DOES TRUTH MATTER? SCIENCE, PSEUDOSCIENCE, AND CIVILIZATION.

Carl Sagan

Science has beauty, power, and majesty that can provide spiritual as well as practical fulfillment. But superstition and pseudoscience keep getting in the way, providing easy answers, casually pressing our awe buttons, and cheapening the experience.

Do we care what's true? Does it matter?

. . . where ignorance is bliss, 'Tis folly to be wise

wrote the poet Thomas Gray. But is it? Edmund Way Teale in his 1950 book Circle of the Seasons understood the dilemma better:

It is morally as bad not to care whether a thing is true or not, so long as it makes you feel good, as it is not to care how you got your money as long as you have got it.

It's disheartening to discover government corruption and incompetence, for example; but is it better not to know about it? Whose interest does ignorance serve? If we humans bear, say, hereditary propensities toward the hatred of strangers, isn't self-knowledge the only antidote? If we long to believe that the stars' rise and set for us, that we are the reason there is a Universe, does science do us a disservice in deflating our conceits?

In The Genealogy of Morals, Friedrich Nietzsche, as so many before and after, decries the "*unbroken progress in the self-belittling of man*" brought about by the scientific revolution. Nietzsche mourns the loss of "*man's belief in his dignity, his uniqueness, his irreplaceability in the scheme of existence.*" For me, it is far better to grasp the Universe as it really is than to persist in delusion, however satisfying and reassuring. Which attitude is better geared for our long-term survival? Which gives us more leverage on our future? And if our naive self-confidence is a little undermined in the process, is that altogether such a loss? Is there not cause to welcome it as a maturing and character-building experience?

To discover that the Universe is some 8 to 15 billion and not 6 to 12 thousand years old(1) improves our appreciation of its sweep and grandeur; to entertain the notion that we are a particularly complex arrangement of atoms, and not some breath of divinity, at the very least enhances our respect for atoms; to discover, as now seems probable, that our planet is one of billions of other worlds in the Milky Way Galaxy and that our galaxy is one of billions more, majestically expands the arena of what is possible; to find that our ancestors were also the ancestors of apes ties us to the rest of life and makes possible important - if occasionally rueful - reflections on human nature.

Plainly there is no way back. Like it or not, we are stuck with science. We had better make the best of it. When we finally come to terms with it and fully recognize its beauty and its power, we will find, in spiritual as well as in practical matters, that we have made a bargain strongly in our favor.

But superstition and pseudoscience keep getting in the way, distracting us, providing easy answers, dodging skeptical scrutiny, casually pressing our awe buttons and cheapening the experience, making us routine and comfortable practitioners as well as victims of credulity. Yes, the world would be a more interesting place if there were UFOs lurking in the deep waters off Bermuda and eating ships and planes, or if dead people could take control of our hands and write us messages. It would be fascinating if adolescents were able to make telephone handsets rocket off their cradles just by thinking at them, or if our dreams could, more often than can be explained by chance and our knowledge of the world, accurately foretell the future.

These are all instances of pseudoscience. They purport to use the methods and findings of science, while in fact they are faithless to its nature - often because they are based on insufficient evidence or because

they ignore clues that point the other way. They ripple with gullibility. With the uninformed cooperation (and often the cynical connivance) of newspapers, magazines, book publishers, radio, television, movie producers, and the like, such ideas are easily and widely available. Far more difficult to come upon are the alternative, more challenging, and even more dazzling findings of science.

Pseudoscience is easier to contrive than science because distracting confrontations with reality - where we cannot control the outcome of the comparison - are more readily avoided. The standards of argument, what passes for evidence, are much more relaxed. In part for these same reasons, it is much easier to present pseudoscience to the general public than science. But this isn't enough to explain its popularity.

Naturally people try various belief systems on for size, to see if they help. And if we're desperate enough, we become all too willing to abandon what may be perceived as the heavy burden of skepticism. Pseudoscience speaks to powerful emotional needs that science often leaves unfulfilled. It caters to fantasies about personal powers we lack and long for (like those attributed to comic book superheroes today, and earlier, to the gods). In some of its manifestations, it offers satisfaction of spiritual hungers, cures for disease, promises that death is not the end. It reassures us of our cosmic centrality and importance. It vouchsafes that we are hooked up with, tied to, the Universe.(2) Sometimes it's a kind of halfway house between old religion and new science, mistrusted by both.

At the heart of some pseudoscience (and some religion also, New Age and Old) is the idea that wishing makes it so. How satisfying it would be, as in folklore and children's stories, to fulfill our heart's desire just by wishing. How seductive this notion is, especially when compared with the hard work and good luck usually required to achieve our hopes. The enchanted fish or the genie from the lamp will grant us three wishes - anything we want except more wishes. Who has not pondered - just to be on the safe side, just in case we ever come upon and accidentally rub an old, squat brass oil lamp - what to ask for?

I remember, from childhood comic strips and books, a top-hatted, mustachioed magician who brandished an ebony walking stick. His name was Zatara. He could make anything happen, anything at all. How did he do it? Easy. He uttered his commands backwards. So if he wanted a million dollars, he would say "*srallod noillim a em evig.*" That's all there was to it. It was something like prayer, but much surer of results.

I spent a lot of time at age eight experimenting in this vein, commanding stones to levitate: "esir, enots." It never worked. I blamed my pronunciation.

Pseudoscience is embraced, it might be argued, in exact proportion as real science is misunderstood - except that the language breaks down here. If you've never heard of science (to say nothing of how it works), you can hardly be aware you're embracing pseudoscience. You're simply thinking in one of the ways that humans always have. Religions are often the state-protected nurseries of pseudoscience, although there's no reason why religions have to play that role. In a way, it's an artifact from times long gone. In some countries nearly everyone believes in astrology and precognition, including government leaders. But this is not simply drummed into them by religion; it is drawn out of the enveloping culture in which everyone is comfortable with these practices, and affirming testimonials are everywhere.

Most of the case histories I will relate are American - because these are the cases I know best, not because pseudoscience and mysticism are more prominent in the United States than elsewhere. But the psychic spoonbender and extraterrestrial channeler Uri Geller hails from Israel. As tensions rise between Algerian secularists and Moslem fundamentalists, more and more people are discreetly consulting the country's 10,000 soothsayers and clairvoyants (about half of whom operate with a license from the government). High French officials, including a former president of France, arranged for millions of dollars to be invested in a scam (the Elf-Aquitaine scandal) to find new petroleum reserves from the air. In Germany, there is concern about carcinogenic "Earth rays" undetectable by science; they can be sensed only by experienced dowsers brandishing forked sticks. "Psychic surgery" flourishes in the Philippines. Ghosts are something of a national obsession in Britain. Since World War II, Japan has spawned enormous numbers of new religions featuring the supernatural. An estimated 100,000 fortune-tellers flourish in Japan; the clientele are mainly young women. Aum Shinrikyo, a sect thought to be involved in the release of the nerve gas sarin in the Tokyo subway system in March 1995, features levitation, faith healing, and ESP among its main tenets. Followers, at a high price, drank the "miracle pond" water - from the bath of Asaraha, their leader. In Thailand, diseases are treated with pills manufactured from pulverized sacred Scripture. "Witches" are today being burned in South Africa. Australian peace-keeping forces in Haiti rescue a woman tied to a tree; she is accused of flying from rooftop to rooftop, and

sucking the blood of children. Astrology is rife in India, geomancy widespread in China.

Perhaps the most successful recent global pseudoscience - by many criteria, already a religion - is the Hindu doctrine of transcendental meditation (TM). The soporific homilies of its founder and spiritual leader, the Maharishi Mahesh Yogi, can be seen on television. Seated in the yogi position, his white hair here and there flecked with black, surrounded by garlands and floral offerings, he has a look. One day while channel surfing we came upon this visage. "You know who that is?" asked our four-year-old son. "God." The worldwide TM organization has an estimated valuation of $3 billion. For a fee they promise through meditation to be able to walk you through walls, to make you invisible, to enable you to fly. By thinking in unison they have, they say, diminished the crime rate in Washington, D.C., and caused the collapse of the Soviet Union, among other secular miracles. Not one smattering of real evidence has been offered for any such claims. TM sells folk medicine, runs trading companies, medical clinics and "research" universities, and has unsuccessfully entered politics. In its oddly charismatic leader, its promise of community, and the offer of magical powers in exchange for money and fervent belief, it is typical of many pseudosciences marketed for sacerdotal export.

At each relinquishing of civil controls and scientific education another little spurt in pseudoscience occurs. Leon Trotsky described it for Germany on the eve of the Hitler takeover (but in a description that might equally have applied to the Soviet Union of 1933):

Not only in peasant homes, but also in city skyscrapers, there lives along side the twentieth century the thirteenth. A hundred million people use electricity and still believe in the magic powers of signs and exorcisms. . . . Movie stars go to mediums. Aviators who pilot miraculous mechanisms created by man's genius wear amulets on their sweaters. What inexhaustible reserves they possess of darkness, ignorance and savagery!

Russia is an instructive case. Under the tsars, religious superstition was encouraged, but scientific and skeptical thinking - except by a few tame scientists - was ruthlessly expunged. Under Communism, both religion and pseudoscience were systematically suppressed - except for the superstition of the state ideological religion. It was advertised as scientific, but fell as far short of this ideal as the most unself-critical mystery cult. Critical thinking - except by scientists in hermetically sealed compartments of knowledge - was recognized as dangerous, was not

taught in the schools, and was punished where expressed. As a result, post-Communism, many Russians view science with suspicion. When the lid was lifted, as was also true of virulent ethnic hatreds, what had all along been bubbling subsurface was exposed to view. The region is now awash in UFOs, poltergeists, faith healers, quack medicines, magic waters, and old-time superstition. A stunning decline in life expectancy, increasing infant mortality, rampant epidemic disease, subminimal medical standards, and ignorance of preventative medicine all work to raise the threshold at which skepticism is triggered in an increasingly desperate population. As I write, the electorally most popular member of the Duma, a leading supporter of the ultranationalist Vladimir Zhirinovksy, is one Anatoly Kashpirovsky - a faith healer who remotely cures diseases ranging from hernias to AIDS by glaring at you out of your television set. His face starts stopped clocks.

A somewhat analogous situation exists in China. After the death of Mao Zedong and the gradual emergence of a market economy, UFOs, channeling, and other examples of Western pseudoscience emerged, along with such ancient Chinese practices as ancestor worship, astrology, and fortune telling - especially that version that involves throwing yarrow sticks and working through the hoary tetragrams of the I Ching. The government newspaper lamented that "the superstition of feudal ideology is reviving in our countryside." It was (and remains) a rural, not primarily an urban, affliction.

Individuals with "special powers" gained enormous followings. They could, they said, project Qi, the "energy field of the Universe," out of their bodies to change the molecular structure of a chemical 2000 kilometers away, to communicate with aliens, to cure diseases. Some patients died under the ministrations of one of these "masters of Qi Gong" who was arrested and convicted in 1993. Wang Hongcheng, an amateur chemist, claimed to have synthesized a liquid, small amounts of which, when added to water, would convert it to gasoline or the equivalent. For a time he was funded by the army and the secret police, but when his invention was found to be a scam he was arrested and imprisoned. Naturally the story spread that his misfortune resulted not from fraud, but from his unwillingness to reveal his "secret formula" to the government. (Similar stories have circulated in America for decades, usually with the government role replaced by a major oil or auto company.) Asian rhinos are being driven to extinction because their horns, when pulverized, are said to prevent impotence; the market encompasses all of East Asia.

The government of China and the Chinese Communist Party were alarmed by certain of these developments. On December 5, 1994, they issued a joint proclamation that read in part:

[P]ublic education in science has been withering in recent years. At the same time, activities of superstition and ignorance have been growing, and antiscience and pseudoscience cases have become frequent. Therefore, effective measures must be applied as soon as possible to strengthen public education in science. The level of public education in science and technology is an important sign of the national scientific accomplishment. It is a matter of overall importance in economic development, scientific advance, and the progress of society. We must be attentive and implement such public education as part of the strategy to modernize our socialist country and to make our nation powerful and prosperous. Ignorance is never socialist, nor is poverty.

So pseudoscience in America is part of a global trend. Its causes, dangers, diagnosis, and treatment are likely to be similar everywhere. Here, psychics ply their wares on extended television commercials, personally endorsed by entertainers. They have their own channel, the "Psychic Friends Network"; a million people a year sign on and use such guidance in their everyday lives. For the CEOs of major corporations, for financial analysts, for lawyers and bankers there is a species of astrologer/soothsayer/psychic ready to advise on any matter. "If people knew how many people, especially the very rich and powerful ones, went to psychics, their jaws would drop through the floor," says a psychic from Cleveland, Ohio. Royalty has traditionally been vulnerable to psychic frauds. In ancient China and Rome astrology was the exclusive property of the emperor; any private use of this potent art was considered a capital offense. Emerging from a particularly credulous Southern California culture, Nancy and Ronald Reagan relied on an astrologer in private and public matters - unknown to the voting public. Some portion of the decision-making that influences the future of our civilization is plainly in the hands of charlatans. If anything, the practice is comparatively muted in America; its venue is worldwide.

As amusing as some of pseudoscience may seem, as confident as we may be that we would never be so gullible as to be swept up by such a doctrine, we know it's happening all around us. Transcendental Meditation and Aum Shinrikyo seem to have attracted a large number of accomplished people, some with advanced degrees in physics or engineering. These are not doctrines for nitwits. Something else is going on.

What's more, no one interested in what religions are and how they begin can ignore them. While vast barriers may seem to stretch between a local, single-focus contention of pseudoscience and something like a world religion, the partitions are very thin. The world presents us with nearly insurmountable problems. A wide variety of solutions are offered, some of very limited worldview, some of portentous sweep. In the usual Darwinian natural selection of doctrines, some thrive for a time, while most quickly vanish. But a few - sometimes, as history has shown, the most scruffy and least prepossessing among them - may have the power to profoundly change the history of the world.

The continuum stretching from ill-practiced science, pseudoscience, and superstition (New Age or Old), all the way to respectable mystery religion, based on revelation, is indistinct. I try not to use the word "cult" in its usual meaning of a religion the speaker dislikes, but try to reach for the headstone of knowledge - do they really know what they claim to know? Everyone, it turns out, has relevant expertise.

I am critical of the excesses of theology, because at the extremes it is difficult to distinguish pseudoscience from rigid, doctrinaire religion. Nevertheless, I want to acknowledge at the outset the prodigious diversity and complexity of religious thought and practice over the millennia; the growth of liberal religion and ecumenical fellowship during the last century; and the fact that - as in the Protestant Reformation, the rise of Reform Judaism, Vatican II, and the so-called higher criticism of the Bible - religion has fought (with varying degrees of success) its own excesses. But in parallel to the many scientists who seem reluctant to debate or even publicly discuss pseudoscience, many proponents of mainstream religions are reluctant to take on extreme conservatives and fundamentalists. If the trend continues, eventually the field is theirs; they can win the debate by default.

One religious leader writes to me of his longing for "disciplined integrity" in religion:

We have grown far too sentimental. . . . Devotionalism and cheap psychology on one side, and arrogance and dogmatic intolerance on the other distort authentic religious life almost beyond recognition. Sometimes I come close to despair, but then I live tenaciously and always with hope. . . . Honest religion, more familiar than its critics with the distortions and absurdities perpetrated in its name, has an active interest in encouraging a healthy skepticism for its own purposes. . . . There is the possibility for religion and science to forge a potent partnership

against pseudo-science. Strangely, I think it would soon be engaged also in opposing pseudo-religion.

Pseudoscience differs from erroneous science. Science thrives on errors, cutting them away one by one. False conclusions are drawn all the time, but they are drawn tentatively. Hypotheses are framed so they are capable of being disproved. A succession of alternative hypotheses is confronted by experiment and observation. Science gropes and staggers toward improved understanding. Proprietary feelings are of course offended when a scientific hypothesis is disproved, but such disproofs are recognized as central to the scientific enterprise.

Pseudoscience is just the opposite. Hypotheses are often framed precisely so they are invulnerable to any experiment that offers a prospect of disproof, so even in principle they cannot be invalidated. Practitioners are defensive and wary. Skeptical scrutiny is opposed. When the pseudoscientific hypothesis fails to catch fire with scientists, conspiracies to suppress it are deduced.

Motor ability in healthy people is almost perfect. We rarely stumble and fall, except in young and old age. We can learn tasks such as riding a bicycle or skating or skipping, jumping rope or driving a car, and retain that mastery for the rest of our lives. Even if we've gone a decade without doing it, it comes back to us effortlessly. The precision and retention of our motor skills may, however, give us a false sense of confidence in our other talents. Our perceptions are fallible. We sometimes see what isn't there. We are prey to optical illusions. Occasionally we hallucinate. We are error-prone. A most illuminating book called How We Know What Isn't So: The Fallibility of Human Reason in Everyday Life, by Thomas Gilovich, shows how people systematically err in understanding numbers, in rejecting unpleasant evidence, in being influenced by the opinions of others. We're good in some things, but not in everything. Wisdom lies in understanding our limitations. "For Man is a giddy thing," teaches William Shakespeare. That's where the stuffy skeptical rigor of science comes in.

Perhaps the sharpest distinction between science and pseudoscience is that science has a far keener appreciation of human imperfections and fallibility than does pseudoscience (or "inerrant" revelation). If we resolutely refuse to acknowledge where we are liable to fall into error, then we can confidently expect that error - even serious error, profound mistakes - will be our companion forever. But if we are capable of a little

courageous self-assessment, whatever rueful reflections they may engender, our chances improve enormously.

If we teach only the findings and products of science - no matter how useful and even inspiring they may be - without communicating its critical method, how can the average person possibly distinguish science from pseudoscience? Both then are presented as unsupported assertion. In Russia and China, it used to be easy. Authoritative science was what the authorities taught. The distinction between science and pseudoscience was made for you. No perplexities needed to be muddled through. But when profound political changes occurred and strictures on free thought were loosened, a host of confident or charismatic claims - specially those that told us what we wanted to hear - gained a vast following. Every notion, however improbable, became authoritative.

It is a supreme challenge for the popularizer of science to make clear the actual, tortuous history of its great discoveries and the misapprehensions and occasional stubborn refusal by its practitioners to change course. Many, perhaps most, science textbooks for budding scientists tread lightly here. It is enormously easier to present in an appealing way the wisdom distilled from centuries of patient and collective interrogation of Nature than to detail the messy distillation apparatus. The method of science, as stodgy and grumpy as it may seem, is far more important than the findings of science.

Notes

1. "No thinking religious person believes this. Old hat," writes one of the referees of this book. But many "scientific creationists" not only believe it, but are making increasingly aggressive and successful efforts to have it taught in the schools, museums, zoos, and textbooks. Why? Because adding up the "begats," the ages of patriarchs and others in the Bible, gives such a figure, and the Bible is "inerrant."

2. Although it's hard for me to see a more profound cosmic connection, than the astonishing findings of modern nuclear astrophysics: Except for hydrogen, all the atoms that make each of us up - the iron in our blood, the calcium in our bones, the carbon in our brains - were manufactured in red giant stars thousands of light-years away in space and billions of years ago in time. We are, as I like to say, starstuff.

RELATED ARTICLE: SCIENCE A SOURCE OF SPIRITUALITY

In its encounter with Nature, science invariably elicits a sense of reverence and awe. The very act of understanding is a celebration of joining, merging, even if on a very modest scale, with the magnificence of the Cosmos. And the cumulative worldwide buildup of knowledge over time converts science into something only a little short of a transnational, transgenerational metamind.

"Spirit" comes from the Latin word "to breathe." What we breathe is air, which is certainly matter, however thin. Despite usage to the contrary, there is no necessary implication in the word "spiritual" that we are talking of anything other than matter (including the matter of which the brain is made), or anything outside the realm of science. On occasion, I will feel free to use the word. Science is not only compatible with spirituality; it is a profound source of spiritually. When we recognize our place in an immensity of light-years and in the passage of ages, when we grasp the intricacy, beauty, and subtlety of life, then that soaring feeling, that sense of elation and humility combined, is surely spiritual. So are our emotions in the presence of great art or music or literature, or of acts of exemplary selfless courage such as those of Mohandas Gandhi or Martin Luther King, Jr. The notion that science and spirituality are somehow mutually exclusive does a disservice to both.

RELATED ARTICLE: THE METAPHYSICIST HAS NO LABORATORY

The truth may be puzzling or counterintuitive. It may contradict deeply held beliefs. Experiment is how we get a handle on it.

At a dinner many decades ago, the physicist Robert W. Wood was asked to respond to the toast, "To physics and metaphysics." By "metaphysics," people then meant something like philosophy, or truths you could recognize just by thinking about them. They could also have included pseudoscience. Wood answered along these lines:

The physicist has an idea. The more he thinks it through, the more sense it seems to make. He consults the scientific literature. The more he reads,

the more promising the idea becomes. Thus prepared, he goes to the laboratory and devises an experiment to test it. The experiment is painstaking. Many possibilities are checked. The accuracy of measurement is refined, the error bars reduced. He lets the chips fall where they may. He is devoted only to what the experiment teaches. At the end of all this work, through careful experimentation, the idea is found to be worthless. So the physicist discards it, frees his mind from the clutter of error, and moves on to something else.(1)

The difference between physics and metaphysics, Wood concluded as he raised his glass high, is not that the practitioners of one are smarter than the practitioners of the other. The difference is that the metaphysicist has no laboratory.

Note

> *As the pioneering physicist Benjamin Franklin put it, "In going on with these experiments, how many pretty systems do we build, which we soon find ourselves obliged to destroy?" At the very least, he thought, the experience sufficed to "help to make a vain Man humble."*

RELATED ARTICLE: THE SIREN SONG OF UNREASON

A Candle in the Dark is the title of a courageous, largely Biblically-based, book by Thomas Ady, published in London in 1656, attacking the witchhunts then in progress as a scam "to delude the people." Any illness or storm, anything out of the ordinary, was popularly attributed to witchcraft. Witches must exist, Ady quoted the "witchmongers" as arguing - "else how should these things be, or come to pass?" For much of our history, we were so fearful of the outside world, with its unpredictable dangers, that we gladly embraced anything that promised to soften or explain away the terror. Science is an attempt, largely successful, to understand the world, to get a grip on things, to get hold of ourselves, to steer a safe course. Microbiology and meteorology now explain what only a few centuries ago was considered sufficient cause to burn women to death.

Ady also warned of the danger that "the Nations [will] perish for lack of knowledge." Avoidable human misery is more often caused not so much

by stupidity as by ignorance, particularly our ignorance about ourselves. I worry that, especially as the Millennium edges nearer, pseudoscience and superstition will seem year by year more tempting, the siren song of unreason more sonorous and attractive. Where have we heard it before? Whenever our ethnic or national prejudices are aroused, in times of scarcity, during challenges to national self-esteem or nerve, when we agonize about our diminished cosmic place and purpose, or when fanaticism is bubbling up around us - then, habits of thought familiar from ages past reach for the controls.

The candle flame gutters. Its little pool of light trembles. Darkness gathers. The demons begin to stir.

RELATED ARTICLE: AN ABSENCE OF ALIEN ARTIFACTS

Some [alleged UFO] abductees say that tiny implants, perhaps metallic, were inserted into their bodies - high up their nostrils, for example. These implants, alien abduction therapists tell us, sometimes accidentally fall out, but "in all but a few of the cases the artifact has been lost or discarded." These abductees seem stupefyingly incurious. A strange object - possibly a transmitter sending telemetered data about the state of your body to an alien spaceship somewhere above the Earth - drops out of your nose; you idly examine it and then throw it in the garbage. Something like this is true, we are told, of the majority of abduction cases.

A few such "implants" have been produced and examined by experts. None has been confirmed as of unearthly manufacture. No components are made of unusual isotopes, despite the fact that other stars and other worlds are known to be constituted of different isotopic proportions than the Earth. There are no metals from the transuranic "island of stability," where physicists think there should be a new family of nonradioactive chemical elements unknown on Earth.

What abduction enthusiasts considered the best case was that of Richard Price, who claims that aliens abducted him when he was eight years old and implanted a small artifact in his penis. A quarter century later a physician confirmed a "foreign body" embedded there. After eight more years, it fell out. Roughly a millimeter in diameter and 4 millimeters

long, it was carefully examined by scientists from MIT and Massachusetts General Hospital. Their conclusion? Collagen formed by the body at sites of inflammation plus cotton fibers from Price's underpants.

On August 28, 1995, television stations owned by Rupert Murdoch ran what was purported to be an autopsy of a dead alien, shot on 16-millimeter film. Masked pathologists in vintage radiation-protection suits (with rectangular glass windows to see out of) cut up a large-eyed 12-fingered figure and examined the internal organs. While the film was sometimes out of focus, and the view of the cadaver often blocked by the humans crowding around it, some viewers found the effect chilling. The Times of London, also owned by Murdoch, didn't know what to make of it, although it did quote one pathologist who thought the autopsy performed with unseemly and unrealistic haste (ideal, though, for television viewing). It was said to have been shot in New Mexico in 1947 by a participant, now in his eighties, who wished to remain anonymous. What appeared to be the clincher was the announcement that the leader of the film (its first few feet) contained coded information that Kodak, the manufacturer, dated to 1947. However, it turns out that the full film magazine was not presented to Kodak, but at most the cut leader. For all we know, the leader could have been cut from a 1947 newsreel, abundantly archived in America, and the "autopsy" staged and filmed separately and recently. There's a dragon footprint all right - but a fakable one. If this is a hoax, it requires not much more cleverness than crop circles and the MJ-12 document.

In none of these stories is there anything strongly suggestive of extraterrestrial origin. There is certainly no retrieval of cunning machinery far beyond current technology. No abductee has filched a page from the captain's logbook, or an examining instrument, or taken an authentic photograph of the interior of the ship, or come back with detailed and verifiable scientific information not hitherto available on Earth. Why not? These failures must tell us something.

Since the middle of the twentieth century, we've been assured by proponents of the extraterrestrial hypothesis that physical evidence - not star maps remembered from years ago, not scars, not disturbed soil, but real alien technology - was in hand. The analysis would be released momentarily. These claims go back to the earliest crashed saucer scam of Newton and GeBauer. Now it's decades later and we're still waiting. Where are the articles published in the refereed scientific literature, in the

metallurgical and ceramics journals, in publications of the Institute of Electrical and Electronic Engineers, in Science or Nature?

Such a discovery would be momentous. If there were real artifacts, physicists and chemists would be fighting for the privilege of discovering that there are aliens among us - who use, say, unknown alloys, or materials of extraordinary tensile strength or ductility or conductivity. The practical implications of such a finding - never mind the confirmation of an alien invasion - would be immense. Discoveries like this are what scientists live for. Their absence must tell us something.

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