirror diameters of up to 2 m were and are still used for this Spaceguard program. A NEO search constitutes, without saying, also a search for a near-earth ETVP. At one AU distance (astronomical unit—distance from earth to sun), the minimum diameter for detecting an NEO or ETVP with an albedo above 0.1 is about 1 km. At lunar distance, i.e. about 1/400 closer, it is a few meters. Some 700 NEOs have been discovered since, but no ETVP seems to be among them. In 2003 a study was carried out to determine the feasibility of a follow-up search for NEOs in solar orbit with a diameter down to 140 m by the year 2028 (Stokes et al. 2003).

Man-made objects in earth orbit are observed by the ground-based US Space Surveillance Network (SSN) and the follow-up Space Fence Network. It comprises some 25 multistatic and conventional radars, optical telescopes, communication links, and data processing facilities (SSN 2011). The ESA is currently configuring a similar network (ESA 2011). Automated optical tracking and laser ranging of small objects in space has also been carried out by the University of Berne (Schildknecht 2010). Nearly ten thousand man-made objects are currently tracked and catalogued in their low, intermediate elliptical, and high geostationary orbits by the Space Fence Network. These active/inactive satellites, spent rockets, and larger space debris constitute a permanent collision hazard. Up to now, neither an earth-orbiting natural object (a second moon) nor an ETVP seems to have been discovered. In 1970 the USA started to deploy a Defense Support Program (DSP), which comprised 23 launches of geostationary satellites (Defense Support Program 2011). They form an infrared imaging platform for intelligence, surveillance, and reconnaissance (ISR) of missile launches. This first-generation platform will, from 2011 on, be progressively replaced by another space-based infrared system (SBIRS) that will be able to observe a variety of thermal objects in near-earth space and on the earth's surface with an improved spatio-temporal resolution and over a wider part of the IR spectrum (SBIRS 2011).

None of the science or engineering teams working in any of the above-mentioned NEO-debris, satellite-debris, space debris, and DSP/SBIRS programs seems to have published any observation concerning an object with features indicative of an ETVP. The presence of an ETVP remains nevertheless a credible hypothesis to explain UAP sightings. Either the ETVP has been designed so as to escape observation by all human-built detection/tracking systems, or else an ETVP has indeed been detected but has never been made the subject of a scientific publication.

New Hypothesis, Characterization of the ETVP

High Earth Orbit

The first unknown property of an ETVP according to the new hypothesis concerns the orbital height. UAPs have been sighted in many places on earth, nearly every month, year after year. An ETVP in a solar orbit is unlikely as it would be located much of the year at a distance of about an AU (earth–sun distance). In order to generate a UAP on earth, the ETVP must emit an SEMB in the NIR (near infrared) range that can be focused down to approximately 1 m. According to the laws of wave optics, the ETVP would require, at one AU distance, an emitting and focusing structure of about 100 km diameter, whereas, in a high earth orbit, a structure of 30 m diameter is sufficient. A 100-km–size structure would require a 10^7 times larger mass which appears an unlikely choice for an ETVP. It is inferred that the ETVP is in an earth orbit, not farther out. According to the hypothesis, the ETVP must have been present for at least as long as UAPs have been sighted. However, none of the ongoing near-earth space observation programs seems to have detected such a probe. This apparent contradiction is solved if it can be shown that a sufficiently stealth ETVP is technically feasible.

Probe Size and Orientation

The second group of unknowns of an ETVP include its size and orbital parameters. An earth-facing, cylindrical reference probe with a diameter of 30 m, orbiting at a distance of 50,000 km, is assumed. A rationale is given in the section “New Hypothesis, Characterization of the SEMB.” The reference diameter and distance together allow for an estimate on how stealth the ETVP needs to be. An NEO with an albedo of 0.1 at the indicated distance would remain undetected if it had a diameter of about 0.3 m or less. The reference probe has a diameter which is two orders of magnitude larger. To remain undetected, its albedo across the visible and infrared wavelengths, for which the telescopes employed are sensitive, and also its radar signature, must, therefore, remain below 10^{-5} . It is deduced that the reference ETVP should have a surface with a specular reflectivity in the entire solar spectral range of about 99.999%. All its visible surfaces should be oriented such that any radiation from the sun, the moon, and the earth itself is reflected away from the earth with its NEO telescopes and Space Fence Network. In order to present no thermal signature to the DSP or to future SBIRS satellites, the reference ETVP should furthermore be reflective in the entire thermal infrared domain or else be cryogenically cooled. It should finally be designed so as to radiate its excess heat only into a

(double) cone which points into the unobserved direction of the earth's axis. Laser mirrors with a required reflectivity of 99.999% in a limited spectral range are state of the art (Rempe, Thompson, Kimble, & Lalezari 1992). The technology needed to design, build, and position a stealth spacecraft is known as well. A US patent, published in 1994, describes a passive conic mirror shield that renders an earth-orbiting satellite practically invisible both in the optical and radar domains (Eldridge, McKechnie, & Hefley 1994). It is inferred that an ETVP may use a similar, but superior stealth technology. To perform beyond the US patent description, the ETVP could actively nullify any residual return signals from radar or lidar beams sent in its direction. An additional detection risk would arise if the ETVP passed repeatedly between the earth and the sun or the moon. It is inferred that the ETVP may modify its orbit from time to time, so as to avoid occluding passages observable from earth.

Probe Power Capacity

The third unknown about an ETVP is its power capacity. In Hessdalen, the maximum visible light power of a UAP, evaluated as an isotropic (4π) emitter has been estimated to be 35 to 100 KW. It will be shown in the sections "New UAP Hypothesis, Discussion of UAP-A and UAP-B" and "Comparing the New Hypothesis with UAP Observations" that a UAP, according to the proposed model, emits into a solid angle of approximately $\pi (0.15)^2 = 0.07$ (or less) and that the relevant NIR to visible light up-conversion efficiency is approximately 30%. The proposed ETVP model thus requires a SEMP-emitting system with a maximum, time-averaged NIR output of about 2 KW.

Probe's Sensors and Reactions

The fourth unknown about an ETVP concerns its sensor and AI subsystem. In Hessdalen, a blinking UAP has been observed to react to a returned small laser beam with a doubling of its blinking frequency (Strand 2000). A number of following and avoidance maneuvers of UAPs with airplanes have been reported (for example Associated Press 1986). UAPs have changed their flight path in reaction to radar beams (see for example Documenting Reality 2000). UAPs also seem to control their distance from the ground, from cars, pedestrians, etc. All these observations lead to the conclusion that UAPs are intelligently steered with a reaction time of probably less than a second. It is inferred that the ETVP must be instrumented to detect various objects on earth in the optical and radar domains, perhaps by using the UAP as a relay device. It is also inferred that the ETVP must process this

earth observation data, interpret it, and then steer the SEMB so as to move a UAP purposefully inside the atmosphere, all in near real time. It is finally inferred that the ETVP must be located at a distance of less than about a light-second from the UAP which is a further indication that the ETVP is located in an earth orbit.

Probe's Orbit and Angle to Earth

The fifth unknown about an ETVP concerns its orbital parameters. UAP sightings have been reported from all continents around the earth (Ballester-Olmos 2009). This excludes the locking of a single ETVP into the earth rotation period. It is deduced that the time of revolution of the ETVP must be different from a stellar day and thus its distance different from a geostationary satellite (36,000 km). UAPs have been observed up to the latitude of Hessdalen (63° north), both in midsummer and in midwinter (Teodorani & Nobili 2002). This requires the ETVP to rise high enough above a northern horizon, and thus indicates an orbit that is strongly inclined with respect to the earth's equator. According to a statistical analysis carried out in 1975, UAPs remain visible for approximately 0.01 to 1 hour; they have been observed in 43 out of 508 sightings for at least 1 hour (Poher & Vallée 1975). Most UAPs have been sighted only locally but some have been observed by successive observers over a flight path of more than 1000 km (for example Sparks 1998). The proposed hypothesis requires that for all sighting locations, durations, and along all flight paths observed, the orbiting ETVP remains above the local horizon by an angle of perhaps 0.2 radian or more. Taken together, these observations lead to the conclusion that its earth revolution must last at least about 6 hours and that the corresponding orbit lies above 10,000 km.

Summing up, it can be stated that the ETVP must orbit the earth at a distance between 10,000 and 100,000 km, that its time of revolution is different from 24 hours, and that its orbital plane is strongly inclined to the equatorial plane. Its actual orbital parameters and size and shape remain unknown. For our further discussion, a reference ETVP in a circular 1.5-day polar orbit, which corresponds to a distance of 50,000 km above the earth surface, is assumed. It situates the ETVP considerably above all human-built geostationary and lower orbit satellites. This fits all observational data and allows for a UAP reaction time of 0.33 sec. The reference ETVP with its 30 m diameter and power capacity in the low KW range remains stealth in the optical, IR, and microwave domains with an albedo as low as 10^{-5} . The physics necessary to build such a space probe is understood today. The hypothesis of a large, yet undetectable ETVP in a high earth orbit is thus legitimate. Its capacity to emit an SEMB which produces UAPs is investigated below.

New Hypothesis, Characterization of the SEMB

The proposed hypothesis, second part, states that the earth-orbiting ETVP sends from time to time an SEMB into the earth's atmosphere where it creates, through a nonlinear photonic interaction with air, a luminous UAP. No publication has been found that formulates this or a similar concept. Also no visual, photographic, or video observation seems to have been published showing an SEMB arriving from space and ending up in a UAP.

It is necessary, therefore, first to investigate how an SEMB crossing the atmosphere could remain invisible to observers located nearby. An SEMB in the visible domain must obviously be excluded; this leaves UV and near infrared (NIR) ranges as major options. According to Raleigh's law, all light waves with a wavelength λ are scattered on the statistical density variations of air molecules with a $1/\lambda^4$ power dependence. An SEMB in the NIR range is more difficult to detect because it scatters nearly 100 times less than one in the UV range. To escape detection, its wavelength λ_s must lie beyond the sensitivity range of all instruments used up to now by UAP observers. It is inferred that the shortest SEMB wavelength that satisfies this conditions lies around $\lambda_s = 1.1 \mu\text{m}$.

In Hessdalen, UAPs have often been sighted near ground and under high air humidity conditions (Teodorani 2004). It is thus required that the SEMB is able to traverse the entire atmosphere with its strong CO_2 and H_2O molecular absorption bands in the NIR range. One explanation is that λ_s lies in between these vibration bands, i.e. in an atmospheric window at 1.0–1.08, 1.2–1.3, 1.5–1.75 μm , etc. Another explanation is that the SEMB is repetitively pulsed with a peak power sufficient to saturate an interacting H_2O or CO_2 absorption band within a few ps (picosecond, i.e. 10^{-12} s). A third explanation is that the SEMB is pulsed even faster, in the fs (femtosecond, i.e. 10^{-15} s) domain, i.e. too rapidly to couple with any molecular vibration modes. It is known that a repetitively pulsed, absorption saturating, or else an ultra fast-pulsed wave-train can traverse fog nearly loss-free at a near IR wavelength (Méjean, Kasparian, Yu, Salmon, Frey, & Wolf 2005).

The model ETVP at 50,000 km distance with an emitting structure of 30-m diameter produces an SEMB at $\lambda_s = 1.1 \mu\text{m}$ which, according to scalar wave optics, can be focused within the atmosphere to an Airy disk of approximately 1 m diameter with a 50% intensity roll-off. An invisible SEMB, which can be focused under a wide range of atmospheric conditions to any chosen point in the atmosphere to create a visible UAP, appears now as a physically realistic concept. An observer located anywhere on the ground, in an airplane, or up in a spacecraft nearby sees only a UAP appearing in midair and nothing else.

A major observational fact that has baffled scientists in Hessdalen, and elsewhere many other persons, concerns the dynamic behavior and shapes of UAPs. UAPs appear out of nothing, remain immobile in the sky, move slowly, accelerate suddenly, take sharp turns, move at a high speed, and disappear instantly. Balls, chains, or clusters of dots, spiral-shaped, and irregularly shaped UAPs have been seen and photographically recorded in Hessdalen (Strand 2011) and elsewhere. Most of the observed UAP movements and shapes are incompatible with any known hypothesis based on natural, earth-related causes.

The new hypothesis, second part, explains the entire static and dynamic behavior of UAPs in a straightforward way. Their appearance is controlled by the ETVP which turns the SEMB on, steers it at various angular speeds in two lateral directions, and then turns it off again (the steering of UAPs in the third, axial direction will be discussed later). It is hypothesized that the ETVP possesses a fast, possibly solid-state, SEMB-generating, modulating, and deflecting system, which operates in the NIR domain. Human-built equivalents exist in the microwave domain. These are phased-array radar systems used to detect and track missiles and airplanes.

A remarkable film recording from Hessdalen shows a moving constellation of partly flaring UAPs in midair (Google Videos 2009). Other UAPs have been photographed sitting quietly on the ground (bubbles). It is estimated that, in order to appear immobile, a UAP should drift sideways by no more than about 0.3 m. It is surmised that the orbiting ETVP possesses a sensor subsystem that tracks a UAP with respect to the local topography (or to some airplane flying nearby) in real time. For the reference ETVP, considering the speed of light, the delay in the control loop of 2 times 50,000 km is 0.33 seconds. An estimate shows that the reference ETVP needs to control the UAP with respect to the earth surface down to lateral speed errors of about 1 m/sec. This amounts to an SEMB angular speed control of 20 nano-radian/sec, allowing for lateral excursions of about 7 nano-radian. To compare: The Hubble space telescope has a pointing accuracy of about 30 nano-radian.

UAPs are not always immobile or slowly moving. In Hessdalen, a bright UAP has been tracked by radar at a speed of 8.5 km/sec (Strand 2000). Similar hypersonic velocities of UAPs have baffled radar operators worldwide and worried air force officers from many countries. The proposed hypothesis readily explains high speed UAPs by a correspondingly high angular scan velocity of the SEMB. From the Hessdalen UAP observation, it is inferred that the reference ETVP would have to steer the SEMB at an angular velocity of 170 μ radian/sec. It is also possible to estimate the required dynamic range of the angular steering system in the ETVP: It must cover speeds from 0

up to about 10 km/sec with a resolution of 1 m/sec. This includes tracking speeds from 0 to 0.46 km/sec, necessary to produce immobile UAPs on the rotating earth, anywhere between the poles and the equator.

New UAP Hypothesis, Understanding Luminous UAP

In Hessdalen and elsewhere UAPs have mostly been observed in the form of luminous white balls or clusters of balls. Such UAPs light up in different positions and sometimes exhibit a jerky motion. A detailed analysis by Teodorani and Nobili (2002) of several Hessdalen UAPs has led to the following conclusions: Their visible spectrum appears broad band without any clearly discernible absorption or emission lines; it resembles a blackbody radiator approaching 6000 °K. Their luminance is nearly flat top, and their total luminosity is proportional to their surface, i.e. to the ball surface multiplied by the number of composing balls. It is noted that the luminance of a UAP is about six orders of magnitude below that of a 6000 °K blackbody. A Hessdalen UAP with an indicative radius of 10 m has been estimated to emit isotropically 35 to 100 KW of light over its luminous surface of about 1260 m² (Teodorani & Nobili 2002). A 6000 °K blackbody source, continuously emitting the same luminous power as this UAP, would require a luminous surface of only 5 to 14 cm². If the Hessdalen UAPs were indeed 6000 °K blackbody radiators, then they would have to repetitively flash up only during a fraction η $0.4 - 1.1 \cdot 10^{-6}$ of the observation time in order to produce their estimated light output.

According to the new hypothesis, second part, the light emitted by a UAP results from an optical filamentation and air breakdown process discovered in 1995 by A. Braun et al. (Braun, Korn, Liu, Du, Squier, & Mourou 1995). This photonic process is obtained by means of an NIR laser which launches collimated fs pulses of sufficiently high power density into a transparent dielectric, for example air. The pulses self-focus, after an initial dark path, into one or several sub-millimetre-size NIR bullets, which are stable electromagnetic wave packets of high-energy density. In air, dark path lengths of up to 350 m have been experimentally produced (Béjot, Bonacina, Extermann, Moret, & Wolf 2007). The gradual self-focusing of pulses, i.e. their radial compression along a dark path, is known to result from a non-linear Kerr effect that locally augments the index of refraction of air. However, self-focusing also augments the electric field inside the pulses up to a point where free electrons are created by multi-photon absorption. Free electrons add a negative contribution to the refractive index which eventually balances the Kerr focusing effect. For typical 100 fs pulses in air the radially compressed NIR bullets reach an equilibrium diameter of about 100 µm for a length of 30 µm. Once formed, they fly over a path length that

again depends on the initial properties of the pulses. Eventually the bullets' flights end; they fade out once the beam energy content has been exhausted. Along their flight path the nearly monochromatic NIR bullets emit a narrow forward cone of super-continuum light (SCL). A powerful pulsed NIR laser, emitting for example at $\lambda_s = 0.8$ or $1.05 \mu\text{m}$, produces a bundle comprising N_B invisible bullets at λ_s , each of which produces a cone of visible SCL. The angle of the SCL cones depends on the wavelength considered. Blue-violet light is emitted in a semi-cone of about 4 mrad, red light in a semi-cone of 2 mrad (Maioli, Salamé, Lascoux, Salmon, Béjot, Kasparian, & Wolf 2009).

According to the proposed hypothesis, the SEMB produces bundles of NIR bullets in the atmosphere and these in turn create bundles of SCL cones equivalent to those obtained with laboratory lasers. The SEMB consists of sequential NIR pulses at λ_s , probably near $1.1 \mu\text{m}$, which follow each other at a suitably high frequency f_s . On their way through space they keep their initial time-amplitude structure. Upon penetrating the stratosphere and part of the troposphere, they are progressively compressed in time and self-focus from their geometric diameter of about 1 m down to a beam waist in the dm range. There each pulse decays into a bundle of sub-millimeter size NIR bullets that each produce a visible SCL cone flashing in the forward direction.

The successive bundles of SCL light flashes aim downward to a fixed point on earth. An observer, positioned within the SCL cones, perceives their light and interprets it as a UAP. An observer close to the cone's axis receives a high fraction of red light and sees an amber-colored UAP. When positioned 2 to 3 mrad off-axis, the UAP appears white. When positioned 3 to 4 mrad off-axis the UAP appears blue. When positioned still further sideways, nothing is visible. This UAP description is valid for an SEMB that aims steadily at a fixed point on the ground. However, the ETVP may rapidly scan the SEMB inside an angular cone of a few milli-radians around a fixed point on the ground. An observer situated within the superimposed SCL and scanning cones then perceives a nearly white UAP, independent from his (small) off-axis position. At the same time the UAP appears to him as a small luminous disk, rather than as a point light source. This description, which is based uniquely on the hypothesis, second part, closely matches the optical properties of many UAPs as observed in Hessdalen and elsewhere.

The energy conversion efficiency from an NIR laser pulse to a bundle of visible SCL flashes has been investigated; it is approximately inverse to the laser pulse length. For very short 30 fs pulses, it reaches 30% (Petit et al. 2011). The forward distance travelled by the SCL is determined only by atmospheric conditions. In a Lidar experiment, single SCL flashes have been sent upward, 20 km into the stratosphere, from where a small fraction

was backscattered and detected on the ground after a roundtrip of 40 km (Béjot, Bonacina, Extermann, Moret, & Wolf 2007). This indicates that, for a downward-directed SEMB, a small time-averaged optical power should already be sufficient to create a UAP which is well-visible to observers situated within the SCL cones.

Each NIR bullet in a round receives the same minimum amount of NIR energy from the SEMB. Provided that the loss mechanisms are the same for all bullets, they fly over the same path length before extinguishing. This path length defines the axial extension of a UAP. There are two major known energy loss mechanisms along the flight path of a bullet: Firstly, the bullet produces a visible SCL cone in forward direction which consumes a minor part of its energy. Secondly, it produces a filament of hot, weakly ionized air that it leaves behind. This heating process absorbs a major part of the initial bullet energy. The air, being inertially confined, has the same molecular density before and after the passage of a bullet. The total time-integrated length of a filament is the same as that of the corresponding bullet path. The ionized part of a filament, however, is much shorter. The initial degree of ionization is about $1 \cdot 10^{-3}$. It decays within the deionization time on the order of 100 ps (Tzortzakis, Prade, Franco, & Mysyrowicz 2000), which corresponds to a instantaneous ionized trail behind the bullet of about 30 mm. The ions emit, upon recombination, an isotropic afterglow. It contains a number of narrow molecular nitrogen and oxygen lines that span over the UV and visible part of the spectrum (Xu, Azarm, Bernhardt, Kamali, & Chin 2009). Farther behind the bullet the filament continues to exist for a few hundred ns in the form of an inertially confined tube of deionized hot air. Still later the filament starts to expand laterally and to cool down further. As a rough approximation it can be assumed that the luminous power emitted by the SCL cones is the same as that emitted by the filament afterglow. However, the SCL is emitted into a cone of approximately 10^{-5} rad^2 whereas the afterglow is emitted into a sphere of approximately 10 rad^2 . A bundle of NIR bullets, when viewed from the side, thus shines approximately 10^6 times less strongly than when viewed against its propagation direction. It is concluded that a UAP, according to the above description, remains practically invisible to observers located outside the SCL cones.

The proposed hypothesis explains how UAPs can appear out of nothing in midair or near the ground, such as is often observed. It is necessary therefore that the invisible SEMB produces NIR bullets and herewith visible SCL cones only after a long dark path across the earth's atmosphere. The equation that describes the dark path length of self-focusing NIR laser pulses in the air, until bullet formation, is known (Chin 2006). It is proportional to the square of the entry-beam diameter and depends furthermore on

optical parameters such as pulse power density, focusing state, and chirp. The atmospheric dark path length of an SEMB, until formation of a visible UAP, should obey the same equation. With an experimental laser beam of 8.2 cm diameter, the dark path length in air could be adjusted up to 350 m (Petit et al. 2011). The SEMB according to the hypothesis has a nominal atmospheric entry beam diameter of 100 cm. It should, therefore, travel over a dark path length that is $(12.2)^2$ times longer than the 8.2 cm beam, i.e. up to 52 km. Such a dark path length is sufficient, even for an obliquely incident SEMB, to traverse the entire earth's atmosphere and to generate a luminous UAP near the ground. The actual optical length of the SEMB dark path depends on its angle of incidence and on the air density integral along its trajectory. An ETVP that tunes the optical parameters of its SEMB in real time should thus be able to control the position of a UAP created along the beam axis. It is concluded that the new hypothesis is capable of explaining UAP sightings at any height above ground, in Hessdalen and elsewhere. It also explains how UAPs can rise from (near) the ground and accelerate unbelievably fast upward, to disappear at a high altitude within seconds.

The hypothesis is also capable of explaining how UAPs can be generated within a wide luminosity range. To this end a few further facts concerning the properties of NIR bullets in air need to be taken from photon physics. A single bullet of light is created as soon as the power density of a time-compressed (chirped) and Kerr-focused NIR pulse becomes high enough to produce a small, i.e. mm size, region of multi-photon ionization. A bundle of N_B bullets is created as soon as the total pulse power is large enough to produce a wider region of multi-filamentation (Petit et al. 2011). The bullets then form and fly with a lateral spacing of 3–10 mm and N_B becomes approximately proportional to the cross-section of the multi-filamentation region (Couairon & Mysyrowicz 2007a). The bullets extinguish as soon as the power density of the NIR pulse again falls below the critical value for beam self-focusing. The bullet flight path length from the point of creation to the point of extinction depends on the distance over which the critical power density is sustained against all dispersing and absorptive effects. This distance depends on the initial pulse power reservoir, on the pulse focusing state, on the mechanisms of bullet power loss, and on bullet mergers which in turn are influenced by optical turbulence (Couairon & Mysyrowicz 2007b). Bullet-path lengths between 6 m and 100 m have been produced by means of one experimental setup (Hao et al. 2009). Other experiments have been carried out to obtain bullet-path lengths spanning from a few cm to 2 km. It is concluded that the luminosity of a UAP is proportional firstly to the number of NIR bullets, i.e. to the number of SCL cones created in a bullet bundle. This means that the luminosity of a UAP is proportional to the

cross-section of the multi-filamentation region formed within the focused SEMB. The luminosity of a UAP is, secondly, proportional to the bullet-flight path length, as this corresponds to the time each SCL cone emits. The luminosity of a UAP is, thirdly, proportional to the pulse frequency f_s , which corresponds to the rate at which bullet bundles, i.e. bundles of SCL cones, are created. If the ETVP is capable of generating an SEMB where each of these three factors can be tuned over a range of 1 to 10, then the luminous intensity of the resulting UAP can be varied across a range of 1 to 1000. An SEMB capable of creating a similarly wide range of luminous intensities appears necessary and sufficient to explain nearly all UAP sightings.

The proposed hypothesis, as described up to here, explains the formation of cylinder-shaped UAPs that are visible only in a narrow forward cone along their axis. Their diameter corresponds to the multi-filamentation region of the SEMB which is estimated to be in the dm range. Such small UAP diameters result from an SEMB with a nominal ETVP launching diameter of 30 m which has been focused first geometrically and then by Kerr effect. The UAP cylinder length corresponds to the bullet flight path length. The resulting UAP, if created at a pulse frequency f_s above the flicker fusion frequency, looks like a white, star-like object in the sky that can be visually observed and instrumentally recorded. Such a UAP can light up, shine steadily or else with variable intensity, and shut down in any time sequence.

This initial UAP description fits many but not all properties of UAPs as observed in Hessdalen and elsewhere.

There are several reports about large, spherical- or disk-shaped UAPs with radii of 10 m and above (Teodorani & Nobili 2002) and also about UAPs with non-spherical, for example triangular, shapes. It is useful, therefore, to extend the initial hypothesis with a view to explaining the production of large, arbitrarily shaped UAPs. The extension is based on an ETVP emitting an SEMB which is recurrently line scanned or scatter scanned, etc., in two lateral directions. The scanning speed necessary to create a large luminous UAP disk of for example 20 m diameter can be estimated as follows: The focus bundle of SCL emitting bullets is 0.2 m across, whereas the diameter of the UAP disk is 100 times larger. To avoid any visual flicker, the entire UAP disk must be scanned at a rate of at least 30 Hz; this yields a scanning speed of $0.2 \text{ m/s} \times 100^2 \times 30 = 60 \text{ km/s}$. To evenly light up the entire visible UAP disk, the SCL pulses must flash every 0.2 m along the scanning path; this yields a pulse frequency $f_s = 300 \text{ KHz}$. It is noted that this SEMB scanning scheme results automatically in a flat-top luminosity distribution across the UAP disk. Such a UAP luminosity distribution has been measured repeatedly in Hessdalen, but could not be interpreted (Teodorani 2004). The

proposed hypothesis furthermore explains those Hessdalen observations where a UAP changes its apparent size while keeping its luminous intensity and its color temperature constant. This is in total contradiction to UAP models based on adiabatically expanding thermal plasma balls (Teodorani & Nobili 2002).

The proposed hypothesis can be further extended to a scanning SEMB which, in addition, is pulse power-modulated at f_s . Such an SEMB creates a UAP in midair in a way similar to a scanning laser projector creating a TV image on a cloud underside. Any stationary or dynamic (morphing) UAP shape can be obtained this way. All observations of UAPs with non-spherical shapes, notably triangular, grape, rod, spiral, polygon, etc., in Hessdalen and elsewhere (Strand 2011), are explained by this extension of the hypothesis. Groupings of point-like UAPs that flare up, pulsate, show jerky movements, split up, and/or fuse have been sighted as well (Google Videos 2007). Such UAPs are explained by the same scanning and pulse power-modulating SEMB hypothesis. Some flickering and/or morphing UAPs could perhaps also be explained by a stationary SEMB that is dynamically deflected by atmospheric turbulence.

UAPs, whether small or large, are known to be silent phenomena (Hill 1995). This intriguing observational fact is impossible to explain on the basis of any hypothesis that presupposes that UAPs are large-size, electrically or thermo-chemically sustained plasma balls. According to the proposed hypothesis, UAPs are generated by angularly scanned bundles of sub-millimeter-sized NIR photon bullets, which are fired at an ultrasonic pulse frequency f_s . Only small air volumes are involved; they heat up within femtoseconds, expand, and then cool on a ps to μ s time scale. A photonic UAP, when averaged over its entire volume and lifetime, represents a nearly ambient temperature and atmospheric pressure phenomenon of very low energy density. This explains the silence of UAPs, even at close range.

To close this section, it is noted that the entire filament generation, conical SCL, and recombination light emission process of ultra-fast laser pulses in air has been investigated for more than 17 years by research groups all around the world and has resulted in approximately 1,000 publications (Filamentation 2013). In Europe, a major group has been formed by researchers working in Berlin, Jena, Lyon, Paris, and Geneva. They have introduced for their experimentation a powerful, mobile, femtosecond laser system called Teramobile (Wille, Rodriguez, Kasparian, Modelain, Yu, Mysyrowicz, Sauerbrey, Wolf, & Wöste 2002). However, neither this nor any other laser research group has ever published a paper that would establish a relationship among filamentation, optical air breakdown, and SCL flash emission on one hand and UAP observations on the other. All

their work has remained focused on photon physics for atmospheric sensing, for lightning control, etc.

New UAP Hypothesis, Discussion of UAP-A and UAP-B

Luminous UAPs, according to the hypothesis explained in the section “New UAP Hypothesis, Understanding Luminous UAP” above, are generated by an invisible SEMB, consisting of single NIR pulses, which are emitted at an ultrasonic frequency f_s typically below 1 MHz. Arriving at some point in the atmosphere, each pulse creates by self-focusing a bundle of for example $N_B = 300$ laterally distributed bullets that fly in parallel inside a cylinder of for example 200-mm diameter until extinction. Each bullet produces along its flight path a narrow cone of SCL, the axis of which prolongs the SEMB. Each bullet also leaves a weakly ionized filament behind which recombines within approximately 100 ps (Tzortzakis, Prade, Franco, & Mysyrowicz 2000), i.e. some 10^4 times faster than the time interval $1/f_s$ between two successive pulses. Each subsequent bundle of bullets is created, therefore, again in deionized, quiescent air. This means that subsequent bundles of bullets and their SCL cones are not deflected by the filaments left over from previous bullets. A UAP that emits such unaltered bundles of SCL cones is now called a UAP-A. It can be understood by direct extrapolation of experimentally and theoretically established femto-laser processes. A UAP-A becomes visible only when its sequential bundles of SCL cones with their opening angle of 4 to 8 mrad reach an observer who then sees a bright light. The line of sight from the observer to the UAP-A must nearly coincide with the prolongation of the incoming SEMB. An observer located outside the narrow SCL cones sees nothing or else only a weak recombination light that is isotropically emitted by the filaments left behind by the bullets. Two observers, located at a lateral distance corresponding to more than about 8 mrad, cannot both see a UAP-A as long as it remains stationary. They will disagree on what they see. If, however, a UAP-A moves sideways, then it becomes visible first to one and, a moment later, to the other observer. They will agree that they have both seen a UAP. The observers may install two laterally displaced, time-synchronized cameras to determine the distance of a UAP-A by optical triangulation; they will find out that their cameras are unable to determine the distance of a UAP-A.

The proposed hypothesis can now be extended as follows: A UAP-B is produced by rounds comprising each N_R pulse instead of single NIR pulses. The rounds follow each other again at an ultrasonic frequency f_s . Each pulse in a round creates, after self-focusing, a bundle of N_B bullets that are laterally distributed in a semi-regular pattern over a circular bundle cross-section. All pulses in a round together create, after self-focusing, a compact

bullet package of $N_B \times N_R$ bullets. Bullet packages with visible SCL cones, generated repeatedly at f_s , produce a seemingly continuous white shining UAP-B. It remains visible to observers who are positioned at large lateral distances from each other.

It is known from theory, numerical simulations, and experiments (Couairon & Mysyrowicz 2007b) that NIR bullets exchange, along their flight path, energy with the surrounding air column which acts as a reservoir for the radially oscillating optical energy. They compress semi-periodically in the space and time domain due to group velocity dispersion. Bullets produce, along their flight path, filaments with diameters varying semi-periodically between about 0.1 and 1 mm. They feature alternating cylindrical and spindle-shaped sections with characteristic lengths in the mm to m region. The free electron density within these sections varies by a factor of 10 to 100 (Couairon & Mysyrowicz 2007b). The air inside a bullet experiences for an instant a high electric field-strength, producing a non-linear Kerr effect that leads to an augmentation of the refractive index. At the same time it becomes partly ionized, which lowers the index. The resulting refractive index inside a bullet remains close to that of ambient air. The air inside a filament just behind a bullet remains partly ionized as well, but experiences no Kerr effect. This leads to an ionization-dependent refractive index in the filament that lies below that of ambient air. It causes subsequent bullets to be deflected. Behind a bullet package the filaments gradually deionize, such that their refractive index reverts back to that of ambient air. Inside a bullet package, but between the bullets and filaments, the refractive index of air remains essentially unaltered.

The first pulse in a round self-focuses into quiescent air. The flight direction of the resulting first bundle of bullets and their SCL cones therefore remains parallel to the UAP-B axis, the same as for a UAP-A. The first bundle of bullets also produces a first bundle of undeflected filaments. The second, third, etc., bundles of bullets and their SCL cones do not form in quiescent air after that. Their points of formation are on average laterally displaced with respect to the filaments already in place. These small displacements are of arbitrary size and azimuthal direction. Second-pulse bullets thus fly along a path that asymmetrically overlaps the ionized filaments from first-pulse bullets. They fly across a refractive index gradient that is nearly perpendicular to their propagation direction. It means, according to ray optics, that these bullets move on a curved path and are deflected into various azimuthal directions. The radius of curvature of their path is inversely proportional to the local refractive index gradient. Second-pulse bullets produce deflected SCL cones and deflected filaments. Third-, fourth-, etc., pulse bullets are not only deflected by straight first-

pulse filaments but also by oblique, second-pulse, etc., filaments. Second-, third-, etc., pulse bullets that fly through filament-spindle sections are deflected into a wider angular range than those flying through cylinder sections. Bullets from later pulses up to $N_B = 100$ are thus multiply deflected into progressively larger conical domains. They produce SCL cones and filaments that are more and more oblique with respect to the initial bullet direction. This multiple-deflection process continues until the bullets and their SCL cones leave the initial filament package obliquely and start to propagate in quiescent air. This explains why UAP-Bs are visible within a much wider cone.

A numeric example appears best-suited to further concretize the proposed UAP-B concept. The SEMB shall be structured into rounds that are composed of each $N_R = 100$ pulse. Each pulse forms, after self-focusing, a bundle of $N_B = 300$ bullets. Each round forms a bullet package with $N_R \times N_B = 3 \cdot 10^4$ bullets. The SEMB shall consist of a 30-sec long sequence of such bullet packages sent at an ultrasonic frequency of $f_s = 300$ KHz. Angular scanning of the SEMB creates a UAP-B which is for example disk-shaped with a diameter of 10 m. Each round is fired within 10 ps at a pulse rate $f_R = 10^{13}$ Hz. A pulse duration $\Delta t_s = 30$ fs is postulated, leaving a time separation of 70 fs between two pulses. It is assumed that this separation is sufficient to decouple the self-focusing process of each pulse from that of its neighbors. The physics of self-focusing a single pulse into a bundle of for example 300 bullets is understood (Couairon & Mysyrowicz 2007a). A short-pulse duration of 30 fs is required firstly to produce an adequately long dark path length of the SEMB across the earth's atmosphere. Only chirped, i.e. time-compressed, pulses allow for combining a long focusing dark path with a high instant power needed for bullet production. A short pulse is required, secondly to obtain the desired bullet path length of $L_B = 10$ m. The high pulse rate of 10^{13} Hz is necessary to build up a high free electron density within the filaments. This is required because only strongly ionized filaments are capable of substantially deflecting bullets. Only deflected bullets produce deflected SCLs, i.e. a UAP-B that is visible within a large angular domain.

Each bundle of 300 bullets shall have an initial diameter of 0.2 m, corresponding to a typical lateral bullet spacing of about 10 mm. An entire round of 100 bundles forms a 3-mm thick, disk-shaped bullet package that flies for 33 ns at $3 \cdot 10^8$ m/s (speed of light) over its 10-m path length before extinguishing. The individual bullets have an average diameter of 200 μm and a thickness of 9 μm , corresponding to their pulse duration of 30 fs. Their thickness is limited by the Fourier transform wavelength spread that corresponds, for a center NIR wavelength $\lambda_s = 1.1$ μm , to about 8

oscillations. Subsequent bullets in a package follow each other at a distance of about 20 μm ; their longitudinal spacing is thus 10 times less than their diameter.

While advancing along their path, the bullets produce filaments with an initial average diameter of 200 μm . The filaments deionize within approximately 100 ps, i.e. some 30 mm behind the bullets. During the 10 ps needed to form a bullet package the deionization process remains negligible. After formation of a first-bullet bundle in a round, the filaments created have a free electron density of approximately $3 \cdot 10^{16} \text{ cm}^{-3}$, (e.g., Couairon & Mysyrowicz 2007b). Atmospheric air has a neutral molecular density of $3 \cdot 10^{19} \text{ cm}^{-3}$ which means that the first filaments are ionized to 0.1%. The second bullet bundle follows 0.1 ps later and flies into the filaments produced by the first bundle. The electron density of the filaments created by the second bundle adds up to that of the first filaments. The electron density then further augments during formation of the remaining nearly 100 bundles to approach $3 \cdot 10^{18} \text{ cm}^{-3}$. After 10 ps and a 3-mm path length, the package is complete and all its bullets participate in maintaining a high degree of ionization within its $3 \cdot 10^4$ filaments.

The question to address next concerns the way bullets within a package are deflected by the ionized filaments along their flight path. The refractive index of ambient air is approximately 1.0003. The refractive index contribution of ionized air molecules inside a filament depends on the electron density and is given by the electron plasma dispersion relation (Bastian 2005). For an electron density rising up to $3 \cdot 10^{18} \text{ cm}^{-3}$ and for $\lambda_s = 1.1 \mu\text{m}$, the refractive index is reduced by 0.0002. The angle of deflection of a bullet by a partly ionized cylindrical filament is determined by its angle of incidence and by the refractive index step across a filament–air interface. The simplest estimate is based on linear ray optics, applied to a bullet flying inside and along a straight, ionized filament with an index of refraction reduced by 0.0002. Applying Snell's law to the limiting angle of total reflection, i.e. to grazing incidence, one obtains a bullet exit angle of 0.02 rad.

Each time a bullet is deflected, it produces a deflected filament. There are $3 \cdot 10^4$ filaments in a bullet package within an initial disk area of $3 \cdot 10^4 \text{ mm}^2$, leading to a filament density of $1/\text{mm}^2$. With an average filament diameter of 0.2 mm, a once-deflected bullet must thus move on average by 5 mm laterally to encounter another filament and to be deflected a second time. A bullet that has been deflected once and moves obliquely at an angle of 0.02 rad is on average deflected a second time after moving forward by $5/0.02 = 250 \text{ mm}$. Such a bullet is on average deflected by an already oblique, either cylinder- or spindle-shaped filament. The resulting second-deflection

angle lies within a cone of approximately ± 40 mrad, which depends on the direction of inclination and azimuthal orientation of the oblique filament and also on its cylindrical or spindle shape.

As a result, the bullet package advances in its initial direction while the individual bullets, except those from the first pulse, are multiply deflected over small angles by the filaments that have been produced in front of them. As the bullet package flies forward, its oblique filaments become intertwined so as to form a filament felt. While advancing, the multiply deflected bullets within the filament felt drift on average into larger radial distances. The drifting process inside the package lasts over the initial bullet path, i.e. as long as the bullet and filament density remains about $1/\text{mm}^2$.

The bullet drift obeys the square root law of a random walk into progressively augmenting radial distances and deflection angles. As the forward-flying bullets drift radially outward, the bullet package progressively augments its disk-shaped area and the bullet paths open up like a fireworks burst. An average bullet in a package, soon after its formation, is now considered. It shall be located at a radial distance of 71 mm, where half of all bullets are found around the center and half farther out. From there, this average bullet must move nearly 30 mm radially to escape over the initial package radius of 100 mm. Its random walk through the filament felt requires, according to the square root law, approximately $(30/5)^2 = 36$ deflections. After having drifted across the filament felt to the rim, the escaping angle of this average bullet is estimated to be at $36^{0.5} \times 20$ mrad = ± 120 mrad.

The average obliqueness of a bullet path during its multiple deflections across the filament felt is estimated to be half the escaping angle, i.e. 60 mrad. For a lateral bullet displacement of 5 mm, a bullet thus advances between two deflections on average by $5/0.06 = 83$ mm; hence, after 36 deflections, it advances by approximately 3 m. Over this initial path the bullet package expands its diameter by $2 \times 0.06 \times 3 \text{ m} = 0.36 \text{ m}$ from 0.2 m to about 0.56 m. This expansion reduces the probability for further bullet deflections by a factor of $(0.56/0.20)^2$, i.e. by about 8. This means that an average bullet escapes from the package after an initial path of approximately 3 m. It then flies nearly without deflections for another 7 m until extinguishing. Overall a bullet package can be described as $3 \cdot 10^4$ bullets moving in a 10-m long forward burst which lasts 33 ns and opens up to approximately ± 120 mrad. Each of the bullets emits a forward SCL cone open to about 6 mrad. The $3 \cdot 10^4$ SCL cones together emit a forward flash of incoherent white light, which opens up to approximately 250 mrad.

In our UAP-B example the ETVP produces, during a time span of 30 sec, an angularly scanned SEMB that transports bullet packages at a rate of

300 KHz. These packages create, somewhere in the earth's atmosphere, a single or multiple, immobile or moving, quiescent or intensity-modulated white UAP-B of fixed or morphing size and shape. This UAP-B is visible in midair within a forward cone of approximately 0.25 rad. From the side and from behind, both UAP-A and UAP-B remain faintly visible because of the recombination light emitted by their filaments.

Comparing the New Hypothesis with UAP Observations

The proposed local SETI hypothesis, first part, defines a reference ETVP that orbits the earth in a 1.5-day polar orbit at a distance of 50,000 km. It predicts, in the second part, that the ETVP occasionally emits an invisible SEMB that produces a UAP at some selected earth longitude, latitude, and height above ground, atmospheric conditions permitting. It also predicts that a UAP-A emits a narrow cone and a UAP-B a wide cone of white light in prolongation of the incident SEMB. This light cone intersects the ground over an elliptic or hyperbolic area within which an observer can see the UAP. He then describes his line of sight by an azimuth and elevation of the UAP.

A simple model example helps to interpret UAP sightings made in Hessdalen and elsewhere. An SEMB, incident from the south at an elevation of 0.2 radian, creates a UAP-A at a height of 2 km above horizontal ground. The distance, where the axis of the UAP light cone intersects the ground, then lies 10 km farther north. For a UAP-A with a cone-opening angle of 6 mrad, the elliptic area intersecting the ground and within which it is visible measures about 60×300 m. For a UAP-B with a cone-opening angle of 0.25 rad, the corresponding elliptic area on the ground starts 6 km north and ends 27 km north of the UAP; in an east–west direction it spans 2.5 km across. For an observer located at the rim of this elliptic area, the line of sight to the UAP-B differs from that to the invisible SEMB by 125 mrad.

The azimuth and elevation of all UAP observations made in Hessdalen between 1998 and 2001 have been assembled into a sky map (Teodorani 2004). The map also includes 15 positions of the moon which allows for calibrating as follows: It covers an elevation angle spanning from nearly 60° below the astronomic horizon to 65° , i.e. 1.13 radian above it. In the azimuthal direction, the map covers an angle of 180° , i.e. of 3.14 radian, spanning from east over south to west. The map shows approximately 200 UAP events that appear to be distributed at random over all azimuths and elevations above the terrain horizon. These sightings could in principle be all of the UAP-A type. It would mean that the invisible ETVP is located each time nearly behind the UAP and that the SEMB aims nearly in the direction of the observer. If this were the case, then the regular earth orbits

of the ETVP may become visible on the sky map as a pattern of preferred UAP sighting directions. As there seems to be no discernible such pattern, it is likely that the ETVP emits the SEMB on average obliquely with respect to the sightline of the observer and that many of the 200 Hessdalen sightings are of the UAP-B type.

The map also shows approximately 20 UAP sightings that are below the terrain horizon. An estimated 13 are located less than 0.1 radian and the other 7 are between 0.1 and 0.4 radian below the horizon. The first 13 sightings can be marginally explained as UAP-B events. The last approximately 7 sightings, which are all located next to the ground, necessitate a separate explanation. A haze layer often covers the Hessdalen Valley. A scanned SEMB, incident from a high elevation angle, shall create a voluminous UAP-B inside the layer. This leads to the condensation of fog droplets that in turn scatter the downward emitted SCL-B light cone over a large solid angle. The UAP then appears as a large white ball of fog (or otherwise-shaped object), sitting on the ground, lit from the inside and visible from everywhere.

An optical EMBLA mission was carried out in Hessdalen from July 29 to August 21, 2001 (Teodorani, Strand, & Hauge 2001). Before its operations started, the Hessdalen Automated Measuring Station (AMS) was upgraded with a pair of coupled video cameras, placed at a lateral distance of 171 m. This computer-controlled camera pair was programmed to measure the distances of UAPs by optical triangulation. Altogether, 20 UAP events have been captured. However, the EMBLA mission report does not state that the two cameras had simultaneously observed the UAPs and that their distance had been determined by triangulation. The UAP distances are reported 16 times as “kilometres” without any explanation and the remaining 4 times as: “5 km”, “5 km”, “2.5 km”, “50–100 m?” with additional estimates as “hundreds of meters”, and “presumably 5 to 7 km”. It is surmised that in many cases only one camera had recorded any particular UAP event and that the planned triangulations could not be carried out. The UAP-A model of a narrow conical emitter explains why the UAP distances could not be determined. At an estimated maximum sighting distance of 7 km, the 6-mrad wide UAP-A cones illuminated a patch of land of 42 m width. This means that a close group of observers near a first AMS camera could jointly see a UAP-A. However, another group of observers and/or a second AMS camera farther away than about 40 m could either see nothing or else another UAP-A located near the first one at the same or at a different distance.

Other Hessdalen observations require the UAP-B model for explanation. They concern UAPs in viewing directions that cannot be in line with the SEMB and thus with the ETVP direction. This can be the case, as already

discussed, for UAPs seen close below the terrain horizon. It must be the case also for immobile UAPs that remain visible for more than a few minutes, for UAPs that move or jump across the field of view, and for multiple UAPs flying in a wide-open formation.

In Hessdalen, several stationary UAPs have been observed during time spans from a few seconds up to a maximum of 3 min (Teodorani 2004). The reference ETVP orbits the earth within 1.5 days and moves, therefore, at 2.9 mrad per min across the sky. An immobile UAP-A with its 6-mrad emission cone can thus be observed for up to 2.1 min. Most Hessdalen observations of stationary UAPs in the sky are compatible, hence, with the UAP-A model. Elsewhere in the world UAP observation times of an hour and more have been reported (Poher & Vallée 1975). In an hour, the reference ETVP moves 175 mrad with respect to the local sky coordinates and also with respect to an immobile UAP. A stationary UAP-B with a light emission cone of ± 125 mrad could thus remain visible for up to 1.7 hours. If the ETVP steered the SEMB such that it aims constantly at one location on the ground, then a slowly moving UAP-A or UAP-B created up in the sky could remain visible to a local observer for an entire night.

In Hessdalen, on December 4, 1999, a video was recorded in which an approximately triangular UAP moves smoothly over 39% of the camera field of view before extinguishing (Strand 1999). The zoom lens setting used has not been indicated. Nevertheless, even with a wide-angle zoom setting, a UAP-B light emission cone of ± 150 mrad would be sufficient to explain this recording. If a 20% longer focal distance setting had been used, then a UAP-B emission cone of ± 125 mrad would suffice. Most other videos of moving UAPs worldwide should become similarly explainable as well.

On September 20, 2007, again in Hessdalen, a 30-sec exposure photographic image was taken with a 50-mm lens, equipped with a transmission grating. It shows the white trace of an intense, multiply flaring UAP moving in an approximately horizontal, jerky path across 42% of the field of view before extinguishing. It shows, below the white trace, a featureless emission spectrum going from red to indigo. The image also shows dark hills, a clear evening sky with a few small clouds and many stars in the background (Hauge 2009). The luminous trace recorded on the image corresponds to a UAP motion over 300 mrad. A slightly adapted UAP-B model, with an emission cone that is 20% wider than the order-of-magnitude model presented in the section “New UAP Hypothesis, Discussion of UAP-A and UAP-B,” again explains this Hessdalen phenomenon. The multiple, sub-second intensity flares and the jerky path recorded are entirely compatible with a scanned and intensity-modulated SEMB–UAP model.

The nearly featureless white spectrum is what a bundle of SCL emission cones are known to produce. It is evident that this Hessdalen phenomenon is totally incompatible with any previous interpretation, were it based on a chemical combustion process in midair, on an atmospheric electrical phenomenon, or on a hoax, etc.

To summarize: The 1998 to 2001 UAP sky map with its approximately 220 sightings and UAP observations in Hessdalen can be entirely explained by either a UAP-A or UAP-B model in direct observation or else in diffuse reflection from a ground haze layer. UAP-As with their 6-mrad, narrow light cones explain the 20 EMBLA 2001 Hessdalen AMS observations and their unsuccessful triangulations. A UAP-B with a much wider light cone explains the December 4, 1999, Hessdalen video and also the September 20, 2007, photographic image and spectrum of a moving UAP. Both UAP models with their white light emission cones of 6 mrad and 250–300 mrad, taken together appear adequate to explain all observations of stationary, moving, single, and multiple UAPs of various shapes that have been sighted in Hessdalen. To decide definitely for each single Hessdalen observation whether and which of the two proposed UAP models applies, it will be necessary to engage in a direct dialogue with the Hessdalen science team and to access their remaining, yet unpublished, instrumental and observational data.

Conclusions

UAP phenomena have, for nearly three generations of scientists, resisted all efforts to find a rational and coherent explanation. Available compilations of UAPs show that they are complex phenomena with a wide range of visual shapes, luminosity, colors, dynamics, reactions, acoustics, electromagnetic, and other properties. UAPs have been observed all over the world for more than six decades (see the section “Major Known Properties of Luminous UAP”). Previous researchers have considered explanations based on alien crafts using “antigravity,” on ball lightning, earth lights, rock piezoelectricity, hoaxes, etc. Each of these hypotheses offers at best a partial fit for a fraction of all UAP sightings. In view of this unsatisfactory situation, some investigators have tried to exclude all UAP sightings that did not match their explanations. However, even for those sightings that seemed to fit best, the researchers were unable to indicate a physical, chemical, etc., process that would model the relevant UAP observations in an overall coherent and quantitative way (see the section “Existing Hypotheses Concerning UAP Sightings”).

The absence of any scientifically acceptable theory to explain UAPs has spurred the creation of thousands of Internet articles, books, movies,

etc., which offer pseudo-scientific or else fantasy explanations. For the general public, observable UAP properties have become indistinguishable from fictional UFO properties, and knowledge about UAPs has become mixed up with irrational beliefs. This is contrary to what an enlightened, democratic, and responsible society should head for.

The present article explains the nature of UAPs by means of an entirely new hypothesis. It combines extensive observational data from UAP research in Hessdalen with experimentally and theoretically well-established facts in physics, notably in photonics, astronomy, palaeontology, history, and future technology (see the section “Stating the New Local SETI Hypothesis”). The proposed hypothesis postulates the existence of a technically superior civilization in our galactic neighborhood at a maximum distance of about 500 light years. It has remotely detected our own civilization at its early agricultural level and has, less than about 5000 years ago, launched an extraterrestrial visiting probe, ETVP, which has travelled at approximately 0.1 c (speed of light). To be in line with historical UAP sightings, this ETVP had been placed into earth orbit several centuries ago. This scenario is compatible with recent advances in exoplanet and exobiology research and with technical forecasting for earth-based telescope, spacecraft, and artificial intelligence systems. It forms, therefore, a credible first part of the proposed hypothesis (see the section “New ETVP Hypothesis, General Exo-Civilization Scenario”). A galactic neighborhood model based on the Drake equation has furthermore been evaluated. The proposed scenario fits herein as well, provided the average lifetime of exo-civilizations is on the order of 10 million years, i.e. comparable to the history of hominids on earth (see the section “New ETVP Hypothesis, Galactic Neighborhood Model”).

Several high-tech optical and radar space surveillance systems have been in operation for fifty years to track satellites, space debris, missiles, and NEOs. They should be able to detect and track a non-stealth ETVP in earth orbit. An Internet search has shown that no observation indicative of such an ETVP has ever been reported (see the section “Previous ETVP Hypotheses and Searches”). Accounting for this and other facts, the proposed hypothesis postulates a highly stealth reference ETVP, located in a 1.5-day polar orbit. The required degree of invisibility is compatible with near-future terrestrial technology (see the section “New Hypothesis, Characterization of the ETVP”).

R. Bracewell, back in 1960, described a hypothetical, radio-emitting ETVP (Bracewell 1960). His article proves that the concept of an interstellar earth-visiting probe was introduced into scientific thinking half a century ago. The postulated presence of an earth-orbiting ETVP is also in line with the main conclusion reached by J. Haqq-Misra and K. Kopparapu in 2012:

“Extraterrestrial technology may exist in the Solar System without our knowledge” (Haqq-Misra & Koppurapu 2012).

The second part of the proposed hypothesis stipulates that the ETVP comprises an advanced sensor-, AI-, and NIR-emitter system that occasionally generates a steered electromagnetic beam (SEMB). This SEMB is directed into the earth’s atmosphere where it creates, through a femtosecond (fs) photonic process, a filamentary plasma discharge, which is seen as a UAP (see the section “New Hypothesis, Characterization of the SEMB). Ultrafast lasers, producing single and multiple filamentary plasma discharges, have been studied for 17 years now by several research groups. They produce conical flashes of super continuous light (SCL) in midair, very much like a UAP. However, no scientist seems to have applied these results from laser technology, quantum optics, and aerology to UAP research.

It is shown (see the section “New UAP Hypothesis, Understanding Luminous UAP) how such a photonic process can be used to build a model UAP-A. It explains the entire gamut of properties of (nearly) stationary UAPs seen in the sky, notably their various shapes and sizes, their morphing, their white and/or colored-light output, their sudden appearance and disappearance, their silence, and their invisible energy source. To obtain a match with all remaining UAP observations, an extended femtosecond photonic process is defined and investigated. It leads to a UAP-B model that is capable of explaining single and multiple UAPs that move smoothly or erratically across the sky, which remain visible for up to several hours, and which appear near the horizon line. Together the two proposed UAP models also explain why UAPs can appear anywhere on earth and under widely different atmospheric conditions (see the section “New UAP Hypothesis, Discussion of UAP-A and UAP-B”).

There are several additional properties of UAPs that have not yet been discussed in the present paper. They concern electromagnetic disturbances, radar echoes, soil marks, etc., associated with UAP sightings.

It is hoped that the UAP generation hypothesis described in this article will help researchers to build a bridge between femtosecond photonics, theoretical engineering, and scientific UAP observations. To bring these activities closer together, an interdisciplinary workshop should be held. Subsequently, a theoretical research project should be planned to investigate and test the new ETVP–SEMB–UAP hypothesis in more detail. The exocivilization scenario part is amenable to statistical modeling. The photonics part is amenable to computer modeling and to experimental testing, i.e. to the creation and investigation of artificial UAPs. A further UAP observation project with suitably extended sensing instrumentation could be envisaged at Hessdalen. A positive experimental and/or observational proof of the

photonic nature of UAPs would render the existence of a stealth ETVP in a high earth orbit highly likely. This in turn would become a proof for the first part of the hypothesis, i.e. for the existence of a neighboring advanced exo-civilization.

It is hoped that the present article can set a cornerstone, from where scientists will be able to till a new field of research. It will enclose investigation of phenomena that require exo-technology for their explanation, such as UAP observations, crop circles, possibly positive SETI signals, etc.

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ESSAY

**Building Alien Worlds—
The Neuropsychological and Evolutionary Implications
of the Astonishing Psychoactive Effects of
N,N-Dimethyltryptamine (DMT)**

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Abstract—Arguably the most remarkable property of the human brain is its ability to construct the world that appears to consciousness. The brain is capable of building worlds during waking life, but also in the complete absence of extrinsic sensory data, entirely from intrinsic thalamocortical activity, as during dreaming. DMT, an extraordinary psychedelic, perturbs brain activity such that indescribably bizarre and apparently alien worlds are built. This property of DMT continues to defy explanation. However, by regarding this unique molecule as equivalent to serotonin, an endogenous neuromodulator with a long-standing relationship with the brain, DMT's effects may be explained. Serotonin has evolved to hold the brain's thalamocortical system in a state in which the consensus world is built. When serotonin is replaced by DMT, the thalamocortical system shifts into an equivalent state, but one in which an apparently alien world is built. This suggests that DMT may be an ancestral neuromodulator, at one time secreted endogenously in psychedelic concentrations—a function apparently now lost. However, DMT maintains a number of unique pharmacological characteristics and a peculiar affinity with the human brain that supports this model. Thus, the modern practice of ingesting exogenous DMT may be the reconstitution of an ancestral function.

Friends, right here and now, one quantum away, there is raging a universe of active intelligence that is transhuman, hyperdimensional, and extremely alien.

—Terence McKenna

Introduction

N,N-dimethyltryptamine, DMT, is a truly exceptional hallucinogen. When smoked or injected in a purified or synthetic form, its effects on consciousness are more profound, shocking, and compelling than any other known psychedelic—the 'DMT flash'. Within seconds of inhaling,

DMT propels the user to an unimaginably bizarre alternate reality, an alien world. And yet, DMT is not an obscure compound, cooked up in the lab of a creative underground chemist, but a ubiquitous natural molecule found in countless plant species and with a long history of human use. Although much has been written on DMT and its effects, this unique drug continues to defy explanation. It is straightforward to assume that the DMT flash is *mere hallucination*, but very few have taken the time to consider, in detail, what this would entail from a neurobiological and neuropsychological standpoint and thus whether this explanation holds water—this paper aims to do just that.

The administration of exogenous DMT is traditionally associated with indigenous Amazonian people, who consume a bitter decoction of at least two types of plant material, known as ayahuasca (Luke 2011). This brew necessarily contains a DMT-containing plant, such as *Psychotria viridis*, together with one containing harmala alkaloids, such as *Banisteriopsis caapi*. These latter alkaloids act as monoamine oxidase (MAO) inhibitors, preventing the DMT being destroyed in the gastrointestinal tract and thus rendering it orally active. This practice can be traced back several thousand years (McKenna 1999). The consumption of relatively pure DMT, extracted and purified from plant material or synthesized chemically, is very much a modern practice. In fact, DMT was identified as psychoactive only in 1956, synthesized and self-administered by Hungarian psychiatrist Stephen Szàra (Szàra 1989). Notable psychedelic pioneers Timothy Leary and Ralph Metzner experimented with, injected, and smoked DMT throughout the 1960s, and a 1966 article by Leary (1966) caught the attention of many in the psychedelic counterculture (Meyer 1994). The late Terence McKenna, the highly articulate ‘bard’ of the psychedelic community, regarded DMT as the most powerful and authentic psychedelic experience one could have—“this isn’t a drug, this is *magic!*” (McKenna 1991). During his lectures he regularly described, in eloquent detail, his experiences after smoking DMT and can probably be credited with popularizing this form of DMT use. Smoking DMT remains the most common mode of administration, producing an extremely intense, but short-lasting experience, both quantitatively and qualitatively different from that of ayahuasca and other oral DMT preparations. This article will focus on smoked or injected DMT, rather than its oral preparations, as the effects of ayahuasca are unlikely to be consistently the result of the action of DMT alone—the harmala alkaloids are known to be psychoactive and no doubt contribute to the experience. Other alkaloids from the many admixture plants that are utilized in the range of different ayahuasca recipes may also color the effects. Whereas the ayahuasca experience builds gradually, as the DMT is slowly absorbed

into the bloodstream, smoking DMT is like “being fired out the muzzle of an atomic cannon with neon-byzantine barrelling” (Leary 1966). Further, as well as allowing DMT to be orally active, MAO inhibition also elevates serotonin levels in the brain, competing with DMT for receptor sites and probably attenuating its effects (Mishor, McKenna, and Callaway 2011). As such, it would be unwise to draw conclusions about the effects of DMT by relying on the effects of ayahuasca. We are most concerned here with the effect of DMT rapidly flooding the brain and overwhelming the user—this is the effect known as the ‘DMT flash’.

This discussion will analyze the DMT flash in terms of what is currently known about perception and the way the brain represents the world that appears to consciousness. It will also justify the position that the DMT flash cannot be explained using the paradigms of modern brain science or pharmacology and cannot be regarded as a dream state. Thus, it may be unwise for science to casually explain away this molecule as simply another naturally occurring psychedelic drug. The DMT molecule, together with the effects it produces in humans, may have profound implications for our understanding of consciousness and the nature of reality itself. The Hard Problem of Consciousness (Chalmers 1995) is as hard as ever, despite the best efforts of scientific endeavor; there is, as yet, no satisfactory explanation for a sense of self or a satisfactory explanation for why we are conscious at all. Faced with apparently unshakeable problems in explaining our conscious world, each and every tool that might help elevate our understanding of it ought to be grasped firmly and resolutely. Cherished paradigms regarding the nature of reality and our place in it may need to be dismantled if we are to progress beyond the confines of materialist dogma. Psychedelic drugs, DMT in particular, may well light the way.

DMT is set apart from the other classical psychedelics, such as LSD and psilocybin, with regard to the effects it so reliably produces at sufficient dosages. DMT is capable of transporting the user, within seconds, to what appears to be a fully autonomous alternate reality (Strassman, Wojtowicz, Luna, & Frecska 2008). This reality is commonly inhabited, even infested, with a variety of entities that often communicate with the user. The point at which many scientists, philosophers, and lay psychonauts diverge is on the question of whether these worlds are real, autonomous realities, or simply products of a hallucinatory state of mind. However, this distinction between reality and hallucination begins to blur when we appreciate that ‘consensus reality’, the world we all live in, is constructed and represented by the brain and that the experience of a ‘world out there’ is an illusion. The suggestion here is not to trivialize consensus reality—the brain’s ability to construct a world of such beauty and complexity is remarkable; a world

that enables us to survive and flourish in whatever is ‘out there’. At the same time, the brain is capable of building worlds undreamed of, worlds of such astonishing beauty and complexity that words fail to adequately describe them. This paper will attempt an explanation for DMT’s unique and remarkable psychopharmacological properties and, hopefully, stimulate further discussion within the scientific community.

Building Worlds from Information

Before discussing the nature of the DMT flash, it is important to clarify exactly which aspects of the conscious experience of a world this paper is attempting to explain and which it is not. Restricting the discussion to the ‘consensus world’ initially, it seems reasonable to suggest that any conscious experience of a world has three requirements—the external world-in-itself, the neural representation of the external world, and subjective consciousness itself (whether or not these are aspects of the same process remains unclear) (Koch 2004). Of course, in explaining hallucinatory phenomena and dreams, we may need to remove the requirement for an external world-in-itself in some circumstances—this issue will be dealt with as it arises, but the three components serve as a useful guide.

It is an intuitive and natural error to equate the world that *appears* before us to the actual world-in-itself. To do this is to confuse the *phenomenon*, the world as experienced, with the *noumenon*, the world-in-itself. This is also the mistake that leads to confusion with regard to the worlds perceived under the influence of DMT, as will be discussed. Whatever the nature of the external world-in-itself, we have no access to it (Metzinger 2009). This also applies to any worlds seen under the influence of a psychedelic drug, such as DMT. What we do have access to, however, is the representation of the external world built by the brain’s information-generating machinery (Koch 2004).

This brings us to the second component—the neural representation of the world. This paper will make the well-supported assumption that if a world appears to consciousness, it must have an informational representation in the brain. This provides no explanation as to how this informational representation is related to the subjective conscious experience, but it does predict that removal of the brain’s ability to generate an informational representation of any feature of the world will preclude that feature of the world from becoming part of the conscious experience of the world. Indeed, this is found to be correct. For example, a lesion in the part of the cortex that represents color will result in that feature of the world disappearing; the world becomes devoid of color (Spillmann, Laskowski, Lange, Kasper, & Schmidt 2000). One doesn’t have to assume that the brain *generates* the conscious

experience of color, but that color must have a representation in the brain in order to become part of conscious experience. This applies to any and all observable features of the world. All worlds that appear to consciousness have an informational structure that has a neural representation in the brain.

Subjective consciousness itself is more difficult to explain and forms the basis of the Hard Problem of Consciousness, as described by Chalmers (1995). In fact, it remains a matter of debate as to whether consciousness is a product of brain function—a monist position—or whether consciousness and the brain somehow interact and yet remain distinct—a dualist position. While the majority of modern neuroscientists might favor the former position, this paper is agnostic on this issue and, as will become clear, it isn't necessary to adopt a stance on this in order to explain the effects of DMT and psychedelic drugs on brain function. In fact, in attempting to explain how DMT can cause such dramatic shifts in consciousness, such that completely novel worlds appear, this paper will limit itself to the more tractable problem of explaining how the brain is able to represent the informational structure of the worlds that appear to consciousness. Having examined how the consensus world is represented by the brain, we can then examine the DMT flash as an alien world constructed analogously. This is a sensible approach because, just as with the consensus world, even if the alien worlds that appear under the influence of DMT have a true external reality, we have no access to this reality directly. However, as with the consensus world, the DMT alien worlds must have a neural representation in the brain that is accessible to us. Having explained how the brain can represent alien worlds under DMT, we will be better equipped to deal with issues of veridicality and autonomy, i.e. whether or not the DMT world is 'real'. This will also avoid the potentially confusing idea that DMT must somehow 'transport' the user to another world, while also avoiding the intellectually facile conclusion that it's 'mere hallucination', which tells us nothing of its nature.

In order to build worlds (or representations of worlds if preferred) under any circumstance, the brain uses information. The information is encoded by patterns of activity within neurons and the multitude of connections between them; sequences of action potentials that oscillate and reverberate throughout the cerebral cortex (Kumar, Rotter, & Aertsen 2010, Stemmler & Koch 1999). Of course, the world doesn't appear to us as information; it appears as a glorious chorus of objects, colors, textures, smells, and sounds. The brain's ability to create such an exquisite, full-color, three-dimensional representation of the world is remarkable, but we must not forget that this exists only within the brain.

The key to understanding the world-building capabilities of the brain

lies in the cerebral cortex. The human cortex is a folded 2–4 mm sheet of about 50 billion neurons among 500 billion supporting cells (Fitzgerald, Gruener, & Mtui 2012). The ability to build worlds lies in the extraordinarily complex connectivity of neurons within the cortex. The two principles that the brain employs to create a unified world are functional segregation and integration. Functional segregation refers to the manner in which specific areas of the cortex are responsible for specific functions (Nelson et al. 2010). In order to illustrate this clearly, we will focus on the visual system. Humans are primarily visual creatures, devoting a large proportion of the cortex to this particular sensory modality, and the DMT flash is a characteristically visual experience. However, this discussion can be extended to the other senses that contribute to the overall appearance of a world. To generate a visual scene, different areas of the cortex have specific roles in representing different features of the world. There are specialized regions devoted to orientation, direction of motion, color, and form, for example. The primary visual cortex (denoted V1) sits at the back of the brain, in the occipital lobe. It is this region that receives visual information from the external world first, from the retina via the thalamus (discussed later). V1 is generally responsible for basic visual features, containing ‘simple’ neurons that are tuned to respond to certain line orientations and spatial frequencies as well as more ‘complex’ neurons that respond only when a line is moving in a specific direction, for example (Snowden, Thompson, & Troscianko 2006). The visual association cortex contains areas that are specialized to represent specific features of the world, such as geometric shapes, colors, and depth perception. Farther downstream, in the temporal lobes, are areas that are specialized for the recognition of certain types of objects, such as faces or animals.

To illustrate, we can imagine a highly simplified brain, containing only a handful of functionally segregated areas (Figure 1). It should be clear how this brain would build a very simple world containing a single object—a smooth red square moving from left to right, for example. In a real human brain, the mechanism is analogous—different functionally segregated areas of the cortex are responsible for mapping the basic features, such as the edges, contours, and their orientations, as well as the overall form of the object and its color, texture, and movement. All of these individual characteristics, each represented by a specific functional region of the cortex, when combined represent a “moving red square” (see Figure 1), which is itself a pattern of activation in the cortex. In reality, of course, the situation is far more complex, but the basic principle is hopefully clear. Complex objects can be represented by specific patterns of activation of functionally specific areas of the cortex (Tsunoda, Yamane, Nishizaki, &

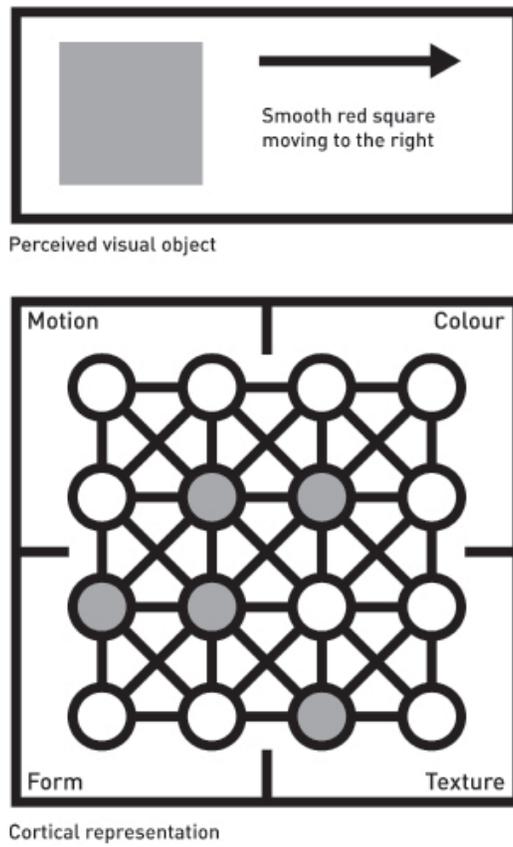


Figure 1. Functional specialization in the visual cortices.

Tanifuji 2001), and, overall, the informational structure of the world that appears in consciousness is represented by an extraordinarily complex cortical activation pattern.

This functional segregation is exemplified in individuals who suffer focal damage to specific regions of the cortex, often due to stroke. For example, damage to an area of the occipital lobe, V5, responsible for the processing of motion, can result in a disorder called akinetopsia or motion-blindness. Individuals with this rare condition see the world as a series of still images and have no perception of motion (Schenk, Norbert, Jochen, & Josef 2000). Likewise, when those areas responsible for representing color are damaged, a monochrome world is the result.

Another example, this time from the auditory system, demonstrates how the brain uses functionally segregated areas of the cortex to represent

sounds. A natural sound normally consists of a number of different frequency waves that combine to form a complex sound wave structure. Specific regions of the auditory cortex are sensitive to specific frequencies of sound. Each frequency component of a complex sound activates its own frequency-specific region of the auditory cortex; these individual activations are then combined to represent the sound heard. This mechanism can be extrapolated across the senses and other functional areas of the cortex to explain how the brain is capable of representing worlds with limitless features and characteristics with such apparent ease.

Of course, the functional segregation in the cortex is much finer than the gross distinctions between sound and vision and even color, form, texture, etc. Another way to think about functional segregation is simply to imagine that the billions of cortical areas are able to generate an almost limitless number of different activation patterns, each pattern representing a single conscious moment in the world (Figure 2). Each pattern is informative as it rules out the countless other possible patterns. This is possible precisely because of the vast number of cortical columns available to contribute to the activation pattern. If there were no functional segregation, and thus all columns were functionally identical, then the brain would have only two patterns available—all areas active or inactive. This would be more analogous to a lightbulb, “on” or “off”—a simple two-state device. The cortex can perhaps be imagined as a board containing billions of lightbulbs, each capable of being switched not only on or off, but also dimmed to varying degrees. It is the pattern of lighting that constitutes the informative brain state or built world.

To understand this process of world-building more deeply, we must look deeper into the cortex. The cortex comprises six layers of neurons—layer I is the outermost, layer VI the deepest. Thus, the functionally specialized areas of cortex are, in fact, three-dimensional columns. These cortical columns are considered the basic unit of functional segregation within the cortex (Hirsch & Martinez 2006). We can thus regard the cortex as a 3D mosaic of cortical columns, specific combinations of which can represent complex visual scenes, soundscapes, and, naturally, complete worlds. While functional segregation allows us to understand how the brain represents the multitude features of the world, in order to produce a unified conscious experience of a world these features must be bound together in some way. In the simple “moving red square” example, the features of movement and redness are somehow bound to the shape despite being processed at separate regions of the cortex. This issue is known as the ‘binding problem’. It is a problem because there is no known supraordinate cortical area where features represented at disparate regions of the cortex

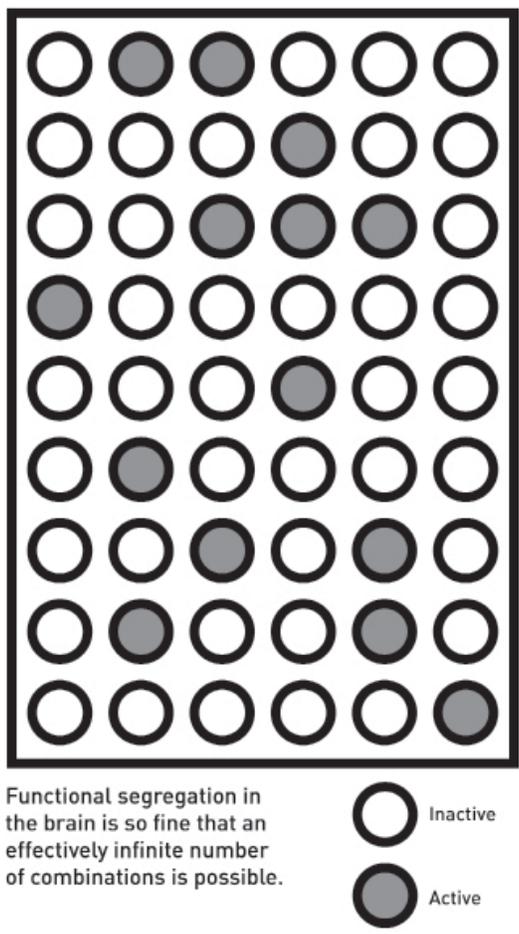


Figure 2. Pattern of activation of functionally segregated areas of the cortex.

are bound together. Although the issue of binding remains an open question in neuroscience, most researchers agree the solution lies in the manner in which the functionally segregated areas of the cortex are massively interconnected. Rather than a mosaic of independent cortical columns, the neurons of different functional areas have dense reciprocal connections that allow strong and rapid interactions (Edelman 2000). This allows the individual cortical columns to be integrated to form a cohesive whole. The world that appears is thus both highly differentiated (informative) and highly integrated (unified).

To understand this more thoroughly, which will be necessary if we are to relate it to the action of psychedelic drugs, such as DMT, we need to consider the role of the thalamus, a key subcortical structure sitting in the center of the brain. The thalamus is commonly seen as a relay station through which all sensory information, barring olfactory, must pass on its way to the cortex (Sherman and Guillery 2002). This is correct but is only part of the story. Each functionally specific area of the cortex, and thus each cortical column, is reciprocally connected to a corresponding region of the thalamus, forming a thalamocortical loop (see Figure 3). In fact, the thalamus has been described as a ‘miniature map’ or seventh layer of the cortex (Ward 2011). Thus, rather than ‘cortical column’, it would be more representative to use the term ‘thalamocortical column’. When the thalamocortical column is activated, the neural activity is observed on an EEG as an oscillating electrical potential. It is now thought that synchronized oscillations, particularly those in the gamma range (~40 Hz), may represent the manner in which information is integrated across the brain (Joliot, Ribary, & Llinas 1994, Engel & Singer 2001). For example, if a moving object is presented as a stimulus to an awake animal, it has been shown that distant regions of the cortex, each with a different functional role in processing the sensory information, begin to display synchronized gamma oscillations as long as the object is present (Gray & Singer 1989). Gamma oscillations enable disparate neuronal populations to synchronize, transiently enhancing their functional connections (Wang 2010).

As well as being part of a functionally specific thalamocortical loop, non-specific thalamic neurons project to regions of the cortex other than to their corresponding specific functional areas. This provides a means by which the functionally differentiated thalamocortical columns can be unified (Figure 3). Thus, while being functionally segregated, the cortex is integrated by means of the highly interconnected structure of the thalamocortical system. When a specific set of thalamocortical columns is activated, their gamma oscillations self-organize and synchronize, resulting in a transient neuronal assembly (Tononi, Edelman, & Sporns 1998)—a ‘thalamocortical state’. The activity of a large number of thalamocortical columns can be integrated within a few hundred milliseconds in order to generate a unified thalamocortical state (Tononi & Edelman 2000) that represents the world. *The world that appears within each conscious moment is represented by a differentiated pattern of activity spread across many different regions of the cortex and unified through the thalamocortical system.* It is conceivable that the information is contained within the specific thalamocortical columns, but bound together by the non-specific thalamocortical circuits (Llinas & Ribary 1993). The world that appears at each conscious moment is unique,

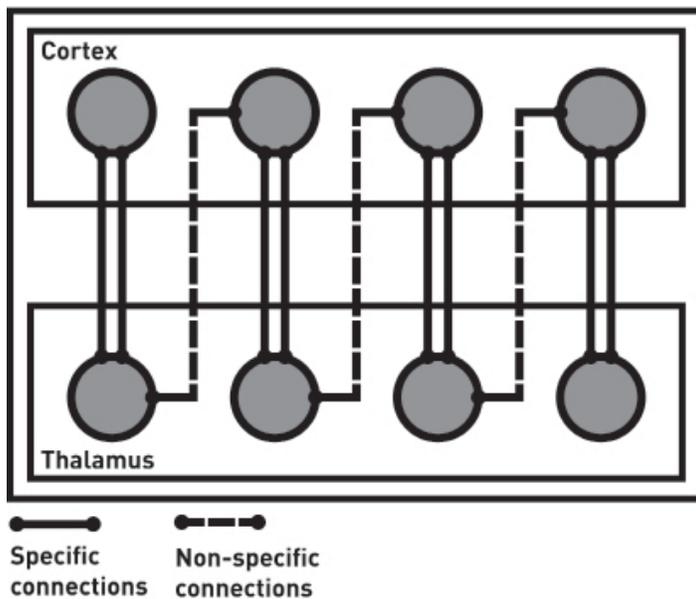


Figure 3. Specific and non-specific connections between the cortex and the thalamus.

with each *thalamocortical state* (i.e. a specific pattern of activation of the thalamocortical system) ruling out literally countless other thalamocortical states. This applies to all conscious moments, whether during waking, dreaming, or a psychedelic experience.

Conscious awareness of a world appears to be a default state of the brain (Llinas & Pare 1991) and can be fully independent of incoming sensory data, as exemplified by dreaming. During REM sleep, the brain is perfectly capable of building completely realistic worlds, with all sensory modalities intact, despite having no access to the external world. In fact, even during waking, sensory stimuli contribute far less to the information used to build the world than might be expected (Edelman 2000). To understand what this means, we need to distinguish between two types of information in the brain. Information generated entirely within the brain, through the differentiated and integrated activity of the thalamocortical system, as discussed, is *intrinsic* information. Information that enters from outside, through the senses, is *extrinsic* information. It is a combination of these two types of information that the brain uses to build worlds. However, it is not simply a case of extrinsic sensory information *adding* to intrinsic

information. Rather, patterns of sensory data amplify or “awaken” (Sporns 2011) existing intrinsic activity within the brain (Edelman 2000), and very little additional information is provided by sensory data (Tononi, Edelman, & Sporns 1998). To put it another way, *extrinsic sensory data is ‘matched’ to ongoing intrinsic activity*, which it amplifies (Tononi, Sporns, & Edelman 1996). The intrinsic activity thus represents a repertoire of thalamocortical states that provide the context for any incoming sensory data. In fact, even in the complete absence of extrinsic sensory data, the intrinsic thalamocortical activity remains perfectly capable of building complete worlds. Of course, this is dreaming, which will be discussed in detail later. However, suffice to say that the principal difference between the waking consensus world and the dream world is the manner in which the former is modulated by extrinsic sensory data. Sensory information *constrains* conscious perception (Behrendt 2003), and the conscious awareness of a world is an intrinsic functional state of the brain that is modulated, but not created, by sensory input (Llinas, Ribary, Contreras, & Pedroarena 1998). Naturally, this begs the question as to why the intrinsic activity of the thalamocortical system tends to build the consensus world as a default and thus why extrinsic sensory data can be so effectively ‘matched’ to ongoing intrinsic activity. This suggests that extrinsic sensory data somehow shaped the thalamocortical system, i.e. that the brain used sensory data from the external world to *learn* to build a representation of it.

Learning to Build the World

In order to explain the intrinsic activity of the thalamocortical system, how it is shaped and how this represents the consensus world, we need to consider two types of connectivity in the brain, structural and functional (Figure 4). Structural connectivity refers to the physical synaptic coupling of neurons and thus can be considered the anatomical connections or ‘wiring’ of the thalamocortical system. The circuits and networks of neurons are relatively stable and static at short time scales, on the order of seconds to minutes. However, they are plastic at longer time scales (hours to days), as connections are strengthened or weakened (Sporns 2011). Functional connectivity is the temporal correlation of distributed thalamocortical columns and is highly dynamic, often changing on a millisecond time scale, modulated by extrinsic sensory data, as well as ongoing intrinsic activity. As a simplification, functional connectivity can be regarded as those transient synchronous activations of the thalamocortical columns of a thalamocortical state. As the thalamocortical system shifts from state to state, some functional connections remain, while others dissolve and new ones are formed. For example, when engaged in a listening task, neuroimaging has demonstrated

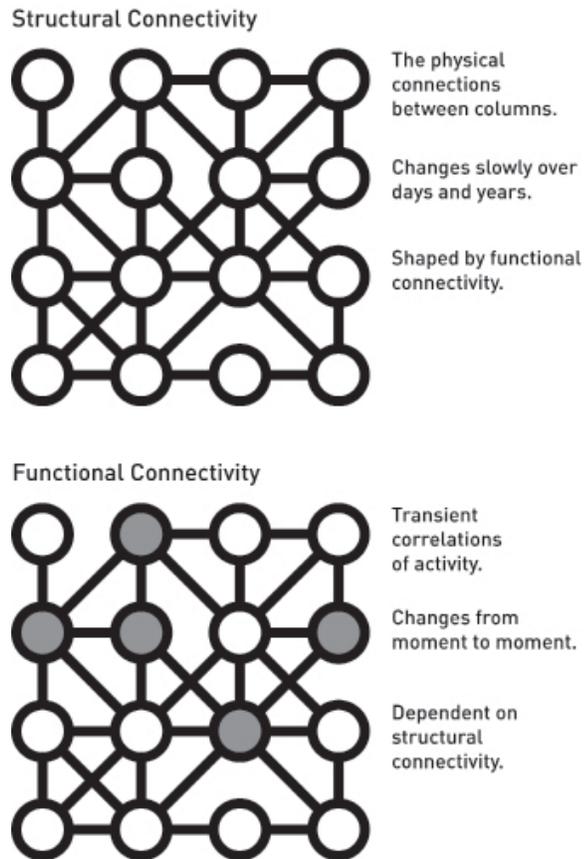


Figure 4. Differences between structural and functional connectivity in the thalamocortical system.

increased functional connectivity between the areas of the brain associated with speech (Broca's area) and the comprehension of the spoken word (Wernicke's area) (Hampson, Peterson, Skudlarski, Gatenby, & Gore 2002). Functional connectivity is obviously limited by the structural connectivity scaffold, and as this scaffold develops and changes so does the repertoire of functional connections and thus the thalamocortical states that can be adopted; structural connectivity 'molds' functional connectivity. However, quite conversely, through a number of use-dependent mechanisms, synaptic (structural) connections are strengthened as they are used (i.e. by functional connectivity). Thus, structural connectivity shapes functional connectivity and functional connectivity, with use, shapes structural connectivity—this

is a mutualistic relationship (Sporns 2011). It is the structural and functional connectivity that determines the intrinsic thalamocortical activity that is so central in representing the world. In fact, when we descend into deep dreamless sleep, the connectivity of the thalamocortical system breaks down (Massimini et al. 2005) and the brain stops building worlds. However, as soon as we begin dreaming, the connectivity returns and appears similar to waking connectivity (Massimini et al. 2010). This makes sense, as the worlds built during waking are of the same nature as those built during dreaming. The dramatic changes in connectivity that occur as consciousness shifts between states demonstrate just how dynamic the system of connectivity is.

At birth, the brain is not pre-wired, ready to receive and process the multitude of sensory signals in a manner analogous to a computer. In order to survive and flourish in the consensus world, the brain “must either inherit or create criteria that enable it to partition the world into perceptual categories according to its adaptive needs” (Edelman 1993). During evolution, development, and experience, sensory information sampled from the environment activates specific neuronal populations, and, consequently, the connections between them become strengthened or weakened—the structural and functional connections, and thus the intrinsic thalamocortical activity, are gradually molded by extrinsic sensory data (Figure 5). Eventually, the intrinsic thalamocortical activity and the patterns of sensory data from the external world become more and more closely ‘matched’ (Tononi, Sporns, & Edelman 1996). At no point does the world built by the brain *become* the external world, and we must not forget that the world that appears is still built by the brain. However, at the same time, the data from the external world is essential to the development of the consensus-world-building capabilities of the brain. Once the structural and functional connectivity has been developed, and continues to develop and change throughout life and across the span of evolutionary time, it becomes absolutely critical in determining how the brain interprets and categorizes sensory information and thus builds the consensus world. The richness of the dream world seems a startling validation of this model, as the brain becomes capable of building worlds in the total absence of extrinsic sensory data, entirely from the intrinsic information generated by the activity of the thalamocortical connectivity molded by evolution, development, and experience.

The worlds that appear in dreams are not mere suggestions or two-dimensional sketches of the consensus waking world, but full-color 3D representations that seem indistinguishable from it. Indeed, the dream state, like the waking state, is characterized by synchronized gamma oscillations and activation of sensory-modality specific areas of the cortex (Llinas &

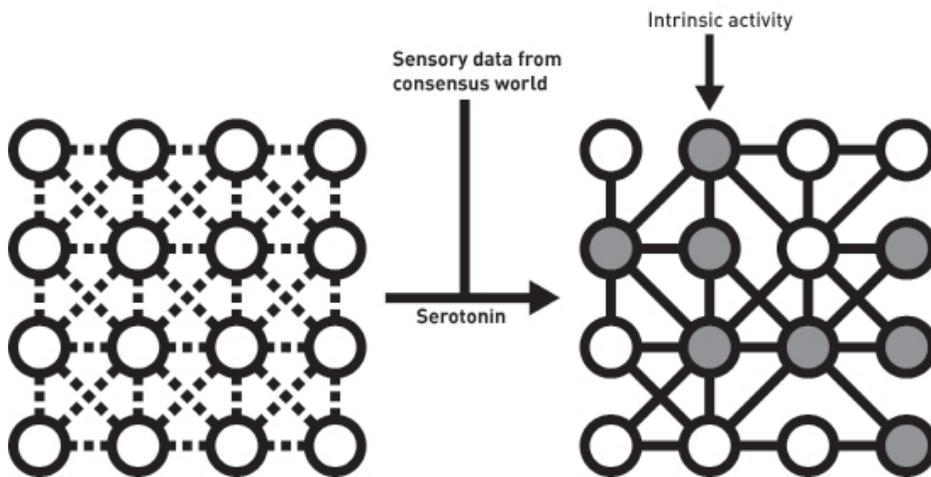


Figure 5. The structural and functional connectivity of the thalamocortical system develops under the modulation of serotonin and subject to sensory data input from the consensus world. Eventually, the intrinsic activity of the system builds the consensus world as a default state. Only strong/characteristic connectivity is shown on the right diagram.

Pare 1991). It seems the brain builds worlds in exactly the same way during dreaming as it does during waking—and why wouldn't it? Indeed, it is the only way the brain is able to build the worlds that appear to us. As pointed out earlier, the primary difference between waking and dreaming is the manner in which the waking world is modulated by extrinsic information. During waking, the formation of coherent oscillatory assemblies (i.e. thalamocortical states) is modulated by incoming sensory information. During dreaming, however, the individual is disconnected from the external environment (although the reason for this remains subject to debate, see Nir & Tononi 2010). The primary sensory areas of the cortex, which normally receive the incoming information before passing it on to higher cortical areas for further processing, also become inactive, as does the prefrontal cortex (Braun et al. 1998). The higher sensory areas of the cortex remain active in building the dream world, using the repertoire of intrinsic thalamocortical states developed during waking life. As the dynamic sequence of thalamocortical states is not constrained by incoming sensory data, however, the dream world can become bizarre, often impossible. Faces of family members become simultaneously associated with distant friends or the family dog, while the scene shifts inexplicably from the front garden

to the inside of an aircraft. Unfortunately, loss of normal critical function means that such ridiculousness is rarely recognized for what it is, unless you happen to be a lucid dreamer.

As explained earlier, the worlds that immerse the DMT user must have a neural representation in the brain if they are perceived. The question that must be answered is whether the DMT world is constructed entirely from intrinsic information, like the dream world, or whether it is modulated by an extrinsic component, as with consensus reality. The former explanation would be favored from an orthodox standpoint and would regard the DMT flash as an elaborate hallucination. The latter must endow DMT with the ability to chemically manipulate the brain to receive sensory information to which it normally has no access. This idea might be favored by those believing DMT capable of transporting the user to an alternate reality. However, both of these explanations have inherent problems that will be addressed later. Rick Strassman (2010) distinguishes between two alternate explanations of the DMT flash. The first is that the DMT experience is generated by the brain. The alternative is that DMT changes the receiving capabilities of the brain such that it can receive sensory data from a normally unseen reality. These explanations, however, are not actually independent, as even if the latter explanation is correct, the brain would still be required to build a neural representation of the worlds observed.

Before discussing DMT specifically, it will be useful to examine how other classical psychedelics, such as LSD and psilocybin, alter brain function and thus produce their effects. These models of hallucinogenesis can then be mapped onto the exceptionally bizarre effects of DMT.

The Mechanism of Action of the Classical Psychedelics

Although more than 100 natural neurotransmitters have been identified that modulate brain function, serotonin seems to be the most important with respect to the action of psychedelics. Serotonin (5-hydroxytryptamine) in the brain is secreted principally by the Raphe nuclei, a cluster of neurons in the brainstem (Fitzgerald, Gruener, & Mtui 2012). This small piece of tissue is responsible for production of serotonin for the entire brain, and neuronal efferents from the Raphe nuclei project to almost every area of the cortex. Serotonin falls into the category of neuromodulator, its function to alter the way that neurons fire on a global scale, with the entire cortical volume within reach of this molecule (Miner, Schroeter, Blakeley, & Sesack 2000). Although serotonin has numerous roles in the cortex, this discussion will focus on its action at cortical pyramidal cells and their associated inhibitory interneurons. The former are the major excitatory neurons that form the cortical component of the thalamocortical loop (Figure 6). There are seven

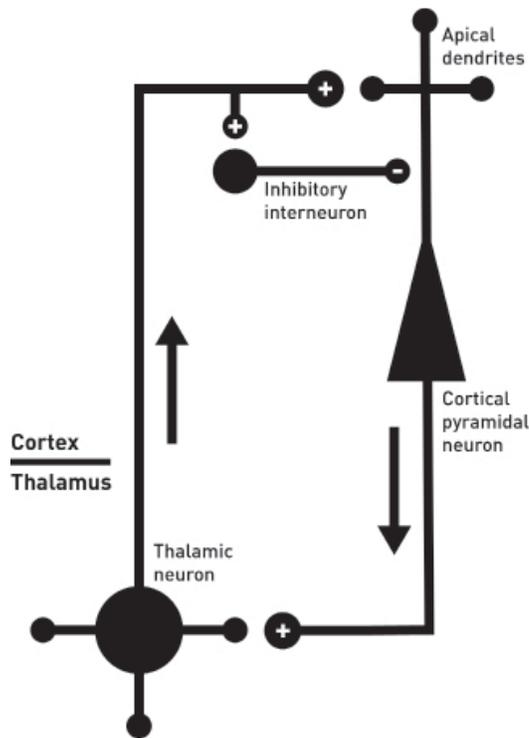


Figure 6. Simplified structure of a thalamocortical loop.

recognized classes of serotonin (5HT) receptor, 5HT1 to 5HT7. There are three subtypes of the 5HT1 receptor (5HT1A, 5HT1B, and 5HT1D) and likewise of the 5HT2 receptor (5HT2A, 5HT2B, and 5HT2C). With respect to the action of psychedelics, it is the 5HT2A receptor that has received the most attention and has long been regarded as the major locus for their effects (Nichols 2004). It has been shown that the potency of a psychedelic drug is strongly correlated with its affinity for 5HT2 receptor subtypes (Glennon, Titeler, & McKenney 1984). Crucially, Vollenweider has demonstrated that specific blockade of this receptor with a 5HT2A antagonist abolishes the activity of psilocybin in humans (Vollenweider et al. 1998). 5HT2A receptors are abundant on the apical dendrites of cortical pyramidal cells and their activation has a depolarizing effect on the neuron, making it more likely that the neuron will fire (Araneda & Andrade 1991). This is in contrast to the 5HT1A receptor, present alongside the 5HT2A receptor, which has a hyperpolarizing effect. These two receptor subtypes thus appear to antagonize each other—the balance of 5HT1A and

5HT2A stimulation sets the excitability of the neuron and, by extension, the entire cortex. 5HT1A and 5HT2A receptors also work antagonistically in regulating gamma oscillations in thalamocortical loops, with 5HT2A receptors promoting them and 5HT1A receptors inhibiting them (Puig, Watakabe, Ushimaru, Yamamori, & Kawaguchi 2010). This simple model is rendered less straightforward by the presence of inhibitory interneurons that are closely associated with the excitatory pyramidal neurons. It is the fast-spiking GABAergic interneurons that are thought to generate the gamma oscillations that are central in synchronizing the thalamocortical columns (Cardin et al. 2009). These interneurons also express 5HT2A receptors and are stimulated by 5HT2A agonists, including LSD (Marek & Aghajanian 1996). In addition, a subpopulation of layer IV interneurons ensures that gamma oscillations don't spread unrestricted across the cortex, helping to sculpt the pattern of thalamocortical column activation (Llinas, Urbano, Leznik, Ramirez, & van Marle 2005). It is clear how a balance of 5HT1A vs. 5HT2A activation, on both pyramidal cells and interneurons, may be necessary to maintain the tightly organized and regulated thalamocortical activation patterns and thus maintain the informational integrity of the thalamocortical states; this is essential for a stable representation of a world.

Under normal circumstances, it is serotonin that occupies and activates both receptor subtypes (Nichols 2004), setting this 5HT1A–5HT2A balance. The classical hallucinogens are primarily selective 5HT2A partial agonists, with little activity at the 5HT1A receptor. This appears to disrupt the balance and results in a more fluid and less predictable world. More specifically, the balance is tipped in favor of depolarization of pyramidal cells and promotion of gamma oscillations in thalamocortical loops. This has two primary effects: Firstly, the cortex becomes more sensitive to incoming sensory data; secondly, highly coherent thalamocortical gamma oscillations (Destexhe, Contreras, & Steriade 1999) are promoted, potentially even in the absence of incoming sensory data. Normally, the context within which incoming sensory data is interpreted is determined by spontaneous intrinsic activity in the thalamocortical system (McCormick 1995, Shu, Hasenstaub, & McCormick 2003, Destexhe, Hughes, Rudolph, & Crunelli 2007), itself an expression of the structural and functional connectivity established during evolution, development, and experience. This development, of course, took place on a background of serotonin modulation, which set the balance of 5HT1A–5HT2A activation. This is a key point that we will return to. The psychedelic-induced 5HT2A-weighting makes it more likely that pyramidal cells will enter into synchronized gamma oscillations. Further, as this effect is widespread over the cortex, such gamma oscillations are likely to spread more freely across the thalamocortical system, recruiting

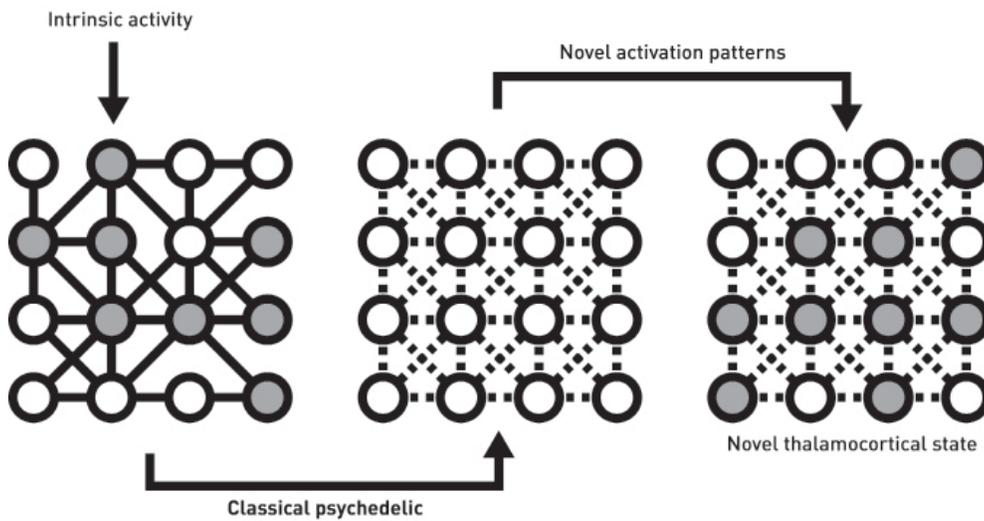


Figure 7. Classical psychedelics depolarize cortical pyramidal neurons and promote synchronized gamma oscillations, facilitating the appearance of novel activation patterns in the thalamocortical system.

areas of the cortex without the tight restraint normally held by serotonin. One can envisage, for example, how information could be spread from one sensory modality to another, generating synaesthesia effects (Aghajanian 2009). Illusions, or misinterpretations of sensory information, can be explained as underconstrained novel reinterpretations of such information. Fully immersive hallucinations of entities, landscapes, and complete worlds can be regarded as stable thalamocortical states that don't have any relationship to incoming sensory data, at least not of the usual kind. Most psychedelic effects, whether visual, auditory, or multisensory, can be regarded as novel thalamocortical activation patterns resulting from the disruption of the 5HT1A–5HT2A balance (Figure 7). The thalamocortical system's connectivities have been selected by development, experience, and evolution—thus the consensus world that appears is predictable and stable, as the appropriate connectivities and activation patterns are well-established. Psychedelics override this by making a much larger repertoire of thalamocortical columns and combinations accessible to the dynamic and shifting thalamocortical states. Thus, unfamiliar connections, illusions, distortions, and hallucinations are facilitated. The principle is analogous to Goekoop and Looijestijn's (2011) network model of the

hallucinations seen in psychotic disorders. The established connectivities of the thalamocortical system create ‘attractor’ states that the system tends to adopt. These attractors constitute the thalamocortical state repertoire and explain why, even in the absence of sensory data (e.g., during dreaming), the thalamocortical system tends to represent the consensus world as a default. However, in schizophrenia for example, the regulation of these attractor states is somehow compromised (possibly by a reduction in regulation by the frontal cortex), and “false-positive” attractor states can be adopted—these are experienced as hallucinations (Goekoop & Looijestijn 2011). The 5HT1A–5HT2A model discussed here suggests that psychedelic drugs are able to induce the formation of novel attractor states in an analogous manner, generating their novel perceptual effects.

This explanation of how psychedelic drugs work is, of course, a highly simplified model of the true picture. Early neuroimaging studies with psilocybin seemed to support the assumption that psychedelic drugs would lead to an increase in cortical activity, in accordance with the 5HT2A receptor’s depolarizing effect on pyramidal neurons (Vollenweider et al. 1997). However, a more recent functional imaging study failed to demonstrate such an increase in neural activity in any specific cortical area and, in fact, saw an overall decrease in cortical activity (Carhart-Harris et al. 2012). This is not particularly surprising—the presence of 5HT2A receptors on the inhibitory interneurons that terminate on cortical pyramidal neurons makes it difficult to predict the overall effect of a 5HT2A active psychedelic agent on the overall level of cortical activity—the effect of hallucinogens is more of a perturbation of functional relationships between thalamocortical columns, rather than a simple activation effect. This discussion has also omitted the effects of hallucinogens on glutamatergic transmission, the thalamic reticular nucleus, locus ceruleus, or the Raphe nucleus itself, all of which may contribute to their effects on brain function (for a full discussion of these aspects, see Nichols 2004 and Nichols & Chemel 2011). Potentially relevant to the action of DMT, in particular, are the “mysterious trace amine” receptors (Burchett & Hicks 2006). The function of these receptors is yet to be fully elucidated, but they are thought to be activated by a range of amines present in very low concentrations in the brain (hence “trace amines”) and may have a role in regulating synaptic transmission. Based on the discovery that DMT is active at these receptors, Wallach (2009) suggests that they might have a role in DMT’s unique perceptual effects. It remains to be seen whether this can be substantiated.

In summary, the crux of this model of psychedelic drug action is that, by their activity at 5HT2A receptors, classical hallucinogens seem to increase the repertoire of states available to the thalamocortical system and shift the

world that appears to consciousness from being stable and predictable to being fluid, unpredictable, and novel. Before attempting to apply this model to DMT, we need to examine the phenomenology of the DMT flash in more detail.

The Phenomenology of the DMT Flash

Rick Strassman's groundbreaking research into the effects of DMT in human volunteers (Strassman 1996) remains the only major study of its kind, the official aim being to obtain human pharmacological data on the drug. However, the study also generated a large number of carefully recorded "trip reports"—far more interesting. Together with hundreds of trip reports posted online at such outstanding sites as Erowid.org, it is possible to identify commonalities across a multitude of experiences and draw general conclusions as to the nature of the DMT world users find themselves fired into.

A number of published studies have attempted a detailed systematic analysis of the phenomenology of DMT, the most notable example being by Shanon (2002), although this focused on its traditional use in oral preparations, namely ayahuasca. Cott and Rock (2008) carried out a small study involving only 19 DMT users, but were able to delineate common themes that characterize the DMT experience:

1. Hallucination—visual, physical, auditory;
2. Entering other realities, sometimes including having contact with other sentient beings, which were described as true or real experiences rather than hallucinations;
3. Lucidity;
4. Affective distortions;
5. Ineffability;
6. Extreme intensity;
7. Spirituality, learning, or being taught about truths of the universe/self;
8. Distortion in sense of time, space, self;
9. Sense of familiarity (Cott & Rock, 2008).

The user typically rushes through a number of stages, before 'breaking through' into the characteristic alien worlds, which are the focus of this discussion. The accounts of Strassman's volunteers and posters on Erowid.org who achieved this breakthrough, while varied, follow a number of recurring themes:

- Merry-go-rounds, fairgrounds, clowns/jesters, circuses;
- Mischievous or playful elves/dwarves/imps;
- Insectoid and reptilian creatures, aliens;
- Futuristic hypertechnological buildings and cities;
- Complex machinery, hyper-advanced technology;
- Being observed and/or experimented upon;
- Unknown places apparently on Earth.

A number of these features are common in ‘trip reports’ by users and, notably, unique to DMT. Users typically describe the DMT world as being more real than ordinary waking reality, even after the experience has ended. The lucidity of the experience is also striking—the lack of haziness or stoning allows the user to experience the effects as if in an ordinary waking state.

Perhaps the most interesting of the recurrent themes, recounted by a significant proportion of users, is the experience of apparently hyperadvanced technological societies, with highly intelligent entities occupying futuristic cities and unearthly landscapes, manipulating complex machinery.

Often the entities appear as mischievous or playful ‘elves’ that vie for the attention of the user:

It was generally like a wacky toy factory. Gadgets, widgets, twirling machines, stair-step pattern, Escher-like “space” and tunnels and chutes. The beings would seem to go “look!” and I felt I was supposed to look. (Erowid Experience 11258)

The elves were dancing in and out of the multidimensional visible language matrix, ‘waving’ their ‘arms’ and ‘limbs/hands/fingers?’ and ‘smiling’ or ‘laughing’. (Erowid Experience 1859)

One of the DMT beings, tall, thin, and golem-like, grasped my head and turned it back to see. (Erowid Experience 131)

Once I entered a room to see what looked like little elves working hard . . . I was watching these little guys work very hard on a bench, and they were building something. (Cott & Rock 2008, Respondent #16)

They are elves/not-elves. They don’t appear, they kind of ooze out of the woodwork seductively and before you know it they’re there—the whole realm is infested with these creatures like nothing else you could ever imagine. (Erowid Experience 1841)

Terence McKenna's recollections of his meetings with the elves are legendary.

*Trying to describe them isn't easy. On one level I call them self-transforming machine elves; half machine, half elf. They are also like self-dribbling jewelled basketballs, about half that volume, and they move very quickly and change. And they are, somehow, awaiting. When you burst into this space, there's a cheer! Pink Floyd has a song, **The Gnomes Have Learned a New Way to Say Hooray**. (McKenna 1993)*

You burst into this space and they're saying, "How wonderful that you're here! You come so rarely! We're so delighted to see you!" (Terence McKenna, unknown audio recording)

This riotous welcome from the elves that many DMT users experience is uncanny:

They kept saying welcome back and words like: the big winner, he has returned, welcome to the end and the beginning, you are The One! As I looked around the room I felt the sense of some huge celebration upon my entry to this place. Bells were ringing, lights flashing . . . (Erowid Experience 1839)

Damn if Terence McKenna wasn't right-on-the-nose about these crazy elves. As this realization washed over me the elves burst into uproarious laughter. They were laughing themselves silly, giggling, rolling across the ceiling, and holding their stomachs. (Erowid Experience 1843)

The new geometry began to unfold layer after layer of laughing, giggling, incredibly lively beings . . . greeting me with enthusiastic cheers . . . the countless wonderful, hilarious, animated self-transforming liquid light energy creatures vied for my attention. . . . They actually all start waving and saying "goodbye [sic]" and "Time to go, nice seeing you, Love you . . ." (Erowid Experience 85120)

The peculiar sense of familiarity, despite the thoroughly alien nature of the experience, is also typical:

"You've done this before. Remember?" echoes in my head. Yes I have done this before. I've been here before! I have come home. An overwhelming sensation of Deja-Vu overcomes me. (Erowid Experience 76492)

Sometimes, the entities actively attempt to communicate with the individual:

“There were creatures and machinery . . . there was a female who, when I felt I was dying, appeared and reassured me. . . . Something green appeared in front of me, rotating, doing things. She was showing me, it seemed, how to use this thing, which resembled a computer terminal. I believe she wanted me to try to communicate with her through that device, but I couldn’t figure it out.” (Strassman, Wojtowicz, Luna, & Frecska 2008)

Sometimes, the entities are described as being ‘insectoid’:

There were insectlike intelligences everywhere, in a hypertechnological space. . . . There was another one helping me. . . . It was very intelligent. It wasn’t at all humanoid. It wasn’t a bee, but it seemed like one. (Strassman, Wojtowicz, Luna, & Frecska 2008)

I was in a very large waiting room, observed by the insect-thing and others like it. . . . They have an agenda. It’s like walking into a different neighbourhood. You’re not really sure what the culture is. (Strassman, Wojtowicz, Luna, & Frecska 2008)

She was a monstrous machine, somewhat insectoid in that she seemed to be spawning all the reality around her. . . (Erowid Experience 74820)

Sometimes, the entities appear as highly intelligent ‘alien’ creatures that inhabit advanced technological domains:

A space station below me and to my right. Presences were guiding me to a platform. I was also aware of many entities inside the space station—automatons, android-like creatures that looked like a cross between crash-test dummies and Empire troops for Star Wars, except they were living beings, not robots. . . . They were doing some kind of routine technological work, and paid little attention to me. (Strassman, Wojtowicz, Luna, & Frecska 2008)

There were these beings that seemed to inhabit this place, that seemed to come off as vastly more intelligent and vastly more capable. (Erowid Experience 52797)

They are . . . the word is ‘machine-like’. The whole thing bodes of high alien technology. . . More fractal machine entities. They are getting bigger, more complex, they join with one another, they break apart, they dance, they sing. THEY SING! (Erowid Experience 76492)

While elves, aliens, and insectoid entities appear regularly, they are by no means the only type of entity met in the DMT realm—angels, demons, monsters, chimeras, and animals, among others, also are reported (Shanon 2002), although some of these are more typical of ayahuasca. Sometimes, the entity isn’t identifiable by form, but manifests as an overwhelming presence that seems extraordinarily powerful (Strassman 2001).

While Strassman suggests that the commonalities among experiences suggest that the “DMT world” is a fully autonomous alternate reality (Strassman, personal communication, January 2012), others disagree (Ayes 2001). It cannot be ignored that Strassman’s study was carried out in a hospital environment and that this may well have colored the experience for many of his volunteers. One author suggests that the aliens and their hypertechnological abodes are simply psychological representations of the physicians and the clinical environment and to suggest otherwise is “just plain silly” (Ayes 2001). At first glance, this might seem reasonable, especially if the reports of Strassman’s volunteers are the only ones considered. However, there is no explanation as to why the physicians would appear as aliens rather than humans, and when accounts of hypertechnological alien entities are noticed throughout the online trip report literature, this position becomes less persuasive. We will return to this central issue later.

Whether or not the worlds that appear under the influence of DMT are autonomous realities or elaborate hallucinations, it is undisputed that DMT is capable of rapidly hurling the user into exquisitely convincing and extremely unusual environments, often inhabited by apparently intelligent entities; these worlds often seem inexplicably familiar, with the user remaining fully of sound mind despite the astonishment. It is remarkable that DMT users remain confident of the veridicality of the DMT world even after the effects have subsided, and yet very few individuals wake from a dream and refuse to accept that a dream is all it was. The totally immersive nature of the experience has been equated with dreaming, which is itself an immersive and convincingly real experience, despite being devoid of extrinsic information (as far as is known) and a model example of the brain’s ability to build worlds purely from intrinsic data. But can the DMT flash really be equated with dreaming?

Is the DMT World a Dream World?

In attempting to explain the sophisticated imagery of the DMT flash, it seems ostensibly reasonable to suggest that DMT might be the ‘dream molecule’, released during REM sleep and generating dreams. As discussed earlier, the neural activity that constitutes the waking state is fundamentally equivalent to that of the dream state. The key difference is that the dream world is not modulated by extrinsic sensory information. Assuming that the DMT world is also entirely lacking an extrinsic component, it makes a certain amount of sense to equate it with the dream world. This would regard the DMT world as a highly elaborate hallucination. Always a source of interesting and novel ideas, it is possible that this idea can be traced back to the musings of Terence McKenna—he has certainly discussed this idea on a number of occasions. The first formal proposal was by Callaway (1988), who suggested that dream sleep begins when psychedelic tryptamine production by the pineal gland increases above an undefined threshold. There is, however, no empirical evidence that DMT is secreted by brain structures during dreaming or, in fact, in psychedelic concentrations at any time. In an attempt to secure evidence for the ‘transmethylation hypothesis’ of schizophrenia (Osmond & Smythies 1952, Smythies 1984), which suggests that the disease may be the result of the endogenous production of psychotomimetic amines (such as DMT), at least 69 published studies between 1955 and 2010 have looked for DMT and/or its metabolites in the bodily fluids of psychiatric patients and controls (Barker, McIlhenny, & Strassman 2012). While DMT was detected in the urine, plasma, and cerebrospinal fluid of schizophrenic patients, levels were generally erratic and not consistently different from those seen in healthy controls (Wyatt, Mandel, Ahn, Walker, & VandenHeuvel 1973, Oon, Murray, Brockington, Rodnight, & Birley 1975, Murray & Oon 1976, Corbett, Christian, Morin, Benington, & Smythies 1978).

Pertinently, one study examined urinary levels of DMT over three eight-hour periods throughout the day and night (Oon, Murray, Rodnight, Murphy, & Birley 1977). While levels fluctuated, there was no diurnal pattern with a peak during the early hours, as would be predicted by the ‘dream molecule’ hypothesis. Aside from the lack of physiological evidence for DMT as a ‘dream molecule’, does this hypothesis even make sense in light of the phenomenology of the DMT flash?

Dreaming is an almost universal experience, one familiar and taken for granted by most. However, dreaming is itself a highly psychedelic experience—a fully immersive world that appears as real as the waking world and, yet, a world that is built entirely from intrinsic information. While modern scientific techniques have described many of the

physiological and neurological features of the dream state, such as rapid eye movements (REM) coupled with high cortical activity as measured by EEG (Desseilles, Dang-Vu, Sterpenich, & Schwartz 2011), dreaming will always remain a fundamentally private experience. As with the DMT flash, “subjective reports offer the primary portal to the qualities of lived experience” (Kahan & LaBerge 2011). These reports are used to map the structure and content of the dream world in the same way they are used to map the DMT world (Schneider & Domhoff 2009). Studies largely support the ‘continuity hypothesis’ of dreaming—that dreaming is continuous with waking (Schredl & Hofmann 2003). Events and activities in the dream world tend to reflect waking life, even down to the proportion of time spent in mundane activities, such as talking on the telephone or watching TV (Schredl & Hofmann 2003). Similarly, the characters who appear in dreams are also from waking life—friends, family members, animals, etc. (Schneider & Domhoff 2009). Further, contrary to commonly held beliefs, all sensory modalities are typically intact during dreaming, although the dominance of any specific sense often varies (Kahan & LaBerge 2011). There are a number of well-known themes that are often associated with the dreaming—being pursued or attacked, falling from a height, losing teeth, or appearing naked in public. However, these themes tend to be less frequent than is commonly believed and by no means do they typify the dream state (Maggiolini, Cagnin, Crippa, Persico, & Rizzi 2010). The symbolic significance of such themes is beyond the scope of this discussion, and has for a long time been a subject ripe for speculation by psychologists.

Overall, the phenomenology of dreaming suggests that, given the neural freedom to build worlds without extrinsic sensory modulation, the brain tends to build worlds that appear remarkably similar to waking reality. This is unsurprising, of course, as the constraints of sensory input experienced during waking life select the neuronal connectivities that define this reality and determine the intrinsic thalamocortical activity that builds the dream world during sleep. In other words, as far as we are aware, your own personal waking world is the only type of world your brain knows how to build.

It ought to be clear by this point, having examined the phenomenology of both and despite speculation that DMT is a ‘dream molecule’, that the DMT world is utterly incomparable to the dream world. While it is possible to identify some minor similarities—entoptic hallucinations that often occur during the descent into sleep (Mavromatis 1987, referenced in Luke, Zychowicz, Richterova, Tjurina, & Polonnikova 2012) might be compared to similar hallucinations seen during the early stages of the DMT flash—the immersive stages of the DMT flash are, unlike the dream world, completely unrelated to consensus reality. It seems reasonable to state that

the dream world differs from the waking world in the manner in which the intrinsic thalamocortical activity is modulated by extrinsic sensory data—for the waking world, this modulation is central; for the dream world, this modulation is effectively nil. Both worlds, however, are of the same character and result from the same thalamocortical activity. This leaves us no closer to an explanation of the DMT flash, but it does enable us to rule out the equating of the DMT flash with dreaming. Given these observations, it seems all the more remarkable that the brain is capable of building such alien worlds, exemplified by those of the DMT flash, at all. If the DMT world does appear entirely as a result of intrinsic thalamocortical activity, then this begs the question as to how the brain ‘learned’ to build these bizarre worlds. This problem would be resolved if, as Strassman and others have suggested, DMT does indeed allow access to an alternate reality and, thus, that the DMT flash has an extrinsic component.

Is There an Extrinsic Component to the DMT Flash?

Individuals have very individual dreams, the contents and themes of which are influenced by very personal factors, such as experiences in waking life, fears, and desires, physiologically expressed by the intrinsic activity of the thalamocortical system, as discussed earlier. The content of an individual’s dreams are thus reasonably explicable in terms of these factors. Dreams are normally representations of waking reality in their gross form. While dreams can seem strange, illogical, even quite bizarre when recounted from the bedside, few dreams resemble anything close to the DMT flash. While the worlds experienced under the influence of DMT undoubtedly vary between individuals, there is a striking correspondence between reports describing the nature of these worlds, particularly at higher dosages. Above an undetermined threshold, DMT reliably induces or facilitates the thalamocortical system’s adoption of completely unfamiliar and yet highly regular activation patterns, such that apparently alien worlds are built. These worlds are not nebulous and hazy suggestions of another reality, or chaotic maelstroms of confusion. They are unmistakable and apparently real alternate realities experienced with absolute sober clarity. It is difficult to generate a simple explanation as to why DMT ought to have this capability. While it is relatively straightforward, as has been discussed, to explain how stable and completely immersive hallucinations could be generated under the influence of a psychedelic drug, there is no obvious explanation as to why these hallucinations would exhibit such characteristic and striking similarities across users and yet bear so little relationship to consensus reality. As has been explained, the brain learns to build a consensus world throughout the course of evolution, development,

and experience. The thalamocortical connectivities so developed enable the brain to build worlds in the total absence of sensory input—these dream worlds are directly analogous to consensus reality. However, when the brain is perturbed by the action of a very simple molecule, DMT, it automatically begins building unimaginable alien worlds of crystalline clarity; worlds that users typically describe as being as or more real than the consensus world. At high enough dosages and unlike with the other classical psychedelics, the experience often appears to have little dependence on set or setting, with the experience seeming to overwhelm and transcend individual psychological idiosyncrasies, expectations, or mood. These alien worlds don't appear to be characteristic to the individual user, but characteristically similar *across* users and characteristically 'other' or 'alien'. [The term 'alien' is used very deliberately, here and throughout this discussion. The idea is not to conjure up images of grey beings arriving in flying discs, but to reflect the thoroughly 'other' nature of the DMT world and its inhabitants, while avoiding unhelpfully loaded terms such as 'spirit' or 'astral'.]

The regular and repeated appearance of thoroughly non-human entities—elves, pixies, dwarves, and goblins (Luke 2011), as well as intelligent insectoids and other alien creatures—is also difficult to explain. Luke (2008) describes the similarities between certain entities met in the DMT world with deities, demons, and other strange discarnate beings that appear in the mythology and folklore of many religious and spiritual traditions. Also, elves, pixies, and related 'little people' are an integral and well-known part of Celtic folklore (Evans-Wentz 1911), and it is tempting to surmise that they might somehow be related to similar beings met in the DMT realms and perhaps even have a common origin (see Hancock 2005 for a detailed discussion). It is all too easy to dismiss the DMT entities as simply being the activation of widely held unconscious imagery, but this is unsatisfactory. Although the DMT user might grasp for the closest familiar archetype in attempting to describe the entities—elves, pixies, insects, etc.—this is often just an attempt to render into common language creatures almost beyond description and far stranger than any being met in Celtic folklore or between the pages of a science fiction novel. Strassman's volunteers typically rejected the suggestion that the experience was a product of unconscious mental content or dreamlike imagery (Strassman, Wojtowicz, Luna, & Frecska 2008), and it is this fact, among others, that persuades Strassman of the reality of these worlds. Even if the DMT entities could be explained as such, it is hard to explain why DMT seems unique in its ability to unearth them. The model described later may offer such an explanation.

Struggling to explain the alien worlds visited under DMT, it might

be time to consider what many scientists might consider unthinkable; that the DMT worlds built by the brain are modulated by extrinsic data from outside the brain, analogous to the manner in which the consensus world is modulated by sensory input from the outside world. This would explain the striking parallels and similarities among users and is in line with the many individuals convinced of DMT's ability to transport the user to an alternate reality. However, this idea begs the question as to the form such an external modulation could take—how does the brain receive data from an alternate reality? Speculators have suggested that DMT somehow 'tunes' the brain to receive "channel DMT" (Hancock 2005, Strassman 2001); the idea being that the brain is capable of receiving sensory input from different realities depending on precise neurochemically defined states, in the same way a radio receives data from different radio stations depending on its tuning. This is an intuitively appealing idea. However, there is no suggestion as to how this tuning would occur to allow the brain access to this alternate data field. Ede Frecska (2008) speculates that DMT allows access to a 'non-local' realm, where the entities reside. Clearly, these types of ideas need to be explored further. While this type of 'tuning' idea is attractive, it is only a hint of a hypothesis and makes no attempt to explain the neurological mechanisms that might be involved. Further, there is no explanation as to why DMT, a ubiquitous natural metabolite, ought to possess this extraordinary ability to 'tune' the brain to 'alien worlds'. Later, a preliminary model to explain the action and effects of DMT will be proposed, without adopting the facile position that DMT is simply another psychedelic drug that produces highly visual hallucinations. The phenomenology of the DMT flash clearly deserves a deeper and more considered explanation. Before attempting this, it would be useful to question whether DMT ought to be regarded more correctly as an exogenous drug or an endogenous metabolite with a true neural function in the human brain. If we are to conclude the latter, then the nature of the DMT flash might be more explicable.

Is DMT an Endogenous Neuromodulator?

The idea that DMT is an endogenous neurochemical, produced naturally by the brain and with a true neural function, is not new (Christian, Harrison, Quayle, Pagel, & Monti 1977). However, authors have consistently attempted to dissociate its psychedelic effects from any purported endogenous physiological role in the brain.

Jacob and Presti (2005), for example, make the case for an anxiolytic role for DMT, based on low-dose effects of DMT in Strassman's volunteers. Strassman noted that, at sub-psychedelic dosages (0.05 mg/kg IV), DMT produced a relaxed and comfortable psychological state. It is somewhat

confusing that, despite DMT's unique and extremely dramatic psychedelic effects, these effects seem to be considered secondary to whatever proposed role that DMT could have as an endogenous neurochemical. This is a very strange position to adopt. It would be truly astounding if an endogenous neurochemical, with a primary anxiolytic role in the brain, produced the astonishing phenomenology of DMT at higher non-physiological concentrations, purely as a secondary effect. DMT doesn't produce 'confusion' or 'delirium' or even a 'psychotic break'; DMT catapults the psyche into bizarre alien realities. Surely, it makes more sense to suggest that any anxiolytic effect of DMT, at low concentrations, is secondary to its primary effect—fully immersive hallucinogenesis. Wallach (2009) proposes a perceptual role for DMT, suggesting that waking reality is a 'tightly regulated psychedelic experience', facilitated by endogenous DMT release—full-blown psychedelic effects occur when this regulation is 'loosened'. This proposal isn't fully explored, but at least avoids completely sidelining DMT's psychedelic effects. Strassman has been bolder than most academics in proposing that DMT's psychedelic effects are its primary functional role in the brain. He suggests that DMT facilitates the exit of the soul from the body at the point of death. While this is an intriguing piece of speculation, Strassman has certainly left the scientific arena by this point and sits squarely within metaphysical territory (this is not a criticism, but an observation). As such, it is difficult to comment further, and the reader is directed to Strassman's excellent book *DMT: The Spirit Molecule* (2001) for further insight. However, it is at least possible in principle, although practically implausible, to measure DMT concentration in the brain at the point of death. Whether or not Strassman is correct, DMT certainly possesses a number of characteristics that suggest it is either an endogenous neurochemical or one with a curious affinity with the human brain and psyche.

Aside from the profoundly alien and inexplicable phenomenology of the DMT experience, the molecule itself is exceptional among psychedelics, both in terms of its structure and pharmacology. DMT is most closely related to the neuromodulator serotonin, both being derived from tryptamine, which is itself derived by decarboxylation of the essential amino acid tryptophan. Serotonin is 5-hydroxytryptamine—the 5-position on the indole ring of tryptamine is hydroxylated (Figure 8). DMT is equally straightforward to derive from tryptamine—the primary amine position is simply methylated twice. The result, from a chemical perspective, is the simplest psychedelic tryptamine; the molecule contains little chemical functionality of any note. In fact, the masking of the primary amine by the dimethyl group renders a structure that could reasonably be regarded

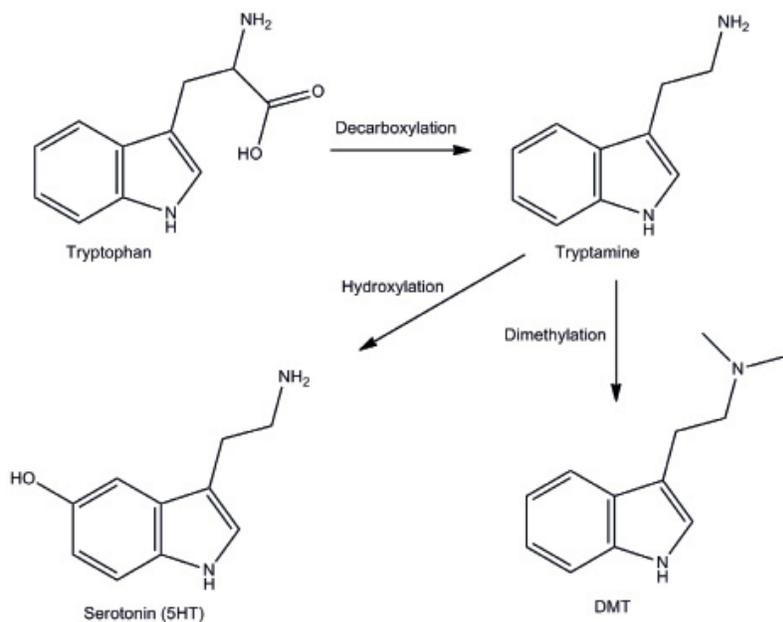


Figure 8. Biosynthesis of serotonin and DMT from tryptophan.

as the simplest possible tryptamine, simpler than tryptamine itself—it has been shown that dimethylation of the primary amine prevents the nitrogen interacting with the 5HT_{2A} receptor (Ebersole, Visiers, Weinstein, & Sealfon 2003). It appears, pharmacologically, to be a rather blunt instrument. And yet, despite this, it also happens to be the most incomprehensibly powerful natural psychedelic drug known. When DMT enters the human brain, its behavior is also unlike any other psychedelic molecule. The DMT trip is characteristically brief, oft noted as mercifully so, owing to the intensity of the experience. The molecule is metabolized and cleared from the brain within minutes, far more rapidly than with other tryptamine psychedelics. When DMT enters the bloodstream, it rapidly moves from the bloodstream into the tissues; most importantly, of course, the brain (Yritia et al. 2002). While it hasn't been demonstrated that DMT is actively transported across the blood–brain barrier, a number of studies have shown the active and selective accumulation of DMT into rat and dog brain (Sangiah, Gomez, & Domino 1979, Takahashi et al. 1985, Yanai et al. 1986). It is possible that a similar mechanism exists in humans, which would explain why it is so rapidly sequestered from the bloodstream after administration and capable

of reaching psychedelic concentrations in the brain within seconds. Cozzi et al. (2009) have shown that DMT is a transport substrate for both the serotonin transporter and monoamine vesicular transporter. It is thus possible that DMT may be actively transported into presynaptic terminals and packaged into synaptic vesicles for synaptic release. It is apparently non-toxic with no known direct adverse effects and is unique among the classical psychedelics in its inability to generate tolerance in users with repeated use (Strassman, Qualls, & Berg 1996). All of these characteristics would be expected for an endogenous neurotransmitter and are not possessed by other classical psychedelics.

It has now been established that the primary site of action of the classical hallucinogens within the brain is the 5HT_{2A} receptor. Indeed, it has been shown that the effects of psilocybin can be blocked by a specific 5HT_{2A} antagonist. As discussed earlier, it can be explained using current understanding of brain function how many of the effects of the classical hallucinogens can be produced by activation of this receptor. Of course, the complete picture is certainly richer and more complex, with other receptors and pathways no doubt being involved in generating the full spectrum of effects of hallucinogens. Owing largely to the work of the Shulgins (Shulgin & Shulgin 1997), we now have limited psychopharmacological data on more than 100 novel tryptamine analogues. Other studies have established their individual receptor binding profiles (Ray 2010). DMT isn't striking or even notable in terms of its affinity for any particular set of receptors; its affinity for the 5HT_{2A} receptor, in particular, lies between that of psilocin and LSD (Ray 2010). From a standard pharmacological perspective, one can make the assumption that DMT generates its remarkable effects because of the highly specific and individual manner in which it binds to a number of receptors and/or the manner in which it activates the receptors it binds, certainly including the 5HT_{2A} receptor. DMT's highly individual and specific receptor binding signature produces a unique perturbation of brain function—one can compare this to how a key is able to open a lock by shifting a specific set of pins in a precise manner within the barrel. If such a precise profile of receptor interactions were not necessary to produce DMT's effects, then one could make the reasonable assumption that a number of other known tryptamines would exhibit comparable effects to DMT, just as a number of mescaline or LSD derivatives exhibit similar effects to their parent molecules. But this is not the case; the effects of DMT are unique to DMT itself. Of itself, this is not a particularly remarkable observation, as all drugs are in some way unique. Sasha Shulgin's peerless work has shown that minor structural changes can have dramatic effects on the psychopharmacology of a molecule. But what *is* remarkable about

DMT is that it sits at the bottom of the list of classical psychedelics in terms of molecular complexity, uniquely possesses a number of characteristics that suggest it is an endogenous neuromodulator, *and* produces some of the most unimaginably profound alterations of consciousness of any naturally occurring drug, firing users into an apparently alien reality. All of the classical psychedelics activate the 5HT_{2A} receptor and yet only DMT reliably facilitates access to characteristic alien worlds. It would be a truly startling coincidence if DMT, the simplest tryptamine possible with little chemical functionality, the most widely distributed in nature and a natural human metabolite, just happens to be the only one capable of perturbing brain chemistry in such a finely tuned manner so as to produce apparent transport to alien worlds—all by chance and without any functional significance. And yet, this is exactly what we are faced with. It is difficult to reconcile these characteristics of DMT and its effects on consciousness with the assumption that DMT is merely an exogenous psychedelic drug and that any psychedelic effects are incidental and unrelated to its neural function. The nature of DMT and its effects might be better understood if, rather than as an exogenous drug, we begin to regard DMT as a neuromodulator with a *long-standing relationship with the human brain*.

Neural Development of World-Building Modes

The functional connectivity patterns of the thalamocortical system of an adult human brain result from three processes working on very different temporal scales—evolution, development, and experience. As discussed, these connectivity patterns are established by the sampling of sensory data from the external world. Eventually, the brain becomes capable of building the consensus world and is able to do so in the presence or absence of sensory data, i.e. waking or dreaming. This is because the selected thalamocortical connectivities generate intrinsic activity that represents the consensus world as a default state. Sensory data (i.e. extrinsic information) can modulate the intrinsic activity of the thalamocortical system only by being ‘matched’ to this ongoing activity and amplifying it. It is of central importance that the development of this connectivity takes place in the presence of serotonin, which modulates the ‘tone’ of the cortical pyramidal and inhibitory interneurons, tuning their excitability by activation of 5HT_{1A} and 5HT_{2A} receptors. As such, the intrinsic activity that builds the consensus world is most reliably expressed in the presence of serotonin. When the normal serotonergic tone is disrupted by a molecule with 5HT_{2A} selectivity, the thalamocortical patterns of activation are no longer tightly constrained and a variety of unpredictable psychedelic effects result. However, when serotonin is displaced by DMT, something very different seems to happen;

the thalamocortical system does not begin to behave unpredictably and with variable effects, but instead begins to behave *as if its structural and functional connectivity and thus intrinsic activity had developed in the presence of DMT and subject to the extrinsic sensory input of a completely different reality*. The thalamocortical states that are generated under DMT modulation are highly regular and highly specific—we know this because the worlds that appear are highly regular and highly specific to DMT. This is difficult to explain unless the brain contains more than one parallel ‘set’ of thalamocortical connectivities—one that developed under the modulation of serotonin (the ‘consensus set’) and one that developed under the modulation of DMT (the ‘alien set’). As such, the set that is expressed depends upon which neuromodulator is present; when serotonin is present, the consensus set is expressed and thus the consensus world appears. When DMT is present, the parallel ‘alien set’ is expressed and the alien world appears. This is a key idea, illustrated in Figure 9, and is worth explaining in more detail.

As explained earlier, the thalamocortical system can be thought of as a 3D mosaic of thalamocortical columns, differentiated but integrated as a unified whole. This system possesses a practically infinite potential for different thalamocortical states, expressed by the structural and functional connectivity and patterns of activation of the thalamocortical columns. However, as specific functional connectivities and activation patterns are developed, as a result of extrinsic sensory data sampled from the consensus world, this potentiality becomes molded to a ‘consensus set’ of connectivities and patterns that represent consensus reality. The integrity and stability of this system depends on a multitude of finely balanced and complex functional interactions among the neurons of the thalamocortical system. The development of these interactions, while driven by extrinsic sensory data, occurred in the presence of serotonin, which acted to tune the excitability of the pyramidal cells and their associated interneurons by its balance of activity at 5HT1A and 5HT2A receptors. As a result, these interactions can be reliably expressed only in the presence of serotonin as only then will the cells be appropriately excitable. When the balance of 5HT1A/5HT2A activation is altered by the presence of a psychedelic drug, the ‘consensus set’ of finely tuned functional interactions breaks down. Consequently, the thalamocortical system becomes ‘re-potentiated’ and capable of adopting a larger repertoire of states. This is experienced as a psychedelic state, but is maintained only as long as the drug is present—as soon as it is cleared from the brain, the ‘consensus set’ re-establishes itself and the user ‘comes down’ from the experience. It is a relatively straightforward conceptual leap to now explain how DMT enables the brain to ‘shift’ into

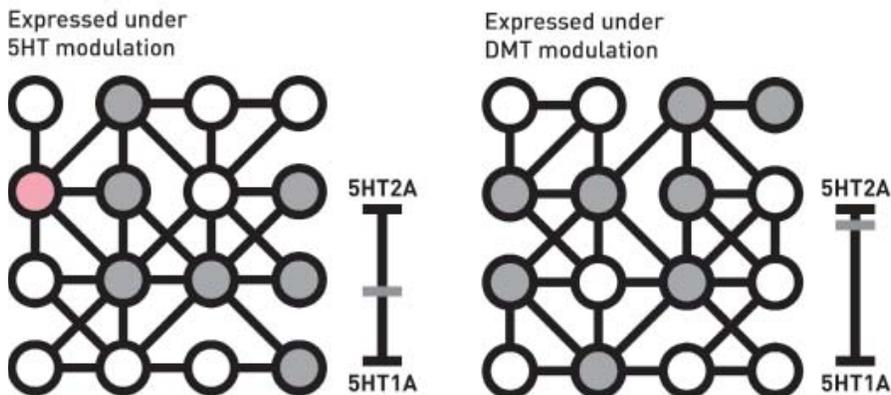


Figure 9. The connectivities of both the consensus and alien worlds exist in parallel. However, specific patterns of connectivity are expressed only in the presence of either 5HT or DMT, depending on which was present when they developed. The patterns expressed determine the intrinsic activity of the thalamocortical system and thus which world is built.

an alien world-building mode. The presence of any molecule that shifts the 5HT1A/5HT2A balance in favor of 5HT2A will result in a temporary breakdown of the ‘consensus set’ of thalamocortical connectivities and re-potentialize the thalamocortical system. This would include DMT, of course. Now, one can imagine that if extrinsic data from an alternate reality (the nature of which is unimportant here) was received when DMT was present, a new set of functional connectivities and activation patterns would begin to develop in exactly the same way that the ‘consensus set’ developed in the presence of serotonin (Figure 10). Further, exactly as with serotonin, this would need to happen repeatedly over an extended period of time (i.e. evolutionary time). Eventually, the thalamocortical system would develop the ability to build the ‘alien world’ in the same way it builds the ‘consensus world’ and thus possess two completely independent and parallel world-building modes. Which mode is expressed (i.e. whether the intrinsic thalamocortical activity constructs the consensus world or the alien world) and thus which world is seen, depends only upon which molecule is present—serotonin or DMT. Conceptually, at least, there would be no issue in the brain accommodating such parallel patterns of functional connectivity, as there is massive redundancy in neural connections, and the majority of neural connections are not functionally expressed at any one time (Edelman 1993). In fact, there are far more ‘potential synapses’ (points of close contact between dendrites and axons) than functional ones (Stepanyants

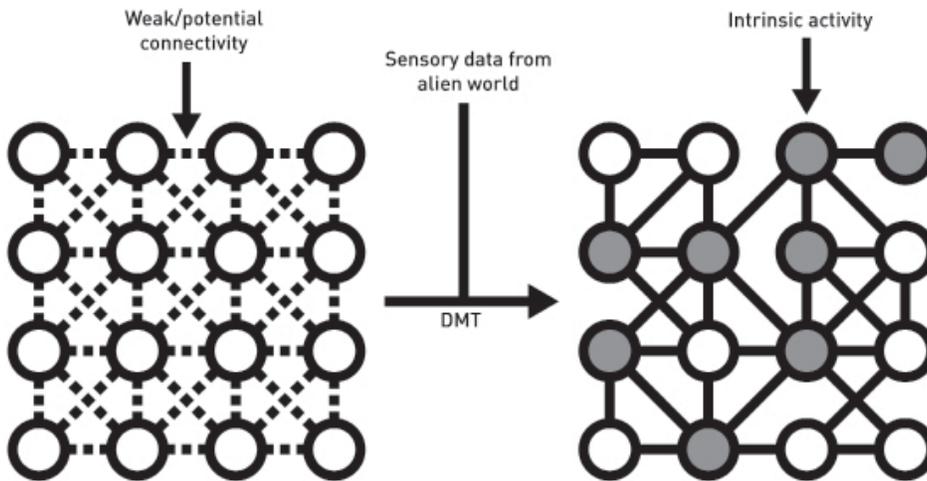


Figure 10. The structural and functional connectivity of the thalamocortical system develops under the modulation of DMT and subject to sensory data input from the alien world. Eventually, the intrinsic activity of the system builds the alien world as a default state, but only in the presence of DMT. Only strong/characteristic connectivity is shown on the diagram on the right.

and Chklovskii 2005). This explanation resolves the question as to why DMT is unique in its ability to transport the user to these characteristic alien worlds. Its uniqueness is simply a consequence of the fact that it was the neuromodulator present when the thalamocortical connectivities of the alien world were developed. As such, the intrinsic activity that generates the appearance of the alien world can be expressed only in its presence, in exactly the same way that the consensus world appears in the presence of serotonin. This also provides a neurological mechanism for the suggestion that DMT ‘tunes’ the brain to receive sensory data from another reality. As discussed earlier, extrinsic sensory information adds very little new information to the brain, but is, rather, ‘matched’ to ongoing intrinsic activity, which it amplifies. Thus, *sensory data from the DMT reality can only be received only when it matches ongoing intrinsic activity within the brain’s thalamocortical system. DMT, by replacing serotonin in the cortex, acts to shift the thalamocortical system into generating the appropriate intrinsic activity.* A structurally unremarkable neuromodulator thus has the most remarkable effects. In fact, this model would predict that DMT is the only molecule capable of shifting the thalamocortical system into a state in which it constructs these characteristic alien worlds. However, this model

also requires that, like serotonin, DMT be present in the brain repeatedly over a span of time on an evolutionary scale. It is intriguing that such an idea might suggest that DMT may well be an endogenous neuromodulator with a very long-standing relationship with the brain. This is precisely the conclusion that was tentatively drawn earlier, based on its unique chemical and pharmacological characteristics. However, DMT has never been detected in psychedelic concentrations in the brain, so there must be more to the story. The following model, while highly speculative, may explain the unique characteristics of DMT, its interaction with the human brain, and its psychedelic effects better than any current model that regards DMT as an exogenous psychedelic drug in the same category as other classical psychedelics.

DMT as an Ancestral Neuromodulator

So far, it has been suggested that the characteristics of DMT and its interaction with the brain are indicative of an endogenous molecule. Also, the psychedelic effects of DMT, fully immersive hallucinogenesis during which the consensus world is completely replaced with an apparently ‘alien’ world, might be explained if DMT was the major neuromodulator present when a parallel set of thalamocortical connectivities were developed. Both of these ideas would make sense if DMT is an *ancestral neuromodulator*, i.e. a neuromodulator that, at some point in our evolutionary past, was secreted in psychedelic concentrations by the brain. However, most of this functional capacity has subsequently been lost and the DMT that is currently present in the brain is possibly vestigial and might not have a significant modern function. So, in this ancestral period, the brain would have produced both serotonin and DMT, although probably not at the same time. The evolution of the consensus world-building capabilities of the brain took place under the modulation of serotonin, and was driven by the extrinsic sensory data from the consensus world. However, periodically, the brain was able to switch from primarily serotonin secretion to DMT secretion. This switch made the brain more sensitive and receptive to sensory data from the alternate reality, the ‘alien world’. This is because DMT’s 5HT1A and 5HT2A binding signature facilitated intrinsic thalamocortical activity that more closely matched the extrinsic sensory data from that particular reality. Over time, the intrinsic activity of the thalamocortical system and the alien reality became more and more closely ‘matched’ (i.e. the same mechanism by which the brain developed its consensus-world-building capabilities, except that DMT, rather than serotonin, was present). Thus, the thalamocortical system developed an ability to build the ‘consensus world’ when serotonin was present and the ‘alien world’

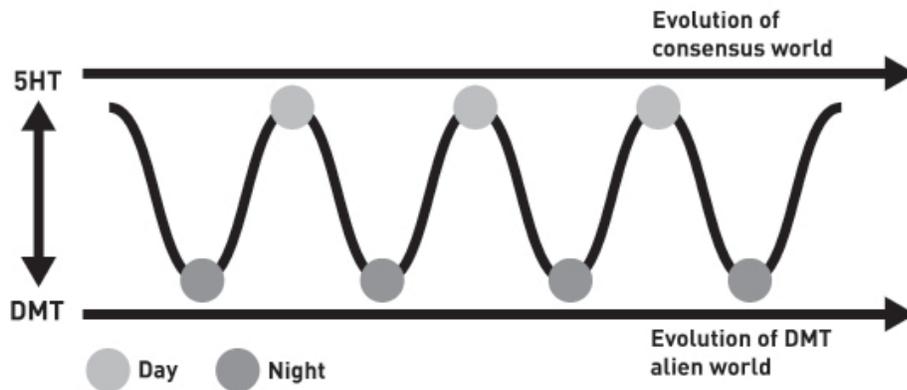


Figure 11. Parallel neural evolution of two separate world-building modes of the thalamocortical system.

when DMT was present. Now it is possible that the brain cycled between serotonin and DMT secretion, possibly with a diurnal rhythm. For example, serotonin could be secreted during waking and thus during interaction with the consensus world. As such, evolution of the brain's consensus world-building ability would occur during waking hours. However, during (REM) sleep, DMT would be secreted. As such, evolution of the brain's 'alien world'-building capabilities would take place during the night. In other words, the brain underwent a *parallel neural evolution*, in which two entirely separate world-building capabilities were developed (Figure 11). Perhaps, however, in order to cement the human species more firmly in the consensus world, the DMT secreting ability of the brain was gradually lost and only serotonin remained. As a consequence, all knowledge of the other reality was eventually forgotten. It is possible that dreaming is a vestigial function from the time when DMT was secreted during sleep. Modern dreaming is not known to have any specific adaptive function (Flanagan 2000), despite speculation as to its possible role in human life. Originally, dreaming would represent the period during maximal DMT secretion and when the individual would interact with the alien world. Now, however, this period has been replaced by modern dreaming, in which the brain maintains the thalamocortical activity that developed under serotonin, with models of the consensus world being built. However, serotonin secretion still cycles between waking and dreaming, with secretion dropping off during REM sleep (McCarley 2007), although this is no longer accompanied by a ramping up of DMT secretion. It is possible that modern dreaming has

additional advantages for survival in the consensus world, which may have helped select for the loss of the DMT secretion function, but this is unclear.

So, rather than the administration of an exogenous drug, smoking DMT could be regarded as reconstitution of an ancestral function. There is no reason to assume that the current repertoire of neuromodulators used by the human brain represents all that have ever been used. This may mean that those looking for a modern function for the small quantities of DMT currently secreted by the brain could be misguided—the function may well be in the past. Why this function was lost is unclear, as is the site of production/secretion in the brain. However, the idea that the human brain has actually regressed functionally in the last ~100,000 years is increasingly attracting attention (Gynn & Wright 2008). It is notable that Gynn and Wright make the case for a decline in pineal function, caused by changes in human's ancestral diet, as an explanation for many modern human 'left brain' characteristics. Although they focus on the pineal gland's role in the production of melatonin, a hormone associated with the diurnal wake–sleep cycle, it is striking that the pineal has been proposed as a possible site of endogenous DMT synthesis (Strassman, Wojtowicz, Luna, & Frecska 2008). Further, the pineal gland's primarily nocturnal activity, secreting melatonin only during darkness, accords with the ancestral neuromodulator proposal. In fact, it is possible that there has been either a contraction of pineal function or a functional reassignment, its role shifting from DMT secretion to melatonin secretion—melatonin is itself a tryptamine (specifically, N-acetyl-5-methoxytryptamine). Luke, Zychowicz, Richterova, Tjurina, and Polonnikova (2012) have explored the idea that the cycle of DMT and melatonin secretion by the pineal might still be correlated and related to precognitive dreams. Although nobody has ever measured DMT levels in the brain directly, it seems likely that any DMT secretion is sub-psychedelic; otherwise, dreams ought to resemble the DMT flash. The pineal has, since ancient times, been regarded as a connection between the material and spiritual worlds (López-Muñoz, Molina, Rubio, & Alamo 2011). Perhaps there is an element of truth in these ostensibly primitive ideas. Certainly, this needs to be explored further and will no doubt be the subject of future discussions.

Seriously proposing that the brain is capable of receiving extrinsic data from an alternate alien reality is certainly bold. However, this discussion has deliberately avoided defining the nature of the external world and certainly shies away from defining the nature of any alien world. A true external alien reality, the nature of which is difficult to comprehend, isn't necessarily a requisite within the ancestral neuromodulator model of DMT. Jung proposed that fragments of the psyche buried in the unconscious might carry on a completely separate existence from the conscious ego. These

autonomous psychic complexes form a miniature, self-contained psyche and are, perhaps, even capable of a consciousness of their own (Jacobi 1959). If confronted, these complexes would appear entirely alien, with qualities of outside objects or persons. It is conceivable that, rather than receiving extrinsic data from an external alien reality, the parallel thalamocortical repertoire explored and developed during elevated DMT secretion in sleep may in fact represent the informational structure of these autonomous psychic complexes. Rather than learning to build a representation of an alien reality external to the brain, the brain in fact may have learned to build a conscious representation of deep unconscious structures. Laughlin (1996) argues that Jung's constellation of human archetypes that constitute the collective consciousness are neurognostic structures (neural structures present from birth that produce the experience of the foetus and infant) that are both inheritable and subject to evolution. It ought to be clear that these neural structures are analogous to, if not identifiable with, the thalamocortical connectivities discussed at length in this paper. Clearly, if ancestral DMT secretion facilitated the development of a parallel set of inheritable neurognostic structures (thalamocortical connectivities), whether or not involving data input from a true external alien reality, these may form an autonomous fragment of the collective unconscious (a *universal autonomous psychic complex*) that can be expressed only when DMT levels in the brain are reconstituted (i.e. by smoking or injection of exogenous DMT). This would explain the phenomenal commonalities reported by DMT users, while also explaining why DMT alone seems capable of evoking these characteristic alien worlds. One can at least speculate that this universal psychic complex might evolve somewhat independently and, perhaps, far more rapidly than other parts of the collective unconscious and the conscious ego. Would this explain why the worlds and their occupants experienced under DMT often appear extremely intelligent and hypertechnological? This requires a far more detailed examination than can be presented here, but it is certainly an interesting idea.

To summarize, the ancestral neuromodulator model provides an explanation for a number of features of the DMT molecule, its interaction with the brain, and psychological effects:

1. Simple structure—as an ancestral neuromodulator, it would be predicted that the molecule be structurally unsophisticated and readily biosynthesized from natural precursors, as is serotonin. In fact, it could be argued that DMT is the least sophisticated derivative of tryptophan, after tryptamine itself, and may well pre-date serotonin in the brain.

2. Unique ability to transport the user to the highly characteristic DMT reality—as evolution of the brain’s ability to build the alien world progressed in DMT’s presence, it would be expected to be unique in its ability to facilitate access to that reality, in the same way serotonin specifically allows access to the consensus world.
3. Active transport into the brain, packaging into synaptic vesicles, and rapid metabolism—all would be predicted for an endogenous neuromodulator, albeit one from the distant past.
4. Highly specific action—the lucidity of the experience enables the user to experience the DMT world in almost the same manner as the consensus world, with little stoning or other psychological distortions. This would be expected if DMT’s role in the brain has evolved to facilitate this reality shift without causing additional physiological perturbations.
5. Total replacement of consensus reality with the alien reality—in the presence of DMT, the thalamocortical system has evolved to shift into the functional state to build/receive the alien reality. As such, the transition would be expected to be rapid and complete, assuming dosage is sufficient.
6. Inter-user commonalities and corroboration—users often seem to go to the same world.
7. Sense of familiarity—many users note that, despite being extremely bizarre, the DMT reality seems strangely familiar. This might be expected if DMT is an ancestral neuromodulator and humans have a long history of access to this alien world, although consciously forgotten.
8. The welcome cheers of the elves—a number of users note how the entities seem to be expecting them and welcome them ‘home’.
9. The vestigial sub-psychedelic secretion of DMT by the brain—DMT remains detectable in bodily fluids, although this may no longer be physiologically significant at current levels.

Overall, serotonin and DMT can be regarded as equivalent—each shifts the thalamocortical system into building a very specific world. Serotonin is a powerful psychedelic neuromodulator that locks the brain into building the consensus world, as the thalamocortical connectivity patterns expressed are those developed under the modulation of serotonin. It is not being suggested that serotonin is the only significant neuromodulator in this regard, but ultimately the world that appears is determined by the chemistry in the brain—change the chemistry and change the world. When the concentration of DMT rises in the brain, either because of endogenous

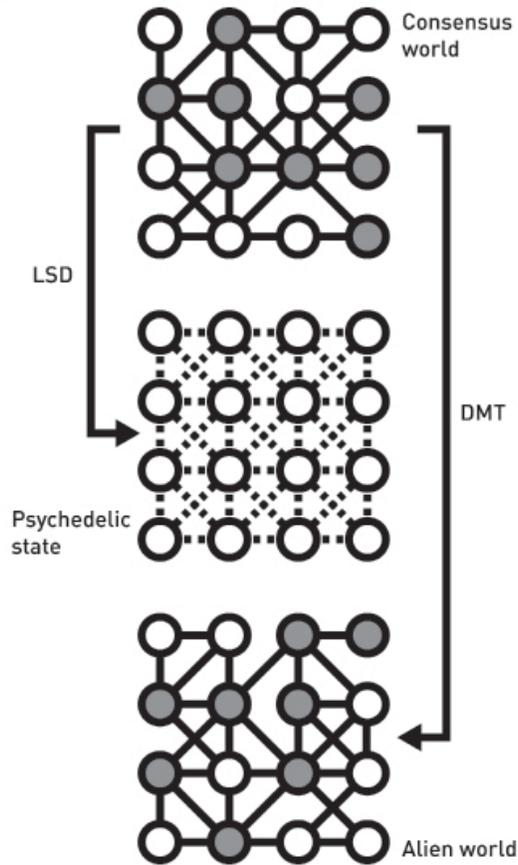


Figure 12. The shifting between world-building modes induced by DMT is very different from the psychedelic state induced by classical psychedelics such as LSD.

secretion or exogenous administration, the thalamocortical connectivities expressed are no longer those of the consensus world; they are of a different world, a bizarre and apparently alien world (Figure 12). Whether or not this state is *currently* modulated by extrinsic sensory data is unclear, and any mechanism for this remains to be discovered. However, it is logical to assume that, if the brain is currently capable of receiving extrinsic data from an alien reality, then it must have evolved to do so. The modern human brain doesn't appear to have been dropped to earth, ready to receive sensory data from this world—it evolved to do so. Thus, if the brain did not evolve to

also receive data from another reality, then there is absolutely no reason why it ought to be capable of doing so, if indeed it does possess this capability. The ‘DMT as ancestral neuromodulator’ model provides an explanation for how this could have been achieved. Whether the alien worlds seen with DMT are real external realities or realms within the collective unconscious, the implication is that they may not be so alien after all, but a deep, long-forgotten part of us, carried around in our heads, waiting to be rediscovered and explored.

Summary and Conclusion

The paradigm of modern materialist neuroscience fails to provide a straightforward explanation for DMT’s remarkable effect on human consciousness. Our current understanding of the action of hallucinogens appears sufficient to explain many of the effects of classic psychedelics, but DMT seems exceptional and is more difficult to account for. This simple molecule has an extraordinary ability to rapidly fire the user into an unimaginably strange alien reality and then return them within a few minutes, shocked and shaken but unharmed. The worlds DMT users find themselves in are completely unlike the dream world, bear no apparent relationship to consensus reality, and yet possess commonalities that are difficult to explain, unless they are modulated by an extrinsic sensory component of an unknown nature or are expressions of autonomous structures within the collective unconscious. The brain’s thalamocortical system learned to construct consensus reality throughout evolution, development, and experience, and it seems likely that it must have also learned to construct alien worlds that appear when DMT floods the brain—this suggests that this simple tryptamine has a long-standing relationship with the brain; a conclusion supported by a number of pharmacological peculiarities unique to DMT. Of course, DMT itself contains none of the information that constitutes the experience—no alien landscapes, no entities, no hidden worlds. However, DMT may allow the expression of intrinsic thalamocortical activation patterns that developed in a world that is not so much alien, but from which we have become alienated, allowing us a brief but astonishing glimpse at a long-forgotten hyperdimensional heritage. Thanks to the curiosity of a small, but growing, number of individuals, this heritage is now being rediscovered and explored. Surely, this can only be a good thing. DMT may be one of the most powerful tools for understanding consciousness and the nature of reality bestowed on the human species and ought to be treated as such. As Terence McKenna was so keen to point out, “DMT is not a secret; it is *the* secret.” Perhaps he was right.

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HISTORICAL PERSPECTIVE

Three Stages of Modern Science

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Abstract—The common view of science is a *mis*understanding of today's science that does not recognize how "modern" science has changed since its inception in the 16th to 17th centuries. Science is generally taken to be objectively reliable because it uses "the scientific method" and because scientists work disinterestedly, publish openly, and keep one another honest through peer review. That common view was not too unrealistic in the early days and the glory days of modern science, but it is quite wrong about contemporary science, which has ceased to be trustworthy because it is subject to commercial and bureaucratic influences that have spawned highly damaging conflicts of interest, institutional as well as personal. The birth of "modern" science is credited uncontroversially to "The" Scientific Revolution of the 17th century, but it has not been widely understood that there have been three distinctly different stages of scientific activity since then. In the first stage, amateurs were seeking to satisfy their curiosity about how the world works. There were essentially no controlling interests other than truth-seeking. Missteps taken resulted chiefly from the inherent difficulty of making discoveries and from such inherent human flaws as pride and avarice. The second stage, roughly the 19th century, saw science becoming a career, a plausible way to make a living, not unlike other careers in academe or professions like engineering: respectable and potentially satisfying but not any obvious path to great influence or wealth. Inevitably there were conflicts of interest between furthering a career and following objectively where evidence pointed, but competition and collegiality served well enough to keep the progress of science little affected by that conflicting career interest. The way to get ahead was by doing good science. In the third and present stage, which began at about the middle of the 20th century, science faces a necessary change in ethos as its centuries-long expansion at an exponential rate has changed to a zero-sum, steady-state situation that has fostered intensely cutthroat competition. At the same time, the record of science's remarkable previous

successes has led industry and government to co-opt and exploit science and scientists. Those interactions offer the possibility for individuals to gain considerable public influence and wealth. That possibility tempts to corruption. Outright fraud in research has become noticeably more frequent, and public pronouncements about matters of science are made for self-interested bureaucratic and commercial motives. The public cannot now rely safely on the soundness of advice from the scientific community.

Keywords: historical changes in science—science become untrustworthy

Introduction

A Society for Scientific Exploration is inevitably concerned with what it means to be scientific, to do science. But almost everyone has wrong ideas about that, including most scientists and those who write or comment about science.

There are two chief reasons for that. One is confusing how science might ideally proceed with what the reality is. The other is failing to understand that today's science is very different from what it was only about half a century ago.

Science is unlike idealized views of it primarily because of conflicts of interest; and the degree to which scientists experience conflicts of interest has increased enormously over the centuries, most especially since World War II. Many people nowadays are willing to acknowledge that Wall Street and Big Pharma enjoy the best Congress their money can buy, but few people seem to understand that nowadays we are also stuck with the best science that money can buy (Mirowski 2011).

Put it another way: Science has become too big to fail. The National Academies of Engineering, Medicine, and Science are too big to fail; the National Institutes of Health are too big to fail; the Centers for Disease Control & Prevention are too big to fail; the World Health Organization is too big to fail—in the sense that their pronouncements about matters of science cannot be effectively countered even by groups of dissenting experts. The institutions of science and medicine determine what is to be believed. If the evidence actually points elsewhere, so much the worse for the evidence and for those who try to speak for it.

The uncomfortable realization that science has become seriously untrustworthy follows from the observation that, in a wide and varied range of fields, unwarranted dogmatism and suppression of competent minority views—which are not supposed to happen in science—have become rampant (Bauer 2012a): concerning aboriginal cultures (Dreger 2011),

Alzheimer's disease, cosmology, dangers of mercury and of second-hand smoke, dinosaur extinction, efficacy of anti-depressants and of many other drugs, evolution of birds from dinosaurs (Feduccia 2012), first humans in the Americas, global warming, HIV/AIDS theory, human sexual diversity (Dreger 2008), low-energy nuclear transformations ("cold fusion"), plate-tectonics theory (continental drift), safety of genetically modified organisms and their products, special relativity theory, string theory, theory of smell.

Evidence and Interpretation

The claim that science could be mistaken over so many matters, through excessively dogmatic adherence to an insufficiently proven mainstream view, goes against what is widely taught and believed about science and the reliability of the scientific method: How could science possibly be so dogmatic and perhaps even mistaken on so many topics?

I had found myself posing a similar rhetorical question when I first read Tim Dinsdale's book about the Loch Ness Monster (Dinsdale 1961). I had found quite credible his tale of having the enormous good luck to capture on film a large animal moving through the water (and the film itself has since borne up well against challenges, for example detailed analysis by up-to-date technology [Bauer no date]). But when I came to Dinsdale's Chapter 9, titled "Monsters Galore," about similar creatures in lakes and seas all over the world, I said to myself, "This is just too much. One such critter not known to science is hard enough to swallow, let alone dozens of them!"

I don't recall how long it took me to recognize how illogical that reaction was. *If* Nessies exist, then it's much more likely that they have siblings or cousins elsewhere, than that one lake in the whole world would be the only place where there are such creatures.

So too with science being excessively dogmatic and suppressing competent alternative views and thereby becoming unreliable. If this had been noted on just one topic, it would seem an aberration that "science" could be so "unscientific" and one would doubt the claim. However, when dissenting experts in widely disparate fields have attested to dogmatic suppression of reasonable evidence-supported viewpoints on the dozen-and-a-half topics listed above, indications are that something about contemporary scientific activity is drastically different from what we had come to expect.

Admittedly, at first sight it seems extraordinarily unlikely that all official institutions could be seriously mistaken over the influence of greenhouse emissions on global warming, say, or over the belief that HIV caused AIDS. But recognizing that a number of less prominent fields have experienced unwarranted hegemony of a less-than-proven hypothesis does

suggest that scientific activity is more subject to dogmatism and less open to self-correction than the popular view would have it. And if so, then perhaps “science” could be wrong also and even over something like climate change, where significant dissent from the official view is given no shrift at all in professional or popular media.

The popular view of science sees it as a search for truth, disinterested and objective, as though secluded in an academic ivory tower and unhindered by anything but seeking the truth. That view came about in part because of the phenomenal progress of scientific understanding since the 17th century and because of an oversimplified, bowdlerized description of those early times and the doings of such intellectual giants as Galileo and Newton. But today’s science is nothing like the science of those early days, and not many of today’s scientists are anything like those intellectual giants.

Modern science has seen three distinctly distinguishable eras.

The First Era of Modern Science

In the first era of modern science, amateurs were seeking authentic knowledge as a matter of sheer and often worshipful curiosity.

Historians are in reasonable agreement that modern science had its beginnings at about the turn into the 17th century. The crucial circumstance, marked by such events as the founding of the Royal Society of London, was that a scientific community began to come into being.

Earlier times had seen individuals gaining bits of scientific knowledge and acquiring and sharing remarkable technological skills, but these remained discrete, not at all like the modern integration of all scientific disciplines and their applications under the stewardship of professional guilds. “The” Scientific Revolution of about the 17th century saw the beginnings of that integrated venture by something like a coherent association of knowledge seekers. They were doing “natural philosophy,” seeking to understand Nature. Some of the participants were clergy to whom the study of Nature was a way to serve God, a way to understand His ways better, while others were doing it just because they wanted to, whether out of sheer curiosity or in the hope of finding materially useful things. The essential point is that they were working primarily as amateurs, following their passions, not distracted by external conflicts of interest.

In this first era of modern science, flaws and errors stemmed partly from the inherent difficulty of understanding how the world works and partly from human characteristics. People naturally took pride in their discoveries and wanted to be recognized for making them, and to be acknowledged as having made them first, and perhaps even to profit materially from them,

and they could be heavily invested in their own theories, sure they were right and others wrong. So there were arguments, sometimes quite bitter, typically over who had priority for a discovery. But those arguments were not exacerbated by interests external to scientists and knowledge-seeking.

That first era of modern science has left its mark on the contemporary view, according to which scientists are self-driven by curiosity with their only interest being to discover what the truth is. That certainly remains accurate for some individual scientists, but it isn't accurate overall: Most researchers nowadays are employees doing what they're paid to do, and influenced by a variety of conflicts of interest whose consequences can be decisive.

The Second Era of Modern Science

In the second era of modern science, science became a career.

By the early 19th century, natural philosophy had accumulated a respectable amount of trustworthy knowledge and understanding of Nature, enough to inspire confidence that even more could be learned in the future. The term "science" was becoming used in something like its modern form; William Whewell is generally credited with first use of the term "scientist" in the 1830s. So the professional identity of "scientist" came into being, and with it the possibility of doing science as a career, a livelihood: at first primarily through teaching, with research as an optional sideline, but soon also through carrying out applied research, beginning perhaps with the synthetic-dye-stuff industry. In the later 19th century, Germany pioneered what have become "research universities," where the teaching of undergraduates tends to play a subsidiary role (Knight 1986).

Now it became not just a matter of personal satisfaction to get there first and to be acknowledged for it and to be right while others were wrong, it was henceforth a way to succeed in practical terms, making a career and attaining better positions. Making great discoveries could even lead to high social status, for example being inducted into the British peerage like William Thomson who became the first Baron Kelvin, or Ernest Rutherford who became the first Baron Rutherford of Nelson in New Zealand.

During the First World War, Germany lost access to the previously imported nitrates needed for explosives as well as fertilizers, and Ernst Haber found out how to synthesize the needed chemicals from the atmosphere's nitrogen. Many other fundamental discoveries turned out to have practical applications. Industrial scientists could sometimes share the benefit from making patentable discoveries. But, by and large, the rewards from being a scientist were more intangible than material, from the satisfaction of

doing the work and being able to earn a decent living from doing something interesting. In this second era of modern science, from about mid-19th century to about mid-20th century, science was in many ways an attractive career, but it was not a path one would choose if seeking wealth or an entrée into the halls of power. The conflicts of interest to which researchers were subject were largely personal ones: They had to mesh doing science honestly with doing what would advance their career. That rarely hindered the drive to do good science, because by and large the way to succeed personally was by doing the best, most original, and most trustworthy science.

The Third Era of Modern Science

The third era of modern science, the contemporary scene, sees science enmeshed inextricably with technology, big money, and big politics, bringing highly influential external and institutional conflicts of interest. Up to this time, scientific activity had been almost entirely the product of individual choices and endeavors. Nowadays it is increasingly a corporate endeavor, and corporations are not people. For example: Historians have described the influence of the Rockefeller Foundation on biological research, as recently as the 1930s, in terms of the character of its president, Warren Weaver; today, by contrast, the influence exerted by the National Institutes of Health results largely from bureaucratic inertia and relatively little from the characters of the individual administrators, who are bureaucratically homogenized and corporately restrained. Thus at the Food and Drug Administration, there have been a number of examples where “larger considerations”—expounded in self-interested fashion by drug companies—have overruled the technical judgments of the scientific staff.

The Second World War introduced this present era of science, in which research can lead to great wealth and to considerable influence on national and international policies. Science has thereby become inseparable from powerful external vested interests. Sheer size of the enterprise has brought bureaucracy to the control and funding and publishing of research. Research may then be for political purposes or for commercial profit rather than for simply truth-seeking. Applications of research may be determined by personal or private or corporate interests even to the exclusion of the public good (Krimsky 2003). The distinction between “pure” science seeking basic understanding and “applied” science based on trustworthy fundamental knowledge has become largely meaningless as more research is funded by patrons interested only in profitable outcomes, not abstract new understanding (Ziman 1994).

Something like a perfect storm ensued because these changes happened

to coincide with an inevitable change from seemingly unlimited expansion of scientific activity to an essentially zero-sum game in which the total resources available for research can no longer grow in the way they had for at least a couple of centuries.

Derek Price (1975, 1986), groundbreaking historian of science, had recognized that during the first two eras of modern science, every available quantitative measure of science had increased at an exponential rate, doubling about every 15 years since the 17th century: numbers of articles published, numbers of scientific journals, numbers of people who could be described as scientists. The ethos of scientific activity was consonant with that, an expectation that every promising avenue could be explored, every new result could find publication, every graduating potential researcher could find employment doing science. By the 20th century, insiders as well as outsiders were looking to numbers as gauges of success in science: numbers of articles published, numbers of students mentored, and especially in the third era of modern science numbers of grants collected and total amount of money raised.

Price also saw that science, broadly defined as “Research & Development” (R&D), had been gaining an increasing proportion of Gross Domestic Product (GDP). By roughly mid-20th century, that had grown in developed societies to about 2% to 3% of GDP, provided by private and corporate patrons as well as by government agencies. That 2% to 3% proportion of GDP could hardly continue to grow appreciably. Science had reached its limit of growth relative to the rest of society and would have to adjust to a relative steady-state—at the same time as research in most fields was becoming more and more sophisticated and expensive. Doing one thing would increasingly mean not doing other things; an early harbinger came in physics with the abandoning as too expensive of a Superconducting SuperCollider.

Under the new circumstances, the numbers of prospective researchers graduated should approximate the numbers needed to replace retiring researchers. New journals would rarely need to be established. Measures of success would need to be more qualitative than quantitative. The ethos of scientific activity that had worked well for two or three centuries would need to be replaced by a significantly different one.

It’s a very tall order, to change the culture that had successfully sustained a working community for a long time (Bauer 2012b). The scientific community has to accommodate a change in ethos of similar magnitude and revolutionary sort as when Western culture changed from largely religion-based to largely secular, a transformation that isn’t fully completed after more than a century. The cultural changes that have been needed in science

for some decades now have barely been broached, and in some ways are being furiously resisted; researchers still try to publish as much as they can, for instance, and to train as many students as they can, and there is a continuing proliferation of new journals and new publishers made possible by the low cost of digital publication (Beall no date).

John Ziman (1994), distinguished physicist turned STS (science, technology, and society) scholar, had detailed the needed changes in ethos nearly two decades ago. The traditional norms, whose definitions are generally credited to Robert Merton, were that science was a universal public good characterized by disinterestedness and organized skepticism, to which Ziman added “originality.” These norms, articulated toward the end of the second era of modern science, are appropriate to something like the first era of science: curious people seeking understanding for its own sake, skeptical of new claims since experience had shown them to be fallible; Ziman’s addition of originality recognized the value of creativity and progress.

In the second era, personal careerism and institutional interests sometimes interfered with disinterestedness or with organized skepticism; but in the third era, the present-day era, the norms of scientists’ behavior are unrecognizably different. Ziman pointed out that research is now largely a matter of authoritative professional experts hired to produce desired results, and the traditional universality of science is typically subordinate to local demands, often commercial ones.

What Ziman did not emphasize is that, under the new regime, the media and the public may be fed “scientific results” that are nowhere near as trustworthy as they used to be since they may be promulgated for bureaucratic, institutional, or profit-making purposes, and not because of any wish to disseminate genuine knowledge. Reports from the World Bank or agencies of the United Nations may be shockingly wrong from a purely scientific point of view (Bauer 2012a:Chapter 8).

Furthermore, the enormous expansion in numbers of researchers has inevitably diluted their average quality, and the possibility of wealth and political influence has also brought a difference in the personalities of those who self-recruit into research. Increasingly, science is being done not out of the inherent curiosity of disinterested knowledge-seekers but rather, as Gordon Tullock put it, out of *curiosity induced, pretended to, by offers of rewards* (Tullock 1966). The necessity for researchers to obtain grants means that what they do is controlled by patrons: Government agencies issue “Requests for proposals” to study a given topic, private foundations also manage to make clear what they are interested in supporting, and industrial offers of research funds rarely make any bones about what is to be studied.

The funding of research has been at something like a zero-sum steady-state for about half a century now, but numbers of would-be researchers and ambitions of researchers have not adjusted to that reality. The funding of research has become absurdly dysfunctional, with scientists spending more time in preparing grant proposals and related activities than in actual research: The success rate of grant applications to the National Institutes of Health is now 18%—more than 4 of every 5 grant applications fail—and the average biomedical researcher becomes a Principal Investigator for the first time at age 42 (Bauer 2012c).

These circumstances have brought cutthroat competition, dishonesty, and the result that public pronouncements from researchers and their patrons or employers cannot be taken as truthful (Bauer 2012d). What the media and the public and the policymakers hear about matters of science has become untrustworthy to a dangerous degree, on such hugely portentous matters as HIV/AIDS and global warming (Bauer 2012a) and the efficacy and safety of prescription drugs (Bauer 2012e), and much more.

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BOOK REVIEW

Heretics: Adventures with the Enemies of Science by Will Storr. Picador, 2013. 450 pp., \$14.99. ISBN 978-1447231684.

Will Storr, journalist and novelist, has written a book about people who vociferously disregard evidence that does not fit comfortably with their dogmas. Yes, many of the usual suspects are here: the holocaust denier, the creationist who ridicules evolutionary theory, and the past Thatcher science advisor who pooh-poohs global warming. But Storr shows that many debunkers and critics of nonmainstream (in our culture) beliefs are equally contemptuous of the scientific method and, in some cases such as that of the “Amazing Randi,” mythologize themselves and lie in order to ridicule and frustrate their opponents. Lying is a strong word, but a refreshing virtue of Storr is that he arrives to his interviews very well-prepared and is fearless in his probes (p. 368, see also McLuhan 2010):

- S: (You) sometimes lie. Get carried away.
R: Oh, I agree. No question of that. I don't know whether the lies are conscious lies all the time . . .
S: So you've never been wrong about anything significant?
R: In regard to the Skeptical movement and my work . . . No. Nothing occurs to me at the moment.

In a note about his method at the end of the book (p. 392), Storr declares that his “knowledge is broad but shallow,” yet he is an astute and vigorous synthesizer of many sources including the media and academic publications. *Heretics* is at it most incisive when it juxtaposes replies from opposite camps, revealing just how similar they actually are despite content divergences. A telling example is from his chapter on homeopathy. First an advocate (p. 121):

- S: What would your response be to a Skeptic who says it's [the active substance in a homeopathic preparation] diluted to such an extent that there is actually nothing to it?
G: I'd say go and look it up.
S: Look it up?
G: Yeah.

S: Have you ever read any scientific studies that have looked at the efficacy of homeopathy?

G: Yes.

S: Which ones?

G: Don't ask me that question.

And now an attendee at a Skeptic conference in which homeopathy is ridiculed (p. 123):

S: Have you read any scientific studies into homeopathy?

D: Not personally. . . . Lots of people, if they take homeopathy and think it's real medicine, they might avoid going to an actual doctor.

S: Do you know anyone that that's happened to?

D: Not personally.

Finally, one of the organizers of the conference (pp. 130–131):

M: There is no evidence for homeopathy. The science has been done. It simply doesn't work.

S: Have you read any of the studies?

M: Yes.

S: And understood them?

M: Yes.

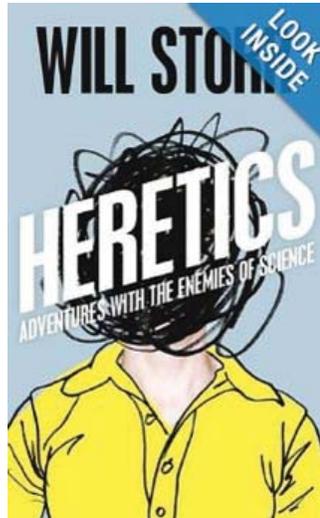
S: Which ones?

M: I can't quote their names.

That dogmatic leaders and followers, independently of their specific beliefs, share a similar antiscientific stance is something I discussed in a paper (Cardeña 2011) in which I contrasted true skeptics, that is those who are skeptical even of their own preconceptions, with “skeptics.” Using the word as an acronym, I posited that the latter provide **S**implistic explanations that disregard the complexity of reality; are **K**nowledge-averse (unless the new information confirms their beliefs); **E**nsure that other perspectives cannot be considered (witness the call by some scientists to forbid the scientific study of parapsychological phenomena!); are **P**ejorative toward those they disagree with; seek to **T**errify others with the claim that even considering alternative perspectives will bring about the end of rationality and science; are **I**nconsistent in the use of standards of proof, requiring standards from their foes that they do not follow themselves; and use **C**ircular and other forms of faulty reasoning, for instance demanding that to be taken seriously research for psi should be published in scientific journals while simultaneously chastising any journal that dares to publish research on such topics.

Heretics is full of examples of the processes I described, but also proposes an explanation as to why so many people, some of them with advanced degrees, are willing to commit fervently to dogmas, ignore any challenging evidence, and, not infrequently, abuse and try to banish those they disagree with. There are many elements to Storr's explanation: the degree to which irrational nonconscious processes determine our evaluations and judgment, how confirmation biases help us maintain a previously held belief instead of revising it when presented with contradictory information (in Piagetian terms, assimilation versus accommodation), how much humans seek to be members of an in-group that targets other groups, and what a minute amount of available information we can process at any one point in time. Storr bases many of his statements on the research of landmark psychologists (Solomon Asch, Jerome Bruner, Daniel Kahneman, Timothy Wilson, and Philip Zimbardo, among others). A paper he missed is Greenwald's (1980) review exposing how much we distort reality and alter our perceptions, evaluations, and memories, in order to maintain a narcissistic self-image, a process that Greenwald compares with that of a totalitarian state. This reference would have strengthened Storr's account of a personal narrative of the self as heroic and battling against the forces of obscurantism, evident in so many "defenders" of science who miss the point of how humbling and difficult the scientific method actually is, requiring of us the unnatural act of putting aside our most cherished (and too often emotional and not fully thought-out) beliefs and expectations and regarding all evidence and its potentially distressing implications.

Heretics covers many interesting topics including psi, homeopathy, extreme obedience to gurus, global warming, and unexplained medical illnesses. I found its discussions generally well-informed and balanced, with one exception. Chapter 10 includes interviews with a British therapist with an unfalsifiable belief in rampant satanic abuse. Dr. Sinason interprets patients saying that they "don't know" whether they were horribly abused as "What they really mean is, 'I can't bear to say'" (p. 214). Her account not only defies common sense (if the powerful, widespread horrible cabals she describes actually existed, they would have killed and eaten her a long time ago), but being so extreme perversely helps those who seek to deny



the horrible abuses that do happen and are described in our newspapers with dizzying frequency. To counterpose Dr. Sinason's stance, which could create or at least distort the memories of her patients, Storr relies on the opinions of two non-clinicians, Drs. French and Loftus, who go to the other extreme of questioning both the possibility of actual trauma being forgotten and remembered later and the diagnosis of dissociative identity disorder (erstwhile known as "multiple personality"), yet Storr does not challenge their perspective. The malleability of memory exemplified by possibly "implanted memories" is actually consistent with that expressed in forgotten but later "recovered memories." There is ample experimental and clinical evidence that psychologically based (i.e. psychogenic) amnesia exists and can be reversed in therapy or spontaneously (Pezdek & Banks 1996, Schacter 1997). The British Psychological Society concluded that therapy-induced beliefs do occur but that "the ground for debate has also shifted from the question of the possibility of recovery of memory from total amnesia to the question of the prevalence of recovery of memory from total amnesia" (Working Party of The British Psychological Society 1996, for instance in Pezdek & Banks 1996:373). Furthermore, there is clinical, cross-cultural, cognitive, and neurological evidence for the validity of dissociative identity disorder (Cardeña & Gleaves 2007).

In a minor vein, Storr falls prey at times to the current neuro-babble of writing about people as if they were just brains (see Tallis 2011) and explaining cognitive and emotional biases exclusively in cognitive and neurological terms. The historian of ideas Isaiah Berlin also characterized (1988/1997) those who have

arrived at clear and unshakeable convictions about what to do and what to be that brooks no possible doubt. . . . [T]hose who rest on such comfortable beds of dogma are victims of forms of self-induced myopia, blinkers that may make for contentment, but not for understanding of what it is to be human. (Berlin 1997:11)

Storr's depiction of some rather unpleasant "heretics," however, shows that they are less content than Berlin thought.

Heretics is also a tale of personal examination in which Storr reveals how much his explanations of irrationality and dogma can refer to many passages in his life and should make readers ponder whether they are taking the very easy step of assuming that it is only "others" who express these deeply irrational and at times destructive mechanisms but not oneself. This book shows how unusual beliefs and experiences (e.g., hallucinations and delusions) are not necessarily an indication of pathology and, in some cases,

are but amplifications of processes present in all of us (Cardeña, Lynn, & Krippner 2013). In often uncomfortable ways, Storr updates the Roman Terence's dictum that nothing human is alien to us.

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BOOK REVIEW

Science and Psychic Phenomena: The Fall of the House of Skeptics

by Chris Carter. Inner Traditions, 2012. 303 pp. \$18.95. ISBN 978-1594774515.

Only fools and charlatans know and understand everything.

—June 9 letter from Anton Chekhov to Scheglov

During a recent stroll through the Campo dè Fiori in Rome, few things could have been farther from my thoughts than writing this review. In the middle of the square, somewhere hidden between rows of fruit stands and tourists, however, stood Ferrari’s monument to Giordano Bruno, the Dominican philosopher, mathematician, astronomer, astrologer, hermeticist, and mnemonist. Bruno was burned alive after the inquisitors inserted in his mouth an iron gag that pierced his tongue and palate. It goes beyond irony to read that in the year 2000 the second-ranking Catholic, Cardinal Sodano, remarked that the inquisitors who tried Bruno “had the desire to serve freedom and promote the common good and did everything possible to save his life” (Seife 2000).

Despite the continuing deadly religious fanaticism of some, humans can breathe a sigh of relief that organized religion is no longer the sole authority on reality and that in many if not most countries it cannot place literal or symbolic gags on those who want to express their opinion. The received wisdom is that science should have swept away the totalitarian, dogmatic, and censorious impulses of the past . . . or has it? Consider the following recent examples out of a much longer list:

1) Physicists Valentini and Towler initially disinvite the physicists Brian Josephson (Nobel prize-winner) and David Peat to a conference on the work of David Bohm because of their interest in parapsychology and synchronicity (Reisz 2010), even though Bohm himself discussed parapsychology favorably (e.g., Bohm 1986).

2) A peer-reviewed paper by an eminent psychologist that described various experiments providing evidence for precognition is published in one of the most important and demanding psychology journals (Bem 2011). A number of scientists, not known to have any experience or expertise on its

subject, are certain that Bem's results must be faulty. Do they then engage the scientific process and carry out studies or additional analyses showing the mistakes in Bem's study? No, they fulminate in *The Opinion Pages* of *The New York Times* that the article should not have been published, but since it had been, it should be ignored (Douglas Hofstadter), or that its mere publication is "an assault on rationality" (David Helfand, who also engaged in some precognition of his own by predicting that replications of this study will fail) (www.nytimes.com/roomfordebate/2011/01/06/the-esp-study-when-science-goes-psyched); (see also Cardeña 2011). In a published critique of the paper, Wagenmakers et al. (2011) confidently stated that Bem's results "conflict(s) with what we know is true about the world," drawing a parallel to the judgment of the religious authorities who were certain that the Copernican model that Bruno endorsed was wrong because it conflicted with what they knew to be true about the world.

3) On a more modest level, after my university's magazine wrote a story on a controlled experiment in which we found support for telepathy, more than 10 other professors at Lund University, none of whom as far as I can tell has any training on parapsychology or even in psychology, fulminated against the magazine for daring to report on our research. Although they did not raise the possibility of burning me alive, in a not-too-veiled threat they mentioned how someone else at Lund had been forced to resign. Later, the Chalmers Institute in Gothenburg had an event in which they discussed my and other research under the question of whether it is an innocent game or a dangerous parasite. This threatening and venomous rhetoric is not that uncommon among "skeptics," who forget to question their own assumptions (see also Cardeña 2011, Storr 2013). They also typically disregard the scientific method and do not carry out empirical analyses or studies to evaluate whether their pronouncements hold any water.

Which brings me to *Science and Psychic Phenomena: The Fall of the House of Skeptics* (SPP), a strong critique of the critics of parapsychology. Although there is no information about it on the cover, this book was originally published in 2007 as *Parapsychology and the Skeptics: A Scientific Argument for the Existence of ESP*. This version, except for minor changes, has not been updated. The change of the title, with a reference to Poe's tale *The Fall of the House of Usher*, is not explained. As much as I disagree with some of the critics mentioned in the book, to equate their perspective to a Gothic nightmare with morbid siblings perishing in the midst of their crumbling manor is wildly overdriven.

After describing some of the many idiocies that eminent scientists have

declared in the past, showing that prejudice has trumped actual enquiry, Carter focuses on critics of parapsychology, comparing their statements with the evidence from the scientific study of psi phenomena. The book is at its best in the chapters that follow historically the arguments and counterarguments of psi researchers and critics, and discuss how critics have at times misrepresented parapsychology research. For instance, the section on the ganzfeld debate describes the joint collaboration of psi researcher Charles Honorton and psi critic Ray Hyman in a paper discussing how methodological weaknesses of a research model using homogeneous sensory stimulation (ganzfeld) could be addressed in later research. After improvements were put in place, studies have continued to find evidence for psi (Storm, Tressoldi, & Di Risio 2010a), yet Hyman and others have provided tendentious critiques or failed to discuss the accumulated evidence (e.g., Storm, Tressoldi, & Di Risio, 2010b). Carter also shows that critics have at times misrepresented their own research when it favored the psi hypothesis (see also Carter 2010, strangely not mentioned in the book).

Carter's discussion of philosophy of science as it applies to parapsychological research, relying mostly on the work of Karl Popper who viewed science as conjectural rather than definitive, provides an antidote to the dogmatic, authoritarian stance of so many scientists, but his treatment of other topics is not as sure-footed. For instance, it is rather odd to define dendrites as "electric tentacles" or neurotransmitters as "drugs" (p. 229), and he uses a very broad brush trying to cover many complex topics including psychology, physics, history of ideas, philosophy of science and, of course, parapsychology. It is not completely fair, for instance, to regard Newton only within the context of determinism and ignore his mystical perspective (cf. Bakan 1973). I would also have appreciated a greater balance overall in the tome. Whereas Carter shines a devastating light on the weaknesses of the critics' arguments, he is mostly mute on the weaknesses of parapsychological research (e.g., little programmatic or integrative research, few attempts to integrate psi with "mainstream" phenomena, see Cardeña 2010) and on the puzzling nature of the data obtained. For instance, one of the most contentious issues in psi research is the commonly observed decline effect within and across psi experiments, in which initial supportive results may decrease or even disappear in later research, although it seems that this effect does not rear its mocking head only in psi research (Schooler 2011). The biggest weakness of *SPP*, however, is that much of the information is dated. For instance, there are frequent references to Helmut Schmidt as continuing to work on micro-psychokines, although he died in 2011 and had not worked in the field for a number of years before his death. And various important meta-analyses and studies published in recent years are not covered. Thus, the volume is more

an account of this area from the early 2000s than an up-to-date analysis. It also fails to provide references for what seem to be factual statements or even quotations, for instance from the *Report of the Experiments on Animal Magnetism* (Colquhoun 1833:2).

Science and Psychic Phenomena is one of a number of recent books that have scrutinized the strange situation of some critics who have made a career of debunking parapsychology while very rarely conducting research to assess their alternative explanations. It also names scientists who pontificate about areas they have not studied or evaluated systematically, failing to do “the necessary homework,” to cite Carl Sagan (1976:2). *Randi's Prize* (McLuhan 2010) covers a greater although less-focused scope than *SPP*, and *The Heretics* (Storr 2013) discusses debunkers within a larger context that attempts to understand why people engage in irrational beliefs. Despite its limitations, *SPP* brings attention to unfair and often unscientific practices by some critics of parapsychology and evidence that the same impulse that had the inquisitors gag Giordano Bruno is very much alive in our day, even though the iron spikes have been retired.

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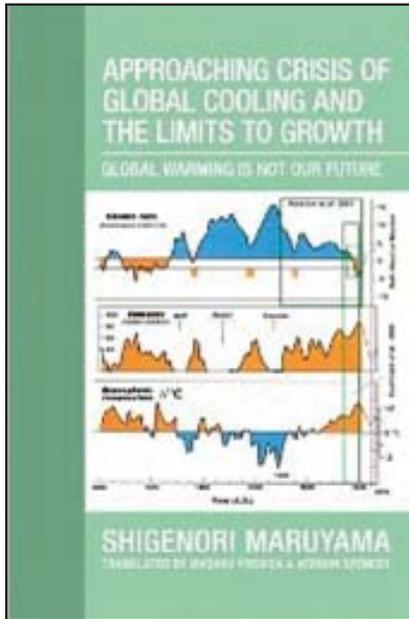
BOOK REVIEW

Approaching Crisis of Global Cooling and the Limits to Growth—Global Warming Is Not Our Future by Shigenori Maruyama. Xlibris, 2012. 156 pp. \$19.99 (paperback). ISBN 978-1477128589.

I have to confess that, when I received the invitation to review the new book published by Shigenori Maruyama, my first impulse was to quickly search the Internet for more information about him. Why? Because Shigenori Maruyama is not a largely known name in either field of proponents or skeptics of anthropogenically driven global warming. In addition, the author is from Japan (the country where the Kyoto Protocol originated), and I am not familiar with Japanese scientists actively involved in climate change debates. These were my reasons for reviewing the book *Approaching Crisis of Global Cooling and the Limits to Growth—Global Warming Is Not Our Future*.

Shigenori Maruyama is a professor at the Tokyo Institute of Technology and a reputable geologist with important contributions describing the role of superplumes in driving the Earth's mantle geodynamics. His interests in climate change studies have the air of a pioneering work, testing the waters and trying to make a point. This situation has its advantages and pitfalls at the same time. Being a novice in the field of climatology, someone may enjoy the status of a candid person, without an agenda. His views are like fresh air in a suffocating arena. At the same time, the lack of credentials in the same field (just one publication in 2008) may jeopardize the credibility of his views which have not been peer-reviewed and accepted in the specialty literature.

After a **Prologue** that sets the coordinates of the entire book, Professor Maruyama exposes **The Crazy Concert of Global Warming** (Chapter 1) that started, according to him, with “the sensational *Inconvenient Truth*” (it is more correct to say “*An Inconvenient Truth*”). Next, we are presented with, among other things, the “*Origin of the Theory of Criminality of Carbon Dioxide*” which is going to be demolished in Chapter 2, **Collapse of the Theory That Carbon Dioxide Is the Criminal**. The refutation is invoking well-known arguments, such as sun spots, cosmic rays, geomagnetism, volcanic activity, or Milankovitch cycles (the author or translators write “Milankovitch cycle,” which is incorrect, because there are



three Milankovitch cycles, not only one). This chapter contains the direst prediction in the entire book: “It is considered that the atmospheric temperature will meet the lowest value for the last one hundred years in 2035 when the solar activity will come to the bottom of the valley” (p. 50), after which “the food production will surely decrease.” This means that we have only 22 years left to deal with the cooling climate apocalypse!

The omen of upcoming global climate cooling is detailed in Chapter 3, **A Cold Period Surely Comes Shortly**, in which the author argues that “variations in solar activity, cosmic rays, geomagnetism, and atmospheric temperature for the

past some hundred years point to the cooling of the earth within some tens of years” (maybe 22 years). This kind of prediction is *locus classicus* in climatology textbooks and the author does not add anything new. What would have been interesting here is the possible offset of this cooling event by increasing anthropogenic carbon dioxide concentration in the atmosphere. As a matter of fact, this is the gist of the current climate change debate: Can *enhanced* global warming (that produced by human activities in addition to *natural* global warming) offset/stop/reverse the cooling trend of the climate as inferred from trends of atmospheric temperature change for the last 400,000 years?

An interesting point the author makes here is that the history of Japan records seven famine episodes in the last 400 years and all of them coincide with climate cooling episodes (Figure 24, p. 67). This demonstration leads the author to develop a gloomy future for humankind where “the true terror is a coming cold period” (p. 64).

Starting with Chapter 4, **What is the True Crisis?**, we are introduced to some of Professor Maruyama’s own research (the theory of plume tectonics), and then we are presented seven countermeasures for the heat island effect, which can artificially increase temperature readings (for example, “Tokyo has had an average 3 °C rise of atmospheric temperature over the last one hundred years, although the world average is only 0.7 °C,” (p. 84).

Water and air contaminations are discussed next, and the author claims that measures to combat these two contaminations are “more urgent” than taking “measures against global cooling.” This chapter also introduces the second theme of the book title, “*The Limits to Growth: Explosion of Population and Exhaustion of Resources*.” I cannot agree more with Professor Maruyama’s statement because I teach a course “Oil, Water, Population, and Climate: A Synergy” that discusses in great detail the inextricable (synergetic) links among population explosion, climate changes, and depletion of energy and water resources.

The Wisdom and Future of Human Beings (Chapter 5) is the capstone of this book. It integrates local situations (“*Japan Shrinks without a Strategy*”) with more global issues: “*Danger of Famine and War*” (a direct consequence of global cooling), or “*Necessary Effort for Saving Oil and Developing New Energy*” (here, in addition to the more effective use of oil and the introduction of burning biomass, the author makes a bold bid for the use of nuclear fusion energy. As we know it now, nobody has been able to produce that kind of energy, and we only hope that future generations will create the technology to harness the power of nuclear fusion). The last pages of this chapter recapitulate two previously discussed topics: “*A Large Human Population as the Biggest Environmental Problem*” and “*A Program for Decreasing the Population Should Start Urgently*.”

The book’s **Epilogue** takes the reader back to the previous description of the major factors that control atmospheric temperature, already mentioned in detail in Chapter 1 and occasionally in other chapters.

Overall, this rather slim book (156 pages) illustrates, using mostly common examples from the literature, the theory of impinging global cooling as opposite to the current view of inevitable global warming supported by other scientists. Without his own published research in climatology, the author relies heavily on published papers dealing with climate changes and offers his own interpretation of these papers, mostly along the lines of so-called climate skeptics. The fact that many of his important allegations/statements are not supported by citations of representative papers makes this book a popularization work rather than a pure scientific endeavor (in other words, the reader should accept the author’s claims without having the opportunity to check the facts by searching the corresponding literature). The book was printed by a vanity publisher (Xlibris) that does not ask for peer reviews and this situation clouds the scientific authority of the text. I believe that if peer-reviewers were employed, some mistakes (I already mentioned two above) would have been corrected. The text discusses “*The Paradox of the Darkened Sun*” (p. 48), when the common name in English is “*The Faint Young Sun Paradox*.” On p. 63 we read about “a

cold period globally and thus has been called the *Small Glacial Age*.” The translators should have known that the consecrated term here is “the *Little Ice Age*.” It is also unusual to read that the “*digital goal* of minus 6% was imposed on Japan” (p. 26). What is a “*digital goal*”? Is there something like “*an analogue goal*” to contrast it with? On p. 45 the author writes: “*The Earth has a diameter of 6,400 km.*” That is the earth’s *radius* (half of the diameter, which is about 12,756 km at the equator). Next, on p. 68, we read: “weakening of the *Mexico Current*, resulting in cold climate in Europe.” I am sure the author/translators meant the *Gulfstream Current*.

I also found some ungrammatical English translations (although one of the translators is a native speaker of English): It is about the anthropomorphization of some things that in English are without gender. For example, the surface environment, the United States of America, and the Earth are referred to as “she.” They may be feminine nouns in Japanese, but in English you have to use poetic license to address those things as “she.”

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ESSAY REVIEW

William Jackson Crawford on the Goligher Circle

The Reality of Psychic Phenomena: Raps, Levitations, Etc.

by W. J. Crawford. New York: E. P. Dutton, 1918. 246 pp. (hardcover). \$24.99 (paperback by Ulan Press, 268 pp., ASIN B0087KDU4I).

Hints and Observations for Those Investigating the Phenomena of Spiritualism

by W. J. Crawford. New York: E. P. Dutton, 1918. 110 pp. (hardcover). \$19.75 (paperback by Nabu Press, 126 pp., ISBN 978-1171753643).

Experiments in Psychical Science: Levitation, Contact, and the Direct Voice

by W. J. Crawford. New York: E. P. Dutton, 1919. 201 pp. (hardcover). \$23.99 (paperback by Ulan Press, 214 pp., ASIN B00B3DED4C).

The Psychic Structures at the Goligher Circle by W. J. Crawford. New York: E. P. Dutton, 1921. 176 pp. (hardcover). \$8.58 (paperback by Forgotten Books, 216 pp., ASIN B0087KDU4I).

*The page references cited are preceded by the abbreviated book title:
Reality, Hints, Experiments, or Structures.*

In 1914, Dr. William J. Crawford, a lecturer in mechanical engineering at Queen's University of Belfast, Ireland, began investigating the mediumship of 16-year-old Kathleen Goligher. The phenomena surrounding the young girl included communicating raps, automatic writing, trance voice, floating objects, and table levitations. In all, Crawford had 87 sittings over some two-and-a-half years with the Goligher Circle. His first, third, and fourth books, as listed above, deal solely with the Goligher phenomena, while the second-listed book is very general and includes observations with other mediums.

Born in New Zealand, Crawford (1881–1920) received his D.Sc. from the University of Glasgow and authored several books in his primary field, including *Elementary Graphic Statics* and *Calculations on the Entropy–Temperature Chart*, before undertaking his research of psychic phenomena.

In addition to Queen's University, he also taught at The Municipal Technical Institute of Belfast.

The Goligher Circle consisted of seven members of the Goligher family—Kathleen, four sisters, their father, and the husband of one sister. Crawford noted that there was a psychic tradition in the family and all of Kathleen's sisters had mediumistic ability to some degree, but Kathleen was clearly the most powerful medium of the group. The séances were usually held in the attic of the family home, although Crawford occasionally held them at his own home and at the homes of friends.

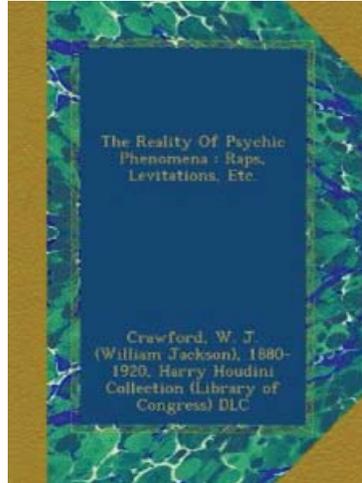
The books are lacking in other historical detail relative to the Goligher family, but indications are that the family members discovered their mediumistic abilities by experimenting with table tilting just shortly before Crawford began sitting with them in 1914. He says that they were Spiritualists, but it is unclear as to whether they were Spiritualists before the phenomena began. He calls Kathleen an upright and honorable young woman and states that she received no monetary recompense for her involvement in the circle. "Her mediumship is absolutely beyond dispute, as many people, some of them well known, are able with certainty to say," Crawford offers.

However, she knows it is my duty to set at rest the minds of those who are afraid of unconscious mediumistic action and the like; of those who, not having been able to attend her séances and see for themselves what actually happens, wish to know what precautions have been taken, and what independent witnesses have to say. (*Reality*:21)

Nor does Crawford give much detail about his other experiences with psychic phenomena. In his *Hints* book, he mentions sitting with other mediums, but provides no names or dates. In that book, he refers to the "Belfast circle," but it is not clear that he is referring to the Goligher Circle. Crawford recalls his introduction to mediumistic phenomena:

A number of us had been sitting round a small table in the usual way and had obtained the usual tiltings and usual mixed-up messages, when suddenly the table twisted round under our hands and did not stop until it had turned through nearly a complete revolution. It did this two or three times. The movement, which was so obviously not produced by any of us present and which we did not expect—this simple little turning movement—caused the first glimmer of doubt in my mind that all table tiltings, etc., were due to subconscious actions of the sitters, as I had strongly held up to that time. From that moment—now years ago—I decided to investigate the matter thoroughly. (*Hints*:61)

The *modus operandi* of a Goligher sitting, Crawford explains, involved the members sitting in a circle about five feet in diameter with a table placed in the center. The ordinary light would be turned off and a red light turned on. This light was ample enough to see all activity and movement in the room. The sitters would then join hands in chain order as one member of the circle would open with a prayer, after which a hymn would be sung to establish the proper harmony. “In a few minutes, sounds—tap, tap, tap—are heard on the floor close to the medium,” he writes.



These are the first “spirit” raps of the evening. They soon become louder and stronger and occur right out in the circle space, on the table, and on the chairs of the sitters. Their magnitude varies in intensity from the slightest audible ticks to blows which might well be produced by a sledge-hammer, the latter really being awe-inspiring and easily heard two stories below and even outside the house. The loud blows perceptibly shake the floor and chairs. (*Experiments:3*)

The raps would sometimes keep time with the hymns sung by members of the circle and at other times they would tap out complicated rhythms on top of the table or on the floor. “Besides the ordinary raps the operators can produce various modifications and peculiar variations,” Crawford continues.

For instance, they can imitate a bouncing ball so perfectly that one would be prepared to affirm a ball was really in the room. They can imitate to perfection the sawing of the table leg, the striking of a match, the walking of a man, and the trotting of a horse. They give double and treble knocks, i.e. two or three fast ones and one slow one. In fact, almost every variety and combination of rap it is possible to imagine is heard. (*Experiments:4*)

As the “operators” (Crawford’s name for the “entities”) effecting the phenomena explained to him, a semi-flexible “psychic rod” (or arm) issues from the body of the medium and is moved up or down to strike the floor or the table, thereby causing the raps, much like one might use a stick to beat a carpet. He opines:

I have no doubt whatever that the operators, i.e. the entities producing the phenomena, whether the reader looks upon such entities as spirits, our subconscious selves, or extra-terrestrial intelligences—have to do a good deal of experimenting in order to obtain satisfactory results. I have many times watched them experimenting in order to bring about some particular phenomenon they desired; they would keep trying even after repeated failures, and would not give in until they realized that what they wished was impossible of accomplishment. (*Hints:97*)

He further surmises that it requires the cooperation of many unseen entities to produce physical phenomena and that the medium and sitters are only the instruments through whom the work is done.

After 15 minutes or so, the rappings would stop and another type of phenomenon would begin. One such phenomenon involved levitation of the table. It would begin with small movements and lurches. “The little table is standing on the floor within the circle formed by the sitters and is not in contact with any of them or with any portion of their clothing,” Crawford relates.

Suddenly the table gives a lurch or moves slightly along the floor. After a while it may give another lurch or it may rise into the air on two legs. These movements—which are executed, as I have said, without physical contact with the medium or the members of the circle—are the preliminary motions which usually take place just previous to the first levitation, i.e. before the table rises completely into the air of itself where it remains suspended for several minutes without visible support. (*Experiments:4–5*)

Crawford brought in a scale large enough to hold the medium while she was sitting in her chair. He discovered that when a table was being levitated, the weight of the table, usually around 16 pounds, was transferred to the medium through the psychic (ectoplasmic) rods extending from the medium. Most of the time, the transfer of weight would be a few ounces short of the weight of the table. Further experimentation revealed that the extra weight was being transferred to the sitters in the room, who apparently furnished small amounts of what Crawford calls “psychic force.”

Crawford says that he witnessed hundreds of levitations under all conditions, but apparently the medium herself was never levitated as reported by Sir William Crookes with D. D. Home. In one sitting Crawford observed a stool rise four feet into the air and move gently up and down for several minutes while he examined it closely and while the medium was seated on a weighing machine. He also witnessed a table turn around completely in the air, turn upside down, and settle to the floor in an upside-down position.

Crawford states that he often worked under the levitated table and between the levitated table and the medium. The psychic energy seemed to peak an hour to an hour-and-a-half into the séance, at which time greater forces were exerted.

For instance, although a heavy man sits upon the table, it moves about the floor with great ease; or the table being levitated, a strong man pushing from the top cannot depress it to the floor; or the table moves to the side of the circle farthest from the medium and an experimenter is asked to lay hold of it and try to prevent its return to the center, but he is totally unable to do so; or the table's weight can be temporarily so much increased that it cannot be lifted, or on the other hand so much reduced that it can be raised by an upward force of an ounce or two; or the table being turned upside down on the floor cannot be raised by a strong upward pull on the legs, being apparently fastened to the floor. (*Hints:7-8*)

In his 1918 book, *On the Threshold of the Unseen*, Sir William Barrett, the British physicist who co-founded the Society for Psychical Research, tells of being invited by Crawford to a sitting with the Goligher Circle. Barrett wrote that they first heard knocks, and then messages were spelled out as one of the sitters recited the alphabet. He then reported observing a floating trumpet, which he tried unsuccessfully to catch, after which the table rose about 18 inches into the air and remained suspended. Barrett then put pressure on it and tried to force it down but failed. He then climbed on the table and sat on it, when the table began to sway and tipped him off. The table then turned upside down and settled back on the floor. When Barrett tried to right it, he could not budge it, but it later righted itself on its own accord. Barrett claimed to have heard an "amused intelligence" (Barrett 1918:47).

As for the difference between the contact phenomenon, where the sitters have their hands on the table, and the non-contact type, Crawford understood that the psychic force was coming through the fingertips of the sitters and was not a result of any muscular action on their part, while in the non-contact type, the medium supplies the psychic arm (ectoplasmic rods). "These invisible psychic arms probably grip the table by adhesion to its under surfaces or legs and thus bring about the movements which appear so mysterious," he writes (*Hints:73,74*).

When the levitations ceased, the trumpet phenomena would often begin. This involved a couple of thin metal cones which fit telescopically into each other and which were placed on the floor between the medium and her father. Crawford writes:

The trumpets now begin to straddle over the floor with little leaps and jerks, remaining in a vertical position until they reach the table in the center of the circle where they fall or are sometimes seemingly pushed over, and are then drawn under the table. A loud shuffling noise is now heard, for the operators are trying to detach the trumpets, a somewhat difficult process as they fit rather tightly together. At length, however, the operators succeed in separating the two pieces, which are soon seen floating in the air, with their ends projecting from under the table. The halves then beat time time to a tune, like the batons of a conductor, after which a visitor is allowed to grasp the end of either and thus “shake hands” with the invisible entities. Sometimes the operators press upwards on the under-surface of the table with one or both of the floating trumpets, thus levitating it. A little handbell is sometimes placed on the floor and this is often lifted and rung. . . . Sometimes raps accompany the ringing of the bell. The sitters are occasionally psychically “touched” on various parts of the body. (*Experiments:6–7*)

Although he never uses the words *teleplasm* or *ectoplasm*, it appears clear that what he calls *psychic force* is the same thing. In his fourth book, he begins calling it *plasma*. He refers to it as feeling clammy, cold, and almost of an oily sensation:

[Plasma is] in fact, an indescribable sensation, as though the air there were mixed with particles of dead and disagreeable matter. Perhaps the best word to describe the feeling is *reptilian*. I have felt the same substance often—and I think it is substance—in the vicinity of the medium, but there it has appeared to me to be moving outwards from her. Once felt, the experimenter always recognizes it again. (*Reality:145–146*)

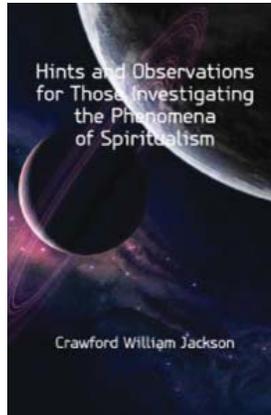
He goes on to say that

. . . in short I think there can be little doubt that it is actual matter temporarily taken from the medium’s body and put back at the end of the séance, and that it is the basic principle underlying the transmission of psychic force. The table soon dropped when I moved my hand to and fro in amongst this psychic stuff. (*Reality:146*)

During his experiments with Goligher, Crawford began communicating with the “operators,” one of whom said he was a medical man when on earth, and that his primary function now was to look after the health of the young medium. This “spirit” explained to Crawford that two types of substances were used in the production of the phenomena. One was taken in large quantities from both the medium and the sitters, then returned to them at the close of the séance. The other substance was taken exclusively from the medium in minute quantities and could not be returned to her as its structure was broken up. It was pointed out that it came from the interior of

the medium's nerve cells and if too much were taken she could suffer serious injury.

On one occasion, a clairvoyant joined in the circle and told Crawford that she could see "a whitish vapory substance, somewhat like smoke," forming under the surface of the table and increasing in density as it was levitated. She could see it flowing from the medium in sort of a rotary motion. From other sitters, she could see thin bands joining into the much larger amount coming from the medium. She also saw various spirit forms and spirit hands manipulating the "psychic stuff."



Unfortunately, Crawford is a much better technical writer than a reporter. He gives very detailed accounts of weighing experiments, with tables and graphs and photos of his instruments, but he rarely explains whether the "spirit communication" is coming to him by raps and taps, table tilting, automatic writing, trance voice, or direct voice. He says that Goligher was not in a trance during the séances, but still lists the trance voice among her phenomena. He does not list the direct voice, but the presence of trumpets suggests direct voice rather than trance voice as trance is usually not required during the direct voice.

While initially subscribing to the "secondary personality" theory, Crawford gradually changed his mind and concluded that they were in fact spirits of the dead. He explains his change of attitude:

[The subconscious] is the alternative I had in mind all through my investigations. As months succeeded month, as each new phase of phenomena was presented, as each new experiment was done, I always said to myself, "Can this very determined work of seemingly intelligent beings be but a simulation after all? Can it be all a fraud? Is it possible that nature holds intelligences belonging to ourselves or otherwise, which could so persistently deceive? Why should our subliminal consciousness (supposing we possess such a thing) carry out for us phenomenal demonstrations on the lines of reason and intelligence, requiring effort and system, for the object of deceiving us?" No! It seems most unlikely and repellant to our sense of the fitness of things. Nobody who has not delved deeply into psychic phenomena can have any conception of its tremendous variety and range. It includes telekinetic phenomena, apports, materialization, the direct voice, clairvoyance, clairaudience, trance, etc., etc. There are, in fact, dozens of phases of psychic action, all consistent in the inference to which they lead, namely, that man survives death, and inconsistent on any other hypothesis. (*Hints*:101-102)

Crawford further concludes that much of what was being looked at as fraud by other researchers and superficial observers was spasmodic kinds of movements by the medium. “These are simply the reactions due to the raps and are what we might expect,” he explains.

The seeker after fraud (who by the way is usually a person with no knowledge of science) immediately puts them down to imposture. My experiments, conducted over a long period of time and more thoroughly than any ever carried out hitherto, have proved to me beyond all question that the medium’s body is either directly or indirectly the focus of all the mechanical actions which result in phenomena. And not only is it the focus but it also seems to supply a kind of duplicate of portions of her body, which can be temporarily detached and projected into the space in front of her. Thus, things happen in the séance room which, from the nature of the case, sometimes bear a superficial appearance of fraud, though, in a properly conducted circle it is only superficial, and the true and genuine nature of the phenomena can always be discovered by a little investigation. (*Experiments*:141–142)

As for the critics’ claim that the phenomena amount to just so much tomfoolery, Crawford agrees that it seems that way, but he concludes that this attitude is a result of mistaken religious beliefs that we all become angels in the afterlife environment, when, in fact, we go over as we leave this world. In effect, most of the operators were not particularly advanced spirits and were simply experimenting on their side just as he was experimenting on this side.

The operators emphatically declare that the fact of death does not in the least degree alter a man’s character. He is exactly the same five minutes after the passing as five minutes before it. So that the next state of existence contains all kinds and conditions of humanity, just as the earth does. They say that malevolence, envy, hate, and all the lower attributes inherent in earth humanity exist also in their world. There are not the two classes only—good and bad—as theology would have us believe. They say that the good bears a higher ratio to the bad than is the case here; so that we have an advance, if it is only a small one, so far as moral qualities are concerned. (*Hints*:17)

Crawford asked the operators if there were many of them looking on during the séances. “Whenever asked the questions they would begin rapping and keep on rapping until we were tired of hearing them,” he writes.

They wished to indicate by this [rapping] that there were great crowds of spirit people looking on. They told me this was the case at all our séances. They gave me the impression that the séance room and the sitters were

surrounded by a huge invisible audience arranged in an orderly and disciplined manner, perhaps tier upon tier as in a lecture theater. The séance to many of them would appear to be as novel as it is to us. (*Hints*:18)

It was only during the last six months or so of his investigation that the operators allowed him to photograph the “plasma.” He was told initially that the medium would not be able to withstand the shock of the flashlight effect and that it was necessary for the operators to gradually prepare her for it. He writes:

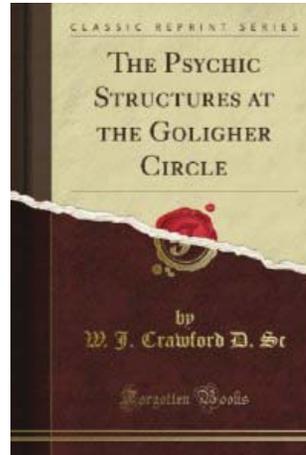
After innumerable attempts, very small patches of plasma were obtained in full view between the medium’s ankles. As time went on these increased in size and variety until great quantities of this psychic stuff could be exteriorized and photographed. Then the operators began to manipulate it in various ways, building it up into columns, or forming into single or double arms, molding it into different shapes with which I had been long familiar in a general way from previous investigation. (*Structures*:171–172)

Crawford died by suicide on July 30, 1920. Skeptics suggested that his suicide was the result of realizing he had been duped. However, four days prior to his death, Crawford wrote to David Gow, the editor of *Light*, the following:

My psychic work was all done before the [mental] collapse, and is the most perfect work I have done in my life. Everything connected with it is absolutely correct, and will bear every scrutiny. It was done when my brain was working perfectly, and it could not be responsible for what has occurred. . . . I wish to affirm my belief that the grave does not finish all. (*Structures*:v)

In 1922, Dr. E. E. Fournier d’Albe had 20 sittings with Kathleen Goligher and obtained limited results, leading him to report that Crawford must have been tricked. However, defenders of Crawford suggested that d’Albe did not bring the proper attitude or harmony to his investigation, thus discouraging phenomena, or Goligher had lost much of her power as mediums are known to do over time.

Although there is considerable overlap or redundancy among the four books, especially the first, third, and fourth, each book offers much food for thought. It may be difficult for many modern parapsychologists to reconcile



Crawford's qualitative research with their quantitative studies, but it is also difficult to dismiss Crawford as the victim of some charlatans over 87 sittings under ample lighting, especially when the likes of Sir William Barrett witnessed some very objective phenomena with the Goligher Circle.

It would be easy to pick holes in Crawford's scientific controls as he obviously saw no need to tie up the medium or completely avoid the Goligher attic. Moreover, one might be suspicious of a group made up of family members, but there does not appear to have been any incentive for the family to carry on a charade for such a long period of time with a man who apparently knew the family well outside of his research.

Crawford's observations of "ectoplasm" are consistent with those of Crookes, Richet, Geley, Schrenck-Notzing, Lodge, Hamilton, and Ducasse, and his photos of the substance speak for themselves, unless, as a last resort, one is to assume that he faked them. Crawford's weighing of the medium and the sitters during levitations are clearly detailed and to some extent replicate weighing experiments by Crookes with D. D. Home, although Crookes apparently never weighed Home during levitations.

Skeptics can also point to the reports that Crawford resisted efforts by other members (than Barrett) of the Society for Psychical Research to sit with the group. It is not documented why he resisted those efforts, but it had apparently become evident by that time that antagonistic researchers could easily defeat the phenomena by their negativity. "The presence of antagonistic and divergent intentions is a cause of disturbance and failure," Geley explained. "This reciprocal sympathy creates a harmonious atmosphere. Similarly, the constitution of the group should remain constant" (Geley 1927:11). It is apparently for this very reason that some leading physical mediums in the world today, e.g., David Thompson and Stewart Alexander, resist scientific scrutiny.

Crawford's research provides seemingly reasonable answers to many questions that have continued to exist since he reported on them nearly a hundred years ago. The lack of physical mediumship in the world today makes it difficult to replicate Crawford's work, but that only leads to the question of how many times a wheel has to be reinvented before it can be accepted.

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ESSAY REVIEW

Not Even Wrong about Science and Politics

The Republican War on Science by Chris Mooney. Basic Books, 2005. 342 pp. \$14.96 (paperback), \$9.66 (Kindle). ISBN 978-0465046751.

Science Left Behind: Feel-Good Fallacies and the Rise of the Anti-Scientific Left by Alex B. Berezow and Hank Campbell. Public Affairs, 2012. 303 pp. \$26.99 (hardcover), \$12.99 (Kindle). ISBN 978-1610391641.

“Not even wrong” is the oft-quoted designation by Wolfgang Pauli¹ of something that is not interesting in any way because it is simply beside any substantive point (whereas wrong statements can stimulate fruitful discussion). These books are not even wrong in Pauli’s sense. They purport to discuss the politically motivated distortion and abuse of science, respectively, by right-oriented and by left-oriented people and organizations, yet they fail to demonstrate any distortion or abuse of science because they ignore the science altogether. These are political rants which simply accept that any deviation from a mainstream consensus constitutes distortion of science or an attack on science or the purveying of pseudo-science or the practice of “denialism,” a term that is superseding “pseudo-science” as the preferred pejorative used by devoted disciples of scientism.

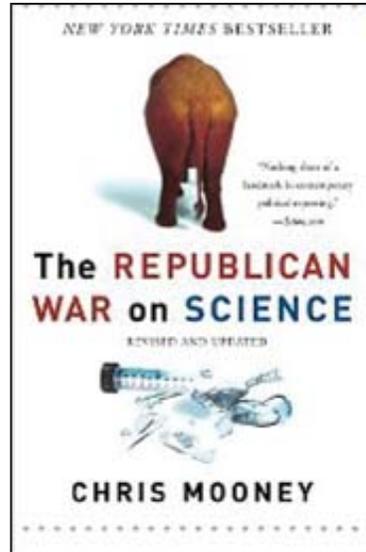
The 2005 book (*The Republican War on Science*) is included here not only because it has the same sort of basic, logical, and substantive flaws as *Science Left Behind* but also because the latter is an explicitly intended counter to it. *Science Left Behind* argues that “progressives” on the Political Left distort and abuse science at least as much as do conservatives or Republicans, who were accused in *The Republican War on Science* of distorting and abusing science to a far greater degree than “liberals” or Democrats. As I was highly critical of both books, readers should know that (as of this writing) Amazon reports a 4½-star positive response to *The Republican War on Science* (some years ago, the *Journal of Scientific Exploration* [19 (2005), 641–647] also published a favorable review of it) while *Science Left Behind* has received only a 3-star response. Take those for what they’re worth—in my view, primarily an insight into who the readers are who bother to post opinions on amazon.com. Substantively, both

books are equally “not even wrong,” but I agree with the amazon.com consensus to the extent that *The Republican War on Science* is distinctly better-written; *Science Left Behind* is notably sloppy and unfocused, and it is replete with cheap *ad hominem* remarks such as “unless we are filthy rich, like Al Gore, who can afford to plaster his house with inefficient solar panels” (*Science Left Behind*:19).

That politics and not science is the agenda is illustrated as Mooney admits that “in politicized fights over science, it is rare to find liberals entirely innocent of abuses. But they are almost never as guilty as the Right” (*War on Science*:9); and he amplifies the comparison by asserting that no one on the Right should criticize left-leaning distortions of science because of “the Right’s . . . systematic, and often far cruder, war on science” (*War on Science*:10). If the distortion of science were the issue, it would be irrelevant whether Right or Left is the more guilty; the point would be to criticize *all* distortions, topic by topic. Berezow and Campbell also reveal their political views early: “We love conservatives because of their adherence to tradition and to the principles that have made the United States the most successful country on earth” (*Science Left Behind*:4). Now *there’s* a feel-good sentiment if ever there was one. Whether it is fallacious of course depends on what “success” means here: happiness or contentment scores are higher in other countries, as are life-spans and health coverage and unemployment insurance and other social-safety-net programs. In what ways is the United States more successful than Norway or Switzerland, say?

Science Left Behind further reveals its political focus in its Introduction: “The conservative ‘sins’ against science (e.g., ethical concerns about human embryonic stem cell research, skepticism about climate science, and fringe religious opposition to evolution) are widely reported and well-known” so the book will focus on the sins of “progressives” (*Science Left Behind*:6). In other words, this book too is about who is worse, who is less bad than the other: “If conservatives have declared a war on science, then progressives have declared Armageddon” (*Science Left Behind*:10). All that is far from examining whether any given view is or is not a distortion of science.

But even on politics, Berezow and Campbell can be either out of their



depth or deliberately misleading: Obama is personally faulted for quite a number of things, for instance a statement that the science about a possible vaccination–autism link is unclear: “For someone with such enormous influence over public health policy to be ignorant of basic medical facts is frightening indeed” (*Science Left Behind*:27). This is absurd. The leaders of much smaller organizations than the United States Government have to rely on staff for guidance on all sorts of factual matters. No President can be expected to be familiar with the facts on all the matters over which he has “enormous influence.” In any case, it isn’t a basic medical fact that vaccines have no relation to autism; at best, one can say that attempts to find a link have been inconclusive, but it *is* a basic medical, scientific, statistical fact that the failure to find evidence for a link cannot exclude that some specific sector of the population—characterized by genetics, or age, or sex, or some combination of those and other variables—might actually experience such a link. Obama is also blamed for a shortage of vaccine during the swine flu pandemic—which wasn’t even an actual pandemic. Chapter 2 in *Science Left Behind* is simply an exercise in overt Obama-bashing, about the BP oil spill and nuclear waste disposal and the environment generally as well as vaccines.

One could legitimately say that nowadays and increasingly, political discussions and decisions have been influenced almost not at all by scientific evidence; further proof is hardly needed for this judgment than that Congress abolished the Office of Technology Assessment in 1995. Matters on which science is relevant are dealt with politically in the same way as are matters on which economics is relevant: Each partisan bloc cites its own experts whose views are politically congenial, no matter how contrary to good evidence or plain common sense. Rare indeed are those who attempt to form their views on the basis of the evidence on each topic, and they are frequently in a tiny minority within their own political bloc. Science is ignored more than distorted, and on different topics it is ignored by progressives, conservatives, and any other social sector or vested interest one cares to look at—not excluding scientists themselves.

Stereotyping

Common to both books is inveterate stereotyping and over-generalizing. Every mention of “conservative,” “progressive,” Republican, Democrat, or similar ilk badly needed the universally missing modifiers: “some,” “a few,” “not all,” and the like. *Science Left Behind* at least begins by acknowledging that sweeping generalities are unwarranted, that all of humanity cannot be neatly divided into liberals and conservatives, but then it proceeds to do little better by dividing humankind into just four categories, one of them the “progressives” who are the villains of this piece.

A fundamental error in such labeling is the confusion of correlation with causation. That there is a statistical correlation between expressed disbelief in “evolution” and right-wing political views does not certify a causative relationship, a *necessary* relationship, that right-wing politics somehow predisposes to disbelief in evolution. It is equally unjustified to regard as characteristic of politically left-inclined individuals a high concern for preserving environments as unchanged as possible. Yet both books make sweeping connections of this sort everywhere.

Berezow and Campbell illustrate who their “progressive” villains are with multiple generalizations:

the kind of people who think that overpriced granola from Whole Foods is healthier and tastier. . . . who buy “Terra Pass” bumper stickers to offset their cars’ carbon emissions. . . . [W]hose beliefs allow them to feel morally superior to everybody else who disagrees. (*Science Left Behind*:9)

Moreover, since “progressives . . . as we know them today . . . [are] unscientific, while claiming the mantle of modernity, [they are] denizens of a world where science is replaced by feel-good fallacies” (*Science Left Behind*:16). Apparently there are four root sources of wrong-headed progressive ideas: “Everything natural is good. . . . Everything *unnatural* is bad. . . . Unchecked science and progress will destroy us. . . . Science is only relative anyway.” Thus, “homeopathy and herbs are as good as actual medicine” (*Science Left Behind*:17).

The intellectually vacuous, sloppy tone of *Science Left Behind* is illustrated here by the logical fallacy that “Everything *unnatural* is bad” is said to follow easily from “Everything natural is good.” It doesn’t. For progressives, “science is ‘just another opinion,’” they “don’t entirely buy that science has a unique claim on secular truth . . . or that there are even any natural laws” (*Science Left Behind*:19). Progressives are said to oppose nuclear power and genetically modified food because they believe “technology is inherently dangerous” (*Science Left Behind*:18).

After those descriptions of their enemy, of course, Berezow and Campbell can rest their case without any need to look into the actual science that is supposed to be distorted and abused.

Scientific Illiteracy

As to science, the fundamental error of both books is the presumption that any mainstream consensus represents “science” and is to be taken as correct. Though not an uncommon mistake, this is nevertheless rank scientific illiteracy (Bauer 2012a, 2012b): The most rudimentary acquaintance with

the history of science and the nature of science teaches that the progress of science has come through perpetual superseding of successive mainstream consensuses, modifying them and sometimes overturning them entirely. Therefore, one cannot automatically take dissent from a mainstream consensus as constituting a distortion of science, it might equally be the harbinger of tomorrow's mainstream consensus. On any given topic one must consider what the actual evidence is and how strongly or weakly it supports the contemporary consensus.

According to Mooney, "House Republicans *even* charged that scientists had grown cozy with government regulators, addicted to federal funding, and highly prone to suppress or ignore dissenting views" (*War on Science*:55, emphasis added). Well, the Republicans happen to have been right about that, that is how scientists on the whole behave nowadays (Bauer 2012c, Greenberg 2001, 2007). The Republicans were again right, and Mooney wrong, in preferring "adversarial 'science courts'" to "major peer-reviewed scientific consensus documents" (*War on Science*:55)—no matter that Mooney cites historian of science Naomi Oreskes to the effect that "Scientific knowledge *is* the intellectual and social consensus of affiliated experts"; evidently not all historians of science are scientifically literate. The incoherence of Mooney's views are illustrated when a few paragraphs later he points out that "science isn't a democracy"—in other words, "consensus" *doesn't* equal science? No, instead of "democracy" science uses "quality control—peer review"! As *Lancet* editor Richard Horton has pointed out, "Peer review . . . is simply a way to collect opinions from experts in the field. Peer review tells us about the acceptability, not the credibility, of a new finding" (Horton 2003).

Scientific illiteracy is illustrated also by the assertion that science can provide "rock-solid facts" (*War on Science*:14). To the contrary: "Facts" are influenced by the methods through which they were accessed and by the theories underlying those methods, which is elementary knowledge to STS (Science & Technology Scholars),² taught in Philosophy of Science 101 and Science Studies 101. Logically incoherent as well as scientifically illiterate is the claim, parroted by Mooney, that science is so reliable because it is self-correcting: If correction is needed, then obviously what went before was *not* reliable, it was in need of correction; at any given instant, how can anyone know which bits of "reliably self-corrected" science are going to be further self-corrected later, perhaps even in the next instant?

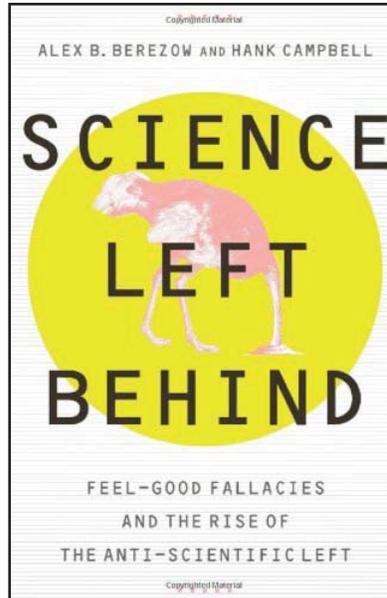
Berezow and Campbell are equally scientifically illiterate, in awe of science because it "rigorously tests hypotheses and theories using well-controlled experiments. . . . Science lets the data speak for itself" (*Science Left Behind*:5). Science Studies 101: Data do not speak for themselves,

they are theory-bound and method-bound; and “the scientific method” of hypothesis testing is a popular myth, not a reality (Bauer 1992).

Mooney acknowledges that philosophy of science has not found “a firm line of demarcation between science and pseudoscience” yet insists that “we can safely use the term ‘pseudoscience’ as long as we simply define it as bad science taken to an extreme” (*War on Science*:21). But the reason for the failure to find demarcation criteria is the failure to find sound ways of defining what bad science is. Here ignorance and arrogance are both on display by Mooney.

Neither book discusses the actual scientific evidence on the topics they use as exemplars. The excuse given is the standard one: The writers do not have the expertise to understand the technical details and must accept what the experts say. Leave aside that writers who so lack understanding of their subjects have no business writing about them. An obvious clue to the validity of a claimed mainstream consensus is the existence of competent experts who dissent from that consensus. It takes absolutely no technical expertise to find out whether such people exist. Any competent interviewer should be able to go back and forth between representatives of opposing viewpoints and note who is responding and who is evading, who resorts to *ad hominem* instead of giving substantive answers, and so on. Journalists and science writers should be just as capable of evaluating truthfulness and reliability as lawyers and judges learn to be, or for that matter journalists when they interview politicians or celebrity entertainers or sports figures.

At any rate, these books do not even attempt to guide the reader toward substantive understanding of the science and its interpretations. They simply equate “science” with mainstream consensus and then cherry-pick topics to make their opposing cases, finding without any trouble instances where politically right-leaning and left-leaning people, respectively, question or deny a mainstream consensus. Thereby these books also talk past one another. Since *Science Left Behind* was written later than *The Republican War on Science*, surely it ought to have tried to convince readers that the



latter work was wrong in labeling something an attack on science, say, about human-caused global warming; instead, both books swallow the mainstream claim unquestioningly, even though the evidence for it is dubious at best (Bauer 2012c, Bauer 2012d).

Rhetorical Ploys

Mis-Direction

These books, then, are purely about politics and not about science. But this is made less obvious as both books often make a pretense of having a good grasp of the nature of science. A common ploy goes something like this: “Admittedly, science is never 100% certain,” followed by “But a well-established soundly based conclusion that something is highly likely,” which is clearly intended to inveigle readers into accepting that in this case it actually *is* 100% for all practical purposes. In a similar vein, Mooney (*War on Science*:15) illustrates how reliable scientific conclusions are by citing the roundness of the Earth and that it orbits the Sun. This is classic rhetorical misdirection, that because science is reliable on absolutely non-controversial matters therefore it should be accepted on all other matters including the controversial ones where qualified experts disagree with the mainstream.

Somewhat similar is the admission that a few radical outliers to one’s own camp push scientifically unwarranted arguments, laying the ground for the claim that the *real* non-Right or non-Left is on the side of science. But since neither book is properly grounded in any of the pertinent science, this gambit may backfire. Thus Mooney admits that “more radical groups have occasionally allowed ideology to usurp fact” (*War on Science*:7), e.g., in objecting to genetically modified (GM) foods; and the Institute of Medicine is cited: “to date, no adverse health effects attributed to genetic engineering have been documented in the human population” (*War on Science*:8). That last, though, is typical bureaucratic weasel-wording that should arouse suspicion. “To date” has not been very long; “documented” raises suspicions that there have nevertheless been some reports; and the need to stress “human” might imply that adverse effects have been observed in non-human animals. Google finds many reports of GM foods linked to allergic reactions in humans.

Counter-Examples

Neither book bothers to mention counter-examples to its sweeping generalizations:

1. Mooney attributes Republican anti-science “at its most basic level” (*War on Science*:5) to conservatism “that generally resists change” whereas science is a “constant onslaught on old orthodoxies.” The last phrase betrays Mooney’s ignorance about the routine resistance by mainstream science to genuine novelties (Barber 1961, Hook 2002, Stent 1972).
2. Mooney’s basic assertion ignores the Right’s love of commercially profitable scientific advances such as genetically modified crops and foods, marketing of new drugs by pharmaceutical companies, or oil-and-gas recovery by increasingly complex technology.
3. Mooney neglects to mention that for many years, almost the whole scientific community deplored the attacks by progressive Democratic Senator William Proxmire on the funding of basic scientific research for which he personally saw no immediate practical applications.
4. “The Right’s oft-expressed disdain for ‘liberal’ higher education” (*War on Science*:6) is the diametric opposite of the true circumstances. The National Association of Scholars and its colleague-in-arms, the Association of College Trustees and Alumni, were founded by certifiably conservative people who have long waged battles against the dumbing down of higher education and in particular the demise of core curricula and liberal education.
5. Mooney contends that “mainstream science, economics, and political analysis” are countered by right-wing institutions such as the Heritage Foundation or the American Enterprise Institute (AEI). Both of those produce intellectually sound material not obviously inferior to what comes from left-leaning institutes, and it is often not obviously politically partisan, for example in the recent collaboration by Norman Ornstein of AEI with Thomas Mann of the left-leaning Brookings Institution (Mann & Ornstein 2012).

Trivialities and Irrelevancies

Polemics often deteriorate into trivialities and irrelevancies; for instance, who is guilty of a greater number of such technical transgressions as typos or unimportant numerical mistakes (Bauer 1984). Thus Mooney asserts that “Bush’s nationally televised claim—that ‘more than sixty genetically diverse’ embryonic stem cell lines existed at the time of his statement—counts as one of the most flagrant purely scientific deceptions ever perpetrated by a U. S. president on an unsuspecting public” (*War on Science*:2). This was so horrendous because “more than three years later, [there were] only twenty-two available lines . . . and *scientists* consider many of those almost useless” (*War on Science*:4, emphasis added).

Note:

1. Had Bush said 22 originally, that would have carried essentially the same rhetorical weight as 60. Both would seem ample enough to begin research on, so far as the lay public is concerned.
2. It was some set of advisers, probably at several successive administrative levels, who came up with Bush's statement, he did not himself conjure up that 60. If Mooney wanted to criticize it, he should have found out how the number came about.
3. "Scientists" are cited as though this were a unanimous judgment—which it certainly is not. Unnamed sources are not very convincing. "Almost" useless is not useless.
4. Mooney does not delve at all into the scientific aspects of doing research at this stage with human embryonic stem cells. Leaving aside all questions of ethics, morals, or religion, one should surely ask, "What evidence is there that such research would deliver the speculative benefits claimed by would-be researchers, such as curing spinal-cord and brain injuries and diseases, and more?" It would seem obvious to me that one would not begin research with human tissues until it had been shown in several mammalian models that such benefits might be potentially achievable. It is no attack on science to be against human-stem-cell research before comprehensive animal trials have been successful.

Among the outrageous distortions of science uncovered by Berezow and Campbell (*Science Left Behind*:1–3) is the replacement of plastic utensils with compostable ones by a Democratic-controlled Congress. Such mole-hills do not mountains make.

Argument by Implication

Both books make copious use of scare quotes as a substitute for evidence. When the Right argues for sound science, Mooney describes that as "sound science," for instance, without anywhere explaining why the Right's asserted stance on the particular issue was *not* sound. That's what scare quotes are for, trying to make a point while finessing the issue.

Adjectives and adverbs are used to the same end as scare quotes. Mooney's book is chock-a-block full of this: Capitalism is *unrestrained*, conservative tendencies are *marked*, right-favored fringe viewpoints are not just fringe, they're *clear* fringe, and their rhetoric is *irresponsible*. On the other hand, conclusions about human-caused global warming are *robust*: "The conclusion has a fairly high degree of scientific certainty" (*War on Science*:19)—once again the implicit assertion that "highly likely" equals "to be taken as true enough for actions to be based on it." So heavily does

Mooney rely on this device that I thought it warranted formal recognition as *argumentum ad adjectivum*, a tactic that I have not seen described in discussions of philosophy or logic. But, as usual with my most original thoughts, Google revealed that others had earlier been no less original (Anderson 2009, Brooke 2012, Logic Wizard 2007, tsig 2011).

Mentioned Topics

A book review would normally give at least a list of the subjects covered. In the present case, both books are so tendentiously written that the actual topics they focus on are almost beside the point. Readers of both books need to be aware of the political bias, scientific illiteracy, and rhetorical tricks and subterfuges aimed at showing distortion of science without demonstrating distortion of science, because the actual scientific evidence is just not presented or described or discussed. Both books should be read between the lines and with deep skepticism about every assertion.

Among the mishandled topics, where these books themselves distort the science:

Mooney accepts mainstream warnings about second-hand smoke, whereas a politically non-partisan, science-based discussion finds the warnings quite unwarranted (Kabat 2008). He thinks “science” justifies research on human embryonic stem cells, even though the hoped-for benefits are no more than hopes. He accuses many Republican leaders of willingly distorting or even denying “the bedrock scientific theory of evolution” (*War on Science*:36). Here “bedrock” is another instance of *argumentum ad adjectivum*, but more important is that any arguments over creationism, intelligent design, and “the” theory of evolution ought to specify what that theory is taken to be: Is it that the Earth’s flora and fauna have evolved through differentiation? From a single ancestor or from several? Did the ancestor(s) arise from inorganic matter? Does evolution proceed purely by “natural selection” from random mutations and accidental environmental changes? “Defenders” of “evolution” (like Richard Dawkins, say) all too often insist on a single origin from inorganic matter, which goes far beyond the “bedrock” evidence. At any rate, in his Chapter 4, “‘Creation Science’ and Reagan’s ‘Dream’,” Mooney links Republican misdeeds as to evolution with young-Earth extremists. He asserts that “Star Wars” “pitted Ronald Reagan against *the* scientific community” [emphasis added], as though no scientists had favored the project; some did.

On human-caused global warming, Mooney says that dissenters “questioned the models’ reliability” whereas “others would merely call their results uncertain—but no reputable scientist ever claimed otherwise” (*War on Science*:63). Perhaps Mooney has missed the statements from

the many non-disreputable mainstream scientists asserting that there is no doubt that human-caused emission of carbon dioxide is contributing to warming. And if results are uncertain, surely they are also unreliable. But *Science Left Behind* agrees that some conservatives “have embraced anti-science positions . . . on . . . climate change” (*Science Left Behind*:10); so Berezow and Campbell haven’t really looked at the evidence either, and they even overlooked the ingenious ploy by mainstream “climate scientists” to substitute unfalsifiable “climate change” for falsifiable “global warming” (Bauer 2012c, 2012d).

For Berezow and Campbell, “progressives have a strange fetish with alternative energy” (*Science Left Behind*:4). They “have championed the unscientific anti-vaccine movement” (*Science Left Behind*:7); but many people have questioned a variety of vaccines, for example that Gardasil or Cervarix convey significant benefits without significant risks (Bauer 2008, 2009, 2011). Nevertheless, Berezow and Campbell assert unequivocally that there has never been controversy over vaccination, and that “the medical and scientific communities have always endorsed vaccines as one of the basic foundations of public health” (*Science Left Behind*:26–27); yes, *in general*, but there has been plenty of controversy over specific vaccines like the aforementioned Gardasil.

For Berezow and Campbell, technological progress to be embraced includes genetically modified crops (*Science Left Behind*:7), and they are sloppily and incorrectly disparaging of “Organic Food: The Holy Eucharist of Environmentalism” (Chapter 3). They claim “not even a single documented case of GM food causing . . . any lingering health problems” (*Science Left Behind*:40) despite the many reports of allergies. That the founder of Whole Foods is an Ayn Rand fan who practices yoga, they find ironic (*Science Left Behind*:40) without explaining why that is ironic. They claim that the “science behind GMOs is straightforward: Find a gene that is useful, and insert it into an unsuspecting organism we care about” (*Science Left Behind*:41). To do this so that the desired gene is expressed as desired remains an unsolved problem, because we do not (yet?) understand genomics well enough to place a gene appropriately; quite apart from the basic fact that “genes” are not the simple entities we used to think they were—*bits* of “genes” get activated and re-arranged and coordinated with other bits of other “genes” in the everyday workings of cells (Ast 2005). Genetic modification of crops is a hit-and-miss affair, for the same reason and just like the medical “gene therapy” that was all the rage several decades ago, before trials of it failed to work and killed enough human guinea-pigs that the glamour wore off.

In places, *Science Left Behind* is simply wrong on factual points:

“Europe’s precautionary principle” is said to put the burden on corporations to prove that a chemical is 100% safe, when nothing can prove that; as opposed to “the status quo in America, which is that the burden is on the opposition to prove something unsafe” (*Science Left Behind*:18). Bunkum. The Food and Drug Administration is legally charged with approving drugs and food additives only if they have been shown to be both safe and effective; that its practices and criteria often fail to meet that commitment doesn’t alter the fact that this is what the law calls for the FDA to do.

In Unhappy Conclusion

These much-hyped books are not even wrong concerning their allegations of political distortion of science, because they do not analyze any of the scientific evidence in order to demonstrate distortion. But both books are also wrong on many aspects of what science is and how it works, and nothing said on any specific topic can safely be taken as authentically reflecting the state of the art in the scientific community as a whole. Both books have clear political agendas, and pursue them with the same rhetorical devices one encounters in any partisan disquisitions.

This review is so negative because the books disappointed me so much, and because the purported theme of political interference with science is so important. I agree with Mooney and other “progressives” that the mainstream Republican agenda has been counterproductive in recent times, and I am dismayed that people agreeing with me on this should be so wrongheaded and ignorant when they bring science into the discussion. When I first heard of *Science Left Behind*, I was delighted that at last the scientifically illiterate bashing of Republicans would be exposed and set right, only to find that it is itself scientifically illiterate and politically motivated.

Notes

- ¹ Wikipedia is correct in attributing this expression to Pauli but totally wrong in saying it refers to “An argument that appears to be scientific . . . [but] cannot be falsified.”
- ² The young discipline of Science & Technology Studies (STS) is an amalgam of history, philosophy, and sociology of science, and of technology, as well as of pertinent bits of other disciplines, e.g., science writing, or public policy—anything and everything that can throw light on the nature of science and of technology and of their place in the wider society.

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ESSAY REVIEW

Criticism: Fair and Foul, Mostly Foul

Noble Savages: My Life among Two Dangerous Tribes—The Yanomamö and the Anthropologists by Napoleon A. Chagnon. New York: Simon & Schuster, 2013. 531 pp. \$32.50 (hardcover), \$14.44 (Kindle). ISBN 978-0684855103.

Darkness's descent on the American Anthropological Association—A cautionary tale by Alice Dreger. *Human Nature*, 22(3) (June 2011), 225–246.

The controversy surrounding *The Man Who Would Be Queen: A case history of the politics of science, identity, and sex in the Internet age* by Alice D. Dreger. *Archives of Sexual Behavior*, 37(3) (June 2008), 366–421.

Anomalists know that being criticized goes with their territory, and that at times it is less substantive and more personally derogatory. But the same thing can be said about many controversies within mainstream disciplines. One instance concerns the anthropologist Napoleon Chagnon, who had studied isolated tribes in the Amazon, the Yanomamö, for about a quarter of a century when he came to national attention through being charged with major malfeasance, including responsibility for a measles epidemic fatal to many natives. The charges came in an article by Patrick Tierney (2000), soon followed and augmented by Tierney's book-length disquisition (2001).

The media coverage and reports of investigations by the American Anthropological Association left the clear impression that Chagnon had behaved badly and unprofessionally. Certainly that had been my own recollection, and a book review (Povinelli 2013) of Chagnon's recent memoir, *Noble Savages*, did nothing to change that impression. However, this book review seemed so mean-spirited, and its accusations were so broad-brush and non-specific, that I resolved to read the memoir and try to make up my own mind.

The first 13 chapters of *Noble Savages*, about 380 of about 460 pages of actual text, report Chagnon's studies in great detail, unlikely to be of

absorbing interest to anyone who does not have anthropologic interests. The last three chapters are Chagnon's critique of the attacks made on him from within anthropology and by the Salesians, a Catholic order that had been doing mission work among the Yanomamö (as, rather competitively, had been the Protestant New Tribes Mission).

The first part of the book describes Chagnon's work as creating detailed genealogies which enabled him to collate biologic relationships with customs and behavior and also made his cooperation fruitful for the human geneticist James V. Neel. Chagnon found that as Yanomamö villages grew, they would split; they combine a sort of mobile agriculture with hunting and gathering that places a practical upper limit on the size of a village. Tracing kinship is complicated by perpetual village-splitting.

Chagnon describes a state of almost constant fighting, largely over women, and including within-village "club fights," somewhat ritualized and thereby limiting the physical damage. Women themselves are subject to much violence by their mates. Between villages, fights can lead to death, and one of Chagnon's highly controversial findings is that men who are known to have killed others benefit by accumulating more wives and achieving more reproductive success. Altogether, Chagnon explains much about Yanomamö behavior in terms of biology and evolution.

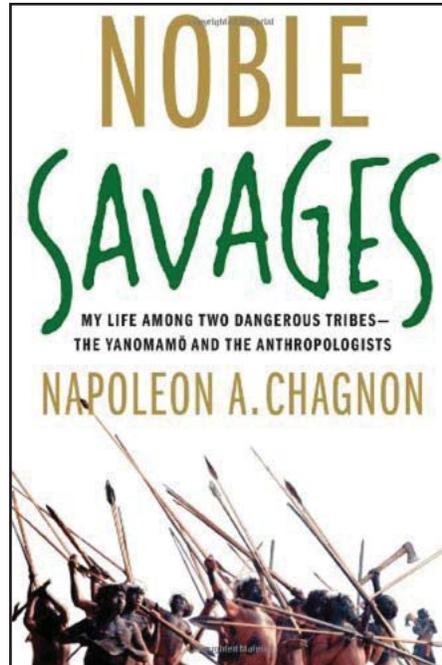
Chagnon also described the Yanomamö as rather avaricious, always on the lookout for chances to receive gifts of trade goods—metal tools and weapons, even shotguns.

Long before Tierney's attack, Chagnon had already been *non grata* to a large sector of anthropologists who believed culture to be essentially everything and biology essentially nothing as causes of behavior; so Chagnon's coupling of reproductive success with success in war was anathema, as was his description of the Yanomamö with warts and all rather than as—following Rousseau—peaceful, happy, natives unspoiled by civilization and living in eco-friendly harmony with Nature. Chagnon describes his troubles within anthropology in those terms, as a clash of explanatory worldviews. He also describes less-than-happy interactions in the jungle with the Salesians, who to his mind were interfering in a damaging way with the Yanomamö way of life.

Chagnon's memoir did not make the best impression on me. He is rather ungenerous in comments about Neel, the geneticist who worked with him and gave him his first job. He has rather bad things to say about a number of other people, including most Venezuelan and Brazilian anthropologists. A large ego is clearly on display, from the earliest times when he was a graduate student who presents himself as already equally authoritative as more senior people—thus he "agreed" to collaborate with the well-established senior

Neel. Nevertheless, even if only a few significant parts of Chagnon's allegations are true, then he was disgracefully mistreated by official representatives of American anthropology and by the Salesians.

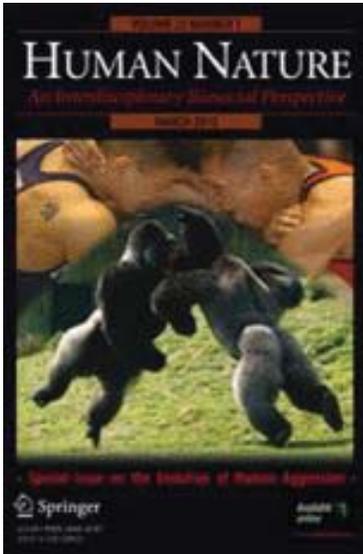
The only way to reach an informed view seemed to be to undertake a thorough analysis of all sides of the pertinent literature. Fortunately, I did not have to do that because I soon came across just such an analysis, the article in *Human Nature* cited above. Its author, Alice Domurat Dreger, came to the controversy almost as late as I did. She is Professor of Clinical Medical Humanities and Bioethics at the Feinberg School of Medicine at



Northwestern University; her Ph.D. had been in History and Philosophy of Science. She had been told to look at the Chagnon case because she was working on a book about scientific controversies and activism in the age of the Internet. Her analysis of the Chagnon affair is stunningly evidence-based and scrupulously documented, and carries many worthwhile as well as disturbing lessons about contemporary academe and science and the media.

Most striking: Dreger found numerous references that had almost immediately exposed Tierney's charges as thoroughly false and his approach shockingly deceitful, in particular that the sources he cited do not say what he claims they said. So Dreger looked into "how and why certain individuals—but especially leaders within the American Anthropological Association (AAA)—played a supporting role to Tierney's work," and her article "chiefly seeks to highlight the problematic aiding and abetting of Tierney by scholars who had the power to know better and to do better." That, I believe, is what makes this affair pertinent to anomalistics in general, and indeed to contemporary science in general, as more and more fields display unwarranted dogmatism and highly uncivil behavior toward anyone who questions mainstream beliefs and practices (Bauer 2012).

One point of similarity with other controversies is that the attacks



on Chagnon had been initiated and stimulated and kept alive by a very small number of true believers—in this case a few anthropologists with a politically correct faith that culture is all, as well as some (especially in Brazil) who resented Chagnon for infringing on their turf: “Tierney’s book appeared to represent a rich new opportunity for drawing attention to Chagnon’s alleged misdeeds.”

Another characteristic of controversies is the sheer irrationality of polemic extremes so that observers may wonder how they could ever have been taken seriously. When it comes to savaging heretics, anything goes, apparently. Thus a memorandum

circulated widely began, “In its scale, ramifications, and sheer criminality and corruption, [the scandal] is unparalleled in the history of Anthropology.” Dreger comments, “the most unbelievable claims seem like they must be believed. . . . Because how could you make this stuff up?”

Once the media have sniffed a big story, the facts have a hard time catching up. “In the current media market, reporters are rewarded for primacy and speed, not for accuracy,” and some stories are “what journalists call ‘too good to check.’” As Dreger points out, the original sin had been committed by Tierney’s publishers, W. W. Norton, and by *The New Yorker*, neither of which had done appropriate fact-checking. It is not difficult to discover that cited references do not say what they are claimed to say; Dreger’s article offers numerous examples. Several professional societies and the University of Michigan (where Neel worked) had early pointed to many falsehoods in Tierney’s book; nevertheless, the AAA embarked on further inquiries.

It’s a truly ugly story, and Dreger brings copious documentation to expose the long-standing attempt by a few individuals to defame Chagnon and hinder his work. As to Tierney: Why write what is so easily found to be false? Dreger obtains a book manuscript Tierney had tried to have published years earlier, and finds in it sufficient acknowledgments of deceit on Tierney’s own part which, if they had been known to W. W. Norton or *The New Yorker*, would surely have made them think more than twice about publishing him. That manuscript also reveals Tierney’s long-standing

prejudice against sociobiology as well as reasons for taking the side of Catholic missionaries.

Much more troubling than a single untrustworthy individual, however, is the damage done when institutions allow themselves to follow along for misguided reasons. The AAA seemed to judge that for reasons of PR it needed to be seen as making a thorough investigation even as they knew it to be unwarranted: the AAA's president wrote to a colleague:

Burn this message. The [Tierney] book is just a piece of sleaze, that's all there is to it (some cosmetic language will be used in the report, but we all agree on that). But I think the AAA had to do something.

One wonders why that "something" could not have been to announce the unanimous finding that the Tierney book was nothing but sleaze?

Dreger goes into much more detail about the culpability of the AAA. Her scrupulous logic is illustrated once again when she distinguishes taking a postmodernist approach from doing good work:

Postmodernism may have contributed to this mess, but it is not the central problem. The central problem here is ideologically-driven pseudo-scholarship pretending it is real.

Not all postmodernists ignore or distort facts.

Anomalists are prone to be misrepresented, and we need to bear in mind what Dreger says about that: "as someone frequently quoted and sometimes misrepresented in the media, there is a limit to what any of us can do to control others' use of our work." In the present case, "Chagnon was alive to experience what it is like to be drawn-and-quartered in the international press as a Nazi-like experimenter responsible for the deaths of hundreds, if not thousands, of Yanomamö." After such exposure, Chagnon could never effectively disarm his accusers, if only because people tend always to assume that "where there's smoke there's fire."

In her article about Chagnon, Dreger cites a similar case of harassment which concerns a subject even more controversial and sensitive than that of primitive tribes, namely, human sexuality and sexual unorthodoxies. Her second article cited above is an analysis of that affair.

A prominent psychologist, Ray Blanchard, had proposed that males who wanted to change sex belong in one of two categories: homosexual men who erotically desire men, and men who have an erotic desire to be women without necessarily having a sexual attraction to men ("autogynephilia"). J. Michael Bailey, also a psychologist, accepts Blanchard's view on this, and also holds that sexual orientation is determined largely by biology rather

than culture, nurture, and environment. In 2003, Bailey wrote *The Man Who Would Be Queen: The Science of Gender-Bending and Transsexualism* (TMWWBQ), published by Joseph Henry Press at Johns Hopkins University but intended for a general and not a scholarly audience.

Immediately there was trouble from individuals to whom Bailey's views are anathema:

dissatisfied with the option of merely criticizing the book, a small number of transgender activists worked to try to ruin Bailey professionally and personally. . . . [They] used the power of the Internet and the press to try to undermine Bailey's professional reputation, undo any positive praise his book received, and make Bailey as personally miserable as possible.

That included comparing Bailey to Nazi racists; his book had been nominated for a Lambda Literary Award (Lambda indicating LGBT—Lesbian, Gay, Bisexual, Transgender) which, according to Bailey's harassers, “would be like nominating *Mein Kampf* for a literary prize in Jewish studies.” The harassers circulated “the names, addresses, URLs, and phone numbers” of people who stood by Bailey.

As with Chagnon,

there were in fact far fewer accusers . . . than all the noise in the press and on the Internet would have you believe. And of the accusations made, almost none appear to have been legitimate. . . . [Nevertheless the attacks] came remarkably close to effectively destroying J. Michael Bailey's reputation and life.

As with Chagnon, so here too the activists launched charges through the press and pushed for institutional investigations of Bailey for alleged misdeeds. One of them

used the Web to publicly harass Bailey's children, his ex-wife, his girlfriend, and his friends. . . . So very intense have been feelings around the Bailey controversy that several people were frightened to speak to me when I sent them inquiries about it a good 3 years after the book's publication.

As with other intense controversies, logic and rationality and the middle ground turn out to be dangerous: Dreger found that people

not entrenched in an 'us versus them' mentality . . . nonetheless have been repeatedly silenced, misrepresented, or misheard by those who assume one must side with an 'us' or a 'them'. . . even those who did not want to get involved often found it impossible not to be.

That Bailey's work itself is neither dogmatic nor extreme is indicated by the fact that "Bailey managed to be vilified by both the right- and left-wing presses."

In my discussion of mainstream dogmatism (Bauer 2012), I suggest that extremist claims can at times be made to seem entirely implausible simply by the application of some common sense. In the Bailey case, the most furious attackers were those who insist that they were born with a male physiology but an essentially feminine gender and that there are no erotic feelings involved. It rather boggles the mind to imagine that anything connected to sex could be entirely non-erotic, yet much of postmodernist and feminist theorizing has pushed that view, including using the term *gender*—which used to mean grammatical rules applying to nouns that connote sex or animateness—as applying to human behavior.

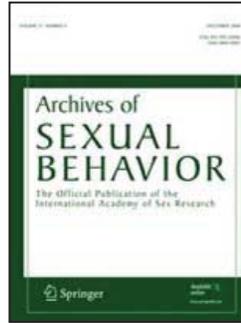
As with too many other controversies, for example the treatment of Peter Duesberg in connection with HIV/AIDS (Farber 2006), "A number of Bailey's colleagues who might have been inclined to explicitly defend him suggested to me in conversation that they feared being both ineffectual and attacked." A number of transgendered individuals who agreed with the views of Blanchard and Bailey and who had discussed the matter with Dreger "All . . . asked to remain anonymous for fear of further attack."

As in the Chagnon case, the most serious charges could have been disproved virtually almost on sight. Bailey had been accused of not getting approval from Northwestern University's Board supervising research involving human subjects, yet all he had done was to interview people who knew he was going to use in his book what they said to him; Dreger explains exhaustively from every conceivable angle why this does not qualify as research on human subjects.

As in too many other controversies,

many people—including professional scholars—were ready to give me detailed opinions about the book while admitting they hadn't bothered to read it . . . many people reacted negatively to TMWWBQ before (or whether) they had even read it.

One of Bailey's harassers is clearly unbalanced mentally, paranoid, and a conspiracy theorist. Dreger refrains from specifying that, merely pointing out that "All this might sound crazy, petty, or amusing to some, but such a reading would minimize the actual damage done to people in the whole TMWWBQ affair."



That the reaction, “Where there’s smoke, there’s fire,” is virtually universal is attested by Dreger herself, who had had no wish to interact with Bailey when she knew only “what everyone else knew,” before a mutual friend convinced her to look into the facts. Then she found that Bailey’s book, described as hostile to all sorts of people and theories, instead

isn’t simply pro- or anti-gay or pro- or anti-trans. It isn’t simply socially constructivist or biologically determinist. It’s significantly more complicated than it at first appears, and much more complicated than its cover and title would lead one to believe. Most importantly for this discussion, *TMWWBQ* is not the book many people assumed it to be—particularly after the phenomenal backlash it received.

“Don’t judge a book by its cover,” in other words; especially since it is often publishers and not authors who determine what the title and cover ought to be. (I’ve published a dozen books, and only rarely was I even invited to comment on a sketch of the cover, and my suggested titles have never been used, though I was able to modify a couple of them.)

Ideologically determined, foul and *ad hominem* rhetoric not only does considerable damage to people: “from questioning the message to questioning the messenger—effectively directed public attention away from the book itself and Blanchard’s theory towards *TMWWBQ*’s author.” As to why such viciousness is aroused? Bailey’s attackers “are so angry . . . not because they are so sure that Bailey is wrong. It is because they worry that he might be at least partly right and this realization is potentially fatal for their hard-earned sense-of-self.”

A point Dreger does not make directly, but which her analyses make plain enough, is that—as in so many other controversies—the attacked scholars or scientists are not their own best advisors or defenders.

Dreger’s fine analyses of these two controversies have much of interest to all anomalists. I recommend them unreservedly. Many of the same points apply in all controversies. When anomalists are called “flat-earthers,” it avoids substantive discussion of UFOs, psychic phenomena, Loch Ness Monsters, etc. Calling Peter Duesberg an “AIDS denialist” finesses having to try to show that his arguments are not sound. And so on. When a claim is readily disproved, it doesn’t stimulate intense personal attacks; only when the claim is feared to have some truth to it do defenders of the faith stoop to character assassination and the like.

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BOOK REVIEW

Among Mediums: A Scientist's Quest for Answers by Julie Beischel. Windbridge Institute, 2013. \$4.99 (e-book). 76 pp. ASIN B00B1MZMHH.

We have certification procedures for all sorts of professions—from physicians and pilots, to electricians and teachers. Why not one for mediums who claim they can talk to the dead?

Dr. Julie Beischel, co-founder of the Windbridge Institute for Applied Research in Human Potential, needed to assemble, from a field filled with fraud, a team of genuinely talented mediums to experiment with. So she created exactly that—a rigorous, eight-step screening, training, and certification process, then ran volunteers through it. Each candidate performed readings under various blinded conditions; if their accuracy score achieved a certain level, they qualified for part two of the multi-month program, learning about the history of modern mediumship research as well as regulations governing scientific research on human subjects.

It cost the Institute \$7,000 to \$10,000 to test each hopeful, and one in four washed out. But some 20 survived (18 of them female) to become Windbridge Certified Research Mediums, or WCRMs. (Applications are now closed. “We’re in the business of performing cutting edge research, not certifying mediums,” Beischel says. The 20 they now have are enough to answer their current research questions.)

What Dr. Beischel is doing with her newly minted WCRMs, and what they’ve scientifically nailed down to date, is recounted with impish humor in her short, self-published, 76-page e-book.

Here’s six things we know to date, per Beischel (my summary):

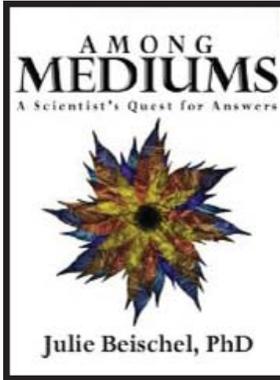
1. Some mediums can and do regularly communicate with the dead.
2. Some mediums can deliver accurate and specific information about the dead—the discarnate’s physical appearance, personality, hobbies, cause of death, and messages for the sitter.
3. WCRMs can do it under tight protocols which rule out typical skeptical explanations—fraud, cold reading, experimenter cueing, and rater bias by the sitter. In her experiments, Beischel employs a quintuple-blind methodology (it’s described in detail in a paper posted on the Institute’s website www.Windbridge.org).

4. The most parsimonious explanation for the source of the information received by Windbridge mediums is the dead—not psi on the part of the medium (telepathy, clairvoyance, precognition), or some posited psychic reservoir of information (e.g., the Akashic records).
5. Windbridge mediums seem to be physiologically and psychologically different from you or me. For example, 83 percent of Windbridge mediums fall in both the Intuition and Feeling categories of the Myers-Briggs personality test, while only 16 percent of the general U.S. population does. They suffer more chronic health problems—seven times the incidence of autoimmune disorders; twice the incidence of diabetes; more than twice the number of migraines as the general female population. Why, we don't know, but Windbridge is collecting additional physiological data on its WCRMs (EEG, blood chemistry, etc.) and hopes to land a grant to conduct fMRI imaging as well.
6. Mediumship has some promising applications. They include helping law enforcement officers catch criminals or find missing persons; and therapeutically treating grief caused by the loss of a loved one.

Beischel is as fascinating as her science.

She believes it's important to know the background and potential biases of anyone serving up controversial science. Consequently, Beischel spends the first quarter of her pint-sized book recounting her tumultuous early life raised in a Catholic family of German descent—which included earning a Ph.D. at the University of Arizona (UA) in the hard sciences (Doctorate in Pharmacology and Toxicology; minor in Microbiology and Immunology/Immunopathology), and the suicide of her mother. The latter triggered her first and only personal sitting with a medium. Some of her professors automatically dismissed her visit, irritating Beischel so much that she sought out Dr. Gary Schwartz in his VERITAS lab at UA where he was employing celebrity mediums such as John Edward and George Anderson to test the hypothesis that consciousness survived death. He offered her a post-doc fellowship, and when his funding ended Beischel wasn't ready to end her own intellectual quest. She and husband Mark scrambled to assemble a website, logo, scientific advisory panel, and chase grant money to create Windbridge.

Passionate as she is about her work, Beischel wants readers to understand she's an "honest-to-goodness real person, not some kind of single-minded science machine." To prove it, she provides possibly the funniest, quirkiest list of Facebook-style tidbits ever shared with the public by a research scientist: Beischel sleeps 10 to 12 hours a night; she owns a 90-pound dog named Moose ("My husband recognizes the pecking order—Moose



came first.”); she’s a huge Denver Broncos fan (“thanks in part to two different boyfriends”); she knows a clever trick to treat ‘brain freeze’ caused by eating ice cream too fast; she subscribes to an online comics service; she’s a practicing vegetarian but hates vegetables (“I’m more of a fruitarian”); and just in case you’re wondering, she’s not ticklish.

Among Mediums is hard science with a shot of humor, less than five bucks, instantly downloadable on your smartphone or iPad, and readable in 90 minutes. Skip the Starbucks today

and spend the change on a look at the latest research addressing Science’s ultimate puzzler—does consciousness survive death?

Michael Schmicker

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BOOK REVIEW

Bad Science: Quacks, Hacks, and Big Pharma Flacks by Ben Goldacre. Faber & Faber, 2010. 304 pp. \$15 (paperback). ISBN 978-0865479180. [First published in 2008 in the UK by 4th Estate]

Ben Goldacre is a British celebrity, columnist in *The Guardian*, non-practicing MD, whose *Bad Science* sold 400,000 copies (Goldacre 2013). I had heard of him some years ago because he had committed a culpably misinformed column about the HIV/AIDS dissident Christine Maggiore (Bauer 2009). I expected only the same from his book, but was very pleasantly surprised: I urge others to read it for its sound discussions of how the media's coverage of science is generally misleading; how misleading, too, is the way in which statistics are disseminated by drug companies and the media; and how the drug companies are not to be trusted. And there are some other interesting tidbits as well:

- Goldacre is spot on about the mess that the media make of covering scientific matters, and how disastrous is the ignorance of those in power (Chapter 11: How the Media Promote the Public Misunderstanding of Science). He cites a dictionary word, *churnalism*, credited to journalist Nick Davies and referring to the uncritical rehashing of press releases as news (*dictionary* was coined by Jack Good to characterize a new word worthy of being in a dictionary; another worthy is *tritto*, repetitions beyond *ditto*).
- Chapter 12, Bad Stats, is generally sound and informative about how statistics can be misused and misrepresented, though the presentation has some loose ends. I don't agree, for example, that "natural frequencies" are the *only* sensible way to communicate risk, though I agree that they should always be included. I would also have liked prime emphasis on correlation never proving causation and high probability never equaling certainty.
- The book acknowledges that serious flaws in clinical trials are quite common (pp. 44–45).
- The drug companies are properly given short shrift, e.g., p. 184 ff.
- Highly informative and with specific detail is the discussion of how clinical trials can be deliberately biased to favor drug approval, and the description of other flaws in the process (pp. 189–206).

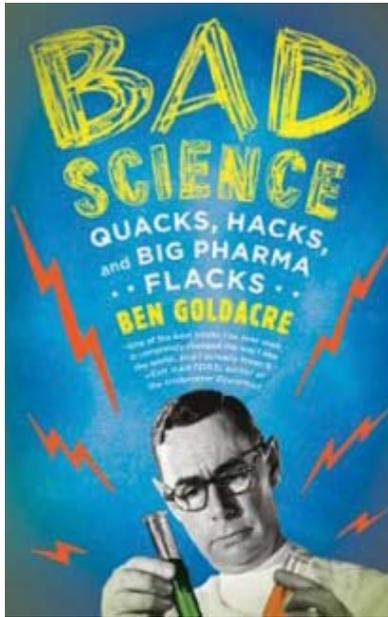
- The detailed debunking of British charlatans, though directly pertinent only for British readers, are well worth reading because similar situations with similar characteristics are present on this side of the Atlantic.
- There are interesting tidbits of information about early German research into smoking and lung cancer (footnote, p. 218) and data indicating that episodes of fear of vaccination have been regional.

On the negative side:

- Goldacre appears to believe that mainstream medicine should be respected as evidence-based (pp. x, 316), when most of it isn't. Later he cites anecdotal evidence that 50%–80% of treatment *decisions* are evidence-based, but only 13% of the *treatments themselves* are evidence-based with another 21% “likely to be beneficial” (p. 182). In other words, doctors who base decisions on the evidence available to them from drug companies and official agencies are, about half the time, relying on unsound evidence. Throughout, the book insinuates that mainstream medicine can be trusted even when admitting that it often cannot be, e.g., at p. 99 when referring to the Cochrane Collaboration. In this vein, Goldacre misleads about John Ioannidis's work (p. 219), implying that it reveals the unreliability of brand-new studies. But Ioannidis has actually shown (Ioannidis 2005, Ioannidis & Panagiotou 2011) that *long accepted* mainstream treatments are based on flawed initial trials done under auspices of drug companies.
- Goldacre is too blithely dismissive of the harm done to “a very small number of people” by any medical intervention or “any human activity” (p. 298). “Whenever we take a child to be vaccinated,” Dr. Goldacre writes, “we're aware that we are striking a balance between benefit and harm, as with any medical intervention” (p. 313). Nonsense. “We” may include statisticians and researchers and pundits like Goldacre, but most patients simply have to trust the recommendations made by doctors—particularly when the patients have no choice but to sign the “informed consent” forms if they want to be treated at all. We—the non-experts—just hope that our trust is warranted, we don't balance benefits against risks. Goldacre may not understand this because he doesn't himself take patients (Goldacre 2013).
- A pervasive strand of Goldacre's bravado is denigration of “humanities graduates” by contrast to scientists, among whom he

seems, wrongly, to include doctors (see for example Bauer 2008). The book's title should really be "Bad Medicine," not *Bad Science*.

- The book implies that glucosamine can do nothing against arthritis (p. 155). A judicious evidence-based assessment says otherwise (O'Mathuna & Larimore 2001).
- Goldacre is quite wrong about HIV/AIDS (p. 88) when even common sense ought to have warned him: If Botswana really has a 48% prevalence of what's supposedly a fatal disease, the country ought to have been depopulated long ago. Antiretrovirals are described as life-saving (p. 184), but they are the opposite (Bauer 2011).
- Goldacre denigrates Linus Pauling for cherry-picking (p. 98)—the Pauling who is widely regarded as the greatest chemist of the 20th century, the founder of molecular biology, winner of two Nobel Prizes, who urged the importance of dietary anti-oxidants (and was maligned for doing so) long before it became the conventional wisdom. This is only one example of Goldacre's outsized ego, hubris, self-confidence, and inability to see himself as others see him. The book's style may turn some people off for this reason; Goldacre is just too full of himself.



On several points, I'm not sure how sound the coverage is:

- Goldacre parrots the mainstream condemnation of Andrew Wakefield who warned that simultaneous multiple vaccinations might be a cause of autism. I've read only enough about this affair to conclude that legitimate questions remain. Goldacre notes the irony that there is a definite correlation between maternal rubella infection while pregnant and autism in the later-born child; but surely this makes plausible Wakefield's belief that exposure to rubella vaccine at an early age might act similarly? In some babies at least?

Since most or all vaccines harm *a few* individuals, surely it is always worth keeping a mind open and studying possible reasons for that, looking for characteristics that might identify people particularly likely to react badly to a specific vaccine.

- David Horrobin is described as marketing by dubious means remedies that turned out to be ineffective (p. 157 ff.). The details Goldacre presents seem sound, but he does not charge Horrobin with actual deceit. This unfavorable picture does not jibe with the David Horrobin who founded *Medical Hypotheses* and published sensible articles about peer review and the like, as well as the fascinating book *The Madness of Adam and Eve* (Horrobin 2002).

Bad Science and the many columns Goldacre has written illustrate two absolute truths:

1. There are no general principles or guidelines that can serve as shortcuts for deciding whether any given controversial claim is worth attending to. There is no sound way to pronounce something “good science” or “bad science” without digging comprehensively into the evidence and the arguments pro and con (Bauer 2001).
2. Any given individual or book can be sound on some general matters and in some specific instances and yet quite wrong about other instances and generalities. The degree to which Goldacre is sound on any given point correlates with the amount of detail with which he is familiar.

Quite generally, compendia of “pseudo-science” are likely to be wrong about some of the topics, because the compilers of such lists simply haven’t had the time to look in sufficient detail at all the topics they cover. Recent examples include science journalist Specter’s *Denialism* (2009), which is uninformed and wrong about HIV/AIDS among other things. A much better book is physicist Friedlander’s *At the Fringes of Science* (1995), but it remains uninformed and wrong about UFOs and cold fusion, for instance. Shermer’s *Why People Believe Weird Things: Pseudoscience, Superstition, and Other Confusions of Our Time*, too, is good about some topics and biased on others. Various older compendia and debunkings of supposed pseudo-science are cited in *Science or Pseudoscience: Magnetic Healing, Psychic Phenomena, and Other Heterodoxies* (Bauer 2001). The mid-20th century classic in this genre is Martin Gardner’s *Fads and Fallacies in the Name of Science* (1952/1957). It is detailed and instructive about some outlandish claims but wrong on others, for example by failing to mention that chiropractic and osteopathy have overcome their cranky birth in one

person's hunch and developed into pragmatically useful healing techniques, superior to mainstream medicine in handling lower-back pain, for example.

All compendia have one thing in common: The authorial claims to base judgments on general principles or assessment of specific evidence are rationalizations; what is labeled as sound is what happened—for whatever reason—to strike the author as sound, and anything the author finds unbelievable—for whatever reason—is labeled pseudo-science. Readers have this choice: Accept the author's personal opinions, or dig into the evidence for themselves and arrive at an informed opinions.

Caveat lector.

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BOOK REVIEW

The Poltergeist by William G. Roll. Foreword by J. B. Rhine. Paraview Special Editions, 2004. 264 pp. \$16.99 (paper). ISBN 1-931044694.

What makes a book written about poltergeists in the early 1970s relevant today? There have been numerous books published since then dedicated to analysis of this spontaneous, physical phenomena. Notable are those by Alan Gauld and Tony Cornell (1979), D. Scott Rogo (1979, 1986), Colin Wilson (1981), John and Anne Spencer (1997), and most recently Claude Lecouteux (in French 2007, English translation 2012), P. G. Maxwell-Stuart (2012), and Geoff Holder (2012, 2013). Preceded by earlier, key book-length examinations by Sacheverell Sitwell, Harry Price, Herbert Thurston, Hereward Carrington, Nandor Fodor, and A. R. G. Owen, what distinguishes William Roll's *The Poltergeist* from all of these works is that it is based on a sustained, systematic series of ongoing poltergeist investigations conducted by Roll himself that further developed his hypothesis that this phenomenon emanated from living people. Alongside longstanding propositions that the poltergeist is a spirit of the dead or a product of human deception, Roll's recurrent spontaneous psychokinesis (RSPK) remains among the most discussed ideas about this strange phenomenon. Through six detailed investigative summaries and a brief historical review, Roll clearly outlined the problems of the poltergeist and the methodologies that through more than a dozen years of investigation he felt could advance the study. Today, *The Poltergeist* vitally continues to refresh analytical viewpoints, essential reading for anyone venturing into field investigations of continuing anomalous phenomena.

After co-investigating events that unfolded in a 1958 on-site investigation in Seaford, Long Island, with J. Gaither Pratt in his early days with J. B. Rhine's Parapsychology Laboratory, Roll coined RSPK to more precisely consider the mechanisms of the poltergeist phenomenon. Roll left Rhine's lab a few years later to lead the Psychical Research Foundation (PRF) which to this day continues to study the possibility that consciousness and personality survives death. As the "heart and soul of the PRF" (Williams 2012:2), Roll sustained poltergeist research, applying the RSPK hypothesis to on-site case studies across the United States. While Roll was indeed keenly interested in research on survival after death, he rethought how anomalous phenomena such as poltergeists, hauntings, and extra-sensory perception could signify an energetic relationship between living people and their environments. In *The Poltergeist*, he concluded that the

psi field may be no other than the complex interrelations of forces and fields which present-day physicists are already probing. The exciting prospect which parapsychology has introduced is that this outer physical world and the inner psychical world may be one and the same. (p. 198)

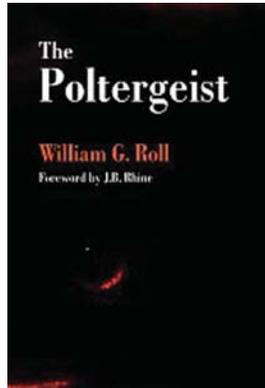
This conviction was further developed through Roll's research and life, and continues to impact studies of anomalous phenomena. Through his field work, Roll demonstrated the importance of interdisciplinary expertise in systematic parapsychological investigations; for example, he relied on the technical knowledge of engineers to conduct physical examinations of households, and psychologists and psychiatrists to assist experiencers through the emotional distress that often accompanied the unwelcomed manifestations. As Loyd Auerbach pointed out in his obituary of Roll in *JSE* 26(2),

the RSPK model as delineated by Roll and others has shown itself to be a practical working model not just for how the phenomena run their course in cases, but as a way to achieve resolution for the people who experience the phenomena. (Auerbach 2012)

In the Foreword to the book, J. B. Rhine accurately called *The Poltergeist* a "progress report" (p. ix). Indeed, this was an initial benchmark in Roll's continuing work. The book is divided into four major themes: a review of past and contemporary cases around the world; an overview of six of Roll's key investigations from 1958 to 1968 (Seaford, Newark, Indianapolis, Clayton, Miami, and Olive Hill); Roll's major theories on the mechanisms of the poltergeist; and an Appendix that includes methodology and questions that can be asked of experiencers. The questions he asks are still pertinent to collecting essential data in the investigative process, and are general enough that they could easily be expanded according to individual case studies.

This book represents a turning point in field investigations and thinking on the contextual aspects that may influence the occurrence of the phenomenon. Through his Miami investigation, Roll considers four significant possibilities in the workings of the poltergeist to develop the RSPK hypothesis. In his concept of the psi field, Roll connects a living person at the center of poltergeist manifestations (the agent) to some form of energy—described as psychokinesis (PK). He argued that RSPK made more sense in poltergeist cases than the idea that a mischievous incorporeal entity was responsible for mysterious rappings and movement of objects. He posited that there was an energetic field, like magnetic or gravitational fields, involved in PK. This was evidence, for example, in how incidents tended to diminish the farther away the agent was from the object. Yet, Roll also noted that objects could sometimes move without a person present,

which he thought could be caused by a residual field. Secondly, Roll reviewed psychological and physiological data collected from people at the center of poltergeist cases, pointing to a common persona that involved evidence of tension often with family that was not outwardly expressed for example through anger. Thirdly, he considered how poltergeist agents scored on parapsychological tests and ways to test their psychokinetic ability by attempting to incite object movements. Lastly, if RSPK is a symptom of deeper, unconscious tensions, Roll concludes that the recognition among therapists that “the human organism extends into the space beyond the skin” (p. 194) would help resolve the phenomenon and associated psychological issues. He wondered if such a physical force could be “controlled or directed into positive channels” (p. 193), and posed the possibility that techniques such as meditation could enhance psi.



While I did not have the pleasure of meeting Dr. Roll in person, I have heard much of his incredible sense of humor, his supportive demeanor toward those who were interested in psychical studies, and of course many who are interested in exploring the frontiers of science know his written works very well. In these works, his dedication to the study of people and their anomalous experiences shines. Along with his study of a 1984 case (Roll & Storey 2004) and a reflection on his career (Roll & Persinger 2001), *The Poltergeist* is part of a published triad that solidly considers this strange phenomenon that continues to evade easy explanation.

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