FRINGE THEORIES

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Abstract. The term 'fringe' is often used to disparage or dismiss a theory as unserious, or obviously false. This paper offers an analysis of fringe theories that remains neutral about their epistemic status, and argues that intolerance towards fringe theories is epistemically harmful to science. Many theories celebrated as mainstream were initially ridiculed and dismissed as fringe, which delayed important research. Objections to tolerance are also considered.

A now-familiar general device that is found in all the arts is this: the author blames nature for any weakness in his art, declaring—on the authority of his art!—that whatever his art can't achieve is intrinsically impossible.

—Francis Bacon (1620/2017), *Novum Organum*

1. INTRODUCTION

In popular science and academic discourse, fringe theories are considered epistemically harmful to science and the public. Fringe theories that question the anthropogenicity of climate change as severe weather events strike, or the safety of vaccinations during a viral pandemic are cases in point, where epistemic harms appear to cost lives. On the rise, too, are bizarre ideas whose epistemic risks seem to be comparatively benign. Take, for example, the theory that consciousness collapses Schrödinger's wave function, or that the Great Pyramid of Giza is not a tomb but a stargate. There is increasing demand across the sciences to show that fringe theories are

misinformed, with increasingly frequent proclamations that some fringe theory is pseudoscientific or debunked.

Despite our lack of patience for fringe theories, there is also increasing recognition that the epistemic status of any given theory remains in flux, and that theories that conflict with mainstream orthodoxies can nevertheless contribute to science, by investigating anomalies, for example, and even sometimes becoming mainstream (Hook, 2021; Miller, 2021). A famous case of a fringe theory rising to mainstream status within the past century is continental drift. Drifters, as proponents were called, faced ridicule throughout the first half of the 20th century, but following 1967 were celebrated as early champions of the new mobilist orthodoxy, plate tectonics. The stigma of scientific heresy associated with theories of continental displacement contributed to geologists' neglect of important lines of research (Tharp, 1999). This neglect, in turn, delayed scientific progress by geologists' own accounts, including technological advancements, such as a means for predicting seismic and volcanic activity on a global scale (Isacks et al., 1968) and directing the search for natural resources with more efficiency (Dietz, 1977).

The question arises, then: do our protective and conservative instincts to dismiss and suppress fringe theories come into conflict with our interests in the expedient uptake of innovations that can be gained through theory change? The underlying paradox is that (1) we must protect established science against fringe theories by discounting them but that (2) we must also value fringe theories for their potential to innovate. This paradox has been variously recognized at least since the late-1950s. Popper (1957) can be seen as puzzling over this paradox in posing the problem for demarcating science from pseudoscience, "knowing very well that science often errs, and that pseudo-science may happen to stumble on the truth" (p. 33). Kuhn (1959) took up the paradox as the "essential tension" between convergent and divergent thought, reflecting tradition and innovation, respectively. Popper and Kuhn were optimistic insofar as both took theirs to be problems for the description but not prescription of norms that make science an epistemically fruitful and progressive enterprise.

My view, by contrast, is both descriptive and prescriptive. It is that intolerance towards fringe theories is both the norm and epistemically harmful to science. Open-mindedness may be celebrated as a scientific virtue, but in theory and practice, constraints on that openness are considered the more virtuous. The oxymoron of openness-with-constraints reflects the paradox at hand, which, I think, presents us with a choice. We cannot, in practice, confidently discount a

theory for reckoning with tradition and still value it for its innovative potential. Motivations to discount and discourage research based on fringe theories work directly against our interests in scientific innovations. My view, furthermore, is that there may be significant epistemic payoffs to promoting the flourishing of fringe theories. Taking a fringe theory off the table inadvertently invites epistemic risks, such as the neglect of important research and the exacerbation of public distrust in science, whereas keeping it open to investigation promotes not only epistemic security but epistemic fruits, such as the hypothesis-based pursuit of discoveries that would otherwise be left to serendipity. Dubious investigations based on fringe theories have recently prompted major discoveries, including the search through old satellite data to corroborate centuries of milky sea sightings by mariners (Miller et al., 2005), and the search for the sunken city Heracleion based on ancient myth and a tip from a pilot (Robinson & Goddio, 2014).

Here I defend the unpopular position that the academic community, and especially its scientists, should encourage and cultivate greater tolerance and receptivity towards even the wildest fringe theories. Rather than dismiss a fringe theory out of hand as absurd, religious, offensive, or obviously falsified by the facts, a fringe theory can and should be received with the wisdom that even the most outrageous alternatives, even those proposed by nonscientist members of the public, can be embraced as questions with potential to advance science. Fringe theories are invitations, indeed, often requests, for more open and imaginative scientific inquiry. Where competitive versions of a fringe theory do not readily present themselves, members of the scientific research community should see it as due diligence to arrive at the most charitable interpretations based on the theory's central tenets.

I begin by explaining the importance of a careful study of the fringe-mainstream distinction for philosophy in particular, and for making progress on issues about consensus and dissent. Any genuine inquiry into whether fringe theories deserve to be taken more seriously requires an account that remains neutral about their epistemic status. Section 2 aims to meet this neutrality requirement by demarcating fringe theories from mainstream theories in terms of sociological, cognitive, and normative features. Section 3 then introduces the concepts of epistemic tolerance and intolerance as opposing attitudes or behavioral stances that may be adopted relative to a fringe theory, and establishes that intolerance has been a longstanding norm. Section 4 presents an inductive argument in support of my view that intolerance towards fringe theories is epistemically harmful to science. Section 5 considers concerns about the costs of taking fringe theories seriously, and

offers further arguments for the view that continuing to treat fringe theories uncharitably in scientific research is unjustified. Fringe theories are not a cultural aberration, but fundamental to the health of science.

2. THE FRINGE-MAINSTREAM DISTINCTION

2.1. Why 'fringe'?

According to Google N-gram, there has been a sharp rise in use of the term 'fringe science' since the late 1960s, and 'fringe theories' since the early 2000s. Both terms are currently in more frequent use than in any previous era. Scholarly literature on 'fringe' science is now proliferating at a near-exponential rate (Benjamin, 1943; Dutch, 1982; Wimmer, 1988; Brewin, 1993; Berezin, 1996; Friedlander, 1998; Binkowsky, 1998; Beyerstein, 2001; Gordin, 2012, 2021, 2022; Silver, 2014; Collins et al., 2017; Hupp & Wiseman, 2022; Chew et al., 2023, Schleifer-McCormick, 2024). The popular use of the fringe-mainstream distinction demands philosophical attention, for both its sociopolitical significance and the referential power of its terms. We readily know which theories are fringe and which are mainstream to science—never mind any demarcation problem.

Meanwhile, demarcation has been recently revived in its classic form (e.g., Pigliucci & Boudry, 2013), and an ongoing literature discusses issues relevant to fringe theories through the lenses of inductive risk, scientific disagreement, and consensus and dissent (e.g., Solomon, 2006; Borgerson, 2011; de Melo-Martín & Intemann, 2013, 2014, 2018; Intemann & de Melo-Martín, 2014; Biddle & Leuschner, 2015; Le Bihan & Amadi, 2016; Leuschner, 2018; Miller, 2019, 2021; Paetkau, 2024). Most philosophers assume fringe theories are the result of ignorance, reflecting denialist or anti-science sentiments (cf. Goldenberg, 2016). Others pass over fringe theories or lump them in with the cases of dissent manufactured for political, religious, or economic gains—or otherwise amongst minority views (Oreskes & Conway, 2010; Kelly, 2011; Hansson, 2017; Levy, 2019; Kovaka, 2019; O'Connor & Weatherall, 2019; McIntyre, 2019; Mason, 2020; Slater et al., 2020; Pinto & Leuschner, 2021; Dang, 2023).

The primary shortcoming in these approaches is a neglect of *theories* themselves. Even when a theory has been propagated by individuals with dubious motives, there remains room for researchers with genuine and virtuous interests to pursue research based on that very same theory.

One reason to move away from a consensus-dissent analysis is that it is all too easy to judge a fringe theory as involving an ignorance of the scientific facts, even where highly respected specialists and experts are involved. For instance, notable proponents of nonviral theories of AIDS include Nobel laureates, such as Luc Montagnier, celebrated for discovering HIV. As we will see, fringe theories are, by definition, saying something other than what the prevailing view in science says. In that sense, they naysay science by default.

The fringe-mainstream distinction allows us to consider alternative theories in their own right and it undermines the idea that heterodox views are misinformation. While fringe theories are usually thought to be wrong in academic circles, a theory's actual lack of epistemic value is not what makes it fall into the category of 'fringe'. What fringe theories lack is not knowledge or promise, but mainstream scientific and academic judgments thereof. "Fringe" is regularly used or abused to convey a negative epistemic attitude. That is a sociological feature of fringe theories, not an epistemic one. Philosophical inquiries into the nature of science are special for their power to be critical of science's assumptions, not for proceeding based on them.

2.2. The epistemic status of fringe theories

Scholars still take up the common connotation that fringe theories are "obviously false" or "false with a substantial amount of available evidence showing they are false" (Schleifer-McCormick, 2024, pp. 2-3). Indeed, the term 'fringe' is, more often than not, wielded to disparage and dismiss a theory. Bioethicist Kevin Smith (2012, p. 1) provides a characteristically dismissive statement: "The notion that homeopathic preparations could have any biological effects represents a fringe viewpoint, one not entertained by serious scientists nor supported by reason and evidence" (see also Grimes, 2016, p. 3). Given this connotation, Shapere (1982, p. 499) is careful to qualify his mention of a "fringe" theory in physics with the parenthetical "but not for that reason necessarily incorrect." Understandably, many scholars opt for alternate terms for what they explicitly identify as the fringe (see, e.g., Henry, 1981; Grim, 1982; Hill, 2017). I preserve the term for its referential clarity, as well as for its readiness to withstand connotative correction. At bare minimum, this paper aims to reclaim the neutrality of the term 'fringe'. Even rugs, beams of light, and truth conditions in logic have had their fringes, and many take pride in the fringe or non-mainstream status of their views (e.g. Hancock, 1995; Cochrane, 2011).

This section provides an account of fringe theories that remains neutral with respect to whether any particular theory deserves epistemic tolerance. This approach is unusual, insofar as scholars of the fringe tend to fall into one of two camps—fringe-positive (e.g. Houran & Bauer, 2022) or fringe-negative (e.g. Dutch, 1982; Silver, 2014). They define fringe theories respectively as either pioneering and insightful, or retrograde and uninformed. We will consider an example of each before turning to an impartial account.

Fringe-negative and fringe-positive accounts have this much in common. Fringe-positive accounts tend to focus on the "edginess" of fringe theories, which aligns with how the fringe perceives itself. The *Journal of Scientific Exploration*—a repository for fringe science—recently published an editorial stating that its purpose is to focus on "frontier" science, or instances of questions or observations that are on "the brink of the unknown" and "ignored or studied inadequately within mainstream science" (Houran & Bauer, 2022, pp. 211-212)

This account is perhaps too generous. Those who traverse unknown terrain are not always celebrated as pioneers, but rather accused of taking imaginative leaps. There is no established method for developing speculative hypotheses—for leaving the logic of established theory and freeing up the imagination. A scientific hypothesis is not a mere possibility, a shot in the dark; it is plausible, inferred from a stable basis of what is known. The imagination, although applauded in extraordinary individuals like Einstein, is generally deemed epistemically deficient, even empty: "To imagine is to represent without aiming at things as they actually… are" (Liao & Gendler, 2011; cf. Badura & Kind, 2021). The word 'speculation' is itself pejorative.

Fringe-negative accounts sometimes deny the fringe even its imagination. Dutch (1982)—though admitting that "Life entirely without fringe theories would be a bit dull"—characterizes the fringe as unimaginative:

> Although fringe science is often portrayed as daring and innovative, it is actually conservative and unimaginative. It hardly ever anticipates real scientific revolutions and often ends up opposing them. Thus, Velikovsky and the creationists doubt plate tectonics, and Velikovsky rejected much of the work on astronomical alignments at Stonehenge. (Dutch, 1982, p. 6)

Kerr (1980) also argues, "During less than a decade, the once-ridiculed idea of moving continents won over nearly the entire earth science community. After 18 years of spacecraft studies of Venus, the fringe still stands alone" (Kerr, 1980, p. 293). Park (2001), too, says, "…there does not appear to be anything resembling progress. The evidence never gets any stronger. Decades pass, and there

is never a clear photograph of a flying saucer or the Loch Ness monster" (p. 200). Collins, Bartlett, and Reyes-Galindo (2017) claim fringe science tends to be "past its sell-by date" (p. 426). All of these accounts present fringe theories as retrograde and uninformed.

Though sometimes slipping into fringe-negativity, Collins et al. (2017) offer instructive sociological directions for demarcating fringe from mainstream theories. They adopt Kuhn's essential tension: "We take it to be a characteristic of science as we know it that there is always a tension between authority and coherence on the one hand and individual brilliance and heterodox discovery on the other" (Collins et al., 2017, p. 427). On their view, things start getting fringe when individualism and heterodoxy (innovation) are no longer in tension with authority and coherence (tradition), and the latter is abandoned. The authors call this individualism "pathological", likely inspired by Langmuir's 1953 lecture, where he coined the term 'pathological science' to refer to unresponsiveness to criticism (Langmuir & Hall, 1989). Apparently he was not immune to it himself (see, e.g., Silver, 2014).

Gordin (2022) provides a promisingly neutral sociological analysis: "Fringe theories aren't fringe, in the sense of being marginal to their culture, including ours. They are marginal only from the point of view of intellectual (or scientific) orthodoxy." Fringe theories are often at the top of our minds in popular culture and politics, and fringe theorizing has even been considered an American pastime (Henry, 1981). Gordin's insight is that 'fringe' refers to the marginal status of fringe theories relative to those that are seriously debated in the relevant academic discipline's forums for discourse.

2.3. Sociological, cognitive, and procedural characteristics of fringe theories

An epistemically neutral sociological measure can be extracted from the accounts just reviewed. Fringe theories are not taken seriously by the majority of professional, and especially academic, scientists. This incredulity is observable in the general absence of proposals and criticism in the pertinent discipline's peer-reviewed journals. A theory's degree of absence in the relevant discipline's peer-reviewed journals published with academic presses could be used to roughly operationalize a theory's degree of fringeness.

A second common characteristic of fringe theories is their tendency to foreground anomalies or reinterpret data through unconventional concepts. Sometimes, fringe theorists take an anomaly to challenge established theories, and reinterpret related facts.

Finally, we might measure a theory's degree of fringeness by the number of scientific norms it defies, which require a theory be, for instance:

1. Supported by evidence acceptable to scientists in the relevant discipline
2. Consistent with established theories, facts, or natural laws
3. Mechanistically understood, or at least potentially
4. Coherent, internally consistent, and reason-based
5. Parsimonious and free of ontological profligacy
6. Grounded in controlled experimental methods
7. Proposed by a person with relevant disciplinary training

Though perhaps not exhaustive, this list captures prevailing standards. The more of these methodological and procedural norms a theory defies, the greater its degree of fringeness.

I summarize this three-dimensional system in Table 1.

Table 1. Measures for determining fringe status

Measure	**Fringe theory**
Sociological	Degree of absence in relevant discipline's forums for discourse
Cognitive	Foregrounds anomalies and/or reinterprets data
Normative	Number of methodological or procedural norms defied

Let's see how these criteria apply to actual fringe theories, such as those in so-called pseudoarchaeology and parapsychology. First, they are largely absent from archaeology and psychology journals. Second, they countenance phenomena that can be interpreted as anomalous to mainstream theories, as well as introduce unconventional concepts to explain those phenomena. Ancient technological feats and precognitive abilities are either neglected, alternatively conceptualized, or denied by mainstream scientists. Apparent megalithic sites are understood as natural geological formations, and cases of precognition are attributed to lower-level perceptual inputs, cognitive processes, or coincidences explanatory in terms of probability. Third, they tend

to defy a number of scientific norms, for example, by invoking magical posits, and lacking convincing explanatory mechanisms.

2.4. Summary

Fringe theories are ostensibly heterodox, but we have seen that this need not mean pioneering and insightful, nor retrograde and uninformed. The system sketched above allows for the determination of a theory's fringe-mainstream status in terms of specific and measurable sociological, cognitive, and procedural properties. Understanding fringe theories through this lens allows us to weigh potential merits of fringe theories against their risks. The account is epistemically neutral insofar as further assumptions would be needed to determine whether fringe theories deserve their academic and scientific marginalization.

3. EPISTEMIC INTOLERANCE

3.1. Intolerance towards fringe theories

This section describes epistemic tolerance and intolerance as opposing attitudes that can be exhibited towards a given theory or set thereof, and then surveys examples of their expressions.. In suit with the previous foundational section, I aim to avoid begging the question against intolerance by offering an analysis that could be used to make equipotent normative cases in defense of both intolerance and tolerance towards fringe theories.

3.2. Tolerance vs. intolerance

Putting our epistemic focus aside for the moment, tolerance simpliciter is an ability to withstand or endure some state of events. Tolerance is an ability, but that does not automatically imply that tolerance is normatively positive: an obvious example is that it would be wrong to tolerate violence towards children. Tolerance relative to violence towards children is an ability that might be cultivated, but it is not a virtue. Rather, when it comes to violence towards children, our aim is to be *dis*abled in tolerance; intolerance is the virtue. So, albeit an ability, one that may be learned, we cannot assume that its epistemic form—i.e., tolerance directed towards an alternative theory—is a virtue.

As I understand them, epistemic tolerance and intolerance are polar ends of a spectrum of attitudes or behavioral states a person or community may exhibit relative to a particular theory or set of theories that they do not endorse. There is no question of tolerance when it comes to theories they *do* endorse; endorsement or acceptance of a theory is just a state of belief or credence. If there is already belief in a theory, questions of tolerance towards that theory become silly.

The *epistemic* status of tolerance does not come from its being a belief-state or matter of some degree of credence; rather it comes from its *being in relation* to a particular knowledge claim or belief-state that is not embraced, or a set thereof.

For my purposes here, epistemic tolerance and intolerance can be considered by and large theory-relative, despite my hopes of treating the broad set of fringe theories. What I mean is that epistemic tolerance is not simply the quality of being an open-minded person about the way the world is, or about what is true and what is false. Rather, it is a non-fixed attitude directed towards a particular theory or set of theories, usually as a factor of those theories that are embraced.

In general, tolerance withstands a threshold, perhaps not precise. Intolerance results when a knowledge (or speculative) claim goes beyond that threshold. Most simply: epistemic tolerance is an individual's or community's ability to endure or allow an alternative hypothesis to be pursued in scientific inquiry. Tolerance is a behavioral disposition or attitude that leads minimally to a lack of interference with research conducted according to a given alternative theory.

3.3. Expressions of intolerance

Academically published statements of epistemic tolerance are unusual—bashful asides (sometimes parenthetical) like Shapere's above. By comparison, proud expressions of epistemic intolerance regularly find their homes in academic journals. Intolerance may sometimes be mild and dismissive, but it can also be more aggressive. Intolerance is often expressed through the label 'pseudoscience'.

A classic expression of intolerance is the famous polemic of popular science writer Martin Gardner (1957), wherein each chapter features the debunking of some particular fringe theory. The skeptical movement hails Gardner as an early hero, promoting scientific skepticism in his wake (not to be confused with science skepticism characteristic of the anti-science movement). The skeptical movement has reached a peak in mainstream media articles focused on debunking, e.g. in *Skeptic Magazine*. These sociological underpinnings of intolerance are important for

understanding why intolerance is sometimes encouraged in the name of scientific skepticism, however, my aim here is primarily to survey expressions of intolerance, and those from academic scientists in particular. The astronomer Carl Sagan, another hero of the skeptical movement, was prolific in his expressions of intolerance through the pseudoscience label, and also leaving behind proverbs like "But extraordinary claims require extraordinary evidence" (Sagan, 1974, p. 73) and "They laughed at Fulton, they laughed at Columbus, but they also laughed at Bozo the Clown" (p. 75). Today, the astrophysicist Neil deGrasse Tyson has taken up Sagan's torch, or "candle in the dark", proclaiming: "We will not be revisiting the question of whether Earth is round; whether the sun is hot; whether humans and chimps share more than 98 percent identical DNA; or whether the air we breathe is 78 percent nitrogen" (deGrasse Tyson, 2016). All of these examples go to show that intolerance *can* be directed towards quite a full range of fringe theories, but it need not be, as we'll see.

Intolerance directed towards specific fringe theories is sometimes adamantly expressed in formal letters to the editors of journals, media outlets, or even the public. In such letters, authors usually aim to undermine a particular fringe theory or its hypotheses. Such efforts tend to be a response to a rival theory gaining or potentially acquiring a significant public audience or following.

A classic example of this type of intolerance is Harlow Shapley's (1950) letter to Macmillan Company, in response to their plan to publish the psychoanalyst Immanuel Velikovsky's *Worlds in Collision*—an infamous book that few academics under the age of 50 will have heard of today. The letter states that the "President of Harvard University and all the members of the Harvard Observatory staff" denounce Macmillan's decision to publish Velikovsky's "venture into the Black Arts" (Shapley, 1950). Shapley (1950) writes, "The Velikovsky declaration or hypothesis or creed that the sun stood still is the most arrant nonsense of my experience, and I have met my share of crackpots," adding, "The fact that civilization exists at the present time is the most profound evidence I know of that nothing of this sort happened in historic times. The earth did not stop rotating in the interests of exegesis."

A recent letter from the Society of American Archeologists (SAA) is similarly exemplary. The letter offers a plea to Netflix and ITN Productions to reclassify the docuseries *Ancient Apocalypse* as "science fiction" because it "disparages archaeologists and devalues the archaeological profession on the basis of false claims and disinformation" (Sandweiss & Society

for American Archaeology, 2022). In that vein, too, the show's infamous host, Graham Hancock, has been regularly dubbed a "pseudoarchaeologist" by academic archaeologists, geologists, and historians alike (e.g. Defant, 2017). Once a respected journalist, Hancock has become a field archaeologist in his own right, absent a professional degree. He is the author of bestsellers proposing alternative ancient histories in which a long-forgotten antediluvian technologically-advanced civilization once flourished—Atlantis—with remnants including megalithic sites (e.g. Hancock, 1995).

The way intolerance plays out amongst theoretical competitors informs the sorts of intentions that tend to underlie verbal denouncements. Even rivals who may not seriously doubt each other's disciplinary expertise have publicly dismissed each other as pseudoscientists, in a fashion familiar to, and perhaps inspired by, the way fringe ideas are dismissed. *Nature* recently broadcasted one such proclamatory letter, through an article titled "Consciousness theory slammed as 'pseudoscience' — sparking uproar" (Lenharo, 2023). The headline refers to a public letter posted to the preprint database PsyArXiv signed by dozens of cognitive scientists, including respected philosophers, psychologists, and neuroscientists. The letter is an explicit effort to undermine media and public interest in the integrated information theory of consciousness (IIT). The "IIT-Concerned" authors deride the theory as pseudoscience:

> IIT is an ambitious theory, but some scientists have labeled it as pseudoscience. According to IIT, an inactive grid of connected logic gates that are not performing any useful computation can be conscious—possibly even more so than humans; organoids created out of petri-dishes, as well as human fetuses at very early stages of development, are likely conscious according to the theory; on some interpretations, even plants may be conscious. These claims have been widely considered untestable, unscientific, 'magicalist', or a 'departure from science as we know it'. Given its panpsychist commitments, until the theory as a whole—not just some hand-picked auxiliary components trivially shared by many others or already known to be true—is empirically testable, we feel that the pseudoscience label should indeed apply. (Fleming et al., 2023)

The intolerance towards IIT is further expressed by naming some political and moral motivations for it, which are apparently meant to weigh just as heavy, if not heavier, than the epistemic ones:

> …IIT [could come to] have a direct impact on clinical practice concerning coma patients, but also a wide array of ethical issues ranging from current debates on AI sentience and its

> regulation, to stem cell research, animal and organoid testing, and abortion. Our consensus is not that IIT and its variants decidedly lack intellectual merit. But with so much at stake, it is essential to provide a fair and truthful perspective on the status of the theory. As researchers, we have a duty to protect the public from scientific misinformation. (Fleming et al., 2023)

The letter also points out that the field of consciousness studies more broadly is still making its way into mainstream respectability. Similar to cases in which a personal insecurity inadvertently manifests in the social criticism of others, recent emergence from the fringe or a struggle to earn respectability can be an implicit motivation and even an explicit reason for intolerant denouncements. The intolerance of SETI scientists to theories in ufology has been particularly flagrant and explicit in this regard. It is also all too common for scientists endorsing divergent versions of the same fringe theory to express intolerance towards one another's views. Many if not most fringe theories, such as flat earth, are explicitly dismissed, in part, for such lack of uniformity.

Beyond verbal denouncements, intolerance can also manifest more behaviorally through demonstrations, as with experimental investigations undertaken for the purposes of debunking, rather than for the purposes of genuine inquiry. In such cases, there may be clumsy or disingenuous efforts to faithfully reproduce an experiment in an effort find whether or not its results can be replicated. The investigations into Jacques Beneveniste's fringe theory of water memory is another classic case, and is of this more demonstrative sort (see, e.g., Ball, 2004)

While I have characterized intolerance as psychological, it can also manifest on an institutional scale, as with the 1976 Committee to Scientifically Investigate Claims of Paranormal and Other Phenomena (CSICOP; as of 2015, renamed Committee for Skeptical Inquiry). Co-founded by a number of scientists and academics, the original purpose of CSICOP was to investigate pseudoscientific claims, or claims inconsistent with mainstream science:

> Many individuals now believe that there is considerable need to organize some strategy of refutation… The time and effort required to systematically point out the errors in fact and logic in a complex pseudoscientific theory are not trivial… (A)ny attempt by scientists to tell why a popularly held idea or theory is not valid inevitably leads to complaints from the wounded of authoritarianism and scientific elitism. (Frazier, 1976, p. 346)

Investigating a fringe theory is one thing, but intolerance enters the picture when "refutation" is, consciously or not, a motivation for that investigation. One founding member of CSICOP, Marcello Truzzi, was so devoted to impartial investigations of pseudoscientific claims that before

long a vote of no confidence was cast against him. Upon his departure from CSICOP, he pioneered the field of anomalistics, or the scientific study of anomalies, which remains fringe to this day. Most of us will have never even heard of anomalistics, which is not indicative of our personal intolerance towards it so much as indicative of our greater academic or scientific community's intolerance towards it (as with Velikovsky's work).

Anomalistics can be traced further to a particularly enlightening case of intolerance. Emeritus Professor of Chemistry and Science Studies at Virginia Tech, Henry Bauer (2000) goes so far as to suggest that 'anomalistics' is a politically correct synonym for 'pseudoscience'. He argues that the various phenomena anomalistics investigates—for example, on the basis of eye-witness reports of UFOs or cryptozoological beings—do not exist, since scientific laws make them impossible. These expressions of intolerance are informative, since, despite them, Bauer has proven to be fairly tolerant towards other fringe ideas. He himself is a founding member of the Society for Scientific Exploration, serving as Editor-in-Chief for its journal during the early 2000s, and coauthoring the more recent fringe-positive account we reviewed in Section 2 that characterizes the fringe as pioneering and insightful. Moreover, his early forays into demarcation led to him to take up serious fringe research himself, which arguably extends into some of the least-tolerated reaches of the fringe. He has expressed tolerance towards (if not belief in) theories of non-viral causes of AIDS, as well as theories espousing the existence of the Loch Ness monster (Gordin, 2022). He has authored full-length book treatments of each, presenting and seriously considering evidence in their favor. Bauer's tolerance and intolerance serve as a concrete example supporting my suggestion that tolerance and intolerance are not fixed, all-encompassing attitudes. Some fringe theories may be tolerated more than others, and more or less at different times.

This subsection focused on instances of severe intolerance. We might call these instances of derisive intolerance. However, intolerance can also be fairly silent, as with inattention, in which a fringe theory is available but only vaguely conceived, neglect, in which a fringe theory is conceived but not as an epistemic contender, or disregard, in which a fringe theory may be seen as an epistemic contender but not seriously considered. Approaching the severe end of the spectrum, but comparatively succinct, intolerance can manifest as dismissal, in which a fringe theory is taken to be unworthy of further judgment, or plain denial, in which a fringe theory is given explicit judgment as wrong. When it comes to derision, a fringe theory is judged to not only be wrong, but offensively so, such that active efforts are taken to suppress it.

3.4. A note on Feyerabend

My account of epistemic tolerance generally conforms with Feyerabend's (1963) notion of "tolerance in matters epistemological." Feyerabend does not explicitly define tolerance, but his use of examples and the connection he draws between tolerance and theoretical pluralism provides insight into what he thinks tolerance consists in. He considers "archaic man" to be an exemplar of tolerance: a "religious eclectic" who "does not object to foreign gods and myths" but rather "adds them to the existing furniture of the world without any attempt at synthesis, or a removal of contradictions" (Feyerabend, 1975/1993, p. 184). Similarly, he takes the Ionian philosophers of nature to exhibit tolerance insofar as they "develop their ideas side by side with myth without trying to eliminate the latter" (Feyerabend, 1975/1993, p. 184). In both cases, he says, "There are no priests, there is no dogma, there are no categorical statements about the gods, humans, the world" (Feyerabend, 1975/1993, p. 184). On Feyerabend's view, later generations find tolerance to be "unacceptable" and a "manifestation of frivolous and simple minds" (Feyerabend, 1975/1993, p. 184). Intolerance is likened to being "hardened" (Feyerabend, 1975/1993, p. 37)—certain and secure in one's knowledge of the facts and what's possible. Tolerance at the very least requires that one not actively attempt to discourage pursuit into alternative ideas, in line with Vine Deloria, Jr.'s (1999) understanding of the Feyerabendian position as "allowing dissident and alternative philosophies to flourish."

For Feyerabend, the contrast between the attitudes of epistemic tolerance and intolerance reflects the difference between the perspectives of theoretical pluralism and monism. While monists operate based on one internally consistent set of facts, pluralists see the world through multiple lenses. I would counter that pluralists can be intolerant and monists can be tolerant. I still think this is the right direction. Tolerance might be supported by a pluralism according to which no particular theory is absolutely epistemically superior, except relative to a given dataset and some stipulated desiderata. Monism, in contrast, takes one particular set of theories to be epistemically superior and authoritative, such that it tends to be a waste of resources and to risk confusion to allow any mutually inconsistent theory to be effortfully explored in research.

The fact that the mainstream does not take fringe theories seriously can be assessed in different ways: as justified or bigoted, as protecting us from harm or as injurious to progress. We

can ask, in a normative voice, should science have a sanguine attitude toward its borderlines or should it shun the fringe? We will now move on to answering this question.

4. AGAINST INTOLERANCE TOWARDS FRINGE THEORIES

4.1. An inductive argument against intolerance

Informed by the accounts provided in the past two sections, we will now consider whether intolerance towards fringe theories is epistemically harmful to science. I argue on an inductive basis that it is. We'll consider several historical cases in which initially unwelcome fringe theories later became mainstream. In these cases, intolerance was responsible for significant delays in research, which suggests that intolerance takes an epistemic toll by delaying scientific advancements. Whether and to what degree an increase in tolerance is ultimately warranted will be considered in the final section.

4.2. From fringe to mainstream

Initially derided fringe theories that are now mainstream can be found across the sciences. We'll start with examples from biology and medicine, working our way towards physical sciences.

Before that, I want to point out that there are several examples in which eyewitness testimony of a rare phenomenon was laughed off, where that phenomenon later became mainstream. Many fringe theories today rely on testimony: bigfoot, flying saucers, and paranormal encounters are most infamous. A well-known historical example here is meteorites, first known as 'aeroliths'. The idea that rocks could fall to earth was dismissed by astronomers for centuries as not just impossible but "vulgar" (Schaffer, 2018). Similarly, rogue waves and giant squid were written off for centuries as tall tales. More recently, firebirds and olfaction in whales, both of which came to scientists' attention through Traditional Ecological Knowledge, were long dismissed as spiritual mythology (Bonta et al., 2017; Thewissen et al., 2011). Another longstanding fringe theory that recently became mainstream is milky seas. Routinely dismissed as hallucinations, glowing waters stretching as far as the eye can see mesmerized mariners for centuries, with 235 events reported between 1915 and 1993 (Miller et al., 2021). It wasn't until 2005 that old satellite images were called in to corroborate these sightings, and a 20-year-old milky water sample was finally put under

a microscope (Miller et al., 2005). The bacterium *Vibrio harveyi* was identified, and found to produce its luminescence through a saprophytic relationship with the microalgae *Phaocystis*.

In biology, Lynn Margulis struggled to publish her famous paper in support of endosymbiosis (Sagan, 1967), which was rejected by 15 journals (Knoll, 2012). Others, notably Konstantin Mereschkowsky, proceeded Margulis in the struggle by decades (Mereschkowsky, 1910; Kowalik & Martin, 2021). Camille Golgi, a histologist of the nervous system, proposed an unknown cell organelle: the 'internal reticular apparatus'. Today known as the Golgi body, it was dismissed by specialists in cytology for over half a century as a coagulum resulting from improper staining techniques (Baker, 1954). Decades after the invention of the electron microscope, a cell was examined, making the organelle indisputable.

In medicine, the intolerance of epidemiologists and physicians (e.g., Meigs, 1854) famously delayed the uptake of the germ theory of disease, including antiseptic handwashing. Tumor-causing viruses (Rous et al., 1912) and disease-causing deforestation (Nuwer, 2020) were long dismissed as nonsense.

In psychology, intolerance delayed the uptake of the Garcia effect, in which associations form with a long delay between taste and illness, after a single pairing (Garcia, 1981; Lubek & Apfelbaum, 1987; Gradowski, 2024).

In astronomy and astrophysics, organic interstellar dust (Hoyle & Wickramasinghe, 1979) and stellar nucleosynthesis (Hoyle & Lyttleton, 1942; Hoyle, 1954; Burbidge et al., 1957) were met with scorn (e.g., by Davies et al., 1984).

4.3. Continental drift and magnetoreception

Let's explore two additional cases in detail. Both continental drift and magnetoreception in birds were ridiculed and dismissed by scientists for over half a century. Continental drift is already well-known as a theory that was initially dismissed, so it should be a relatively uncontroversial case. Some neglected facts I add here serve to confirm and amplify that record. The case of magnetoreception is little known, thus serving as a test case that has not been previously examined. In each case, we see that (1) scientists were intolerant towards initial proposals of a theory that is today mainstream, (2) the respective theory change constituted a scientific advancement, and (3) a significant amount of time elapsed between proposal and research uptake.

Continental drift. Meteorologist and degreed-astronomer Alfred Wegener famously proposed his geological theory of continental drift in the early 1910s, but was preceded by others in formulating ideas of continental displacement based on the jigsaw-fit of the continents on either side of the Atlantic. Abraham Ortelius (1596) made an early suggestion of continental displacement, and several others proposed similar ideas leading up to Wegener's proposal (e.g. Placet, 1666; Lilienthal, 1756; Buffon & Leclerc, 1778; von Humboldt, 1801; Young, 1807; Hooker, 1853; Owen, 1857; Snider-Pellegrini, 1858; Darwin, 1879; Fisher, 1882; Mantovani, 1889; Ortmann, 1902; Pickering, 1907; Taylor, 1910; Bailey, 1910; Baker, 1912). Continental displacement theories were long dismissed as inconsistent with uniformitarianism, and regularly ridiculed by geologists during the first half of the 20th century. There were few publications anywhere on continental drift between 1930 and 1960, and no publications at all in *Nature* before 1960—"as though no self-respecting geologist in the Northern Hemisphere was prepared to risk his reputation by publishing a full-length article on continental drift" (Vine, 1977, p. 20). Drift became mainstream around 1967, when seafloor spreading was corroborated, and plate tectonics offered a possible mechanism for continental fracturing and displacement.

Magnetoreception in birds. The first hypotheses that animals—namely, birds—can sense the Earth's magnetic field for directional orientation and navigation were proposed in the 19th century (von Middendorff, 1859; Viguier, 1882), and rejected as "absurd" and "magical" by the famous biologist August Weismann in *Nature* (1834-1914; Newton & Weismann, 1879, p. 580). In the same entry, Alfred Newton (1829-1907; Newton & Weissman, 1879, p. 580) says, "[I had] no need to declare my disbelief in Dr. von Middendorff's magnetic hypothesis… I considered it had been set at rest for ever by Prof. Baird…" This conclusiveness reverberated into the 20th century. By the time of Wolfgang Wiltschko's revolutionary investigations in the 1960s, magnetoreception had been excluded as a possible explanation for migratory activity. Failures to experimentally demonstrate a behavioral response to changing magnetic fields—for instance, by giving a carrier pigeon a magnet!—had by then accumulated (e.g. Casamajor, 1927; Stresemann, 1935; Griffin, 1952; Sauer, 1957; Perdeck, 1963; Wallraf, 1966). Moreover, still no known mechanism could explain how magnetic field information could be converted into electrical impulses detectable by a nervous system; not to mention that the geomagnetic

field—100,000 times weaker than a MRI—was thought to be too weak for detection by any kind of biological equipment in the first place. Birds also seemed to have no need to sense the earth's magnetic field, since the sun compass and nocturnal orientation by stars, both discovered in the 1950s, could explain birds' super-abilities. In 1966, Wiltschko, then a doctoral student, along with his professor, Friedrich Wilhelm "Fritz" Merkel, published results demonstrating that the migratory behavior of European robins (*Erithacus rubecula*) was sensitive to a change in their surrounding magnetic field (Wiltschko & Merkel, 1966). Helmholtz coils were used to deflect geomagnetic north, and the robins reoriented their migratory activity accordingly. As late as this, the claim that these night-migrating birds could orient themselves without the help of stars was met with "great skepticism" (Wiltschko et al., 2021, p. 9).

Recall the fringe-negative account that understands fringe theories as past their sell-by date (Section 2). The thinking seems to go: if a fringe theory has remained fringe for decades, it will always be fringe. We can now see that this inference doesn't hold up. More strikingly, cases of eventual success allow for an optimistic induction that some fringe theories may be vindicated. The upshot is not that fringe theories in general anticipate scientific revolutions, but it is that they can and sometimes do.

A further implication is that a theory's fringe-mainstream status must be historically indexed. We sometimes treat fringe theories as bizarre at their core, but there need not be anything intrinsically fringe about a fringe theory. What matters is the current mainstream. Given the possibility of future success, established by the history of science, we might want to encourage tolerance towards fringe theories. The worry remains that tolerance might present even greater risks, which we'll now consider.

5. THE COSTS OF TOLERANCE

5.1. Intolerance should be scrutinized

Historical cases suggest that epistemic intolerance towards fringe theories can result in epistemic setbacks. The costs of intolerance can be severe, especially when it comes to medical interventions.

Intolerance towards the hypothesis that childbed fever might be spread by invisible entities on the hands of physicians is responsible for decades of deadly infections that handwashing might have prevented.

The prescriptive conclusions we can draw from this are limited. It doesn't straightforwardly follow from anything we've established that intolerance is a vice. Despite risks, intolerance may come with epistemic benefits. According to mainstream accounts, had the Mbeki administration been intolerant towards nonviral-AIDS theories, antiretrovirals might have saved hundreds of thousands of South African lives (Natrass, 2008). This suggests that tolerance comes with significant costs of its own.

This section concludes by providing some directions for relieving concerns about tolerance. My aim is to establish that we should be more wary of intolerance towards fringe theories. The intolerance of scientists and academics more generally should be scrutinized. We should welcome that scrutiny with the recognition that it is in our best interests. I envision a science where intolerance no longer flies as the norm, and the debunking efforts celebrated as scientific skepticism are no longer met with praise. At minimum, we need to take more seriously the possibility that a fringe theory ends up directing us towards significant insights, even in cases where its tenets strike us as completely silly, magical, and contrary to the facts. A mainstream community that was merely able to recognize its own occasions of intolerance and its associated risks would be a significant achievement.

5.2. Tolerance can be encouraged

My own view is that tolerance should be encouraged, but I won't make the full case for that here. Serious concerns tend to arise with any suggestion that academics and scientists should cultivate greater tolerance towards fringe theories. Objections often revolve around the costs of tolerance: might taking an unpromising fringe theory seriously have similar or even greater costs than failing to take a promising fringe theory seriously?

This question, as an objection to tolerance, calls for further study, for example, through (1) a risk-benefit calculation, or (2) another demarcation problem, this time between promising and unpromising fringe theories. Both projects could be foundational to future fringe studies. Concerns about tolerance are typically eased with a simple reminder of what tolerance does and does not involve.

The discomfort here is attributable to a tendency to conflate tolerance with belief. Epistemic intolerance ostensibly correlates with disbelief, which might explain the tendency to think the inverse is true. As emphasized in Section 3, questions of tolerance do not even arise when it comes to theories that are believed. For example, it would be odd, and I think also wrong, to say that mainstream biologists are tolerant towards the theory that DNA has a double-helix structure. The statement implies that mainstream biologists do not currently *believe* that DNA has a double-helix structure, which is plainly not the case. Compare that to the intolerance biologists might feel in response to a proposal to bring back Pauling's theory of a triple-helix structure. That intolerance would be directly connected to the entrenchment of an inconsistent belief.

With this clarification, let's return to the two approaches critics often suggest. So long as most scientists remain monists, it does seem reasonable to think that their tolerance of a fringe theory might be a slippery slope to their belief in it, as with both Mbeki's and Bauer's tolerance of nonviral-AIDS theories.

5.3. The risk-benefit analysis approach to the costs of tolerance

Let's consider the risk-benefit calculation approach to relieving the worry: we might consider the costs of failing to take promising fringe theories seriously against the costs of taking a fringe theory seriously when we shouldn't have. I don't think this endeavor is currently realistic, but I would encourage anyone enthusiastic about it to take up the project. My view is that a risk-benefit analysis might be done (albeit imperfectly and probably not without biases) for some *specific* fringe theory, but I don't assume this approach will be reliable in every case.

Still, perhaps intolerance serves us epistemically. One reason is that intolerance may protect scientific truths. In the vast majority of cases, fringe theories seem to fail, or at least have not yet made their way into the mainstream. A second reason is that one might think intolerance is a way of giving fringe theories a hearing, alongside criticism for their improvement.

In response to the first point, we cannot infer much from the failure of fringe theories. Given widespread intolerance, bad outcomes are unsurprising. Moreover, failure in science is generally provisional, and, as pessimistic induction suggests, most mainstream theories fail as well. As for the second reason, I concede that there might be cases in which specific kinds of intolerance—public and loud ones—might actually help a fringe theory mature, motivating proponents to

address criticisms and in front of a larger audience, ultimately giving it greater potential to enter the mainstream if worthy.

Nevertheless, I think tolerance offers advantages that go well beyond those of the explicit denouncements and debunking efforts that typify potentially useful instances of intolerance. Intolerance has a tendency to stymy research, and especially open research. Intolerance can make a fringe theory more taboo, leading to silence and lack of motivation for research amongst the relevant experts who might actually have sympathies towards it. Tolerance resolves these setbacks. Tolerance promotes constructive criticism rather than debunking. Tolerance also allows trained scientists to collaborate with fringe theorists without the stigma, allowing for research that might otherwise be lost in secret diaries.

5.4. The demarcation approach to the costs of tolerance

The promising-unpromising distinction suggests the other approach of establishing criteria to demarcate promising from unpromising fringe theories. I haven't said anything about what makes the successful cases successful. Might we determine the properties that make a fringe theory worthwhile by examining the successful cases retrospectively? Even the most sympathetic critics hope we might determine criteria to exclude some subset of fringe theories doomed to fail.

An obstacle for this approach is that a number of the features that distinguish the successful cases are already included in my account of fringe theories above. One property shared by nearly all the successful fringe theories I have studied is that their initial proponents were either domain outsiders, or altogether institutionally independent. Alfred Wegener was a degreed astronomer, meteorologist, and polar explorer; he only spent a few months reading up on geology before making his drift theory public. Franck Goddio, a degreed mathematician who served as an economic adviser to the United Nations, is responsible for pursuing the fringe hypothesis that an ancient city of legend, Heracleion, was to be found at the bottom of Abukir Bay off the coast of Egypt (Robinson & Goddio, 2014; Lawler, 2005). Robin Baker, human magnetoreception pioneer, is a degreed zoologist, and to this day criticized for his ignorance of controls in psychological studies (e.g. by Greshko, 2015). He ultimately left academia altogether due to the ridicule he faced (personal communication, 2022). Ignaz Semmelweis (1861) pioneered antiseptic handwashing as an obstetrics assistant at Vienna General Hospital. The list goes on.

It is tempting to think that a line might be drawn at fringe theories with ill-intent, specifically those that are fraudulent, i.e. intentionally deceptive. However, it turns out things are not so simple, and not just because it is complicated to know whether researchers are being deceptive. The bigger reason is theories have a life of their own.. Just as well-intended theories of the past are by today's lights seen as ill-inducing—take bloodletting or phrenology—an ill-intended theory may turn out to work wonders.

We also overestimate the necessity of consensus. People who reject anthropogenic climate change still have good reason to promote changes in the way humans treat the earth. The current strategy of using anthropogenic climate change to create regulations has proven to be limiting. The case for environmental regulations is weakened when it is presented as depending on a contested theory. Imagine if it were the case that teachers would only educate their students if they had data to support the conclusion that they were directly responsible for their students' lack of education.

There may be doubt that knowing what it means to treat the earth with care can be done without rigorous science. Reassurance is easy to find in cultures that are said to lack that. They do not need the tools of Western science to know to treat the environment with care. The Bribri people of Costa Rica knew that deforestation would cause disease for many centuries before Western scientists began to take that hypothesis seriously, replacing the spiritual basis for that theory with a mechanistic explanation that deforestation takes disease-carrying fauna out of their natural habitats, leading to contact with human populations (Nuwer, 2020).

Though we'd like to believe otherwise, ill-intended theories can just as easily be touted in the mainstream, which makes them all the more devastating. The theory that heart disease is caused by saturated fats rather than sugars was promoted in a review authored by Harvard researchers funded by sugar industry stakeholders. This ploy to deceive the public, including other nutrition scientists, successfully stalled research into the harmful effects of sugar consumption for nearly half a century. Today, nutrition experts believe that sugar is the primary factor driving the obesity crisis. Obesity is considered a major risk factor for cardiovascular illness, including heart disease, which, according to the CDC, is the number one cause of death in the United States (Kochanek et al., 2023).

Critics wanting demarcation must recognize that 'promising' has been retroactively applied to successful cases. Furthermore, being considered promising in the first place plays a vital role in a theory fulfilling its promise.

Moreover, pursuing a fringe hypothesis openly, even skeptically, is a reputation risk. Experts in the discipline where the fringe theory treads are rarely to be caught doing so. For academics especially, it means putting one's career and livelihood at stake. Academics conform to a systemic 'publish or perish' norm—specifically in the relevant peer-reviewed journals. Few aspire to become the "crackpot", even one with funding.

5.5. Two final objections

Critics object that tolerating fringe theories would lead to (1) wasted resources, (2) the epistemic decline of science, and (3) the exacerbation of public distrust and confusion. I'll end by responding to these points:

1. Increasing our tolerance towards fringe theories would put important resources in jeopardy. Given the vast array of fringe theories, increasing tolerance across the board will spread resources too thin. Tolerance towards fringe theories would result in the poor and inadequate allocation of scientists' energies, lab spaces and materials, as well as funds. The percentage of fringe theories that become mainstream is miniscule in comparison to those that don't. Thus, tolerance is unjustified.
2. What is more is that many fringe theories are epistemically harmful to science. Taking fringe theories more seriously will result in the neglect of the most promising lines of research that have supported scientific advancements, ultimately leading to the decline of science.
3. Given increasing public distrust, experts taking fringe theories seriously will seem to justify denialist and anti-science movements. Furthermore, the vindication of fringe theories could lead to an exacerbation of public confusion, which is especially dangerous. For instance, taking fringe theories about the harms of vaccines seriously would only serve to further undermine vaccine compliance.

As for the first worry, increasing our tolerance towards fringe theories should not require an increase in resources. It may actually free up resources, efforts, and pages that would otherwise be allocated towards discouraging (i.e. shaming, not critiquing) fringe research. Fringe research is usually pursued out of pocket by independent researchers, and mainstream projects increasingly demand funding into the billions.

Furthermore, mainstream research teams oftentimes test the same hypotheses, using the same databases of information, background assumptions, and experimental designs. These monopolies are limiting, but what is more is that null results are rarely published and people are competing for priority, leading resources to be wasted in needless undertakings of the same studies over and over again, the majority of which have funding. We've known since Merton (1957) that in many cases of discovery, multiple independently working research groups had it at their fingertips. Embracing the fringe opens up new research directions.

A recent study in *Nature* investigates a discrepancy in well-established datasets that indicate a decline in discoveries despite an exponential increase in knowledge content. The results of the study suggest the explanation is that research is becoming decreasingly "disruptive" over time, or "less likely to break with the past in ways that push science and technology in new directions" (Park et al., 2023, p. 138). The authors report an increasingly limited use of past knowledge content, indicating that theories are becoming increasingly entrenched. Contrary to the second objection, the findings suggest that intolerance is responsible for the decline of science.

One might counter that a decrease in disruptive innovations reflects the fact that science is approaching its epistemic limits: there is less to discover because we've already discovered it. In that case, science may suffer from a problem of over-abundance. We have more scientists per capita today than ever before (UNESCO, 2021). If opportunities for discovery have declined due to theoretical maturity, we face diminishing returns on our investments. Given an increasing surfeit of intellectual resources, we can afford to pursue fringe theories.

As for the worry that increased tolerance will jeopardize public trust in science, skepticism and denialism seems to be exacerbated, if anything, by cases in which silencing of fringe theories has been ostensible; the media is more prone than ever to respond loudly to such silencing, as we recently witnessed in the aftermath of COVID-19 (Shir-Raz et al., 2023). When it comes to policy decisions, respected scientists acknowledging that a given fringe theory is still under construction can only serve to reinforce the likelihood of a decision based on well-established views. Where it doesn't, we should remember that the history of science is replete with cases in which mainstream theories met with their demise. Any faith we have in the idea that our mainstream theories will be maintained is far outweighed by the faith we ought to have in our own epistemic humility.

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