Number 4 | July–September 2010

EdgeScience

Current Research and Insights

You, too, might be surprised

to learn that the motions of the pendulum are not entirely explained, that the human aura is not just new age mumbo jumbo, that a mind can affect a machine, that good evidence exists for reincarnation, and that some UFOs may actually pose a threat to aviation safety.

A publication of the Society for Scientific Exploration

EdgeScience #4
July–September 2010

EdgeScience is a quarterly magazine.
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Why EdgeScience? Because, contrary to public perception, scientific knowledge is still full of unknowns. What remains to be discovered—what we don't know—very likely dwarfs what we do know. And what we think we know may not be entirely correct or fully understood. Anomalies, which researchers tend to sweep under the rug, should be actively pursued as clues to potential breakthroughs and new directions in science.

The Society for Scientific Exploration (SSE) is a professional organization of scientists and scholars who study unusual and unexplained phenomena. The primary goal of the Society is to provide a professional forum for presentations, criticism, and debate concerning topics which are for various reasons ignored or studied inadequately within mainstream science. A secondary goal is to promote improved understanding of those factors that unnecessarily limit the scope of scientific inquiry, such as sociological constraints, restrictive world views, hidden theoretical assumptions, and the temptation to convert prevailing theory into prevailing dogma. Topics under investigation cover a wide spectrum. At one end are apparent anomalies in well established disciplines. At the other, we find paradoxical phenomena that belong to no established discipline and therefore may offer the greatest potential for scientific advance and the expansion of human knowledge. The SSE was founded in 1982 and has approximately 800 members in 45 countries worldwide. The Society also publishes the peer-reviewed *Journal of Scientific Exploration,* and holds annual meetings in the U.S. and biennial meetings in Europe. Associate and student memberships are available to the public.To join the Society, or for more information, visit the website at scientificexploration.org.

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Billy Cox

The Latest Challenge

Ten years ago, Richard Haines, former chief of the Space Human Factors Office for NASA/Ames Research Center, produced a groundbreaking and largely ignored report called "Aviation Safety in America: A Previously Neglected Factor." Built upon detailed case studies of 56 near misses involving UFOs going back half a century, Haines argued that pilots attempting to avoid collisions might well overcorrect, with catastrophic results.

Haines' research evolved into the National Aviation Reporting Center on Anomalous Phenomena (NARCAP), and in a semantic effort to veer away from the loaded UFO term, his team of volunteer analysts — which include pilots, air traffic controllers, aviation administrators — agreed on a new acronym: UAP, or unidentified aerial phenomena.

In April, NARCAP released a 154-page monster follow-up entitled "Spherical UAO Activity: A Critical Review," which should be mandatory reading for Seth Shostak, Paul Davies, Stephen Hawking, and all the other media favorites who keep trying to convince the public there's no scientific UFO data to evaluate. Cautious and restrained, this "Project Sphere" report takes a remarkable look at one of the most commonly reported UFO configurations on the books, second only to discs. Whether seen as glowing balls of nocturnal light or metallic orbs at high noon, the highly maneuverable spheres are complicated by their often elusive signatures on radar scopes, their dazzling spontaneity, and sometimes adverse effects on onboard electronics. NARCAP explores all possible explanations for these objects, including natural phenomena, such as plasmas and ball lighting.

The report contains technical reports from a cast of 16 international contributors, one being Dominique Weinstein of the French National Center for Space Studies' UFO study, GEIPAN. He analyzed 300 cases of unidentified aerial phenomena (UAP) activity reported across the world by military and civilian pilots from 1947-2007. In support of NARCAP's contention that these encounters pose flight-safety hazards, Weinstein addresses 39 incidents, or 14 percent, involving electromagnetic effects. Specifically, 15 planes lost some form of UHF/VHF radio communication; nine had their magnetic compasses screwed up, including one that showed two compasses pointing in opposite directions; seven automatic radio-compasses went haywire; six planes experienced engine problems; five reported varying levels of weapons-system failure; and three logged general electrical issues. In all but two cases, the effects were temporary, as systems returned to normal when the UAP left the vicinity. Eighty seven percent of these encounters occurred at cruising altitude. Radar data confirmation, or lack thereof, was available for 146 reports. Eighty one of those incidents generated radar data, with 15 reflecting both ground and air radar coverage.

Weinstein identified 122 cases involving potential aviation safety. Thirty-four incidents involved UAP on collision courses, 20 others crossed aircraft flight paths, 24 pilots took evasive action, and three encounters in the 1950s resulted in passenger injury. And in the mysterious 1978 case of Frederick Valentich, both plane and pilot vanished altogether.

Most troubling to NARCAP executive director Ted Roe are the ones that don't show up on radar, especially the spheres. Roe analyzed 120 cases, 44 of which involved spheres over U.S. territory Only four of those 44 were painted by ground radar, but 15 were categorized as near misses. In four cases, pilots switched on their landing or taxi lights to alert oncoming spheres to their presence. "Given the low survival rate of aircrews experiencing mid-air collisions and the reported radar transparency of many spherical UAP," Roe warned in his report, "it can not be said with certainty that UAP have not been primary factors in past catastrophic air crashes."

Many of these cases have been on file for decades, but as NARCAP investigators Carlos Guzman and Alphonso Salazar report, near-miss spheres dogged airliners over Mexico as recently as January. There's plenty of material here. But getting people to take a look is another matter.

"While a proactive approach toward UAP and aviation safety may cost money and even political support from certain political bodies," writes Haines, "can the ongoing state of inaction and passivity toward the problem of UAP really be justified? If the governments of Chile, France, Peru, and Uruguay can establish official study commissions (made up of civil aviation, academic, military aviation, and private organizations) to investigate the safety implications of UAP, why can't the USA, England, Germany and others?"

Noting how pilots routinely undergo simulator training for relatively rare events such as wind shear, Haines argues it's illogical for the FAA to ignore the documented UAP hazards. "NARCAP believes that enough is known about the 'usual' flight behavior of UAP to be able to plan an effective special pilot recurrency flight training curriculum for use in airline flight simulators," Haines writes.

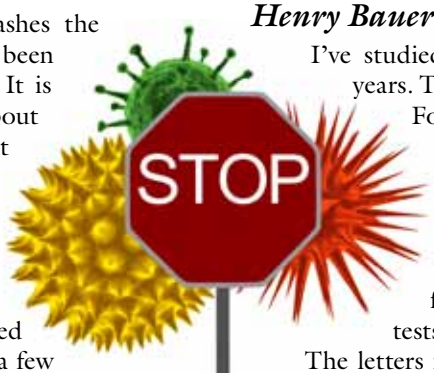
Oh really? This is the part where, were this any other issue, you'd expect the usual aviation experts to chime in. Except they won't. They'll just ignore it. As usual. Because they can.

"Knowledge isn't knowledge unless there's a social sanction for it," says Roe. "So this is an experiment, really. Science is a slow process."

Given our recent history, it'll take a major accident to grab anybody's attention.

BILLY COX is a reporter for the *Herald Tribune* in Sarasoga, Florida. His blog, De Void, is "the mainstream media's lonely UFO web log." Says Cox: "When I started De Void I was naïve enough to think I could offer myself as a sacrificial bridge across which the mainstream media would stroll and open up a new frontier. It's three years later, and not one has walked across that bridge yet."

Readers React to "HIV Does Not Cause AIDS"



Henry Bauer's HIV denialist article rehashes the same old, worn out allegations that have been floating around the Internet for decades. It is true that there are unanswered questions about HIV/AIDS (and many other diseases), but to deny what has been clearly established based on opinion rather than scientific evidence is hardly convincing. Bauer's references, for the most part, are to his and other HIV-skeptic publications rather than the volumes of scientific studies conducted over the past 30 years. In fact, more than a few of his unreferenced assertions are notably incorrect (see below). Either denialists like Bauer choose to ignore the facts, or they truly do not know or understand them.

If facts are not important to Bauer, I suggest that he spend some time at a community-based AIDS service organization. I challenge him to look into the eyes of a woman dying of AIDS who has been infected by an HIV-positive partner and tell her that HIV is not sexually transmitted. I challenge him to speak with a nurse who contracted HIV from a needle stick and tell her that there are "no authenticated cases" of occupational exposure. I challenge him to tell the late tennis player Arthur Ashe's widow that he did not develop AIDS as a result of a blood transfusion with HIV-contaminated blood. I challenge him to talk to someone with AIDS who was on the brink of death before beginning "toxic" antiretroviral therapy, who now is well and holding down a job. And finally, I challenge Bauer to confront a woman who bore a child infected with HIV, because she did not know she was HIV positive and had no access to therapy when she was pregnant, and tell her that HIV is "not infectious."

As someone who has worked in HIV/AIDS at the Federal, state, and local levels since the beginning of the epidemic, I believe it is the HIV denialists themselves who have "damaged the health of untold numbers of people." It is time to stop beating this horse to death and move on.

—Judy Murphy
Olympia, Washington

Judy Murphy is a former Deputy Director of Communications, National Institute of Allergy and Infectious Diseases, National Institutes of Health; Office of HIV/AIDS Prevention, New Mexico Department of Health; United Communities AIDS Network.

I was shocked that you would publish an article entitled "HIV does not case AIDS." Despite the pseudo-science in the article, there is broad scientific consensus as to the HIV-AIDS connection. Articles such as yours cause a great deal of harm.

HIV+ individuals who believe your article may 1) defer life-saving medical treatment, or 2) may believe they do not have to practice safer sex, causing the spread of the virus.

Shame on you.

—Denis LeBlanc
Ottawa, Canada

Henry Bauer responds:

I've studied scientific controversies for more than 30 years. That's how I became interested in HIV/AIDS. For about a decade it interested me purely as another example of a controversy. Then I came across an assertion that couldn't be true if the mainstream position was correct, and I checked the cited source fully expecting to discredit that assertion. I was astonished to find, instead, that the published data on HIV tests prove the mainstream view to be wrong.

The letters from Murphy and LeBlanc are typical emotional outbursts instead of substantive discussion that we AIDS Rethinkers and HIV Skeptics face from defenders of the orthodoxy. Why don't Murphy and LeBlanc say explicitly what I've got wrong in my book, *The Origin, Persistence and Failings of HIV/AIDS Theory*? Up to now no one has. Indeed, the CDC wrote that I am correct about the regularities and trends displayed in the data.

Murphy rehashes the same old, worn out, undocumented anecdotes that have been floating around the Internet for decades. She cannot cite tests approved to diagnose HIV infection because there are none; that purported woman with an "HIV-positive" partner dying of AIDS could not know that her partner is HIV-infected–no one could. There are no authenticated cases of needle-stick HIV infections, so again Murphy tells a story instead of citing a documented case. Duesberg (*Inventing the AIDS Virus*) and others have pointed out that hemophiliacs did not experience increased mortality in the AIDS era until they were fed AZT. Root-Bernstein (*Rethinking AIDS: The Tragedy of Premature Consensus*) emphasized that people receive blood transfusions when they are at death's door, without any help from "HIV." Murphy should have been at the Rethinking AIDS conference (http://ra2009.org/) to look in the eyes of Lindsey Nagel's parents, who rescued their "HIV-positive" daughter from AZT poisoning by rejecting orthodox opinion and hiding from the HIV/AIDS police. Murphy could also have met many gay men who credit their present good health to avoiding antiretroviral drugs while watching friends succumb to them. As to the Lazarus effect, Murphy could have heard Dr. Claus Köhnlein on why "antiretroviral" drugs are sometimes useful against fungal infections, not against some purported "HIV." By the way, Köhnlein, like Dr. Juliane Sacher, has a documented better record of saving AIDS patients from death than do the antiretroviral-drugs-dispensing robots.

LeBlanc says, "there is broad scientific consensus as to the HIV-AIDS connection." Who denies that? But so what? Any familiarity with history of science reveals that such broad consensus is often wrong on important questions.

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René Verreault

Swinging Anomalies

Originally proving Earth rotation, Foucault pendulums now seem to detect Moon motion

One would imagine that a device as simple as the pendulum would have long ago revealed all its secrets to physics. In fact, it hasn't. Despite more than a century of mathematical studies by hundreds of physicists and mathematicians, including a couple of Nobel prize winners, a few subtle deviations in its motion still seem to escape explanation by both Newton's and Einstein's gravitation theories. For the past 50 years in particular, the subject has been mired in controversy. In an attempt to understand how and why, let's look at a short story of the Foucault pendulum.

Experiments first

After Galileo's excommunication in 1633 for teaching, according to Copernicus, that the Earth was rotating under a sky with fixed stars, it took a few centuries for someone to come up with the first experimental proof of the Earth's rotation. In 1851 Jean-Bernard Léon Foucault, working on a lathe in his cellar, had one end of a slender rod fixed into the lathe. He then noticed that if he manually forced the free end of that rod to swing in a vertical plane, the rod maintained its vertical direction of vibration even if the lathe was slowly rotated by hand. Mentally transposing that rod to a long hanging wire clamped in a fixed position relative to the Earth, he figured out that, from inertia, a swinging mass at the end of the hanging wire should behave similarly. If the sky were to rotate about a static Earth, the oscillation plane would retain its orientation relative to the floor. If, on the contrary, the sky does not move but the Earth rotates, say in a counter-clockwise direction, then the oscillation plane would appear to rotate, or precess, relative to the floor in the opposite direction. By observing, in fact, the precession of the oscillation plane, Foucault proved experimentally that, contrary to the previous Church belief, Galileo was right in his claim that the Earth was rotating, not the sky.

Nevertheless, people in the 19th century found that duplicating Foucault's experiment was not as easy as they had imagined. Although the apparently simple instrument behaved roughly as expected during the first minutes after starting up, it soon developed all sorts of peculiar deviations that modern physicists and mathematicians have not yet completely reduced to equations even today.

What is understood

As early as May 1851, Sir George Biddell Airy, Astronomer Royal, showed that the non-linear restoring effect of the gravitational force gave the pendulum's bob a tendency to precess if it pursued an elliptical trajectory. A major improvement in interpreting the orbits of the bob occurred in 1879 with the doctoral thesis of Heike Kamerlingh Onnes, who would later discover superconductivity and be awarded a Nobel Prize for it. Throughout his 290 pages of equations, Kamerlingh Onnes demystified some of the unwanted elliptical orbits as being due to the lack of symmetry of the pendulum's suspension. Even today, a perfectly symmetric suspension has not yet been achieved. But much effort has been made so that the deviations can be accounted for by calculation. (Significant contributions to such an understanding of Foucault's pendulum have been made by Alexander S. Chessin (1895), John Hopkins University; William D. MacMillan (1915), University of Chicago, whose name was later given to a Moon crater; Aladine C. Longden (1919), Knox College, Illinois; Martin G. Olsson (1978), University of Wisconsin; Robert Latham (1980), Imperial College, London; Robert A. Nelson (1985), University of Maryland; and by Alfred Bryan Pippard (1988) from the Cavendish Laboratory in U.K.)

Nevertheless, none of the Foucault pendulums built since 1851 were meant to make precise measurements of the Earth's rotational speed. Their most frequent use was to serve as an utterly simple pedagogical instrument for illustrating some basic laws of physics or, in a similar way, to decorate museums and institutes while promoting science to the general public. In those implementations, the major drawback of the free (ordinary) pendulum was the rapid decay of its oscillations. In 1980 Carl F. Moppert and William J. Bonwick at Monash University stated that even some 130 years after Foucault's original performance, a run with an ordinary pendulum "takes, at the most, three hours…" It is thus not surprising that, in an effort to circumvent the rapid decay and the early onset of uncontrollable ellipses, physicists and engineers took up the

challenge of designing systems that would sustain nice linear oscillations indefinitely.

Pioneering work in that direction was achieved by Fernand Charron in 1931 at the Catholic University of Angers, France. The pendulum swing was amplified by synchronized magnetic impulsions (parametric amplification) until the wire touched the inner part of a friction ring (the Charron ring) placed a few centimeters below the suspension point. Any lateral movement of the wire at the end of the swing was therefore efficiently damped, so that the tendency to generate ellipses was hindered. Practically all sustained pendulums used for public demonstration today incorporate such damping rings in order to maintain suitably large amplitude oscillations. But all in all, it seems that the free pendulum still possesses one good quality that is inherent to many untamed, unstable systems, namely some kind of hypersensitivity.

Speaking of untamed pendulums, a word must be said about suspension systems. Every "textbook" pendulum is in fact a mathematical idealization where a point mass revolves about a fixed suspension "point." Such a mathematical pendulum consists of a point mass (the bob) moving on the surface of a sphere of constant radius (the pendulum length). However real life pendulums involve a spatially extended bob moving about a mobile instantaneous center of rotation located somewhere within a strained region of a clamped wire, which creeps under traction, or inside the deformed contact area of an (initially) sharp point or knife edge that ends up being crushed by compression. These permanent deformations of the heavily stressed suspension region finally alter an essential characteristic: the putative constant effective length of the pendulum.

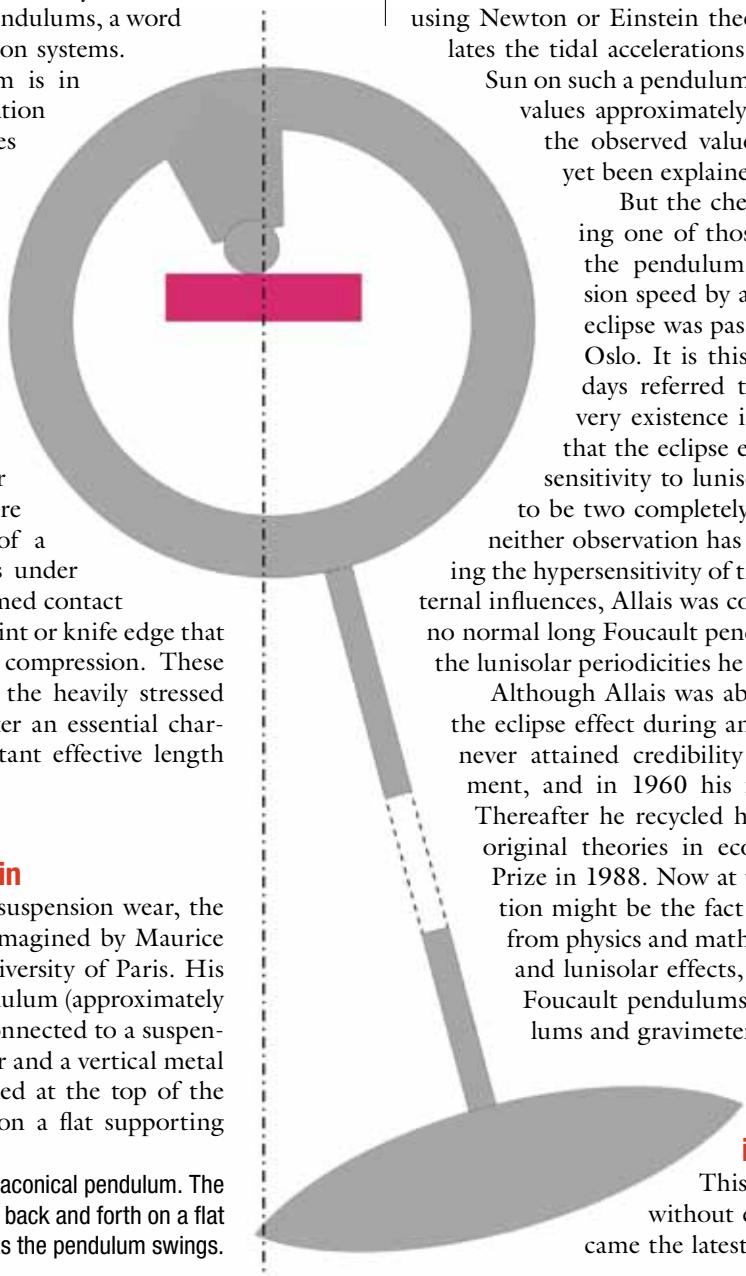
Where controversy sets in

In an attempt to minimize suspension wear, the paraconical pendulum was imagined by Maurice Allais, a physicist at the University of Paris. His design was a short rigid pendulum (approximately 1 meter) where the bob is connected to a suspension ball through a metal bar and a vertical metal ring. That ball, which is fixed at the top of the inner ring surface, rolls upon a flat supporting surface when the pendulum is swinging. The suspension losses are thus reduced, but at the expense of adding one new degree of freedom: such a system can twist freely about the rod axis. By the same token, the instability and the sensitivity to external influences are increased. In hindsight, one is tempted to say that in compensation for this increased complexity two unexpected observations occurred: (1) the Moon periodicities in the precession angle of the swinging plane and (2) the so-called Allais effect in 1954.

Allais routinely organized a number of nonstop, day and night, 30-day-long experiments, where a team of students on shifts would restart the pendulum every 20 minutes for 14-minute long episodes followed by 6-minute pauses. He was able in that manner to detect the lunisolar periodicities of the tides in the time series of the azimuth changes (the precession) at the end of each 14-minute episode. So far, so good. But if, using Newton or Einstein theories of gravitation, one calculates the tidal accelerations exerted by the Moon and the Sun on such a pendulum, one comes up with precession values approximately 8 orders of magnitude below the observed values. That phenomenon has not yet been explained.

But the cherry on the icing appeared during one of those 30-day runs in 1954, when the pendulum showed a change in precession speed by a factor of 5 just as a total solar eclipse was passing some 1,300 km away near Oslo. It is this "eclipse effect" that is nowadays referred to as the Allais effect, and its very existence is controversial. It may well be that the eclipse effect and the above mentioned sensitivity to lunisolar tide periodicities turn out to be two completely distinct phenomena. Anyway, neither observation has been explained so far. Regarding the hypersensitivity of the paraconical pendulum to external influences, Allais was confident enough to predict that no normal long Foucault pendulum should be able to detect the lunisolar periodicities he observed.

Although Allais was able to repeat the observation of the eclipse effect during another solar eclipse in 1959, he never attained credibility within the physics establishment, and in 1960 his financial support disappeared. Thereafter he recycled himself as an economist whose original theories in economics earned him a Nobel Prize in 1988. Now at the age of 99, his sole consolation might be the fact that roughly a dozen disciples from physics and mathematics are still chasing eclipse and lunisolar effects, not only with paraconical and Foucault pendulums, but also with torsion pendulums and gravimeters.



Suspension principle of the paraconical pendulum. The pendulum-ring-ball unit rolls back and forth on a flat supporting surface as the pendulum swings.

How I became involved in the controversy

This story would not be complete without explaining how, in 2006, I became the latest recruit among those disciples.

As a professor of physics at the University of Quebec at Chicoutimi, Canada, I was vaguely aware that, over a 30-year span, students involved with the Foucault experiment routinely measured precession speeds in "error" by 15-20% with respect to the theoretical value and consequently would receive a "D" for their untidy work. Then in 2001, when a student named Sonia asked me to supervise her pendulum experiment, I decided that this final attempt (as the honors program in physics at the school was being phased out) should be a scientific beauty. We needed height and quiet. Consequently, I finally convinced the Bishop of Chicoutimi to grant us the exclusive use of the cathedral for 36 hours (and by the same token taking a secret revenge over the abuse that Galileo had suffered). We then hung a 10 kg mass from the 17.6 meter high roof structure and made it swing freely for 12 hours with no significant ellipse until the end. (In a different experiment in 2006, a more aerodynamic version ran for 36 hours!–not 3 hours–without generating any significant ellipse, while the cathedral floor revolved by more than one complete turn with respect to the oscillation plane of the pendulum.) Using my earlier research experience with remote sensing instrumentation, the pendulum position was recorded 30 times per second via a high definition video camera at an accuracy of ±180 micrometers (today ± 20 µm). To sum up, I think that I can claim without offending modesty that we ended up with a high performance instrument, which may mark a major breakthrough in Foucault pendulum implementation since 1851.

Conclusion

After applying image processing to the recorded cathedral data, it turned out that precession speed variations of ±10 % were observed, but with a measurement error so small that there was no room for student untidiness. In addition, the three most significant lunisolar periods of the tide in the nearby Saguenay River were also detected with ~10:1 signal to noise ratios in the waveform of the precession speed variation, despite Allais' prediction that a long Foucault pendulum could not detect the lunisolar periodicities.

To date, all attempts to explain that result quantitatively with known theories of gravitation have failed by many orders of magnitude, either by considering the direct gravitational effect of the Moon on the pendulum, or by considering the gravitational effect of the incoming tidal water mass in the Saguenay River. The subject remains wide open for theoretcians.

It is also interesting to note that, contrary to Allais' opinion, a high performance standard Foucault pendulum may be suitable for detecting such anomalies, which are suspected to be of gravitational nature, although there is no actual proof of this yet.

Prospective views

It was only in 2005 when I looked at the literature before publishing these findings that I came across the work of Allais and his successors. Among the latter, Thomas Goodey may be considered as one of the most dedicated pendulum researchers today. Apart from acting as the webmaster of an important website on the subject (http://www.allais.info), he has greatly upgraded Allais' paraconical pendulum, now re-christened the "ball-borne pendulum," by producing a robotized version that can operate unattended for several days. On some occasions his pendulum has also shown lunisolar periodicities and eclipse anomalies. It must be emphasized that the numerous attempts to duplicate Allais' results are confronted with the fact that the circumstances surrounding any two eclipses are never the same and, even for the same eclipse, different experimenters are usually stationed in different locations with respect to the eclipse line.

Photo credit: Thomas Gooey.

Goodey's ball-borne pendulum. The supporting flat surface (not seen) is part of a very rigid massive tripod structure. The brass lenticular bob can be observed at the end of the stainless steel rigid rod. Here, the suspension ring is replaced by a rigid stainless steel rectangular bar-rod assembly.

Photo credit: Thomas Goodey

Gathering of pendulum specialists in Maldives for the Jan. 15, 2010 annular solar eclipse. From left to right: Victor Lesanu, demonstrator at the Suceava Planetarium, Romania; Maxime Verreault, professor of physics at College Ste-Foy, Canada; Ed Oberg, retired from NASA, Australia; René Verreault, professor of physics at University of Quebec, Canada; Hector Munera, professor of physics at the International Physics Institute, Colombia; Dimitrie Olenici, director of the Suceava Planetarium, Romania; and Thomas Goodey, independent researcher, England.

The latest episode in this chase occurred earlier this year with the annular solar eclipse of January 15, 2010 over the Maldives. That expedition turned out to be the most important gathering of pendulum specialists ever. It is still too early to give a final assessment of the results. For instance, the recorded data for the 9-meter long Foucault pendulum totals 1.5 terabytes of video images to be processed. The development of powerful software to cope with such experiments is presently well underway. Meanwhile, the research effort goes on, gathering as much experimental evidence as possible, partly by chasing all the available eclipses with the available instrumentation, partly by designing robotized instruments that might be operated in concert with different research units distributed along the path of the forthcoming 2017 eclipse over North America.

On the theoretical side, there might be a light at the end of the tunnel. Independent research on the properties of light reported in a survey by Chris P. Duif, a physicist at Delft University of Technology in the Netherlands, shows that there is no experimental justification for postulating the speed of light as a universal constant. New theories of gravitation, which encompass more observed phenomena than General Relativity does, are being worked out, namely one by Reginald T. Cahill at Flinders University, Australia, and another one by Hector A. Munera at the International Center for Physics, Colombia. It is hoped that such theories will finally allow crucial pendulum experiments to be designed around the Earth-Moon-Sun alignments.

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RENÉ VERREAULT is a physics professor at the University of Quebec at Chicoutimi, Canada. His principal research interests include aerial remote sensing and the anomalous response of pendulums to positions of celestial bodies. This interest converted him into an academic eclipse chaser twice a year, trying to accumulate experimental evidence while otherwise working on pendulum theory.

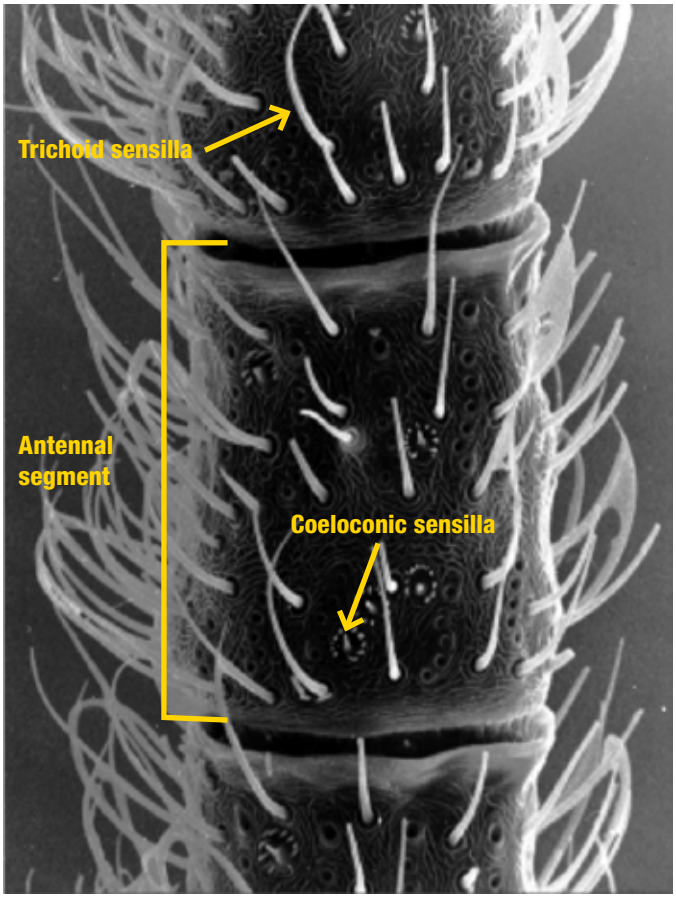
Photo credit: University of Quebec

Thomas M. Dykstra

Insects and the Speed of Smell Problem

How do insects smell? The usual answer is: "They smell with their antennae!" Everyone seems to know this. From the earliest grades it is taught to schoolchildren who sometimes call the antenna "feelers." We know that if we excise an insect's antennae, it is no longer able to smell. So the topic seems to be an open and shut case.

The textbooks are rather clear about the common thread that connects the theory of insect olfaction together. This thread is diffusion. For example, the odorant molecules diffuse through the air. They then land on the antennae. The odorant molecules diffuse through the external wax layer. Concluding this migratory journey, they diffuse through the tiny pores on the sensillae. Next, they are picked off by an odorant binding protein (OBP) and diffuse across the sensillar space, sometimes referred to as the lumen, which is a sea of gel-like material. Without diffusion, the odorant never makes it to the receptor on the dendrite and insects would never smell. It is cut and dry. There is seemingly nothing to dispute. The textbooks report this. The professors teach this. Nobody should contradict a textbook and nobody should disagree with the professor.



A scanning electron micrograph (SEM) of a representative insect antenna showing two types of sensillae.

Certainly, I felt this way when I graduated from Cornell University. I had no reason to question the wisdom of my professors, nor the textbooks they taught from or maybe even penned. Many years later, I was obligated to research the details of this theory. It was in looking at the details that problems arose for me, and not just me, because there is universal confusion in the entomological ranks over exactly how insects smell with their antennae. Using hard science as well as logic and reasoning, let's look at the details and see if we can explain where this confusion stems.

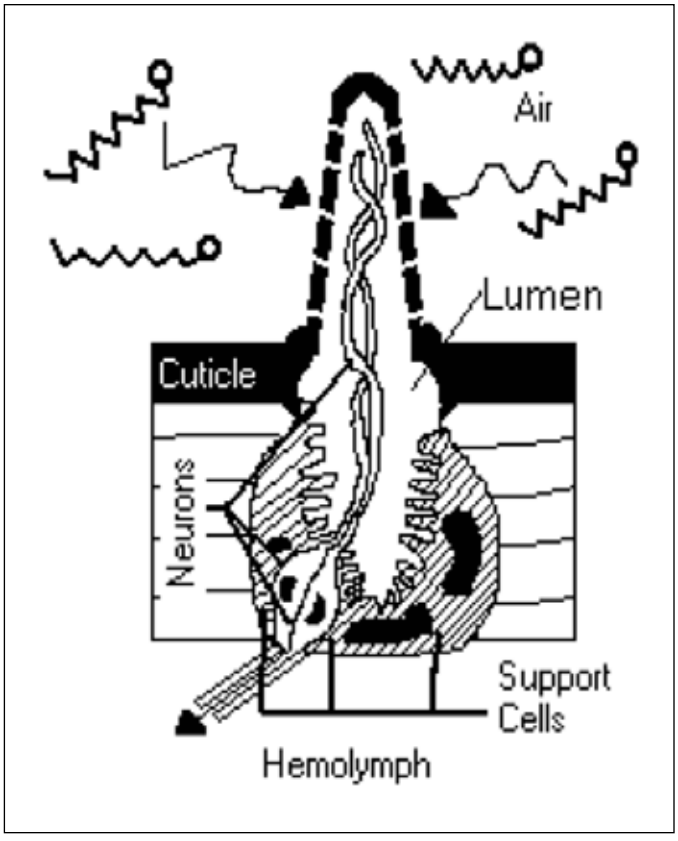
In order to determine how quickly an insect can smell, we need to first defer to the electrophysiologists. These scientists blow odorants across insect antennae and then record the nerve impulses. According to them, insects respond with these impulses between 1 and 10 milliseconds after initial odorant exposure. This is such a fast response that any significant delay would render the insect temporarily anosmic, which means unable to smell. Because insects are able to smell that fast, there can be no delays in the system. Only one serious delay would be enough to cast doubt on the current theory of olfaction.

Allow me to present several.

Odorant molecules pass through the air and are subject to wind currents. Getting them to land on the antenna is no small arbitrary feat. But it is nowhere near even this easy. Instead, the odorant molecules must land on only a small part of the insect's antenna, the sensilla. (see left) This is where odorant detection is known to occur, not the antenna proper. If you assume equal distribution of the odorant on the insects' antennae, then the system is highly inefficient because a good portion of the odorant will not land on the sensillae at all. In fact, you could make a good case for the odorant preferentially depositing on various parts of the body, much less the antennae. The laws of diffusion, which are based on random motion, teach us this.

In contrast to this, not only do we know that odorants preferably land on the sensilla, but 70% of the odorant lands on the distal half of the sensilla (Kanaujia and Kaissling, 1985), despite the surface area running between 20-49% of the total surface of the sensilla. Diffusion alone is not sufficient to explain this fact. This is the first clue that something is amiss with current insect olfactory theory.

Once odors are deposited on the sensilla, they must diffuse through the wax layer, which is continuous over the entire



A diagram of the sensilla in cross-section.

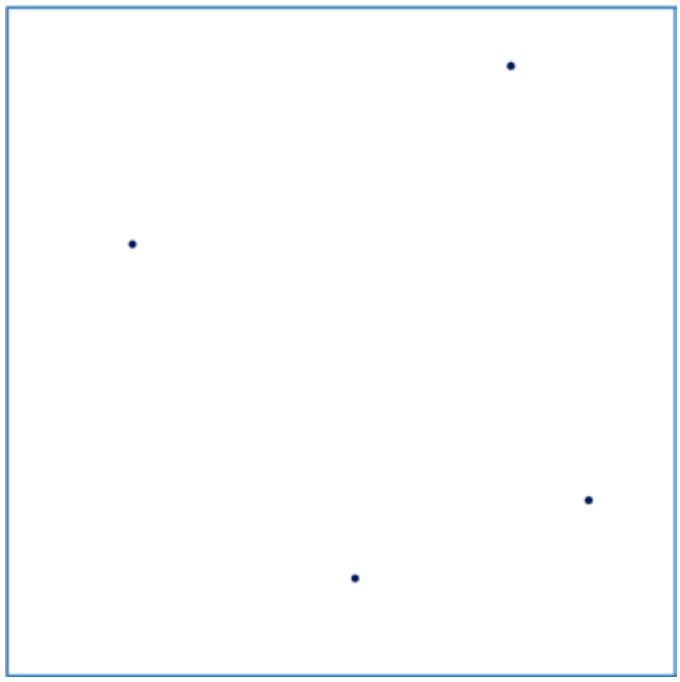
body of the insect. Insects have epicuticular waxes that are predominantly more than 20 carbons in length (McClain et al., 1985) with melting points starting at 40 C (Gibbs, 2002). For our purposes, however, antennal waxes have been shown to be between 35-39 carbons long (Arsene et al., 2004) often with even higher melting points. Since virtually all the epicuticular waxes will be solid at temperatures in which insects are active, odorant diffusion must be occurring through a solid. Admittedly diffusion can occur very slowly through some solids, but generally no diffusion of note occurs in any solid whatsoever. It is logical to assume that no diffusion occurs at all in this wax layer. It would otherwise defy physical laws. The insect olfactory theory teaches that odorants first embed themselves in the epicuticular wax layer. But if odorants do remain in the wax layer for extended periods of time, how do they ever make it to the dendrites located inside a sensilla? This is further contradictory evidence that the theory is in error.

But for the sake of continuing this discussion, let us assume diffusion occurs through the solid wax layer. The theory teaches that the odorant must be transported through tiny pores in the cuticle (see above). When you and I breathe in through our nose, we inhale air through two relatively large nostrils (several millimeters in diameter). This brings odorants into our nasal passages so that we may be able to detect (smell) them. Since insects do not breathe through their antennae, no similar mechanism is known to assist odorants in passing into these pores. More incredibly, these pores are between 6-65 nanometers in diameter (Steinbrecht, 1997). These pores are so tiny as to be very difficult to locate even on a scanning electron micrograph (SEM). The pores collectively represent about 1% or less of the surface area of the sensilla (see below). This fact severely reduces their random tendency to permeate the cuticle. Some researchers have reported that the wax layer is continuous over the pores (Steinbrecht, 1997), which just adds to the problem of odorant transport.

Again, for the sake of argument, let us assume the odorant permeates the cuticle with ease. The odorant now finds itself inside the sensilla. At this point, everything must stop. The reason is that the sensillar lymph, or liquid inside the sensilla, is predominantly water, and since many of the odorants are lipids, and thus hydrophobic, the odorant cannot dissolve in this watery matrix. The odorants, especially the Lepidopteran (butterflies and moths) pheromones, collect at this interface and would accumulate over time. This is a delay the insect cannot afford.

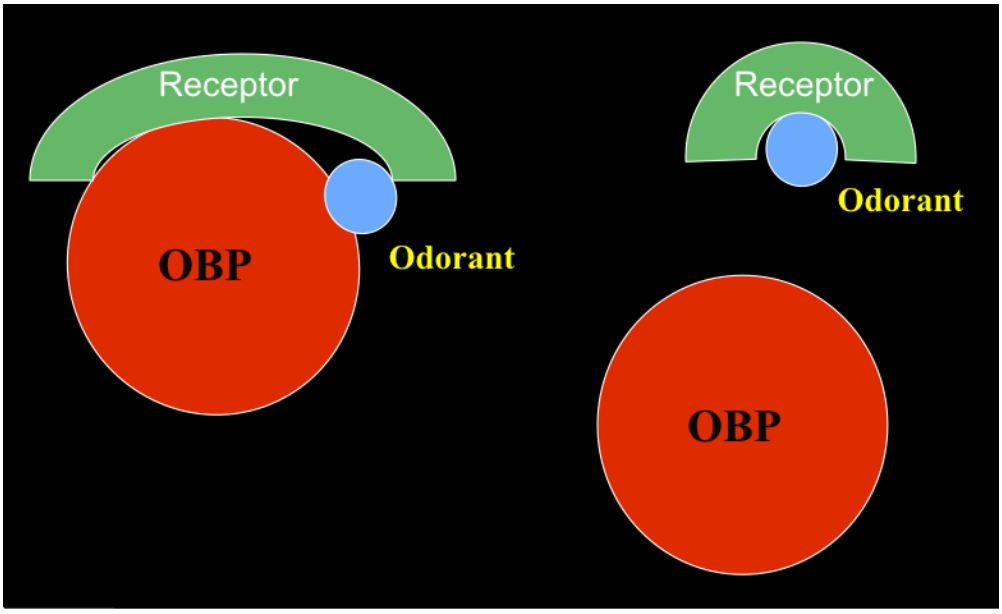
Unable to overcome the delay, but able to overcome the solubility problem, researchers discovered odorant binding proteins. Odorant binding proteins are located in the sensillar lymph and are known to bind to odorants, essentially irreversibly. The theory teaches that these large proteins of about 14 kDa (more than 60 times larger than a given odorant molecule) bind the odorant and may be thought of as "ferryboats" that solubilize and thus transfer the odorant to the dendrite. Although this is scientifically possible, there is a temporal issue. The odorant and the binding protein are still subject to diffusion laws.

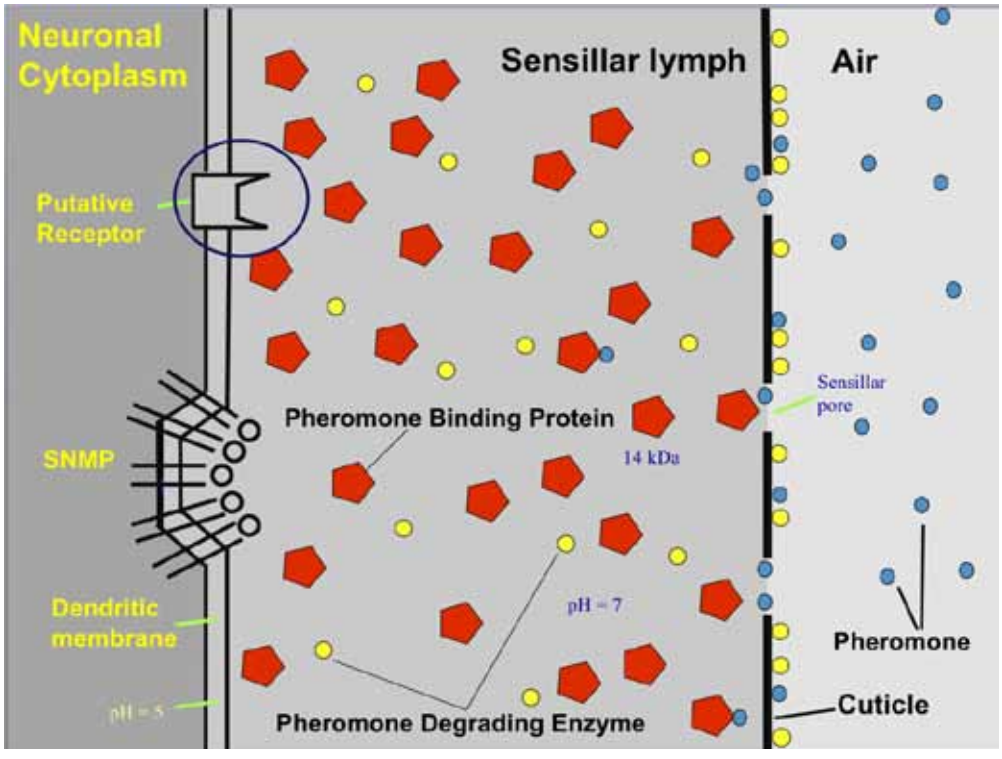
Diffusion coefficients are a measure of how quickly molecules diffuse through a given substance. Diffusion coefficients



Representative surface area of a *sensilla trichodea* on *Bombyx mori* and the actual number of pores and pore size drawn to scale

are commonly determined in either of two mediums, those being air and water. For comparative purposes, water is the most appropriate medium to use. If I ignore the fact that diffusion coefficients are given for two dimensions and I make a linear extrapolation for three dimensions (an illegal move on my part), and if I assume a protein concentration gradient that doesn't exist, and if I assume a pure water solvent represents the sensillar lymph *in vivo,* and if I further assume that the dendritic sheath does not mechanically cover any part of the dendrite, and then assume that there are no bound water molecules to the binding protein thus slowing down its diffusion coefficient, and that there is no change in temperature or viscosity over time, then I can calculate a rough, albeit, incorrect diffusion coefficient. By completely ignoring all the valid conditions discussed above, a 14 kDa globular protein will diffuse across the sensillar lymph of a trichoid sensilla (in *Antheraea polyphemus*) in about 12 milliseconds (Brune and Kim, 1993). What does this all mean? This one step takes more time than the total time it takes an insect to respond to an odorant (1-10 milliseconds). Even after substantial and purposeful cheating, this estimate is too slow to satisfy the current theory of insect olfaction.





So let us bypass this problem and assume the odorant reaches the dendrite still attached to its odorant binding protein. Some researchers believe that the odorant binding protein separates, or dissociates from the odorant, and others do not. If dissociation does occur, then the odorant would bind to a dendritic receptor. If not, then the whole odorant/odorant binding protein complex would bind to a dendritic receptor and a step would be saved (see top left). Assuming dissociation, analysis of an additional step becomes necessary.

Liquids can often be characterized as acidic, like orange juice, while others may be considered basic, like milk. The liquid surrounding a dendrite is very close to neutral, neither acidic nor basic. A pH value of 7 is assigned to these liquids and this is the pH in which most organisms operate. Fluctuations down to 6 (more acidic) or up to 8 (more basic) are highly unusual. Under normal pH values of 7, the odorant binding protein dissociates from the odorant on the order of 100 seconds (not milliseconds). This time period is totally incompatible with the theory. If, however, the pH is reduced to 5, then dissociation can occur in 9 milliseconds (Leal et al., 2005). But since a pH of 5 does not exist in the sensillar lymph, dissociation cannot occur.

However, a highly localized pH of 5 can exist at the dendritic membrane. Although this has not been shown for insects, it has been shown to occur in other organisms and so we will assume this is

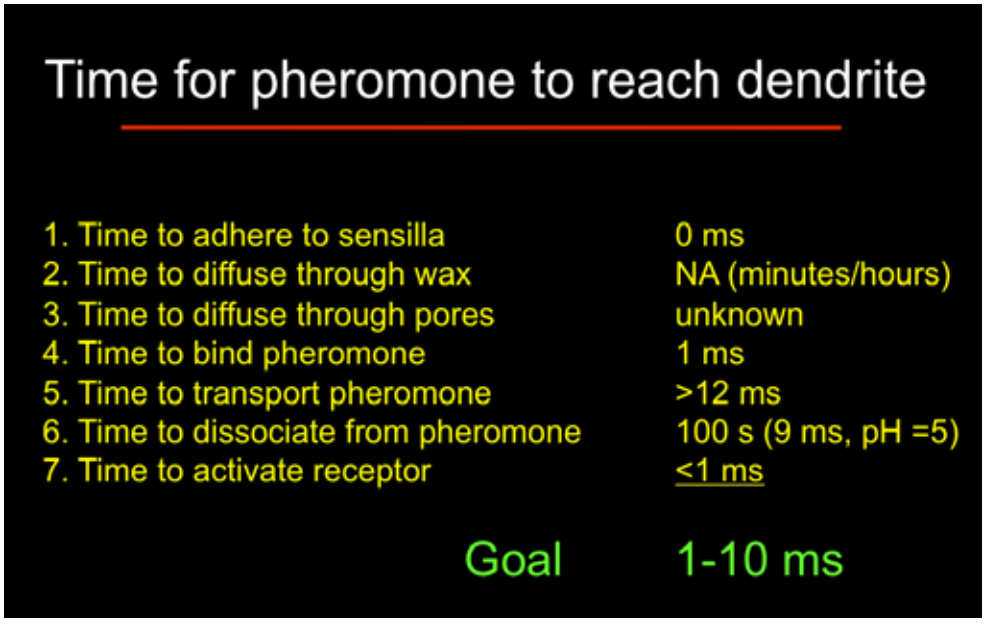
valid for our insect system. Unlike the sensillar lymph, this pH is membrane bound. Under these conditions then, physical contact between the molecular complex and the membrane is practically required in order to instigate dissociation. The dissociated odorant must then reenter the sensillar lymph and further diffuse to a receptor. Diffusion is not strictly a lateral process, but it would need to be in this case since the odorant cannot reenter the sensillar lymph. Not only because of the additional time that would be required for this action, but also because the odorant could very easily get picked off by another binding protein before it had a chance to bind with the putative receptor. It may even get picked off by the same protein that just released it.

Immunological studies reveal the putative odorant receptor to be in very low density on the dendrite (Dobritsa et al., 2003). So, after dissociation, the odorant would be required to travel a significant distance in order to bind with the putative receptor. It follows then that additional time, above and beyond the necessary 9 milliseconds required for dissociation, would be absolutely required. This temporal component has not been determined or published, but even an additional 1 millisecond would make this final step irreconcilable with the theory. Already, this single 9 millisecond step (maybe longer) consumes most, if not all, of the time needed to explain the current theory of insect olfaction. My delays are now legion.

If the odorant eventually binds with the putative receptor, activation probably occurs on the order of picoseconds, and so this step should not be a rate limiting step in any way shape or form.

So I am unable to adhere to the current theory of insect olfaction on temporal grounds. But there are some additional problems related to the temporal dynamics that help to invalidate the theory. One of these is the presence of odorant degrading enzymes. These enzymes are reported in the literature to degrade pheromones (a special type of odorant) in about 15 milliseconds (Vogt & Riddiford, 1981). These enzymes are present on the outside of the insect antennae (page 11, bottom) and would degrade the odorant before it ever enters the sensillar lymph (Kasang and Kaissling, 1972; Mayer, 1975). They can also be found on the inside of the sensillae (Ferkovich et al., 1982) serving the same purpose. If the odorant does not immediately bind with an odorant binding protein, it is likely the odorant will be degraded by one of these enzymes. If the odorant is eventually released by an odorant binding protein at the dendritic membrane interface (discussed previously), these enzymes are available to quickly degrade the now exposed odorant. The presence of these enzymes on both the outside and the inside of the sensillae raises some pressing questions about why the insect is working so hard to degrade the odorant before it can reach the dendrite.

As I stated earlier, insects smell very quickly. A large number of scientific articles discussing insect olfaction pay homage to the extremely sensitive olfactory abilities of insects. Truly the insects do possess remarkable olfactory abilities. Unfortunately, as I have shown, there is nothing efficient about the system as it is currently described in the literature and in the classroom. The current theory is plagued by too many temporal problems. It simply is not scientifically valid.



A summary of the time problem in insect olfaction. Current theory says it happens in 1-10 ms, but the standard offered mechnism requires considerably more time than that.

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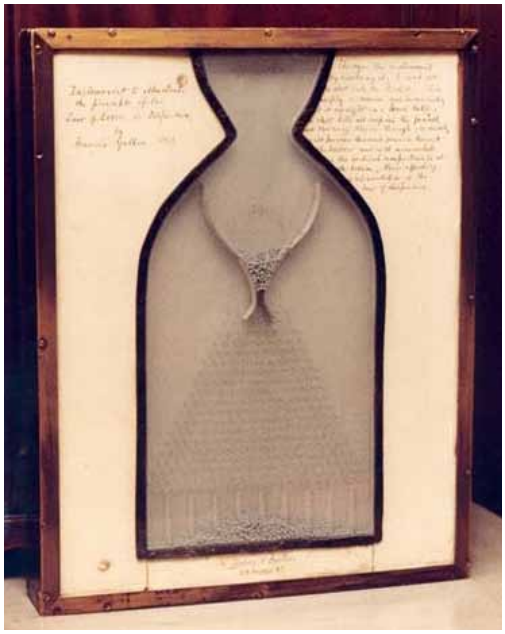
Robert G. Jahn and Brenda J. Dunne

The Effects of Human Intention on a Machine Named Murphy

The Princeton Engineering Anomalies Research (PEAR) laboratory experimentally explored the effects of human intention on the behavior of random physical systems for more than a quarter century. Most often this involved microelectronic random event generators (REGs) that produce a string of random binary samples, or bits, at a rate of 1,000 per second, in trials of 200 bits each. A human operator without any particular or noted "psychic" abilities attempted to influence the distribution of the output of the device as displayed on a computer monitor in accordance with his or her pre-recorded intentions ("higher" or "lower"). The generated data were then examined for correlations between the intentions and the output of the device.

PEAR's "benchmark results," which involved some 840,000 trials per intention by 91 different individuals over a 12-year period, showed statistically significant correlations between operator intentions and the mean counts of 200 sample trials. The likelihood of the degree of separation between "high" efforts and "low" efforts being due to chance alone was less than 5 in 100,000, an extraordinarily high degree of significance.

While most PEAR experiments involved REGs, other devices, such as a pendulum and a water fountain whose output was also random, were also used. Included among these was a random mechanical cascade (RMC) of small polystyrene balls bouncing randomly down among a set of dowels to end up in one or another of 19 plastic bins. Designated "Murphy," this device yielded an output similar to that obtained with the REG and other devices. In the following excerpt from their forthcoming book, Consciousness and the Source of Reality *(ICRL Press), Robert Jahn and Brenda Dunne describe Murphy and their experimental results:*



Galton Board on Display at the Galton Laboratory, University College, London. "Instrument to Illustrate the Principle of the Law of Error or Dispersion." Image courtesy Stephen M. Stigler.

Early in 1979, several months before the PEAR lab was formally established, we had an opportunity to visit the Museum of Science and Industry in Chicago. There we noticed and admired a large random mechanical cascade device, modeled after the well-known Galton desk design that demonstrated the development of random Gaussian distributions by the compounding of a multitude of binary events, or what is commonly known as the "bell curve." As we stood before the apparatus and playfully attempted to encourage it to shift its distribution of cascading marbles to the right, we were amused and intrigued by the clearly right-shifted distribution it produced in response. During this time a group of school children looked on, listening in disbelief as their instructor, whose back was to the device, explained how it would always generate a properly centered normal curve. We decided on the spot that we needed to have such a machine in our new laboratory, and shortly thereafter we designed and built a version of it in our own engineering school machine shop.

Originally, this had seemed like a relatively simple task, but it actually took the better part of three years to complete. During that period it presented an incessant sequence of technical challenges, confirming Murphy's Law "Anything that can go wrong, will," and resulting in the device acquiring the affectionate nickname of "Murphy." It even surpassed that law by demonstrating a few things that couldn't possibly go wrong, such as occasionally slicing some of the balls in half. There was one memorable occasion when after our technician had spent several months unsuccessfully trying to design a funnel system that would preclude the balls jamming in the bin counters, he was given warning that if the problem wasn't solved more expeditiously "heads would roll." As this message was being transmitted, the platform supporting the ball distribution suddenly collapsed and all of the balls that were in the collecting bins crashed loudly to the floor of the storage reservoir, terrifying the poor man!

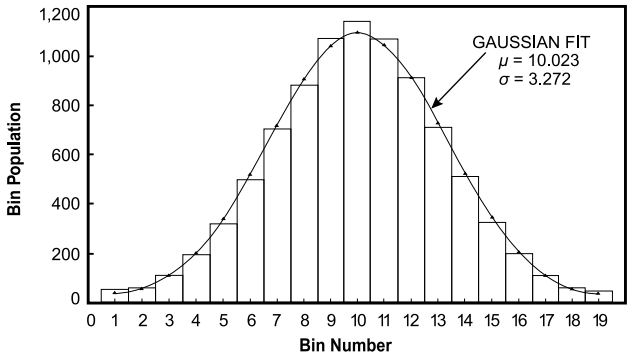
While our various microelectronic REGs, which permitted the rapid accumulation of large bodies of data, ultimately became the workhorses of the PEAR laboratory, it was Murphy, the random mechanical cascade (RMC), that turned out to be its most popular experimental device, and ultimately, its best public relations representative. Over the years, numerous TV producers were fascinated to film Murphy for their programs, and he even appeared on the front page of the *New York Times*. In addition, many of the countless school children who visited PEAR used it as a model for designing their own experiments in probability. More than any of our other devices, Murphy took on a distinctly anthropomorphic character,

and our operators usually addressed him by name. On one occasion, when the machine was down for repairs for a few days, one of his operators actually sent him a "get well" card.

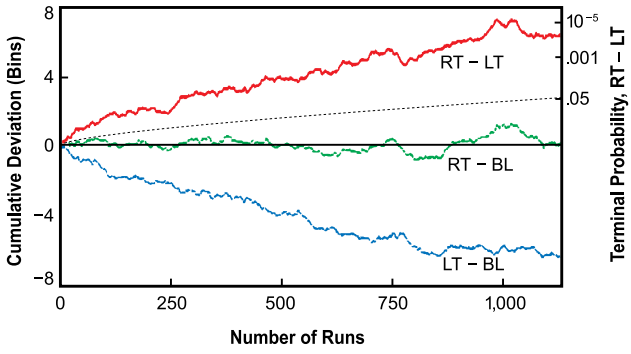
Our earliest REG results had clearly posed the categorical question of whether similar phenomena could be demonstrated using a broader range of random processors, in particular with devices of macroscopic scale, and Murphy provided an ideal opportunity to address this. Ten feet high and six feet wide, the machine was mounted on a wall in the reception area of the laboratory, facing a comfortable couch. In operation, 9,000 precision-cast polystyrene balls, ¾" in diameter, trickled downward from an entrance funnel into a quincunx array of 330 nylon pegs, also of ¾" diameter, mounted on 2¼" centers. The balls bounced in complex random paths through the array, colliding elastically with the pegs and with other balls, ultimately accumulating in nineteen parallel collecting bins across the bottom. The fronts of the peg chamber and the collecting bins below it were made of transparent plastic sheets so that the cascade of balls and their developing distributions of bin populations were visible as feedback to the operators. After considerable empirical modifications to determine appropriate combinations of peg spacing, ball inlet arrangement, and material properties, the resulting distribution of ball populations in the collecting bins could be tuned to a good approximation of a Gaussian distribution.

The entrance to each collecting bin was equipped with a photoelectric sensor that detected and recorded the arrival of each ball, and the growing populations of all bins were displayed on LED counters below each bin, and graphically on a computer terminal screen. The disposition of each of the 9,000 balls in every run was recorded on-line in an appropriately coded computer file that later could be accessed to yield a faithful reproduction of the complete history of all of the bin fillings for more detailed study, or to calculate statistical properties of the terminal distributions. In addition, a photograph of the distribution and LED-displayed bin counts was taken after every run. As with all PEAR experimental devices, extensive calibrations were performed to provide background statistical data and to explore possible sensitivities to temperature and humidity, which were routinely measured and recorded before each run.

"Murphy," the Random Mechanical Cascade Machine, Operating in PEAR Reception Area



Random Mechanical Cascade Bin Populations



RMC Cumulative Deviations: All Differential Data.

The experimental tripolar RMC protocol called for the operator, seated on the couch approximately eight feet from the machine, to attempt to distort the distribution of balls in the bins toward the right or higher numbered bins (RT), or to the left or lower numbered bins (LT), or to generate baselines (BL) with no conscious intention. These efforts were interspersed in concomitant sets of three runs, each lasting approximately twelve minutes. The hundreds of experimental data sets thus obtained displayed similar anomalies in their overall concatenations to those achieved in the REG studies, including strongly operator-specific patterns of achievement. Detailed tabulations and cumulative deviation and structural graphs of the results can be found in a number of the archival references. Above we include only the cumulative deviation plots of all data acquired in an extended sequence of these experiments.

Unlike the REG experiments, where theoretical baselines confirmed by calibration were available for comparison with the operator-generated data, the internal mechanics of the RMC were too complex to submit to detailed theoretical prediction. This forced us to utilize a differential criterion based upon comparison of the empirical means of the RT and LT distributions with the local baseline of the same experimental set. This strategy had the advantage of minimizing any spurious effects of short- or long-term drift in the machine operation, but introduced the confounding possibility that an

operator might inadvertently influence the empirical baseline distribution as well.

And indeed, as we examined the overall cumulative deviation graphs (previous page), plotted as RT – LT, RT – BL, LT – BL differences, an intriguing secondary anomaly appeared. Whereas it was abundantly evident that the overall RT – LT mean separation was statistically highly significant ($\varepsilon\mu = 1.93$, $z\mu = 3.89$; $\rho\mu = 5 \times 10^{-5}$), it also displayed a curious asymmetry in the LT direction. Namely, virtually all of the compounding RT – LT anomalous deviation was attributable to the LT – BL separation alone; the RT and BL evolutions were statistically indistinguishable!

For some time we attempted to resolve this asymmetry empirically: operators changed their positions on the couch, closed and opened laboratory doors, and one mounted a mirror on the facing wall and observed the reflected runs. One even stood on his head, but to no avail! It was several years later, in the course of our study of gender differences, that it was discovered that this propensity was entirely attributable to the tendency of many of the female operators to produce baselines that were strongly shifted in the right-going direction, thus producing results that showed a significant deviation in their LT – BL efforts, but a null result in the RT – BL. A similar gender-related trend subsequently was found to prevail in several other PEAR experiments.

As in the REG experiments, the total number of runs conforming to the intended direction to any degree was found to be considerably higher than the chance prediction, so that once again we concluded that the overall patterns of anomalous mean shifts of the mean were being compounded from an overall accumulation of small individual anomalous effects. We also again observed some operator-specific dependencies of the results on the secondary parameters of the experiment, such as the time of day, the volitional vs. instructed assignment of run order, or whether the LED count display was on or off.

Perhaps of higher importance, however, was the similarity of many of the individual operator cumulative deviation patterns with those they demonstrated in the microelectronic REG experiments. Despite their inherently stochastic character, the evident gross similarities of their signatures had major implications for experimental design and theoretical modeling. Namely, although the observed anomalous effects were clearly operator-specific and in many cases condition-specific, they appeared not to be nearly so device-specific, a feature later confirmed over a much wider range of physical processes, scales, and energies. Thus, once again, it appeared that any direct influence of operator consciousness on these widely different physical processes, e.g. the flow of electrons in the REG noise diode, or the cascade of balls in the macroscopic RMC, are less likely to be direct dynamical mechanisms than more holistic interactions with the statistical information common to both these systems.

Finally, we might note that although the RMC differed substantially from the REG devices in its scale and physical process, it retained a certain quasi-digital character in the manner in which it generated information. Specifically, each falling ball, upon collision with a peg, might be diverted either to the right or to the left, and it was the compounding of these binary right/left options that primarily determined the terminal distributions in the bins. To be sure, in this machine the binary right/left probabilities were not simply .50/.50, since the balls did collide with one another as well, and therefore their subsequent trajectories were not at all uniform, but nonetheless, a synthetic binary quantification could be, and actually was, imposed in the analyses.

A further step in tracking the ubiquitousness of operator-related anomalies, therefore, was to apply similar protocols to physical systems that were yet more analogue in character, even to those whose central random processes and outputs lent themselves to continuum representation. All of these experiments utilized similar tripolar protocols to those followed for their digital counterparts, and from this array of studies we broadened our conclusion that the specific character of the physical random sources employed was not a primary correlate of their anomalous responses.

When the PEAR laboratory closed in 2007, perhaps the most emotionally poignant moment was Murphy's disassembly. He had played a vital role in our program, both in the valuable data he had produced and in his contribution to the laboratory's physical and subjective ambiance. Fortunately, he has found a new home with an organization in California, Index Fund Advisors, whose staff seems to find him just as engaging and instructive as we did.

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Bernard O. Williams

Imaging the Human Energy Field

Research converging from many fields indicates that the body is a complex energy system, not merely a molecular, clockwork machine of cellular gears and parts that is often espoused in conventional medicine. Albert Szent-Giorgi, early in the 20th century, proposed that physiology should be studied from an electrical perspective because biochemistry is governed by the electrical forces in molecular processes. Robert Becker, in his study of electricity in growth and tissue repair, overcame much controversy to prove the importance of electrical currents in living bodies. Using Becker's principles, broken bones that won't mend spontaneously can often be healed by applying tiny electrical currents across the fracture. Bioelectromagnetics is the emerging science that studies how living organisms interact with electromagnetic fields.

The electromagnetic spectrum spans a broad range of frequencies and wavelengths, and living systems have evolved within the context of this energy spectrum. Claims for the existence of subtle energy fields in human beings have been widely accepted in various Eastern medical practices for many centuries, such as the concept of Qi in Chinese medicine and Prana in Ayurvedic medicine. Such ideas were rejected by Western scientists because they did not believe objective evidence could demonstrate these energy fields.

Kirlian photography

This situation began to change in the late nineteenth century, when photographs were made of electrical discharges from living objects when a strong electrical field was present. The term "electrography" was coined to describe these images explored by the Czech physicist Navratil in 1888, and in the early 20th century by Russian biologist Nardkevitch-Jodko, and by Landel de Morua, a Brasilian priest. In 1939, Semyon Kirlian, a Russian electrician, rediscovered this phenomenon. He and his wife Valentina explored the possible significance of the colored auras or coronas they saw surrounding the objects photographed with his electrical stimulation technique. Kirlian photography subsequently became a topic of wide interest to European and American investigators. A bibliography compiled in 1994 by L. Wigh listed several hundred publications.

Thelma Moss and Kendall Johnson at the UCLA Center for the Health Sciences carried out one of the most extensive early American investigations of Kirlian photography. Their project produced more than 10,000 Kirlian photographs, chiefly of the human fingertip, leaves, and metal objects. They found that a subject's energy field was affected by ingesting alcohol, performing yogic breathing, undergoing hypnosis, or experiencing emotional states. Moss and Johnson also found intriguing patterns of interpersonal influence on the photographs. The corona was different when the experimenter and subject were the same gender, as opposed to when they were of different genders. Dramatic differences in the corona were found before and after acupuncture treatment.

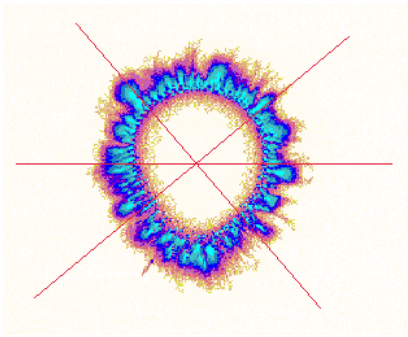
Another American researcher of Kirlian photography, L.W. Konikiewicz, correctly identified, in double-blind studies, cystic fibrosis patients and carriers of the gene with a high order of accuracy. He also found that the day of a woman's menstrual cycle influenced variations in the brightness of the energy field and that ovulation could be detected.

Scientific acceptance of Kirlian photography was limited, however, because the type of equipment used in earlier years varied markedly from investigator to investigator and a wide range of parameters needed to be controlled for successful use of the method. In careful work detailing the physical processes of Kirlian imaging, William Tiller showed that producing enough light for a photographic record on a chemical emulsion was not a stable process, because it required such strong electrical fields.

ElectroPhotonic Imaging

A computerized refinement of Kirlian imaging using video recording rather than photographic film appears to provide the stability, reproducibility, and reliability missing in photographic emulsion methods. The new technique, called ElectroPhotonic Imaging (EPI), also known as the Gas Discharge Visualization (GDV) technique, comes from the pioneering efforts of Konstantin Korotkov, Ph.D., a physicist at Saint Petersburg Federal Technical University. Among his 12 patents in biophysics is the device for the GDV technique (#110649), which was certified as a medical instrument in January 2000, by the Russian Ministry of Health. In essence, it creates a high intensity electric field around an object that produces a gas discharge. This discharge produces photon emissions, so it can be photographed. The device is safe for both the subject and the operator.

Specifically, a train of electrical impulses is applied to the test subject for a very brief duration (ranging from 0.1 second to a few seconds) with high voltages in the range of 3,000 to 6,000 volts, but with very small amperage (a few millivolts) for a safe but effective electrical stimulation. With humans, the stimulus is applied to the fingertips. Induced by these electrical impulses, the subject produces a burst of electron emissions and optical radiation in the visual and ultraviolet range. These particles and photons initiate electron–ion cascades, called a sliding gas discharge—a tiny lighting storm. This sliding ionic



Individual Fingertip Healthy Corona

cascade amplifies the optical radiation. The spatial distribution of the discharge is registered by a charge coupled device (CCD) video camera and written into bit-mapped image or dynamic video files for display and mathematical analysis. The CCD is a very sensitive device originally developed for astronomy and is now the basis of everyday video and digital cameras.

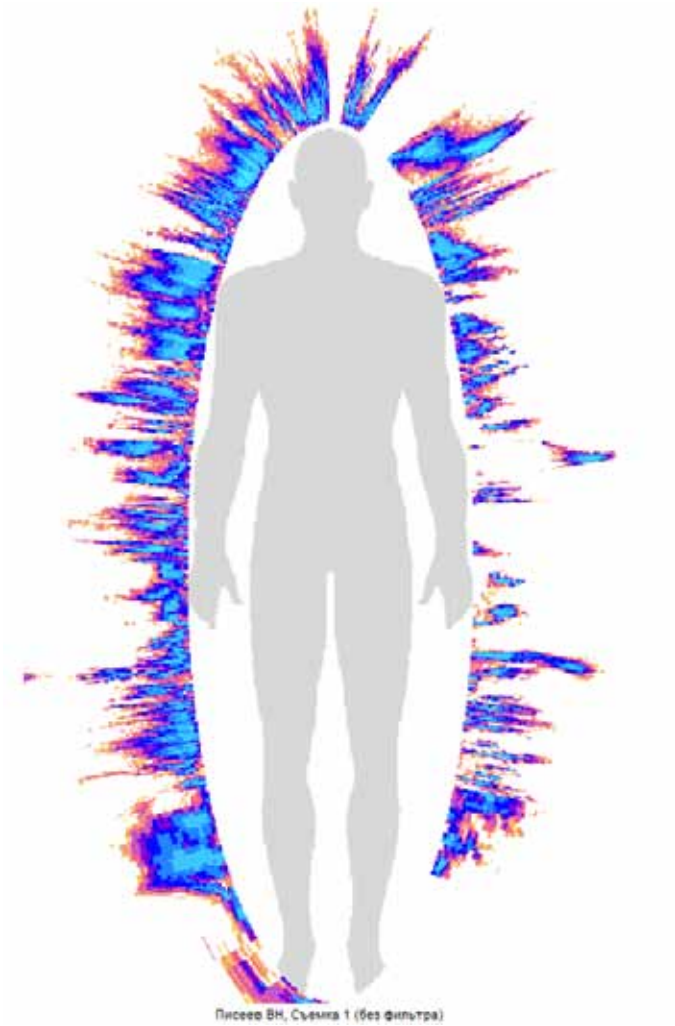
Dynamic television recordings of the image glow show that the emission centers repeatedly appear from the same points on the skin for each individual person.

The outburst current is believed to result from the transport of electrons within structural complexes of skin or other tissues, and suggests a connection to acupuncture points and the meridian system.

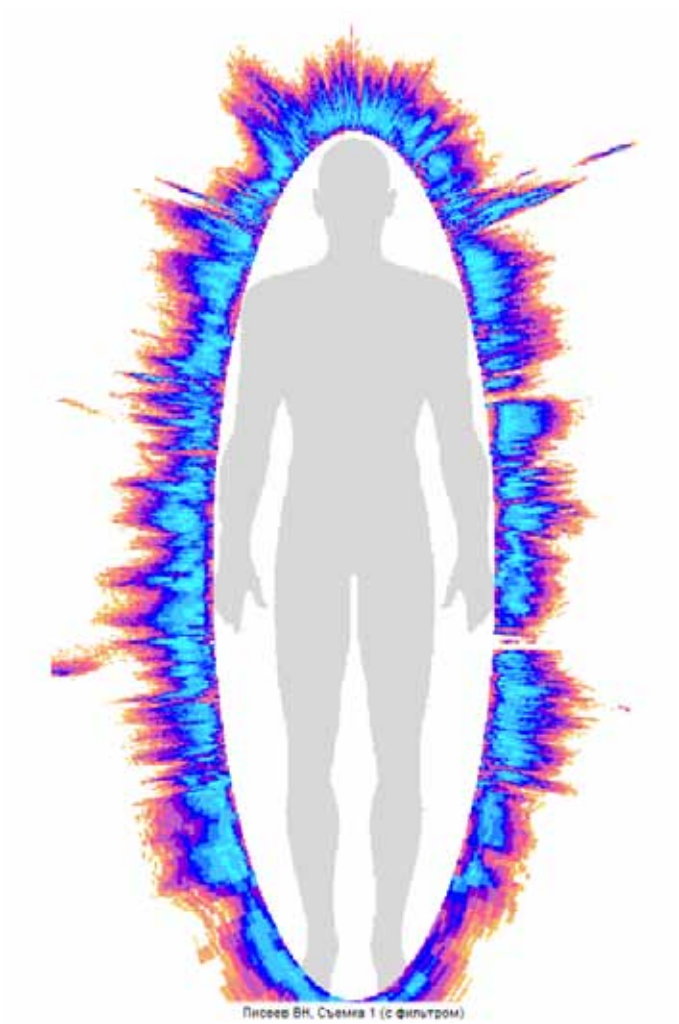
By dividing multiple sectors around each finger tip and assigning each sector to specific organs and functional subsystems, useful clinical information can be obtained with the EPI. The sector maps around each fingertip were originally based on a school of Korean hand acupuncture called Su Jok. These sector assignments have been modified through clinical experience, first by Peter Mandel in Germany, and further refined by mathematical analysis using the EPI in clinical observations during developmental research in Russia.

Each of the 10 fingertips are photographed and displayed separately. The corona images are mathematically analyzed for display using various color pallets, and presented along with the sector analysis for each fingertip. An example of a color sector analysis of an individual healthy fingertip is shown on the left.

Each individual sector or portion of the fingertip is connected energetically with specific organs and organ systems, such as the respiratory system, through the acupuncture meridians. The data of the 10 individual fingertips are collated and interpolated, creating an image of the entire "aura" or



Before Acupuncture Treatment



After Acupuncture Treatment

full body energy field. Gaps and reduced emissions are quite obvious in the energy field of an unhealthy person. The full body images on the previous page show the composite field before and after a course of acupuncture treatment. The improvement can be seen in the composite image and analyzed in detail by mathematical image analysis.

Reliable correlations between EPI indications and conventional clinical diagnoses have been demonstrated in a wide range of physical and psychological conditions, such as musculoskeletal and respiratory system pathologies, gastrointestinal pathologies requiring surgery, infectious diseases, monitoring cancer patient response to chemotherapy, and psychological problems of anxiety and neuroticism.

The EPI has also been used to identify positive traits, such as personality dimensions of openness and agreeableness, and monitoring relief from emotional distress during short-term therapy. Post-surgery recovery progress correlates with EPI parameters. Assessment of athletes can provide independent diagnostic measures of their psychophysical reserves, directly assessing their training progress and predicting potential performance.

EPI assessment provides quantitative measures of available energy in the physiologic systems, stress levels, and overall vitality. Increasing numbers of clinical studies show that measurement data from the EPI correlate with conditions characterized using standard medical diagnostics, as well as assessment methods used in a wide range of complementary medicine, such as pulse diagnosis in Chinese medicine.

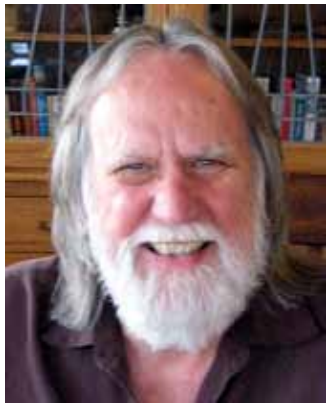
The human aura

Does a relationship exist between the information obtained by the EPI and the aura observed by clairvoyant healers? The EPI assesses the energetic resources of the individual. Healers who can see the human aura also assess the energetic resources of a person. The relationship between EPI analysis and the aura have not yet been studied in detail. An aura is not observed with conventional sight and the colors reported by clairvoyant healers do not necessarily conform to the spectrum of visible light.

The EPI does record evoked light emissions in the visible spectrum, but the image displays do not render the emitted colors directly. EPI displays are based on mathematical analysis—combining frequency, amplitude, and the spatial distributions of variations. The EPI displays can produce various palettes of color-coding based on measured variations in the corona discharges. Each particular coloring scheme is useful for revealing different details in the information.

We would not necessarily expect the colors of light evoked from fingertips by pulses from a strong electromagnetic field to conform to the colors seen using a nonphysical clairvoyant process. But when Valerie Hunt used electromyography to relate the energetic states of the body with clairvoyant observations by healers, there were consistent correlations. She found regular oscillations in the Extreme Low Frequency (ELF) range in the "background noise" from conventional electromyographic instruments. The frequencies of the ELF "noise" correlated with the colors seen at the same locations on the body, but there was no direct connection between the frequencies of the ELF measures and any specific frequency of visible light for the colors reported by the healers. Future studies may be able to reveal connections, if any, between physical processes and such subtle observations as clairvoyant healing.

To date, EPI technology has demonstrated strong connections between our conventional understanding of physiology and the classical Vedic and Taoist explanations of living energies. With the help of this technology, our understanding of the multilayered energetic processes of life continues to evolve.



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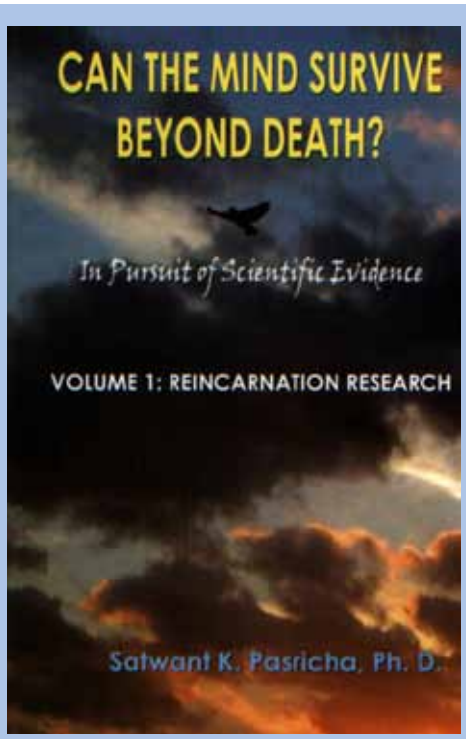
Book Review by Jim Tucker

On Memories of Previous Lives

Satwant Pasricha is a clinical psychologist in India who began working with Ian Stevenson (see sidebar) in 1974 on cases of children who report memories of previous lives. After training under Stevenson, she became his collaborator and then an independent researcher. In 2009, she completed a long tenure as Professor of Clinical Psychology at the National Institute of Mental Health and Neurosciences (NIMFIANS) in Bangalore, and her book notes that she is the only person in India with training in both clinical psychology and parapsychology. She is sole author or lead author of 17 of the previously published papers that appear in the two-volume work called *Can the Mind Survive Beyond Death?*



Can the Mind Survive Beyond Death? In Pursuit of Scientific Evidence by Satwant K. Pasricha. Harman Publishing House, 2008.

Pasricha includes a pair of papers in the book, both having Stevenson as first author, covering two of the most remarkable and perplexing cases ever to appear in the literature. The first is that of Uttara Huddar, a woman who at the age of 32 suddenly displayed a new personality. This personality did not recognize Uttara's family or friends and could not speak Marathi, Uttara's native language. Instead, she spoke what was eventually understood to be Bengali, which Uttara did not know. She called herself Sharanda and seemed to come from another time, as she showed a lack of familiarity with any tools, appliances, or vehicles developed after the industrial revolution. Sharanda stayed "in control" for several weeks. Uttara then returned to her normal personality, but Sharanda continued to emerge intermittently.

In addition to discussing various locations in Bengal, Sharanda gave the names of a number of family members, and these were eventually traced to a family that lived in West Bengal in the early nineteenth century. The names and relationships that she gave for her father and six other male members of the family all matched a male genealogy of the family that was discovered. The genealogy had been published in a Bengali magazine with a local circulation, but as Uttara had never visited that state, the authors were confident she had never seen it.

Regarding Sharanda's ability to speak Bengali, Uttara and her family said she had never learned it. One of the authors' associates, Professor Pal, had four long talks with Sharanda in Bengali, and he and five other native Bengali speakers all agreed that despite some imperfections in her speech, she had a solid command of the language. Stevenson later gave new details in a subsequent report. He noted that Uttara had been accused of having learned Bengali in school, though the evidence for that was meager. He had also asked a linguist to listen to two recordings made of Sharanda speaking and singing. The linguist said that her accent was non-native Bengali, and, based on the recordings, he did not hear indications of archaic speech that others had heard in conversation with her. Was this a case of possession by a Bengali spirit using the imperfect instrument of a woman who had never spoken Bengali, or was it a very strange case of dissociation, in which a woman, as in examples of multiple personality disorder, suddenly took on the identification and behaviors of a different person, in this case somehow even displaying knowledge she seemingly could not have acquired in her life?

Another remarkable case described in the book involves a young woman named Sumitra who experienced possible seizure episodes and then seemed to die during one of them. As her family began grieving and preparing for her funeral, she revived and, after a period of confusion, said that her name was Shiva and that she had been murdered by her in-laws in a place called Dibiyapur, some 55 km away. She rejected her husband and her child and asked to be taken to Shiva's two children. She gave many details that were found to correspond to the life of one Shiva Divedi, who was unknown to Sumitra's family and who had died violently (how and at whose hand was unclear, though her in-laws were under considerable suspicion) in Dibiyapur two months before Sumitra's transformation. Sumitra/Shiva was initially unable to recognize her own family and friends around her but later recognized 23 people from Shiva's life either in person or in photographs. Her transformation also included changes in her behavior, from "that of a simple village girl to that of a moderately well-educated woman of higher caste and more urban manners, who could now read and write Hindi fluently." Except for a period of a few hours that occurred a year after her transformation, Sumitra/Shiva had remained Shiva constantly for two years when the investigation was completed.

Continued on page 22

SIDEBAR

A SCIENTIST WHO NOW KNOWS IF HUMAN PERSONALITY SURVIVES DEATH

Peer reviewed scientific journals rarely devote an entire issue to the work or memory of one person. Ian Stevenson has been twice honored in this manner. In 1977, most of an issue of *The Journal of Nervous and Mental Disease* was devoted to his work. And the Spring 2008 issue of the *Journal of Scientific Exploration* was devoted to his memory.

Ian Stevenson was a distinguished scientist, professor, and chairman of the Department of Psychiatry at the University of Virginia, who is best known for his pioneering work in the scientific study of reincarnation, having collected and meticulously researched thousands of cases of children who, on their own, seemed to recall a past life. "Stevenson was an extraordinary human being," wrote psychologists Emily Kelley and Carlos Alvarado in their introduction to this special issue, "who put all of his immense capacities and energies to work on the most important question a person can ask: Who and what are we?"

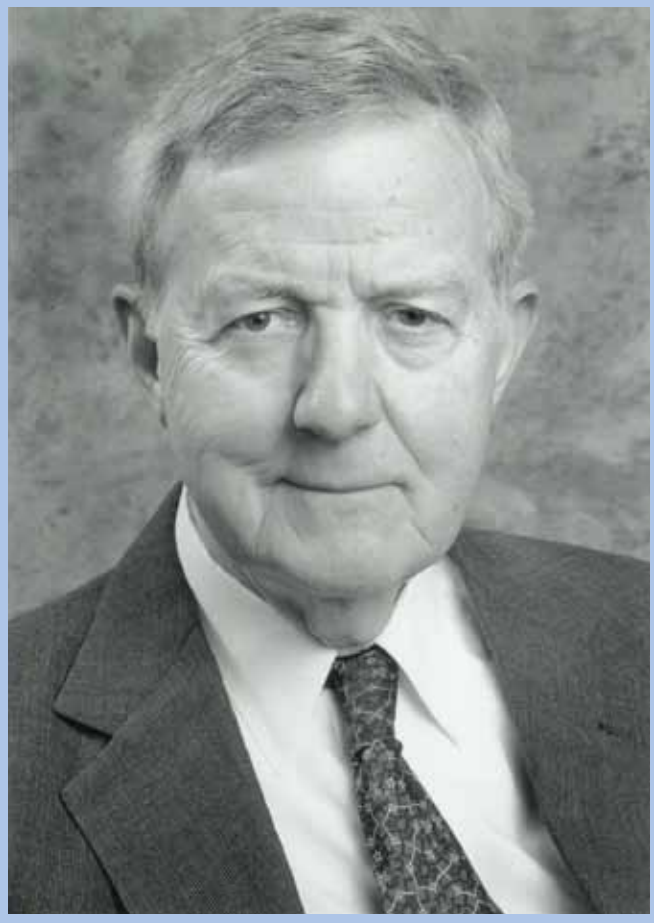
Stevenson was a remarkable scholar who touched the lives of a parade of philosophers, psychologists, physicists, as well as a *Washington Post* journalist named Tom Shroder, who accompanied Stevenson on two of his last journeys in search of children claiming previous lives and who wrote a book on the experience called *Old Souls.* "Neither self-delusion, intentional fraud, peer pressure, nor coincidence," wrote Shroder, "could explain how the children Ian investigated could have known all that they knew about strangers who'd died before they were born."

Ian Stevenson was born and raised in Canada, and studied at St. Andrews University in Scotland and at McGill University in Montreal, where he received an M.D. in 1943. He became an assistant professor of psychiatry at Tulane University in 1950, the head of the department of psychiatry at the University of Virginia in 1957, and the Director of the Division of Parapsychology (later renamed the Division of Personality Studies and then the Division of Perceptual Studies) in 1967. Before concentrating on the work for which he became best known, he carried out extensive studies of spontaneous telepathic experiences, on what would become known as cases of near-death experiences, as well as on cryptoamnesia, cases of apparent xenoglossy, "maternal impressions," and certain types of mediumistic communications.

Stevenson's first paper on reincarnation, published in 1960, came to the attention of Chester Carlson, the inventor of Xerox, who provided funds for further research on reincarnation and eventually endowed a chair for him at the University of Virginia. This allowed Stevenson and his colleagues to conduct field research on reincarnation in Africa, Alaska, British Columbia, Burma, India, South America, Lebanon, Turkey, among other places. Over a period of 45 years, he amassed reports of 2,600 individuals who recounted memories of places, experiences, events, circumstances, and individuals that provided evidence for "cases of the reincarnation type," as he carefully referred to them. The children studied usually started recalling their past lives between the ages of two and four but would forget them by the age of seven or eight. Many had clear memories of their previous death, which was often violent.

Stevenson published more than 200 articles and several books on his research, his magnum opus being the two-volume *Reincarnation and Biology,* which featured more than 200 cases in which children displayed often strikingly unusual birthmarks or birth defects that corresponded to wounds or injuries that killed the person whose life the child claimed to remember. Stevenson, who retired in 2002, was a founding member of the Society for Scientific Exploration and exemplified the kind of scientist the Society was founded (in 1982) to encourage. He died in 2007 at the age of 88.

—Patrick Huyghe



Pasricha began that investigation a month after Sumitra/Shiva first met a member of Shiva's family, her father. She and Stevenson ultimately interviewed 24 members of the two families, along with 29 other individuals for background information. Unless the case is an elaborate fraud perpetrated by a large number of people for no apparent purpose, Pasricha and Stevenson certainly seem to have documented a case of possession. Of this, they write: "Although we do not dogmatically assert that this is the correct interpretation of this case, we believe much of the evidence makes it the most plausible one."

Other chapters in the book focus on cases that provide still more compelling evidence of survival. One describes children in India born with birthmarks or birth defects that appear to match wounds suffered by the deceased individual whose life the child is thought to remember. Though Pasricha focuses rightly on the marks and defects, I would have liked to have heard more about the statements some of the children made. Deepak Babu Misra and Ramniri Jatav both apparently gave names and locations matching the previous lives of strangers some distance away, and it would be helpful to know how well the history of their statements could be documented.

Though the book mostly deals with cases of the reincarnation type, related areas such as near-death experiences (NDEs) are addressed as well. The three chapters on near-death experiences show the cross-cultural similarities as well as cross-cultural differences in reports of NDEs. One difference between those in India and those in the West is that the Indian ones are all what Stevenson termed "bureaucratic bungling cases," in which the ill person reports being taken by messengers to a man or woman who looks over a book or papers and determines that the wrong person has been sent for. As an example, the man with the book in one case says in a rage to the messengers: "I had asked you to bring Vasudev the gardener. Our garden is drying up. You have brought Vasudev the student."

In a large survey, Pasricha found that 62% of the individuals in India who were reported to have died but survived said they had had NDEs, far above the percentage in American surveys. She points out that all but one of the Indian subjects had their experiences at home, as opposed to the classic American ones that occur in hospitals when patients are revived after their hearts briefly stop. Though this raises the question of whether the Indian subjects were actually at the point of death as opposed to being merely ill, it is not clear how much difference that makes. A paper by Stevenson, Cook, and McClean-Rice examined the medical records of 40 American patients who had reported NDEs and found that 22 seemed to have had no life-threatening condition. In another paper, Owens, Cook, and Stevenson compared the NDE reports of those close to death versus those who were not and found few differences, except that those who really were close to death were more likely to report an enhanced perception of light and enhanced cognitive powers.

Though the differences in NDEs across cultures may strengthen the opinions of those who think NDEs are psychological creations, they weaken the case for a biological explanation. After proposing a neurological mechanism for how the dying mind might produce a tunnel-like visual experience, Susan Blackmore tried to say that Indian reports of NDEs included tunnel experiences, even though they did not. In a paper that Pasricha was a coauthor of but which is not included in the book (Kellehear, Stevenson, Pasricha, and Cook, 1994), the authors correctly took her to task for this. Of course, a tunnel experience is only reported by a minority of American subjects as well, so their importance may be overstated at times. All in all, Pasricha's documentation of Indian NDEs is an important contribution to the field.

While all this book's chapters deal in some way with the question in its title, some of the more interesting ones do so only indirectly. One examines why so few cases of past-life memories are reported in South India even though they seem practically ubiquitous in North India. Pasricha presents seven cases from South India that reveal features similar to those to the north, but these represent a paltry set compared with the nearly 450 cases she notes in North India. In another paper Barker and Pasricha found a prevalence rate of 2.2 cases per thousand inhabitants in Uttar Pradesh in North India. While no systematic survey has been conducted in South India, when Pasricha used the opportunity during a systematic survey of near-death experiences to inquire about past-life memories, she did not hear about a single case. She explores reasons for a disparity in prevalence rates between the two regions. She notes that Hinduism is the majority religion in both, though subtle differences exist in some of the beliefs and practices. She also suggests that differences in education and literacy rates (higher in South India) or childrearing practices may contribute to the disparity, but she is unable to reach any definite conclusion. I wonder if genetics may play a role, both in differences in various regions of a country as well as in differences across cultures.

Another chapter details survival cases that were found to involve deception or self-deception. Written by Stevenson, Pasricha, and Godwin Samararatne, it tells some interesting stories, including that of a Turkish boy who was named Kenedi when he was born in 1965 to a father who admired John Kennedy immensely. Though his few statements about Kennedy's life only involved information well-known generally–that he was President Kennedy, that he lived in America, was married, had two children, and was rich–the boy became fully convinced that he had been the president and remained convinced at least until he was interviewed at age 20. Another case, which Stevenson helped expose, was a complete fabrication, concocted out of whole cloth by a journalist and published in the magazine *Fate*. The deception cases all serve as cautions against accepting claims too credulously and as evidence that researchers do not approach the cases already convinced of their legitimacy.

Other chapters cover topics such as the role parental guidance may play in the cases, phobias that some subjects show toward the mode of death of the previous individual, cases in which no deceased person is found who matches the details given by the child, and cases in which the child appears to remember a life of someone who practiced a different religion. All the chapters are interesting, and with Pasricha's clear and concise writing, easily enjoyed by any general reader with an interest in these topics. Though the book does not provide

a definitive answer to the question of whether the mind can survive beyond death, it gives much food for thought. And it does provide definitive evidence of Pasricha's contribution to the field, both as Stevenson's colleague and as a very accomplished researcher in her own right.

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THE OTHER UNKNOWNS

"There are known knowns. These are things we know that we know.

"There are known unknowns. That is to say, there are things that we now know we don't know.

"But there are also unknown unknowns. These are things we do not know we don't know."

Those are words spoken by United States Secretary of Defense Donald Rumsfeld at a press briefing on February 12, 2002, about the increasingly unstable situation in post-invasion Afghanistan. Rumsfeld's words were generally regarded as elusive and arrogant, but some defended Rumsfeld, saying that it was a profound and rather brilliant distillation of a complex philosophical truth, a truth that, we might add, quite well applies to scientific knowledge as well.

David Dunning, a social psychologist at Cornell University, has given a lot of thought to unknown unknowns as well. In an interview with filmmaker Errol Morris that appeared on June 24, 2010, as an online *New York Times* commentary called "The Anosognosic's Dilemma: Something's Wrong but You'll Never Know What It Is (Part 1)," Dunning stated: "There have been many psychological studies that tell us what we see and what we hear is shaped by our preferences, our wishes, our fears, our desires and so forth. We literally see the world the way we want to see it. But the Dunning-Kruger effect [our incompetence masks our ability to recognize our incompetence] suggests that there is a problem beyond that. Even if you are just the most honest, impartial person that you could be, you would still have a problem — namely, when your knowledge or expertise is imperfect, you really don't know it. Left to your own devices, you just don't know it. We're not very good at knowing what we don't know."

There is really nothing wrong with that obviously. No one can be faulted for not knowing what he or she doesn't know—when one has made a serious and honest attempt to know all there is to know on a subject.

But there is one category that seems to be missing from Rumsfeld's deconstruction of human knowledge. It's the not-so-unknown unknowns. Those are the unknowns that are brushed aside, or under the carpet, either for contradicting what's thought to be known, or simply because they are deemed unworthy of consideration for one reason or another. Those can be the most damming unknowns of all. They're the ones we may one day regret, saying: we actually knew better.

– Patrick Huyghe

Peter Sturrock

Three Laws of Intellectual Motion

Over three hundred years ago, Sir Isaac Newton clarified our understanding of dynamical processes by formulating his famous three laws, which read as follows:

Credit: Linearcurves/istockphoto

Newton's Three Laws Of Motion

1. Every object in a state of uniform motion tends to remain in that state of motion unless an external force is applied to it.
2. The relationship between an object's mass m, its acceleration a, and the applied force f is $f = ma$.
3. For every action there is an equal and opposite reaction.

We have all engaged in discussions where one person tries to change another person's opinion. On rare occasions, these attempts may be successful, but in general they are not. My experience leads me to offer for consideration and discussion the following reformulation of Newton's laws:

Sturrock's Three Laws Of Intellectual Motion

1. Opinions tend to remain in a state of stagnation unless acted upon by an external argument.
2. The rate of change of opinion is proportional to the strength of the applied argument, and inversely proportional to the intellectual inertia of the person holding that opinion.
3. For every attempt to change another person's opinion, that person will make an equal and opposite attempt to change the first person's opinion.

With regard to the second law, note that intellectual inertia is weakly correlated with age but strongly correlated with status.

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