

## Scientific Anomalies and How the Mind Manages Them

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In honor of PEAR's twentieth birthday, I'd like to do three things today. I'll begin by saying something about how my relationship with PEAR and its remarkable inhabitants began. I want to start with that because for me the day it all began was one of those days that mattered. It mattered because for me PEAR has mattered – deeply, unequivocally and with a kind of galvanizing force I'm very, very grateful for. After I talk about how we first met up with each other, I'll talk about a particular direction PEAR's work has recently stimulated me to explore. Finally, I'll offer some speculation about one aspect of the territory I think PEAR's work has positioned us to tackle at this point and for the future.

"Mattered" – how striking that it's the word *mattered* which comes to mind in describing the work of people who've spent these past twenty years radically re-conceiving matter and what we call material. In fact, it's been PEAR's radical re-conception of matter that's been what's really mattered about their work. The people at PEAR have taken matter seriously enough to play with it – and played with matter enough to find out what taking matter seriously actually means. They've suggested that what matters about matter may transcend matter enough to make matter as we know it break the rules, evade our expectations, even disappear. But what matters about matter will – they've said – still matter. And as embodied material people who do embodied material science, we'll not only survive to tell the story – we'll also end up knowing more about matter than we knew before, and more about matter that really matters.

All that's been a brave thing for the people at PEAR to do. In the world of science as we know it, it's been a very brave thing to do. So hats off to your courage. Hats off as well to your patience and to your faith that what matters about science – including what matters about matter – can be ultimately trusted to matter in the face of all the many ways you've challenged both science and matter.

But now back to my particular version of how you've mattered, and back to the day we met. It was five years ago. I was driving a sixteen-year-old daughter around New England for her college interviews. On one particular stretch of the Mass. Pike, she fell asleep and I pulled out a large packet of audio tapes I'd received from the Center for Frontier Sciences some weeks earlier. Eyes still on the road, I grabbed one and glanced at the label before sticking it in the tape deck. I didn't recognize the name: Robert G. Jahn, Ph.D., of Princeton University. I inserted it in the deck and prepared to half-listen as I drove, my attention mostly on the pleasures of watching spring come to New England. Little did I know.

Twenty minutes later I'd forgotten all about spring as well as my daughter's interviews. With the inimitable understatement I later came to know so well, Bob Jahn was outlining a history of the work he and his colleagues had been doing at the PEAR Lab for some fifteen years. As the tape concluded, we arrived in Providence, Rhode Island. I promptly headed for a phone. I called the Princeton switchboard, asked for the PEAR Lab, and Brenda Dunne picked up the phone. I'd planned on asking for available reprints and leaving it at that. Needless to say, I didn't – yet – know Brenda. To say that I ended up describing who I was, what I did, everything that most interested me as well as where I secretly hoped my daughter would end up in college, would be drastically to underestimate the extent of our conversation. Forty minutes later, with a promise of technical reports soon to arrive on my doorstep, I hung up the phone.

But I'd caught a glimpse of something that already I recognized as something that mattered. I'd caught a glimpse of colleagues out there with very different backgrounds and credentials than my own, but working at a

vision of science and what science helps us know that resonated with aspects of my own work in profoundly invigorating ways.

And catching even that quick, introductory glimpse of resonance would, I sensed, add up to something that mattered – because genuine resonance is one of those things that matters. I’m a musician and for those of you who play music – or love to listen to it – you know the difference a resonant space makes. In a dead space, you hear a note and it’s over – gone. No overtones. In a resonant space, you hear the note but you hear more. In a *really* resonant space, you hear a range and succession of overtones you’d barely imagined.

My sense is that ideas work the same way. Drop an idea in a dead space: a single note and it’s gone. Drop an idea in a resonant space and that idea sprouts overtones the way a cello does. For me the PEAR Lab has acted as a marvelously resonant space. The people at PEAR have helped me hear overtones I’d scarcely imagined in my own work as well as in the work of others. So that’s one way of saying how the day we met turned into one of those days that mattered.

But now back to the actual work the people at PEAR have been doing. They’ve set themselves a simple but enormously ambitious agenda. It amounts to something like this. Let’s start, they’ve said, from scratch. Let’s not take the parameters of reality as given. Let’s particularly not take any parameters of material reality as given. Let’s go to the margins and see what the world looks like from there. Let’s live outside the box. Let’s see what happens if we start with the idea that the world as we know it bears a more complex relationship to something called consciousness than science has yet allowed for. But at the same time, let’s remember we’re profoundly committed to science. Let’s see if we can hold onto the essential and highest principles of science while we look in new ways at this question of consciousness and its relation to the world we inhabit. Meantime, let’s stay rigorous. Let’s stay cautious. Let’s remember that observation and inference are different. Let’s not confuse correlation with causality. Above all, let’s honor the scientific method as perhaps the single greatest achievement of the Western mind over the past millennium – while not letting the science of the past become the religion of the

present. Let's remain as open-minded about where science may take us in the next millennium as Copernicus and Darwin and Einstein and Heisenberg managed to be in the last.

As I see it, those are the kinds of overarching principles that have guided what the PEAR Lab has been up to over these past twenty years. The work of putting those principles into practice has involved all the mundane, painstaking, daily repetitiveness of designing experiments, carrying them out and replicating them – time after time after time. On a good day – maybe – it turns out that all the labor has paid off and finally warrants taking one tiny baby step forward into the next, slightly more informative, slightly bolder new experiment. Over the years, there have been enough of those good days at PEAR to convince a number of us in a number of fields that there are some very exciting new areas of inquiry opening up on the horizon.

On the other hand, PEAR's work hasn't had an altogether easy reception in some of the quarters which house mainstream science. That's no surprise to anybody who makes a business of scientific anomalies. Anomalies don't invite widespread acceptance until they've stopped being anomalous. That's normal science and it's old news.

But I want today to suggest that just because it's old news doesn't mean it's not worth a fresh look as interesting news. A fresh look that turns it into interesting news may do us the particular favor of enabling us to move beyond all those tired arguments over whether or not work like that being done at PEAR belongs in the register of what mainstream science likes to call science. Those are by now very tired arguments. As arguments they're boring. They rarely convince anyone of anything and worse, they have a peculiarly draining quality which usually leads me to feel with Melville's Bartelby the Scrivener that, invited to engage, I Prefer Not.

So I'm suggesting we abandon the argument strategy and go a different route. Not argument. Nor its frequent alternative: pessimistic retreat. I'm suggesting we mobilize our respective capacities for finding things interesting and maximally engage the problem of how the scientific mind manages anomalies as a frankly fascinating phenomenon. I think the pay-off may be considerable. We may learn some useful things about the human mind. We

may learn some useful things about how to communicate with colleagues. We may even learn a thing or two about the nature of the anomalies which lie at the heart of what occupies some of us.

Now at this point it's only fair to back up and tell you I'm a psychoanalyst. Worse – a few other respectable credentials notwithstanding – I'm an old-fashioned, Freudian-trained psychoanalyst who hasn't seen fit to recant. I haven't recanted because, once the mountains of chaff have been lifted from what's accumulated as the body of psychoanalytic knowledge, there remain a few key truths which function – I find – as remarkably powerful tools for understanding a number of things about people. Especially relevant for the question of why, in considering work like PEAR's, normally open-minded scientists sometimes display astonishing defiance of the open-mindedness to which they're in principle devoted: *psychoanalytic thinking nourishes an ineluctable fascination with why people resist certain ideas and experiences in ways that are not only tenacious but in ways that at times run directly counter to their own interests*. People resist all kinds of things as if their lives depended on it. But there's an intriguing irony. It's often precisely the things people most vigorously resist which stand a chance at turning them into happier people. It's the patent self-destructiveness of the ways they resist which is so impressive. When people recognize the self-destructiveness of their resistances, it's remarkable how often and how quickly they find ways to give them up. Helping them get to the point where they choose to do that is the challenge which psychoanalysis has made a fine art of exploring.

In fact, it's precisely that challenge which analysts tackle daily and repeatedly, patient by patient and hour by hour. We tackle it with brilliantly creative artists who resist putting brush to canvas, with deeply loving husbands who resist telling wives they love them, with natural leaders who resist the lead by playing perpetual second fiddle. At our best, I would say we psychoanalysts are out to help people become as fascinated by what on earth they're doing as we ourselves are. We try to harness our own fascination in the service of stimulating a parallel fascination in the people we're trying to help. That's one way of describing the psychoanalyst's job. Particularly, we try to nourish fascination with all the ways people manage to resist those

things which, in the long run, might turn their lives into happier, more fulfilled lives.

There's a straightforward logic to why nourishing that fascination proves useful. When people start to be fascinated by something, they tend to entertain all kinds of questions about it. And when new questions are out and on the table, they stimulate new ways of thinking. Often those new ways of thinking significantly re-cast treasured convictions and long-held positions in life. Old solutions to things may suddenly show up as outmoded or rooted in illusion or grounded in pathogenic fantasies which people are ready to abandon. When that happens, people have a shot – quite literally – at re-inventing themselves.

The interesting thing for our purposes is not just that psychoanalysis aims at helping people do that. Most people – certainly most of our skeptical scientist friends – have no interest in submitting themselves to a psychoanalytic couch. And unless they're struggling with much more than the skepticism to which they've been thoroughly educated, it's unlikely that the couch is where they belong. On the other hand, what I do think may be relevant for our purposes today is this. One of the things psychoanalysis has done best is develop a clinical theory about how people actually *get* to the point of being able to re-invent themselves – especially in relation to things they've spent their lives resisting. Clinical psychoanalytic theory has some very specific things to say about that. Argument doesn't work, nor does persuasion, nor does wishing the resistance would go away nor does pretending it isn't there. What works is respect for the resistance. What works is a certain kind of dance with it. For me the clinical theory that matters is the clinical theory which describes that dance and how to do it.

Now there are a number of things about a dance – a *good* dance. One is, it is fun. The more intricate, the more fun – if, that is, you've caught on to the step as well as to your partner. But you do have to catch on to both. In addition, it's rarely useful to hate either the step or your partner. Nor to be bored by either. Nor view either with contempt. Those things distract from the fun. More important, they distract from giving yourself over to heartfelt mutual engagement with the other. And when that's missing, you end up a

dull couple. Neither of you delights in the surprising places to which you take the other, nor in the even more surprising places from which you manage to rescue the other.

I think there are some useful principles here that might inform us as we think about how people approach anomalies – especially the really interesting ones with implications which stand to alter our thinking in crucial and underlying ways.

So let me at this point spell out some basics about how I see the psychoanalytic dance and the way it works to alter the way the mind manages things, scientific anomalies included. First, I see clinical psychoanalytic theory rooted in two simple but basic assumptions, both of which have sweeping implications for our understanding of human beings. They're assumptions which critically position us in relation to our patients such that we end up able to help them take new and previously aversive, frightening steps in life. It's keeping those assumptions in mind (and I mean *deeply* in mind: in our bones and throughout the fabric of our thinking as we work) which permits the psychoanalytic collaboration to take people in novel and often astonishingly unexpected directions.

The first of those basic assumptions is that people are motivated by two essential desires. They want to be loved and they want to love. In being loved, they want to be loved not just by others but also by themselves. And in loving, they want to love not just themselves but also others. The distortions of human existence are at bottom distortions of the ways those essential desires get expressed and lived out.

The second basic assumption is that those two essential desires are embedded in a mind which doesn't know itself, a mind which operates according to beliefs, memories, and wishes that are out of awareness and not subject to conscious regulation – in brief, unconscious. It's that fact which helps make sense out of the patently irrational and self-destructive things people do in their efforts to love and be loved.

Taking those assumptions as basic locates people's problems not in the nature of their desires, but in the misguided ways they go about achieving them. Taking them as basic results – I find – in a profound optimism about

people. Psychoanalytic thinking becomes the frank project of recognizing misguidedness. The psychoanalytic dance involves stepping with patients into the heart of their misguidedness such that they find themselves moving with it in new ways. In the process, misguidedness starts to become apparent for what it is. Moving differently into life becomes an inevitable option. Patients gain increased freedom to re-negotiate their lives: to construct lives which come closer to getting them what they're really after.

Now I can already hear a few of you scientifically-minded types murmuring, "Well, that all sounds very nice - metaphorically appealing and maybe it even makes people feel better, but is there any hard scientific evidence for an underlying mental organization which would explain why psychoanalysis might actually *alter* people's propensities to resist certain ideas and feelings in ways that are self-destructive for them?"

My colleague, Drew Westen at Harvard, has recently written a paper called "Freud is Alive and Well in the Lab." It's a remarkable paper. One of the things he demonstrates is that recent work on memory leads us radically to reconceptualize the notion that memories are "stored" in the brain. "Storing" a memory suggests stasis: a place for everything and everything in its place. It suggests the way we store things in kitchen cabinets: dry goods in one place, fresh fruit in another, drinks in another. In a kitchen, the process of storing and retrieving items becomes automatic because everything – at least in principle – has its place, stays in its place, and that's what makes getting around kitchens efficient. However, says Westen, that's simply not how it works with memory. That's not the process which makes getting around our minds efficient. Memories aren't "stored." A memory is a set of neurons organized for a particular function at a particular moment in time, only retrievable as the experience of memory in accordance with a multiplicity of adaptational principles and constraints which lead to our sense that we've captured what we call "a memory." Memory is pure potential. It's only actualized as the probability that a certain number of neurons which once fired together are firing together once again. The more often a given set of neurons have fired together, the more readily they'll fire together another time.



That's why we're subject to what we call habit or conditioning; it's what allows us to manage the world in a way which feels predictable.

Now a bit of the language I've been using must have a familiar ring to you physicists. States of pure potential? Only actualized as an experience of fixed reality in accordance with probabilistic determinants and constraints? Psychoanalysts are less accustomed to living with those theoretical constructs than are you physical scientists these days. On the other hand, analysts have developed a *clinical* theory – a day-by-day, down-in-the-trenches, working theory – which turns out to represent an extrapolation of precisely those probabilistic parameters. As the biological evidence comes overwhelmingly in, we're starting to grasp that our psychological world, like our material world, is best described in post-Newtonian language, a language which critically emphasizes how tiny alterations in a balance of interactive possibilities has radical import for whatever emergent probability determines our eventual perception of reality - in this case, the reality of "memory."

So what's the relevance of all this to scientific anomalies and how the mind comes to terms with them? Well - in my view - enormous. The probabilistic nature of that which eventually emerges as memory means, first, that myriad possibilities for *other* experiences of memory get bypassed as we arrive at the memory we ultimately call real or true. *And those other possibilities are bypassed entirely outside awareness, outside what we call consciousness.* That's where Freud enters the picture. Not only does current biological evidence point up the extent to which memory is produced unconsciously, along lines impressively parallel to those Freud conjectured some hundred years ago. Equally dramatic, the plasticity and malleability of unconscious memory, something for which analysts have seen clinical evidence ever since Freud explored the unconscious roots of Anna O.'s hysteria, is stunningly born out by recent biological research concerning the on-line processing that unconscious memory entails.

At this point I want to shift gears from Freud to another scientific pioneer, the biologist Ludwig Fleck. During the 1930's, he wrote about the experience of teaching students to examine cellular structure under a microscope. Ask, he said, biology students to look at cells under a microscope for

the first time and tell you what they see. You'll get responses that vary all over the map: wild disorganization, patterns from a child's kaleidoscope, maybe the artistic few will associate to images of a Paul Klee or a Seurat. You'll get as many interpretations as there are students. You won't hear much that resembles the description of cellular structure which every one of those students will consensually recognize and describe some months down the road, once they're well on their way into being educated as up-and-coming young biologists.

But Fleck didn't stop with that observation, one familiar to most of us. He went on. He noted that a few months later, those young biologists will not only agree about what cellular structure looks like – *equally interesting, they will have lost the capacity to see whatever it was they saw that very first time they looked under the microscope.* That fact intrigued Fleck. He wondered what conceivable alternative biologies might look like, the ones that might derive from the rejected perceptions, those never pursued as possible organizers of biological structure as it's been systematically developed.

In other words, Fleck was addressing a highly pragmatic consequence of the work on memory I've just been describing. What students learn as the memory of what cells look like constitutes one possibility out of many. The more often the neurons organizing that particular possibility are activated, the more probable their re-activation becomes. And the less likely others become.

So for science in general. The world of science as we know it is colossally determined by a massive network of trans-generational, trans-individual, trans-cultural neurons that have been repeatedly activated in the service of organizing the collective memory which we call science. That scientific world is critically defined by concepts like replicability, reliability and validity, concepts rooted in a very particular set of assumptions about the nature of memory. They're assumptions which incorporate profound implications for how the specific scientific memory to which we collectively adhere carries the quintessential linchpins of scientific truth.

But here's the psychoanalytic rub. Our collective scientific memory - like all memory - is organized to make only certain constellations of neuronal

firings accessible and likely. *All sorts of other constellations remain present but in a state of pure potential: less likely, less accessible, and central to my point this afternoon, increasingly avoided over time as both unfamiliar and uncomfortable at the level of conscious subjective experience.*

That's where we get to the key question psychoanalytic clinical theory may help us consider. *Why* is what's unfamiliar avoided over time as increasingly uncomfortable by most people, most of the time? And can recent work on the nature of memory help us systematically understand what analysts have actually been doing all these years to render the unfamiliar less aversive, such that people really do find themselves able to re-invent how they relate to what's unfamiliar? Most relevant for our purposes, might whatever those analysts have been doing hold implications for why we encounter resistance to open-minded consideration of frankly anomalous ideas from scientists whose daily scientific practice is characterized by genuine devotion to open-mindedness as the basis of both scientific method and a scientific attitude? Finally, might we then extrapolate any indications for how we can effectively approach those resistances?

I think so.

One of Freud's greatest contributions was his development of a concept called signal anxiety. (For you German-speakers: *Angstsignal*.) Signal anxiety describes an unconscious mental function which operates as a kind of early warning system for the psyche. It's what, after you've been burned once, stops you from having consciously to consider the merits of grasping the red-hot end of a poker every time you want to pull it out of a blazing fire. It's what leads a child to go promptly back to class when he hears the end-of-recess bell after repeated scoldings for staying on the playground. It's what makes a child pathologically phobic about leaving home if he imagines his wish for independence has caused his mother to get depressed.

What's happened in each of those instances is that perceived danger has led to an experience of anxiety. Anxiety has then mobilized a defensive response in the interests of averting further anxiety. But the key to understanding signal anxiety is that it's a concept about *learning*, not just reaction to danger. Once danger has been recognized, signal anxiety operates as an

*attenuated form of the original anxiety reaction stimulated by the original danger* (Laplanche and Pontalis, 1973). To that extent, it's a concept about memory and how we use memory. We don't, for example, confronted with red-hot poker, keep repeating the sequence of behaviors that led us once to pick up the hot end, scream with pain and then drop it. We've learned not to do that. We develop instead a straightforward set of defensive strategies stimulated by the anxiety that we might get burned again. We pick up the cool end or we use an insulated glove or we wait until the hot end is no longer hot. We find some way not to get burned and we'll usually do it with an automaticity that allows us to avoid any conscious experience of anxiety. *But that's not because we aren't actively processing anxiety in order to achieve our newly adaptive strategies for avoiding the experience of getting burned again.* It's because that anxiety is being processed without our being consciously aware of it; unconscious signal anxiety is triggering the defensive behaviors we require.

By and large, that's how defensive processes work. They're mobilized by signal anxiety, usually unconscious signal anxiety. At their most efficient, those defensive operations go smoothly into action with little if any conscious awareness that anxiety has stimulated them in the first place.

Let me return now to the boy who develops a phobia about leaving home. What's especially interesting about that example is not just that the anxiety which propels his phobia operates unconsciously. Even more interesting is the fact that rarely - if ever - will he be able to tell you why he doesn't want to leave home or what's making him anxious. The fact is, he blames himself for his mother's depression. The reason his self-blame stays unconscious is because he's in conflict about it. He's in conflict about the impulses that fuel it. He wants two things at once. He wants to stay tied to his mother but he also wants to experiment with being on his own. By contrast, even though we may feel stupid for getting burned by a red-hot poker, we experience little or no conflict about picking the poker up again. If anyone bothered to ask why we no longer touch red-hot pokers, we'd readily tell them it's no fun getting burned.

We're able to do that because picking up red-hot poker has very little psychic pay-off. We don't experience internal conflict about continuing the behavior that led to our original experience of danger - getting burned - and about the resultant anxiety that we could get burned again. But the child who's wanting independence from his mother is in a very different situation. He doesn't want to give up the behavior that's simultaneously making him anxious. So he *is* in conflict. What starts to get really interesting is that years later, it's likely to be that same child who finds himself offering elaborate rationales to his prospective spouse about why they shouldn't buy a house which suits their needs perfectly but happens to require that he commute to work. None of his rationales are likely to touch on the fact that he's worried about commuting, being far from home and the effect on his wife. Instead he's likely to offer his fiancée a series of carefully conscious, beautifully logical rationales which no one - he least of all - will recognize as completely irrelevant to what's actually driving his resistance to buying the perfect house. His girlfriend will offer one reasonable argument after another and get nowhere. She'll feel misunderstood and so will he. Things will start going awry between them and they won't be able to figure out why they're talking past each other.

Sound familiar? Reminiscent of any occasion on which you've felt you just can't get on the same page with a valued scientific colleague?

What's happened with the prospective groom is that the idea of being far from home has mobilized a set of neuronal firings very close to the set which constellated his original experience of trauma: going to school and imagining he's causing his mother to get depressed. That in turn has stimulated the signal anxiety which triggered his childhood phobia. As a child, his phobia offered him a set of defensive maneuvers which enabled him to proceed through life - phobically perhaps, but protected from the worse alternative of having to choose between loving and caring for his mother, versus exercising his wish for independence.

Day-to-day, with things like red-hot poker, it's precisely that organization of memory which functions as a highly adaptive way for us to live. But signal anxiety can end up organizing patterns of neuronal firing which

turn out not so adaptive for the ongoing business of living - as in the case of phobias or other neurotic, symptomatically rigid habits of mind. While those patterns may once have constituted the best someone could do in coping with unconsciously assessed danger, they may or may not continue to serve that person well as life goes on and new challenges develop. Their maladaptive-ness can become glaringly evident when - motivated by the desire to avoid some experience of painful conflict - people end up constructing watertight rationales for why particular memories justify behaviors that prove repeatedly self-destructive. Since the on-line processing which organizes memory happens outside conscious awareness, those individuals won't know why they keep getting into trouble. They won't recognize that the explanations to which they keep resorting have little or nothing to do with the original anxieties that organized the patterns of neuronal firings still constellating the memories and ensuing behaviors leading them to feel safe in the world.

So back to anomalous ideas and why arguing with conscious resistance to them tends to have little pay-off. Those arguments can't possibly have pay-off if they're arguments with artifacts, with *post-facto* constructions that have little or nothing to do with the actual anxieties holding people's resistances in place. Psychoanalysts who tried to argue people out of phobias or hysterical symptoms discovered the futility of that effort long ago.

Where, then, does that leave us in relation to our skeptical scientist friends? I think it leaves us precisely where psychoanalytic clinical theory has positioned analysts for years: not arguing, not persuading, *but systematically working to establish those idiosyncratic conditions of safety that allow someone to experiment with disarming the early warning systems which organize that person's peculiar array of neuronal firings as unconscious signal anxieties*. What I'm recommending is that our best shot at fruitfully engaging the resistances of our reluctant scientist friends will have us re-thinking our structures for scientific dialogue. I think we'll find the insights of clinical psychoanalysis supremely useful in showing us how we can effectively do that. Particularly, I think those insights may help us nourish people's fascination with how they resist the unfamiliar in ways they may ultimately find themselves choosing to reconsider. From there I think we'll find the conversation

changes - and changes radically. That's where the engagement I termed the psychoanalytic dance becomes crucial. Its principles become crucial. Those principles are about how signal anxiety manifests so we can recognize it. They're principles about how people get themselves to the point of challenging the automaticity of signal anxiety and the memories that fuel it. They're principles about how dialogue between people can operate as a crucible within which life-long defensive patterns end up available for testing and newly open to question. They're principles about how to listen for the underlying anxieties which hold people's resistances so stubbornly in place. Finally, they're principles about how it's possible to establish an environment of safety in arenas which people don't consciously recognize as threatening.

So on the one hand, I'm arguing against argument. But I'm also arguing for something that doesn't just send us retreating to our personal labs or to comforting gatherings of like-minded individuals. I don't believe those are the only alternatives we've got. Those alternatives have limited pay-off in the larger community of scientists to which we belong.

It's true that the dialogues I'm recommending instead take patience. They take profound respect for our colleagues, no matter how skeptical. They take myriad skills in building trust and human relationships. And we all know those aren't the first thing graduate programs in science or medical schools tend to reward. Nor do they typically designate the fast track to tenure.

But I firmly believe we're on the edge of some radically new paradigms in science that will inform the ways science can continue to constitute a cornerstone of life on our planet. These past twenty years at PEAR have made a significant contribution in getting us to that point. We now face the question of how we can engage those paradigms on the working forefronts of science with all the vigor to which the weight of evidence is starting to entitle us.

## References

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