

OutPost on the Endless FrontierTM

EPRI e-News on Recent Key Developments in Energy Science and Technology
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Too Good To Be True

Somewhere about the time I was in the 8th grade, coincident with the start of the economic boom that followed World War II, the following story was part of the everyday buzz for a couple of months. It went something like this:

A man purchased a new car from one of the auto companies that had just switched back to peacetime domestic production. He drove it from the dealer with a full tank of gas. A few days later, having put a couple of hundred miles on the odometer, he noticed the gas gauge still rested on full. Thinking his new vehicle had a defective meter, he brought it back to the dealer to get fixed. After about an hour in the shop, the mechanic went into the dealer's office where the customer then observed that both became involved in a long intense phone conversation with a third party. On hanging up, the dealer emerged from his office and said to the buyer, "I'm very sorry, sir, but the car we sold you was an experimental model somehow mistakenly shipped from the factory. We need to return it as soon as we can. The factory offers you the choice of any other car we have in stock for free, and \$10,000 in cash as well for your trouble. You only have to agree to keep this incident to yourself."

Of course, the moral of the tale was that the automobile manufacturers had discovered during the war the secret of making vehicles that would run on almost no gasoline at all, and had subsequently, upon peace, entered into a conspiracy with the oil companies to withhold this knowledge from the public indefinitely. Being a somewhat precocious kid, enough science had already rubbed off on me to make me deeply suspicious that you could get something for nothing. Besides that, I was a born "man from Missouri (New York, actually, which implies generally the same sort of personality)." I got into heated arguments with my peers, who claimed the story had to be true, because they were told it "by my parents." This episode was one of my earliest encounters with the general public credulity regarding technical and scientific matters, and the belief by many that much of their daily life was governed by conspiracies political and industrial.¹ Not that these institutions don't have agendas and great power and wealth to protect their interests, but it doesn't extend to "covering up" the laws of Nature.² Give me a break.

From time to time your correspondent has been contacted by EPRI members inquiring into various claims, usually "free energy" in character, that they hear about which all sound "too good to be true."³ I've thus decided to devote several forthcoming issues of *OutPost* to both general and specific topics on "bad science and energy." Our objective

will be to provide a loose set of rules and perspectives, a toolkit whereby you, the reader, can exercise preliminary judgement yourself on encountering claims that promise the energy deliverance of mankind. This *OutPost* will begin with an admittedly personal view of how “real science” is done, but it’s one which is shared by many of my senior colleagues who spent a major portion of their careers in basic research.⁴ Other *OutPosts* to follow (not necessarily sequentially) will take up specific examples of “unreal” science.⁵

What exactly is “scientific truth?” Now there’s a cosmic question whose contemplation can fill libraries⁶...and has. Here’s my cut at it...scientific truth comprises an inherent three-fold hierarchy...a “Holy Trinity,” if you will, of methodologies through which Nature reveals Herself.

I: “Eppur si muove!” The Legacy of Galileo, Bacon and Newton

Experiment and Observation followed by Deduction and Induction - what today we call “hard science” or Physics - these were the great gifts brought us by these three giants of the Renaissance, Galileo Galilei, Francis Bacon and Isaac Newton. In other words, you can understand how Nature works simply by asking Her the right questions, applying rational analysis to Her answers, and finally, inferring from a general pattern of Her responses toward a synthesis of Her Grand Design. How obvious. Why did it take us so long to see this? And, miracle of miracles, throughout all Nature speaks to us in the language of mathematics!

All of physics begins with experiment and observation with the imprimatur “keep it simple, stupid,” so that everyone, everywhere gets the same answer when they ask the same question. Galileo did not let fall a cannonball and feather in a hurricane. His genius was to intuitively understand such an experiment had too many variables too difficult to control. His carefully constructed inclined planes, long enough and of sufficiently shallow pitch to permit accurate timing of rolling balls of widely varying mass, combined all the elements of accuracy, precision and reproducibility to pluck from a morass of otherwise confounding factors, the Law of Falling Bodies (forget Pisa - that was a PR stunt). By following his prescription, anyone on Earth could get the same answer - 32.2 ft/s^2 independent of the mass of the falling object.⁸ Reproducibility is at the very heart of experimental physics.

From experimental and observational data, we induce particular syntheses, or “theories.” The construction of successful theories is at once both intellectually satisfying and useful. Satisfying because we find we can reduce the answers Nature gives us to a few unifying and simple (yes, simple!) mathematical statements (this job is by no means complete, however⁹), and useful because the theories of physics provide the rules for the practice of engineering. Keep in mind that theories are just that - theories. Your correspondent feels too much emphasis is given “theory” by the popular media. Experiment and observation reign supreme in physics,¹⁰ and such is the cardinal dictum you should use in judging claims that sound “too good to be true.” Can the experimental results be broadly

repeated?¹¹ It's as easy as that. Don't worry about the theoretical implications or consequences.

II. "Wash Your Hands!" Pasteur and Semmelweiss

I'm sure most *OutPost* readers are aware of the great accomplishments of Louis Pasteur, but perhaps the contributions of the Austrian physician Ignaz Semmelweiss may be somewhat less well known. Both were exemplary practitioners of what I call the "empirical approach" to the advance of scientific knowledge. In other words, "if it works, it must be right." Physicists, like myself, generally abhor empirical methods and only grudgingly admit their validity until we can find out "what's really going on." In point of fact, we often employ this technique ourselves, except we use the euphemism "semi-empirical" which I guess means we half-know what we're doing.

Semmelweiss¹² and Pasteur¹³ co-founded the practice of antisepsis from the empirical observation that good hygiene prevented disease and bad caused it, well before anyone knew why. Today empirical methods, exemplified by the "double blind" technique,¹⁴ are the mainstay of much of medical research and pharmacology. Someday we are certain to understand all the cellular physics involved, but in the meantime, if it works, use it. However, proper empiricism has one vital aspect in common with the gift of Galileo - control and reproducibility of the experiment. Be properly skeptical of any empirical claims that lack such evidence. Asserting that a new field maintenance practice you want to introduce is bound to succeed because you wore your winning tennis socks during its formulation won't hack it.

III. "Lies, Damn Lies, and Statistics." Lord Beaconsfield

Despite Benjamin Disraeli's reservations, proper and considered statistical analysis of data obtained from "experience" and not "experiment" can be a valid source of scientific understanding. Examples of scientific endeavors which depend almost solely on "experience," or use of data whose sources cannot be directly controlled are given by archeology, paleontology, anthropology and epidemiology.¹⁵ Therefore, it is difficult for these disciplines to achieve the level of surety possible with the first two members of our trinity. As a consequence, one usually insists the statistical connection (probability) between data and conclusions derived therefrom at least be substantially better than random. You can get into a lot of arguments about what that number should be. Physicists, of course, would like it to be unity, as is the probability that one of their experiments will conserve energy and momentum.

Take epidemiology, that branch of medicine dealing with the incidence and distribution of disease in various populations according to a given set of probative factors, and one which our industry has dealt with at great cost relative to the presumed health effects of low frequency, low intensity magnetic fields. The statistical results of the relative beneficial or adverse effects of exposure to a particular environment of two otherwise identical populations is generally distilled into a "risk factor," the relative probability that the group so exposed will develop a response. One of the great triumphs of epidemiology

was in establishing the association between lung cancer and cigarette smoking. Here the risk factor was enormous, somewhere in excess of 20 if I remember correctly. That is, cigarette smokers were 20 times more likely to develop lung cancer than non-smokers. It is when an epidemiological case study produces risk factors marginally greater than one that much confusion and controversy can be created,¹⁶ and which may result in the introduction of expensive, and perhaps unnecessary, “prudent avoidance” practices by public agencies.

As you might expect, the view of most physicists, myself included, is that the foundation of knowledge revealed by the last two members of the “science trinity,” especially the third, is “on hold” until the state of our discipline advances to a level where specific causative agents are found to be present (or absent).¹⁷ Estimation of probabilities based on noisy data is a tricky business. After all, it is finitely possible that sometime in the future of the universe all the molecules in the cylinders of your parked car may spontaneously line up in a single direction and push on the pistons producing “useful work” (making your car move) in violation of the Second Law of Thermodynamics. But, not to worry. You can return the car to the manufacturer and receive a Porsche Boxer in addition to a munificent sum to buy your silence.

We’ll get back to you with more tips on how to separate the scientific wheat from the chaff in future *OutPosts*, but in the meantime, if you hear of a new energy scheme that sounds “too good to be true,” it usually is...too good to be true!¹⁸

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¹It’s prudent (at least it was in my neighborhood) as an adolescent not to appear to be too smart, unless you’re willing to defend your stand with your fists, or, depending on the size of your intellectual adversary, to beat a rapid retreat with your feet. On achieving maturity one learns to debate with mental fisticuffs, not physical...hopefully.

²It is rumored that a prominent Senator from Massachusetts once offered a bill on the upper house floor to repeal the Second Law of Thermodynamics. Mind me, it is only so rumored.

³If truth be known, I get significantly more inquiries from venture capitalists and equities agents (no, no, I only give technical perspective and references, not investment recommendations, pro or con) and journalists than from members...unfortunately. I encourage EPRI members to use the SS&T core group and Initiative staff more often than at present. Let us be your first contact. We’ll keep your client relations rep in the loop.

⁴*Apologia ante facto*. Warning: Your correspondent is apt to pontificate and be prone to condescension from this point on. We will do our utmost to keep the current *OutPost* from becoming a polemic. Alas, arrogance is the occupational disease of physicists for which there is no known treatment yet. *Op cit*. Ref. 1.

⁵See, as examples of future *OutPosts* on emerging “to good to be true” issues, *OutPost 3: Unidentified Superconducting Objects* (www.epriweb.com/srd/outpost/outpost3.html), and *OutPost 4: Journey Down the Path of Least Resistance* (www.epriweb.com/srd/outpost/outpost4.html).

⁶We’ll try to keep our heads above water here, and not get into such matters as the philosopher/mathematician Kurt Goedel’s oft-misunderstood theorem that “you can’t know everything,” or similarly notions based on Heisenberg’s Uncertainty Principle (I’ve got a teeshirt that says “Werner was here...maybe.”). Perhaps we can have some fun with these matters later on as business pressure permits.

⁷”Nevertheless, it moves.” Galileo’s legendary and defiant last words, spoken from an agreed exile of silence and recantation entered into with the Vatican concerning the terracentric vs. heliocentric nature of the solar system, an episode that showed neither party at their finest. Don’t judge Galileo too harshly unless you know your own response to being shown “the instruments of torture.” On the other hand, I once built a small model of Galileo’s original telescope, a design where the ocular lens (eyepiece) is convex (not concave like today). Since the focal plane of the heavenly image lies within the telescope for a concave ocular, the image can be severely distorted and using the instrument takes a little getting used to. It’s understandable that when Galileo turned to his telescope to the moons of Jupiter, the Jesuits that looked through it said they didn’t see them...especially since they didn’t believe they were there to begin with!

⁸One of the finest, perhaps the finest, exposition of the essence of physics for laymen (and physicists) that I’ve ever seen is *Physics for Poets*, (ISBN 0070402485) by Robert H. March, former professor of physics at UC Santa Cruz and now at the University of Wisconsin. March wrote the text for use in physics-requirement classes to be taken by scientifically-challenged undergraduates such as pre-med and pre-law students.

⁹See *OutPost 1: Opening Act: Is It the Final Curtain Already?* (<http://www.epriweb.com/srd/outpost/outpost1.html>)

¹⁰I saw a marvelous film clip on PBS some time ago of a young Richard Feynman delivering the opening lecture in freshman physics at Cornell or Cal Tech. It shows Feynman, one of the great theoretical physicists of all time, pounding on the lectern and practically screaming at the cowered students, “Remember, if your theory doesn’t fit experiment, it’s wrong! It doesn’t matter if it’s the most elegant mathematics or philosophical reasoning, if there’s an experiment that violates it, you’re simply wrong!”

¹¹We will definitely pursue this requirement in an *OutPost* dedicated to a comparative study of two “cold fever” events of the 1980s, the discovery of high temperature superconductivity and the announcement of anomalous effects in deuterated palladium, both of which infected your correspondent. Absolutely stay tuned for this one.

¹²Semmelweis worked in a Vienna obstetrics clinic in the mid-1840s. He noticed a huge difference in mortality rates of mothers and children from “childbed fever” between those

attended by midwives (low) and physicians (much higher). He observed that the physicians often came directly from the autopsy chamber to administer their female patients and reasoned they must be carrying some unknown agent on their hands which caused the resulting infection. He became fanatic about washing one's hands between patient calls, and would often wrestle to the floor recalcitrant physicians, interns and students to prevent them from completing their rounds. The mortality rate dramatically decreased. Of course the hospital authorities ordered him to desist, and, of course, the incidence of death immediately soared. So your mother was right after all. Visit <http://www.idahohealth.com/family/story28b.htm>.

¹³It's not widely known that Pasteur started out as a physicist, a crystallographer, in fact.

¹⁴The traditional practice of medicine and pharmacology to evaluate the effectiveness of a given drug or procedure. Neither the researchers nor the participants are aware whether they are administering and receiving the test procedure or a "placebo." Usually a quite conclusive methodology, but occasionally the "placebo" has temporary effectiveness beyond expectation. If one thinks one is getting well, physical improvement can appear. The connection between the brain and physical well-being is ill-understood, to say the least. In the meantime, we will still have places like Lourdes.

¹⁵You might think astronomy and astrophysics would fall into this category...after all, you can't controllably reproduce a supernova. However, much of galactic physics, including that of supernovae, can be studied through controlled terrestrial experiment (black holes not quite yet, but some friends at Lawrence Livermore National Laboratory have a few ideas!). Consider also that Galileo and Newton did not have to wait for a meteor shower to observe and deduce the behavior of gravity. You can't produce earthquakes, lightning and hurricanes at will either, but we know an awful lot about their physics from controlled laboratory experiments (prediction is another matter...a question involving the new physics of chaotic behavior and sensitivity to initial conditions). Of course, the quintessential example is the physics of the creation of the universe. We don't have to produce another Big Bang because we can study its microscopic origins with the particle colliders of Fermilab and CERN.

¹⁶Your correspondent was told by a prominent epidemiologist, a member of the faculty of the Harvard School of Public Health, that he made much of his consulting income analyzing studies with associated risk factors less than three.

¹⁷A prospective link between cellular changes that would prelude tumor growth and low frequency, low intensity magnetic fields is an area that is amenable to analysis by both physical measurement and theoretical prediction. No evidence has been found for such a link that satisfies the prescriptions demanded by the first discipline of our "trinity of science."

¹⁸Also, don't forget to e-mail me the details at pgrant@epri.com.