



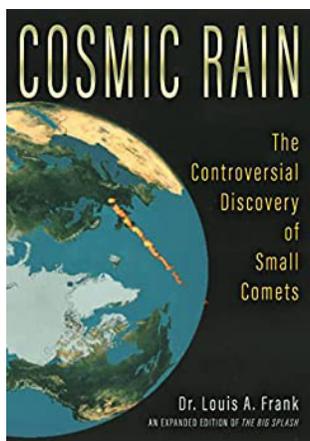
ESSAY
BOOK REVIEW

Startling Discoveries and Contrarian Anomalies: Small Comets and Other Heresies

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Cosmic Rain: The Controversial Discovery of Small Comets by Louis A. Frank



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This book should be required reading for all scholars and students of Science and Technology Studies (STS), which encompasses the history and sociology of science and the interaction of science with society as a whole.¹ Anomalists will find the discovery narrative engrossing and the whole book rewarding, well worth coping with the occasional technicalities. Lay readers should likewise appreciate Part 1 and will miss little of importance to them by scanning Part 2 more rapidly.

CONTENT OVERVIEW

Cosmic Rain is really several books in one. Most directly, it is a fascinating scientific detective story. At the same time, as Frank recognized (p. 4), it is an important case study in the history of science, illuminating most particularly the circumstances of scientific breakthroughs that are surprising and unforeseen. Frank's experiences illustrate several general points about the manner in which science receives—or rather, resists—startling novelty.

Furthermore, this book is a very detailed first-hand description of scientific activity, warts and all, that should enable non-scientists to begin to recognize that scientific activity is very much like other human activities: influenced by human behavior and human psychology, not only by the objective technical considerations.

Louis Frank was a distinguished physicist at the University of Iowa whose specialty was plasma physics. In the early 1980s, he was puzzled by persistent dark spots in ultraviolet (UV) images of the outer reaches of the Earth taken from a satellite, the Dynamics Explorer, which carried several instruments that were Frank's responsibility.

Frank and his associates made strenuous efforts trying, unsuccessfully, to identify flaws in the instruments that could be responsible for those dark spots. Eventually they concluded that the cause had to be some actual physical phenomenon capable of absorbing UV at such discrete points. The culprit seemed to be water, since its molecules and components absorb UV of the pertinent wavelengths. But at the relevant altitude above the Earth's surface, that water could not have originated at the Earth's surface, it must have arrived from outer space. Frank deduced that it originated in the so-called "Oort disc," a vast reservoir of comets feeding the more well-known "Oort cloud" that



had long been regarded as the source of such major comets as the iconic Halley's, which periodically becomes visible from the Earth.

But comets of Halley's size would be far too large to account for those little dark spots, so apparently the Earth was being impacted by quite small water-containing comets—"small" relative only to the commonly visible ones like Halley's, namely in the range of a few tons of mass and producing, on contact with the Earth's outermost reaches, clouds of water vapor some tens of miles in size.

Frank's conclusion was not immediately palatable to large swaths of the scientific community. It was the very first time that the existence of such comets had been suggested, let alone how many of them were needed to account for the observed UV-dark spots: something like *ten million* per year. Why had they not been seen by other means?

Frank's small, water-carrying comets infringed on long-standing presumptions about quite a range of issues: the material composition and the mechanisms of formation of stars and planets and moons, of the universe as a whole, and specifically of our own solar system. Wherefrom came all the water on Earth and the other planets and moons? How? When?

So Frank experienced the typical reactions: denial, resistance, difficulty getting the work published. Grants continued to be awarded for his plasma work but not for studying small comets. Peer review relating to the small-comet hypothesis was biased and incompetent. Vigorous opposition was marked by behavior of which the perpetrators might well be thoroughly ashamed: hypocrisy, dishonesty to varying degrees, and in a variety of circumstances "intrigue, back-biting, and small-mindedness" (p. 3). *Cosmic Rain* is replete with examples of such behavior, to the extent that I frequently penned the marginal note "ugh."

That Frank's small comets have such wide-ranging implications serves to explain in some part how lengthy and nasty was the opposition to his discovery. That lengthy resistance also illustrates that Frank's own personality is a crucial element in the story: He needed to have the self-confidence and moral strength to push his evidence strongly and persistently; and thereby he behaved *inevitably* in ways that could easily be described as arrogant, inflexible, unreasonable, self-promoting, like a crank or a crackpot. As I. J. ("Jack") Good, the leading 20th-century proponent of Bayesian statistics, liked to say (Good, 1998): Geniuses are cranks who happen to be right, and cranks are geniuses who happen to be wrong.² And George Bernard Shaw pointed out long ago that progress depends on the actions of unreasonable individuals.³

Such individuals (cf. Peter Duesberg, below, re HIV/

AIDS) have no easy time of it. Louis Frank had been highly respected (for work primarily in plasma physics), but he became *persona non grata* when he proposed the small-comets hypothesis. Frank himself cited (p. 22) the similar experiences of Alfred Wegener (continental drift) and Hannes Alfvén (theories in plasma physics). In the most recent years, another instance is that of Thomas Gold, highly respected for his work in astrophysics but ignored and derided when he made a suggestion about the mechanism of hearing (Gold, 1989)—a suggestion that much later turned out to have been well-founded; and again ignored and even laughed at for his suggestions about the origin of oil and the presence of primordial life at great depths in the Earth.⁴

Frank's confidence about being right, and thus appearing arrogant, is illustrated by the grandiose subtitle of his original book (Frank, with Huyghe, 1990), and by his remarks on page 1: "The textbooks in a dozen sciences will have to be rewritten . . . lakes, rivers, and oceans were not formed . . . early in Earth's history . . . the substances necessary for the origin of life on this planet may well have arrived from space." If, as it seems, all of the present water on Earth represents the cumulative arrival of small water-bearing comets over the course of some 4 billion years, it might make us more aware of the possibility that terrestrial events are influenced or coerced by comets, meteors, asteroids, cosmic radiation. The notion that life on Earth might have been seeded from space has not been widely welcomed, even as evidence for it may be mounting (Wickramasinghe, 2022).

The first part of *Cosmic Rain*, chapters 1–27, is the gripping detective story of discovering that the little dark spots in UV images of the top of the atmosphere are caused by "small" water-bearing comets. It is essentially a reprint of the original edition of Frank's (1990, with Huyghe) book, and describes in fascinating detail how Frank was *forced* by the range and nature of the evidence to conclude that small comets are the only conceivable explanation for the spotty absorption of UV that had first puzzled him. Chapter 6 shows that the composition and history of the oceans fit with the idea that the water originated from cometary sources. Chapter 7 reveals how Frank arrived at plausible conclusions about what, besides water, those small comets contain—and, again, these plausible speculations will have aroused mainstream resistance because of their pertinence to the origin of life on Earth. Common objections to Frank's small comets included that they ought to be observed directly by radars that are continually active as safeguards against hostile missiles, so chapter 9 discusses the flaws in that objection. Chapter 10 indicates how, where, and when small comets can best be actually seen. Some reports of "flying saucers," as UFOs

were first called, might be explainable by small comets, as well as such other controversial reports as the falling from the heavens of large blocks of ice (chapter 11). Later chapters fill in details about whether there should be visible signs of small comets hitting the moon; attempts to gather data about the small comets by means of various man-made Earth satellites; and, unfortunately, quite a lot about the unethical and often hypocritical behavior of the determined activists of mainstream resistance. Chapter 27, “The Turning Point,” sums it up: “The search was over. The existence of small comets had been confirmed. But few believed it. We had won after nine innings, but the others insisted that the game go on.”

Part 2 of *Cosmic Rain*, “Vindication,” has been edited after Frank’s death by Patrick Huyghe, who explains in Appendix 2 how this came about. It details how various sectors of the scientific community accepted, eventually and piecemeal, the existence and import of the water-bearing comets. Many casual readers may find Part 2 less gripping than Part 1, but it is nevertheless a vital part of this case study, illustrating how some adherents of the overturned “consensus” persisted with unwarranted and unethical opposition to the facts long after the case had been objectively proved. Many pages in Part 2 carry my marginal “ugh” note, including about the supposedly most authoritative journals, *Nature* and *Science* (pp. 165–166).⁵

Frank’s (1990) book did not get reviewed by prominent scientific journals; but popular media (and also Arthur C. Clarke) described it as interesting, including about how science treats such novelties. That seems quite typical, to be ignored by the mainstream experts but not by the general public. Contrarian books about HIV/AIDS, global warming, and cholesterol, below, met similar fates. In economics, Milton Friedman’s *Capitalism and Freedom* (1962, University of Chicago Press) was not reviewed in any major national publication yet sold 400,000 copies (Brooks, 1998).

This ignoring or evading or denigrating of a mass of substantive evidence offered by fully qualified people is illustrated on a number of other topics of great public importance (below), for instance HIV/AIDS, global warming, the toxicity of common aluminum compounds, and the theory that “bad” cholesterol as the cause of cardiovascular disease (CVD).

CONTEXT

Several of the general points brought out in the immediately following section are cogently illustrated in the book under review, adding further examples on those points and underscoring the lessons waiting to be learned.

How Science Reacts to Novelty

Anomalists, members of the Society for Scientific Exploration—scientific *explorers*—know full well that their endeavors are not appreciated by “science,” indeed that they tend to be ignored, or dismissed out of hand, or denigrated, or positively maligned. And, rather naturally, we may regard that as unwarranted and resent it. But researchers working entirely within the scientific mainstream encounter the same positive resistance (Barber, 1961), lack of appreciation, and even career-damaging persecution if they happen to come up with evidence or interpretations that are not consonant with the prevailing “scientific consensus.”

The popular view, the conventional wisdom shared by many scientists and would-be scientists, imagines that “science” is always on the lookout for new things, new facts, and new theories. But that is simply not the case nowadays (Bauer, 2017). Contemporary science welcomes novelty only if it fits nicely with what it currently believes; things that don’t fit are treated in the same way as are the striking anomalies in which Scientific Explorers are interested.

The mistaken popular view is based on a superficial acquaintance with the early days of modern science, the heyday of natural philosophy, when it seemed as though almost everything about natural phenomena remained to be properly understood, and the small elite community of natural philosophers indeed welcomed and was excited about genuine novelties. But those were times before anyone was called a scientist,⁶ and long before there existed such specialist disciplines as physics and chemistry and geology and biology and so on.

“Disciplines” is highly appropriate here: Modern sciences are indeed *disciplined*. They have developed approaches, methodologies, bodies of knowledge, and theories in which scientists are trained and which they are expected to follow. Every specialty has its own *paradigm*⁷ (Kuhn, 1970) of how research should be done. That model has become effectively a demand, a dogma that governs research: Getting jobs and grants and other resources is guided by “peer review,” which enforces the accepted ways, in practice hegemonic because they constitute the standards, the guidelines; and getting one’s work output published, at the mercy of peer review.

If research happens to come up with data or ideas that do not fit the established paradigm, but without directly or positively contradicting it, then that research comes to survive in a sort of limbo, as what Gunther Stent (1972) called “premature discoveries,” his iconic example being Avery’s discovery of DNA as the chemical carrier of hereditary information.

But if a discovery or interpretation positively *contradicts*

the “scientific consensus” in the particular specialty, then even well-established, lauded, accomplished scientists may lose the respect of their peers, their access to grant funds, their invitations to conferences and seminars; and thereby also their standing and credibility in the eyes of the media and the general public.

Scholars of STS, historians of science, and sociologists of science are among a small minority of people who have long known and understood that the most striking advances in science are routinely and usually vigorously opposed by the scientific majority, the mainstream “consensus” (Barber, 1961), what Frank calls “the current wisdom.”⁸ For an authentic understanding of scientific activity, it is essential to recognize that this sort of behavior is not a matter of “a few bad apples” within the scientific community, it is an inevitable consequence of human nature when long-held and strongly held beliefs are challenged: “As men in society, scientists are sometimes the agents, sometimes the objects” of resistance to unorthodoxies (Barber, 1961). One quite general factor is Groupthink (Janis 1972/1982), the tendency for members of any group to suppress individual doubts and reservations and to go along with the prevailing group “consensus.”⁹ So the most startling discoveries routinely encounter resistance, including behavior that in other circumstances would be widely condemned as unscrupulous and unethical; as illustrated by innumerable episodes in global history, perfectly ordinary human beings can behave monstrously when they are part of a mob.

Increasingly since about the middle of the 20th century (Bauer, 2017, p. 17 ff.), researchers have worked in an hyper-competitive environment in which career advancement and even career survival has demanded constantly successful grant-getting and prolific publishing—as well as not rocking any boats, be they norms of the specialist technical community or of one’s vocational environment that may have no obvious relevance to technical expertise: In many places, for example, at the very least lip service is expected nowadays to the values of “equity, diversity, inclusion” (Krylov, 2021).

Altogether, the resistance to claims that do not seem to fit the contemporary paradigm can be even more vigorous now than in the past, and it is often *ad hominem*.

How Are Novel Discoveries Made?

The *reception* of novelty has just been discussed; but how does novelty arise in the first place?

The importance of how novelty is received is that something cannot realistically be said to have been discovered until it is recognized by “science”; that is the dilemma for anomalists.

With discoveries in the mainstream, those that fit become accredited, as earlier noted. Those that do not fit are treated just like the matters promoted by anomalists. They are noticed in the first place only by chance, serendipitously, since they are contrary to the scientific consensus and therefore no funds are available to find or study them. As Stephan and Levin (1992) point out, it is a matter of being in the right place at the right time. Sometimes the right place is in a neighboring specialty, or even in a quite different field: The most remarkably novel discoveries often come from outsiders (Harman & Dietrich, 2013), albeit not always (Gieryn & Hirsh, 1983).

This ignoring or evading or denigrating of a mass of substantive evidence offered by fully qualified people is illustrated on a number of other topics of great public importance, for instance HIV/AIDS; global warming; the theory that “bad” cholesterol is the cause of cardiovascular disease (CVD); the toxicity of aluminum compounds.

SOME SIMILAR CASES

HIV/AIDS and Peter Duesberg

Peter Duesberg, molecular biologist and cancer researcher at the University of California Berkeley, had been highly acclaimed as discoverer of the first oncogene (Duesberg, 1987). He was elected to the National Academy at a rather unusually early age and awarded a rare 7-year Outstanding Investigator Award by the National Institutes of Health.

I had all the students I wanted. I got all the grants awarded. . . . I became California Scientist of the Year. All my papers were published. I could do no wrong, almost, professionally . . . until I started questioning the claim . . . or the hypothesis that HIV is the cause of AIDS. Then everything changed. (Scovill, 2004)

After Duesberg pointed out that HIV, since it was supposedly a retrovirus, could not be the cause of AIDS, he was promptly excommunicated: no more research grants, and even ejected from his home department at Berkeley into space in a different building, and no longer given access to graduate students. To ensure that Duesberg received no more invitations to conferences or seminars, the “HIV” celebrity scientists Anthony Fauci and Robert Gallo made known that they would not attend if Duesberg were invited (Bauer, 2007, p. 229).

Duesberg’s (1989) main contrarian publication in the *Proceedings of the National Academy* has an editorial footnote promising a response from a proponent of the HIV-AIDS theory, but that promised response never

eventuated. Despite a general understanding that members of the Academy have a right to publish in its *Proceedings*, Duesberg's intended follow-up article was rejected (the only other Academy member to experience such a rejection had been Linus Pauling, Nobelist for both Chemistry and Peace). Journalists were warned (Bauer, 2007, p. 175) that they could lose their access to official sources if they paid attention to such mavericks as Duesberg. When President Mbeki of South Africa convened an advisory committee composed of both proponents and adversaries of HIV-AIDS theory, it recommended several of Duesberg's suggestions for critical studies that could settle the matter; but those projects were never carried out for lack of funding.

When polemicists cannot summon convincing evidence or arguments, they resort to ad hominem. A professor at McGill University called Duesberg "probably the closest thing we have . . . to a scientific psychopath" (Bauer, 2007, p. 212). Robert Gallo derided Duesberg's credentials for never having personally worked with AIDS patients or HIV (Bauer, 2007, p. 234), he "is not an epidemiologist, a physician, or a public health official" (Bauer, 2007, p. 235). One might bear in mind that Gallo himself is an MD, which carries no training for scientific research, whereas Duesberg is a fully-fledged molecular biologist with degrees in *science*. Gallo also derided Duesberg's work on cancer (Bauer, 2007, pp. 234, 237), which others have widely acknowledged as significant, so much so as to warrant an article in *Scientific American* (Duesberg, 2007)—albeit, the editors in effect apologized for daring to publish something by Duesberg, emphasizing that they were not endorsing his views about AIDS!

When Duesberg (1996) wrote a comprehensive book, the publisher was one that specializes in conservative, politically right-leaning matters, illustrating how topics in science have become enmeshed with political ideologies; not only over HIV/AIDS but also about global warming (Bauer, 2012a).

On so prominent a public matter, a book by such a prominent dissenter would surely warrant substantive review, even if only unfavorable, in leading scientific and medical journals, but Duesberg's gained only one, in *Perspectives in Biology and Medicine* (Friedmann, 1997), and it is not substantive at all, describing the book as "conspiracy-laden innuendo, selective truths, and high-handed language." There was an equally outraged review in *The New York Times* (Osborn, 1996) by an MD who described herself explicitly as a scientist [!] and made plainly false statements, for instance that "many major biomedical research journals have arranged for formal, published debates between Mr. Duesberg and other distinguished scientists," whereas in fact there had not even been the promised response in the *Proceedings of the National Academy*.

By contrast to those belittling reviews by professional specialists, both *Booklist* and *Kirkus Review* described the book as presenting a quite plausible and soundly argued case; and readers at amazon.com rated the book very positively, 4.7/5.

Like Frank's, Duesberg's case is typical in several ways: ad hominem rather than substantive attacks; boycotted or largely ignored by disciplinary publications and venues; book not reviewed by appropriate disciplinary journals but significantly appreciated by general readers; accused of lacking supposedly needed credentials.

Global Warming and Climate Change

In common parlance, "global warming" and "climate change" are presumed to mean "caused by human activities, primarily release of carbon dioxide." Innumerable references in the media are framed in such apocalyptic terms as "existential threat" (Bauer, 2012b, p. 18f.), even as a great number of qualified experts disagree strongly enough to publish petitions.¹⁰ Nevertheless, human-caused climate change is the experts' current wisdom, duly enshrined in the media's and the public's conventional wisdom. Those who openly disagree are ignored or maligned ("denialists").

Physicist Steven Koonin is as qualified as anyone to discuss climate change, having pioneered in computer-modeling and having worked on sustainable-energy projects both in industry and in government. In *Unsettled* (Koonin, 2021) he cites copiously from the published reports of the International Panel on Climate Change (IPCC) to demonstrate that many of the shibboleths continually parroted by climate-change alarmists are simply contrary to the actual facts in the official reports themselves, for instance about an alleged (but not data-supported) increased frequency of such "extreme weather events" as hurricanes.

It is worth noting that Koonin strives mightily not to appear critical of the dogmatic insistence of the doomsayers. He uses moderate language and everywhere cites the official data. But he does suggest that dialogue between believers and skeptics would be good, citing so-called "Blue Team / Red Team exercises" to safeguard against injudicious policies and actions: Once the Blue Team has come to a conclusion, they ask an independent set of specialists—the Red Team—to examine the Blue Team's evidence and arguments and conclusions, to act as Devil's Advocate looking for mistakes and inadequacies. The two teams then discuss and argue further, with the intention of making ensuing publications and recommendations as sound and close to objective as possible. The concept of such "adversarial collaboration" has been discussed also by Cowan et al. (2020) and Clark et al. (2021), and the

proposal for a specifically Science Court has much the same rationale (Bauer, 2017, chapter 12).

Just as with Frank's and Duesberg's, Koonin's book has not received appropriate review in major journals. Indeed, some of the reviews (Boslough, 2021; Ward, 2021; Yohe, 2021) have been ad hominem¹¹ rather than substantive, at the same time as readers rate the book highly both at amazon.com (4.7/5) and at goodreads.com (4.4/5). My own review in this Journal is positive (Bauer, 2021a), and several online reviews¹²⁻¹⁴ agree that the book is sound and unbiased, as does Levine (2021).

How these topics of importance to everyone become politically polarized is again illustrated here by the fact that the only substantive, even-handed early review was in *The Wall Street Journal* (Mills, 2021).

The Cholesterol Hypothesis of Cardiovascular Disease

Some researchers and some practicing physicians have presented evidence for some three decades or more that "bad" cholesterol is not the cause of cardiovascular disease. But their claims have not been engaged with publicly or substantively by proponents of the accepted, official belief; the latter simply declare that the evidence supporting the cholesterol hypothesis is decisive, that "the science is settled."

That lack of substantive public engagement means that anyone who happens to wonder whether the cholesterol hypothesis really is true, the last word on the matter, needs to wade through and assess for themselves the details and technicalities offered by the dissenting experts. Few people have the interest, time, or technical facility to do that, which means that the mainstream "scientific consensus" remains effectively dominant—no matter how objectively, factually strong the dissenters' cases may be.

The literature of dissent from the cholesterol hypothesis is actually quite voluminous. A large part of it comes from well-informed and technically expert people—physicians who became convinced of the flaws in the mainstream belief through their own first-hand experience as well as from research and surveys of the pertinent literature.

Uffe Ravnskov, a Swedish physician and medical researcher, was among the first to argue publicly against the cholesterol hypothesis. His book, *The Cholesterol Myths* (Ravnskov, 2003), was published in Sweden in 1991 and in English translation a dozen years later. Many years on, *The Great Cholesterol Con* (Kendrick, 2008) was published by a Scottish physician and medical researcher.¹⁵ Between those years, a great number of articles and books aimed to debunk the cholesterol hypothesis as well as describing

seriously harmful "side" effects of the cholesterol-lowering statin drugs, for example, *Lipitor: Thief of Memory* (Graveline, 2006) by an astronaut-physician.¹⁶

This contrarian literature argues that the official view is not supported by the evidence: Lowering cholesterol does not reduce the risk of cardiovascular disease, heart attacks, or strokes, and does not decrease all-cause mortality. These contrarian publications are replete with citations to the mainstream literature and with seemingly reasonable interpretations of it; a very detailed survey has been given by Kauffman (2006, Myth 3, pp. 78–104).

But the proponents of the mainstream consensus have not engaged directly or substantively with this critical literature. In view of how important the matter is to the general public and to medical authorities and policymakers, one might have expected to find reviews of the books by Ravnskov, Kendrick, Graveline, and others in such publications as the *British Medical Journal*, the *Journal of the American Medical Association (JAMA)*, the *New England Journal of Medicine*, and in *Science* and *Nature*, the scientific periodicals whose mission is to report on all really important topics in science and medicine. So I searched for such reviews in the online *Book Review Digest Plus and Retrospective*¹⁷ and in *PubMed*¹⁸ and with Google; but the only reviews I found were on websites and in newsletters of proponents of alternative medicine and other contrarians. Dr. Kendrick confirmed to me¹⁹ that none of his books have been reviewed in those prominent mainstream periodicals.²⁰ Yet considerable interest on this matter is displayed by the general public. On amazon.com, Kendrick's *The Great Cholesterol Con* has a 4.6/5 rating and on goodreads.com it rates 4.2/5. Graveline's and Ravnskov's books also are rated highly by readers.

Toxicity of Aluminum Compounds

Christopher Exley has studied the toxicity of aluminum compounds for several decades, publishing a couple of hundred articles²¹ and a book (Exley, 2020; Bauer, 2021c) that summarizes his findings.

Exley's work has brought antagonism because many manufacturers of a variety of products do not like to see evidence of possible toxicity, especially toxicity that appears to target the brain—unusually high amounts of aluminum are found in brains of deceased autism and Alzheimer's victims, for example. And aluminum compounds occur in baby food and other processed foods, many ointments and skin lotions, in antacid preparations, and, perhaps most disturbingly, as adjuvants in vaccine. So Big Pharma as well as the aluminum industry would have preferred that Exley not do his research.

The funding for it came from as variety of individuals

and institutions outside Exley's place of work, the University of Keele in Staffordshire, England. The university maintained an online portal through which donations could be made to the work of any given faculty member, and Exley's research received donations in that way for several years, but then the administration imposed increasing difficulties; that seemed contemporaneous with changes in the university's top administration and university funding from the Gates Foundation and a pharmaceutical company. Eventually Exley was unable to continue his research, and he has described the sad story in a detailed online "Leaving Statement."²²

MORALS AND LESSONS

Frank's story and case study, and the similar cases just described, illustrate a number of points of general import:

— **Startling discoveries come serendipitously.**

Frank was researching plasmas, not comets.

Serendipity is more likely the less certain is the pre-existing knowledge or, much the same thing, the more complicated is the system involved—as for instance, in environmental matters or in medical matters. Thus in medicine, substances envisaged as potentially useful against one condition may turn up unforeseen benefits: Something tried for ameliorating cardiovascular disease becomes Viagra, the magic blue pill to treat erectile dysfunction. Drug companies quite often ask the Food and Drug Administration to approve existing drugs for new applications, "repositioning" them.

— **Really novel discoveries likely follow after innovations in technique, in this case observations possible only from satellites above the Earth.**

It behooves anomalists to be vigilant for possibly useful new techniques; for example, "environmental DNA" was studied some years ago at Loch Ness as potentially providing information about the rumored "monsters" (Green, 2020), and it should obviously be employed whenever looking for evidence of the existence of species thought mythical or extinct (for example, the Eastern cougar in USA, the thylacine in Australia).

— **Contrarian discoveries often come from disciplinary outsiders, as earlier noted.**

But personality also can guard against succumbing to Groupthink: Frank had been from childhood something of a loner and outsider (p. 19).

— **The general importance of personality in science.**

Many people observing such small, indistinct, and unexpected spots in images acquired for quite other purposes might well have dismissed them as likely artefacts of instrumental flaws and not inquired further;

but by Frank's self-description, he was pedantically, obsessively meticulous, *everything* had to be just right and fully understood.

More generally, scientific activity has nowadays become so intensely competitive as to be dysfunctional in several respects. Finding the best interpretation, theory, or understanding is helped—from an objective standpoint—if differing claims and evidence engage directly and openly, as in the resort to Devils' Advocates or Blue-Team/Red-Team exercises (above; Koonin, 2021) or through "adversarial collaborations" (Cowan et al., 2020; Clark et al., 2021). But that sort of procedure calls for more patient consideration, less rush to publish, than is now commonplace; personalities that were ideal for doing science before, say, the middle of the 20th century (Bauer, 2017, p. 17 ff.), would probably not find modern-day science a congenial vocation.

— **Resistance to scientific discovery is routine (Barber, 1961); facts do not win out immediately (Bauer, 2021b); revolutionary paradigm shifts come only eventually (Kuhn, 1970).**

Here again personality plays a part. That believers in the old ways have to die off (Planck, 1949) is illustrated in Frank's story by the continuing opposition to the bitter end of some prominent individuals, for instance the journal editor Alex Dessler, who is mentioned three dozen times in the book, far more often than anyone else.

— **It may have helped in the eventual overcoming of mainstream denial that the small comets do not directly disprove long and strongly held beliefs, only presumptions, not based directly on strong evidence, about how the planets and moons formed from available material.**

The intense specialization of modern science conspires to make it difficult to connect actually related matters: The water-bearing small comets have implications for research in what might not seem obviously related topics, say, the search for Earth-like planets as well as the origin of water on, say, the moons of Saturn or Jupiter.

Still, even presumptions are not abandoned until a better explanation is forthcoming; and Frank's comets solved some conundrums in planetary science. That will have helped the acceptance of the small-comets theory, piecemeal among various separate, not routinely interacting scientific specialties.

— **Mainstream science—including mainstream media coverage of science—nowadays does not serve society in a reliable, trustworthy way.**

Perhaps the most obvious problem is that implications of science affect so many societal sectors and interests that political partisanship can drown out substantive truth-seeking: Thus, left- and right-leaning groups and

media favor opposite sides regarding whether HIV causes AIDS and whether carbon dioxide is the prime mover in global warming and most recently over how to deal with COVID-19.

Startling but soundly based discoveries are prematurely and dogmatically dismissed if they do not fit the prevailing paradigm or the experts' current wisdom.

Lay audiences may be better-informed by popular sources than by the expert wisdom: Reviews in popular media, amazon.com, and goodreads.com were more appropriate regarding Frank's comets, Koonin's climate-change book, and several cholesterol critiques.

So too with anomalistic topics. When, more than 50 years ago, I became interested in the possible reality of Loch Ness "monsters," I was dismayed to find absolutely nothing about that in the scientific literature, and mere dismissive paragraphs in encyclopedias. While the online *Britannica*²³ now has more information, it is wrong on several points, for instance that the iconic photo has been proven a hoax (Shuker, 1995, 86–88). Wikipedia is as unreliable as usual, in this case allowing the *Skeptic's Dictionary* to speak for "the scientific community."²⁴

CAN MAINSTREAM DISCOVERERS AND ANOMALISTS LESSEN THE ROUTINE RESISTANCE THEY ENCOUNTER?

The problem hinges on the difference between Kuhn's (1970) normal science and revolutionary science (see for instance McClenon [1984] re parapsychology) or between the avocational, amateur pursuit of anomalistics and the professional, living-earning pursuit of mainstream science (Bauer, 1986, pp. 77–79).

No matter how certain one is about being right, it makes a much better impression to appear to be making suggestions that oneself finds hard to accept: Present a conundrum, a mystery, not an attempted *fait accompli*.

If possible, present the claim as not directly contradicting hegemonic doctrine even if it doesn't exactly fit it either. One might seek advice in private from open-minded mainstream experts, sounding them out by offering the best evidence, in effect trying to engage in a personal "Red-Team / Blue-Team" exercise. But actual cases suggest that Groupthink is an enormous barrier. Jeffrey Meldrum and Grover Krantz were experts in anatomy but failed to arouse interest among their peers about the quest for the alleged Bigfoot (or Sasquatch) creatures. In the search at Loch Ness, Robert Rines engaged the famous inventor of strobe photography, Harold Edgerton, as well as sonar expert Marty Klein and photographic expert Charles Wyckoff, without making the quest respectable in mainstream quarters.

The issue of lessening resistance is social and political more than intellectual. Moreover, the experts' current wisdom and the society's conventional wisdom are interrelated, and general acceptance requires that the two be in harmony. So gaining peer recognition may be important and even necessary, but so too is acceptance by the popular media; being trusted by journalists and science writers can be very useful, and relations with such people should be cultivated.

NOTES

¹ "Science & Technology Studies" has become the standard name for this scholarly field; Earlier names included "Science Studies" and "Science, Technology, & Society." A good overview is by Sismondo (2004).

² The difference might be illustrated by two people who were similar in a great many ways: Albert Szent-Györgyi, awarded a Nobel Prize, and Wilhelm Reich, widely dismissed as a crackpot (Bauer, 2017, p. 108).

³ "The reasonable man adapts himself to the world; the unreasonable one persists in trying to adapt the world to himself. Therefore, all progress depends on the unreasonable man".

This is often cited as from George Bernard Shaw, *Man and Superman*. The latter is one of Shaw's plays, but the quote is not from the script of the play. Published versions of Shaw's plays include a preface and other additional material. This particular quote is from one of the appendixes, "Maxims for revolutionaries", under "Reason", p. 282 in the 1946 Penguin edition. The original publication was in 1903.

⁴ Gold also illustrates Barber's generalization that anyone may be sometimes the agent, sometimes the object of resistance: Gold the maverick did not care for maverick Frank's small comets (p. 24).

⁵ Paul Lauterbur, Nobel Prize 2003, pioneered medical applications of magnetic resonance imaging (MRI). He pointed out (cited by Michael Goodspeed, "Science and the coming dark age" at rense.com) that "you could write the entire history of science in the last 50 years in terms of papers rejected by *Science* or *Nature*"—as indeed his had been, describing the very work that later brought him a Nobel Prize.

⁶ The label was coined by William Whewell about 1834.

⁷ Kuhn defines a scientific paradigm as: "universally recognized scientific achievements that, for a time, provide model problems and solutions for a community of practitioners."

⁸ Economist Kenneth Galbraith coined the frequently used phrase, "the conventional wisdom" to describe beliefs hegemonic in society as a whole. I think "current wisdom"

is better for what is hegemonic within the supposedly expert community.

- ⁹ Abba Eban is credited with the insight that a consensus means that everyone agrees to say collectively what no one believes individually: a clear corollary of Groupthink.
- ¹⁰ For example, the Leipzig Declaration on Global Climate Change. http://henryhbauer.homestead.com/Leipzig_DeclarationPontius2005.pdf
- ¹¹ Hit piece against Koonin's book *Unsettled* lacks substance. <https://clintel.org/hit-piece-against-koonins-book-unsettled-lacks-substance>
- ¹² Book Review: *Unsettled* by Steven Koonin. <https://www.hefner.energy/articles/book-review-unsettled-by-steven-koonin>
- ¹³ Ian Hore-Lacy. <https://iscast.org/reviews/review-of-unsettled-what-climate-science-tells-us-what-it-doesn-t-and-why-it-matters-by-steven-e-koonin/>
- ¹⁴ <https://www.independent.org/publications/tir/article.asp?id=1669>
- ¹⁵ <https://drmalcolmkendrick.org>
- ¹⁶ <https://spacedoc.com>
- ¹⁷ *Book Review Digest Plus and Retrospective* from EBSCO: "Book Review Digest indexes reviews of current fiction and non-fiction, and provides review excerpts and over 100,000 full-text reviews. 1905–present."
- ¹⁸ PubMed does list *articles* by Graveline, Kendrick, and Ravnskov.
- ¹⁹ Personal communication, email of December 19, 2021.
- ²⁰ *The Great Cholesterol Con* did get a favorable review in 2007 in the *British Journal of General Practice*, 57, 336.
- ²¹ <https://www.researchgate.net/scientific-contributions/Christopher-Exley-39683428>
- ²² <https://www.aluminiumresearchgroup.com/history>
- ²³ <https://www.britannica.com/topic/Loch-Ness-monster-legendary-creature>
- ²⁴ https://en.wikipedia.org/wiki/Loch_Ness_Monster#cite_ref-3

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