

## Telling Stories in Science: Feyerabend and Thought Experiments

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## **Abstract**

The history of the philosophy of thought experiments has touched on the work of Kuhn, Popper, Duhem, Mach, Lakatos, and other big names of the 20<sup>th</sup> century. But so far, almost nothing has been written about Paul Feyerabend. His most influential work was *Against Method*, 8 chapters of which concern a case study of Galileo with a significant focus on Galileo's thought experiments. In addition, the later Feyerabend was interested in what might be called the epistemology of drama, including stories and myths. This paper brings these different aspects of Feyerabend's work together in an attempt to present what might have been his considered views on scientific thought experiments. According to Feyerabend, TEs are a special kind of story that can help to demolish a dominant myth and instigate a new one through the use of propaganda to change our habits, by appealing to our sense of what is interesting, appealing, revealing, comprehensible, coherent and surprising. I conclude by contrasting Feyerabend's ideas with two modern currents in the debate surrounding thought experiments: 1) the claim that the epistemology of thought experiments is just the epistemology of deductive or inductive arguments, and 2) the claim that the specifically *narrative* quality of thought experiments must be taken into account if we want a complete epistemology of thought experiments.

## **Introduction**

Paul Feyerabend (1924-1994) has been dismissed as a “clown” (see Munévar 1991, ix), an “enfant terrible” (Suppe 1991, 297), and the “worst enemy of science” (Theocharis and Psimopoulos 1987), someone who defends voodoo and astrology, attacks strawpeople, misses the point (see Shaw 2017) and is a postmodernist (Reaven 2000, 23; see Kidd 2016). Others appreciate him as “one of the most exciting philosophers of science of this century” (Munévar 1991, ix), someone who played a crucial role in the development of ideas that we now take for granted in HPS, including pluralism, the disunity and value-ladenness of science, topics in feminist philosophy of science (see Brown and Kidd 2016, 2) and green philosophy (Naess 1991).

Feyerabend wasn't always an unreliable narrator, but he was a narrator. He tells stories, and claims to be a philosopher only in the sense in which dogs can be philosophers (1991, 509; 1995, 162). Some argue he has no positive philosophy at all (e.g., Dierderich 1991, 216), and even Feyerabend had trouble pinning himself down on key issues (1995, 145). Then again, according to Feyerabend, “pinning down” is something only “deep thinkers” do when they want to get stuck in the academic mud (1975, 53). In any case, there are still many unharvested philosophical fruits in Feyerabend, especially in his later work. Two specific areas that need more attention are Feyerabend's comments on metaphilosophy, and the epistemological purposes he sees for drama (Brown and Kidd 2016, 7). This paper hopes to pursue both of these by attempting to locate Feyerabend's views on thought experiments. Thought experiments (TEs) are tools of the imagination used to make epistemological progress in philosophy and science (making them relevant for metaphilosophy), and they typically have a narrative structure (making them relevant for an analysis of the epistemological use of drama).

The next section argues that it is fair to discuss Feyerabend as someone who had views about TEs, despite rarely having used that term in his published work. Following this, I try to reconstruct Feyerabend's views on scientific TEs by considering his comments on the epistemological impact of stories and story-telling. Specifically, I read Feyerabend's early remarks on Galileo's TE in *Against Method* through the lens of his work published in the 90s, especially *Killing Time* and *The Tyranny of Science*.<sup>1</sup> In section 3, I put Feyerabend into conversation with current trends in the literature on TEs.

## 1 Feyerabend and TEs

Feyerabend didn't use the term "thought experiment" very often in published work: it appears only in the following instances. First, there is an approving reference to Ernst Mach's (1897) discussion of Stevin's inclined prism TE (Feyerabend 1987, 706-7): "it is entirely reasonable to correct and perhaps even to suspend the results of [laboratory] experiments" in favour of the output of a TE. He also applied the label in passing to some TEs in quantum mechanics (1968, 319; 1991a, 28), and said of Wheeler's delayed choice TE that it "reeks of High Science" (1996, 28).

Despite not using the term "thought experiment" often, there are several reasons to treat Feyerabend's published work as being relevant to a discussion of them. Feyerabend is perhaps best known for his 1975 book *Against Method*, especially for its "epistemological anarchism" expressed in the catchphrase, "anything goes." Of its 20 chapters, 8 focus on Galileo's role in the Copernican revolution.<sup>2</sup> While Feyerabend doesn't use the term "thought experiment" in

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<sup>1</sup> I present Feyerabend's ideas here without defending them. For a philosophical defense of some of them see (Stuart forthcoming).

<sup>2</sup> In *Against Method*, Feyerabend summarizes "anything goes" this way: "*all methodologies, even the most obvious ones, have their limits*" (23). In *Tyranny of Science* the claim is even

*Against Method*, he claims that “many of [Galileo’s] ‘experiences’ or ‘experiments’ used in the arguments about the motion of the earth are entirely fictitious” (1975, 75).<sup>3</sup> These ‘experiments’ are important because it is by means of them that “the transition from a geostatic cosmology to the point of view of Copernicus and Kepler is achieved” (1975, 75-6; emphasis removed).

As examples of such ‘experiments,’ Feyerabend includes Galileo’s narratives about objects falling from the top of a tower and from a ship’s mast. Feyerabend seems to believe that Galileo didn’t really perform these experiments. Rather, they are meant to invent new imaginary experiences (1975, 65, 121). If this is so, they sound quite a bit like TEs.<sup>4</sup>

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more general, “anything goes” “means only ‘don’t restrict your imagination’ because a very silly idea can lead to a very solid result” (2011, 130-131).

<sup>3</sup> Perhaps Feyerabend uses cognates like “fictitious experiments” and “invented experiences” instead of “TE” because he thinks they sound better. Perhaps he is following Mach (someone Feyerabend admired very much), who called TEs by many names, including “instinctive [instinktiven] experiments,” “thought-guided [Denken geleiteten] experiments” (134), “planned [planmäßig eingeleiteten] experiments,” “thought experiences [Gedankenerfahrung]” (136) and “phantasies [das Phantasieren]” (144). Or perhaps Feyerabend was accustomed to the term Gedankenexperiment used in the context of Einstein’s TEs, and had something more general in mind.

<sup>4</sup> There is a long history of discussion concerning whether Galileo really did perform the experiments that were attributed to him, perhaps beginning with Stillman Drake and Alexandre Koyré. For a recent evaluation of the relationship between Galileo’s TEs and physically performed experiments, see Palmieri (2018).

Galileo's fictitious experiments do intuitively feel like TEs. For example, Feyerabend quotes at length "a certain fantasy which passed through [Galileo's] imagination" concerning a ship voyage (1975, 65-7). If you sailed from Venice to Alexandretta holding a pen steady the whole time, the pen's tip would trace the shape of an arc (since the earth is round). If instead you spent the trip doodling, the tip of the pen would still (roughly) trace an arc through space, even though someone standing beside you would only see the doodle. The difference is that when the arc-motion is shared by you, the pen, the paper, and your witnesses, that motion is "inoperative": it's not noticed. From a different perspective, say, from someone on the shore, both motions would be noticed. Perhaps because this story and similar ones have an experimental feel, they are labelled and discussed as paradigm cases of TEs (e.g., Brown 2013, 54; Budden 1998; McAllister 2004, 1169).

This has led philosophers to interpret Feyerabend as having views on TEs. Thus Michael Bishop attributes to Feyerabend the view that TEs are only psychological tricks (1998, 28). Bishop argues that TEs can be more than mere rhetoric, and indeed can assist us in the rational assessment of scientific theories. Feyerabend could certainly agree that this is a possible use for TEs; nowhere does he suggest that TEs work by trickery *only*, just that they can (and sometimes should) employ trickery.

In a different vein, Richard Arthur extends Feyerabend's analysis of Galileo's tower TE to his falling bodies TE in order to argue that these TEs provide a priori knowledge by changing our "natural interpretations" (Arthur 1999). I will not discuss Arthur's main point, which concerns whether the knowledge produced by TEs is a priori or otherwise, but I will follow Arthur in thinking that natural interpretations are important for a discussion of Feyerabend and TEs.

Finally, and most importantly, there is a letter from Feyerabend to Kuhn (reprinted in Hoyningen-Huene 2006) providing comments on a draft of what would become Kuhn's 1964

paper on TEs. Feyerabend calls Kuhn's paper "extremely illuminating" (2006, 630), but he sharply criticizes Kuhn for comparing scientific TEs to the puzzles and examples used by ordinary language philosophers ("OLPs"). In his criticism, Feyerabend emphasizes the difference between OLPs ("a bunch of Ignoramuses") and scientists, whose TEs "proceeded to a recasting of our ways of thinking about nature." The scientist realizes that "ordinary means of expression" are insufficient for many problems. The need to revise language can be "presented, most clearly, in an imaginary experiment," which enables the scientist to "tear down large pieces of common idiom and to replace it by what at first sight will seem a fairly artificial idiom, but what as a matter of fact will be much more adequate." Thus, for the scientist, "a thought experiment is a starting point of the revision of language." For OLPs it's the opposite: "the purpose is not revision of language, but realization that, properly understood, the language one is talking can already take care of the situation" (630). This typically requires "a kind of swindle" (631). Feyerabend insists that a comparison of Stevin's inclined plane to one of the TEs of the OLPs would "most convincingly show the tremendous advantage of the 'Galilean method' of revision as opposed to the other method of talking around and around the problem until one has lost track of it" (631).

We can take from this that Feyerabend respects scientific thought experiments as something which may help us recast our thoughts about nature, by, or in conjunction with, a revision of language. Feyerabend names TEs as things that can achieve these goals, and this is precisely what Galileo's TEs are credited with in *Against Method*. So, I conclude that it is fair to discuss Feyerabend in the context of TEs.

In the next section I will argue for a new interpretation of Feyerabend's views: TEs are a kind of *story*. Stories, which have an undeserved negative reputation, can solidify into myths, which can be dogmatic and harmful. Despite the genealogical connection between stories and

myths, stories can be used to overturn harmful myths. And TEs in science can be extremely powerful versions of this kind of story.<sup>5</sup>

## 2 Stories, Myths and Thought Experiments

### *Stories*

In his 1995 autobiography, *Killing Time*, Feyerabend speaks approvingly about those who use narrative rather than argument to convey ideas (e.g., 1995, 103, 142). And he claims that one reason he continued to teach philosophy is because he likes telling stories (1995, 162). A general theme of the later Feyerabend is that, fundamentally, stories are all that we have, since truth is always mediated by its packaging. Stories may assume different forms, including epics, poems, lampoons, scientific prose, dramas, political speeches, novels, shorts stories and dialogues (1991b, 493). But for the later Feyerabend, all communication is story telling, so “why not avoid the fraud by using stories right away?” (1995, 163).

Importantly, this is not to equate science with fiction. Stories are “not just poetic playthings.” Rather, they can be used to inform and criticize (1991b, 493). Stories can reveal true things about the world, and our desire for such stories is a major driving force of epistemic progress.

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<sup>5</sup> If I’m wrong, my interpretation of Feyerabend can be taken as a new story, which might be independently interesting. This is a strategy Feyerabend would have approved of, since this is exactly how he views his own remarks about Galileo. “If my account of Galileo is historically correct, then the argument stands as formulated. If it turns out to be a fairy-tale, then this fairy-tale tells us that a conflict between reason and the preconditions of progress is *possible*, it indicates how it might arise, and it forces us to conclude that our chances to progress *may* be obstructed by our desire to be rational” (1975, 117).

Thus, the sciences tell stories about the world in the same way that the humanities tell stories about who we are, how we got here, and what we should do.

Not all stories are equally good. Good stories are those that are interesting, appealing, and revealing. Stories are interesting and appealing when they describe “perfectly ordinary situations” in a way that is “slightly off center.” This may be affected by a sudden change in framing or point of view, which helps us to combine objects and events we are comfortable with, in ways that reveal new things (1995, 142). To craft a good story, we begin with a general idea. Then we add words and rhythm, whose “meaning must be slightly off center; nothing dulls the mind as thoroughly as a sequence of familiar notions. Then comes the story. It should be interesting and comprehensible, and it should have some unusual twists...The elements hang together beautifully, but the argument itself is from outer space, as it were, unless it is connected with the lives and interests of individuals or special groups. Of course, it is always so connected, otherwise it would not be understood, but the connection is concealed” (1995, 163).

This passage identifies several more conditions for a good story: comprehensibility, coherence and surprisingness. It is important to recognize that because of these conditions, one story cannot be *objectively* better or worse than another because some of the success conditions of stories are audience-dependent. No one story will be equally interesting and appealing to people from every cognitive-cultural background.<sup>6</sup>

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<sup>6</sup> When Feyerabend started teaching students at Berkeley who were not European or Anglo-American, he realized that the “wonderful stories I had so far told...might just be dreams, reflections of the conceit of a small group who had succeeded in enslaving everyone else with their ideas” (1975, 264).

So, stories may come in different forms, with different goals, and some of those goals can be epistemic. Importantly, attempts at clarification render them lifeless. For example, the stories of philosophers “are hardly stories any longer.” They “use abstract and emotionally decontaminated concepts...not to sharpen our vision or to enrich our existence but to push us into narrow and dark passages. Feelings, impressions, desires can enter the debate only after they have been caught like butterflies, killed and stretched out on some philosophical rack.” The problem is that “philosophers, rationalists especially, are interested in general principles, not in particulars. Considering the richness of our world this means that their stories will be either empty, or tyrannical; people must mutilate their lives to fit the stories. (1991b, 494)

For Feyerabend, when stories become “tyrannical,” they become myths.

### *Myths*

A myth is a story that has been frozen into dogma. For Feyerabend, the Third Reich is a myth in the same sense that the superiority of Western Science is a myth. Myths are stories that we take for granted. They are no longer “alive” and changeable.

The complete absence of myth in modern society is not possible. But this is not necessarily lamentable, as competition between myths can increase our knowledge. “Knowledge...is...an ever increasing ocean of mutually incompatible alternatives, each single theory, each fairy-tale, each myth that is part of the collection forcing the others into greater articulation and all of them contributing, via this process of competition, to the development of our consciousness” (1975, 11).

And individual myths may themselves contain some truth. Feyerabend writes, “far from being a figment of the imagination that is clearly opposed to what is known to be the real world a myth is...a system of thought supported by numerous and very direct and forceful

experiences... There must be something amiss with the fairly popular idea that the distinction between a myth and a scientific theory lies in the factual basis of the latter” (1961, 23).

Thus, myths can be empirically supported,<sup>7</sup> and their interaction with competing myths can drive epistemic progress. The danger comes when we have an entire community that is subjugated under a single myth. This is the “myth predicament,” and overcoming it is not just epistemologically important, it is morally right. *“Unanimity of opinion may be fitting for a rigid church, for the frightened or greedy victims of some (ancient, or modern) myth, or for the weak and willing followers of some tyrant. Variety of opinion is necessary for objective knowledge. And a method that encourages variety is also the only method that is compatible with a humanitarian outlook”* (1975, 31-2).<sup>8</sup> Stories can express theories and points of view, but they are not themselves points of view or theories. These escape the stories to become myths, which are no longer *just* stories (1975, 29).

Mythical monism requires conformism, which “leads to a deterioration of intellectual capabilities, of the power of the imagination. It destroys the most precious gift of the young, their tremendous power of imagination” (1975, 96-7). To keep a myth dominant, monists rebrand “childlike” questions as “intellectual pains” which they are “apt to dismiss as ‘imagination’” (1975, 131). The “tyranny of science” that Feyerabend often refers to is in many ways a tyranny of the imagination. Thus, “‘teachers’ using grades and the fear of failure mould the brains of the young until they have lost every ounce of imagination they might

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<sup>7</sup> See also Feyerabend’s arguments in “Problems of Empiricism” (1965), in which Feyerabend argues that empiricism does not have the resources to distinguish between myth and scientific theory. Thanks to Jamie Shaw for bringing this to my attention.

<sup>8</sup> See Preston (1997 ch. 5) for a careful discussion of the role of the myth predicament in Feyerabend’s philosophy.

once have possessed. This is a disastrous situation, and one not easily mended... We must stop the scientists from taking over education and from teaching as ‘fact’ and as ‘the one true method’ whatever the myth of the day happens to be. Agreement with science, decision to work in accordance with the canons of science should be the result of examination and choice, and *not* of a particular way of bringing up children” (1975, 160-162).

This dulling of imagination is epistemically and morally deleterious (1975, 11), especially since, as we will see, imagination is an important link between myths, stories, and epistemic progress in science.<sup>9</sup>

Sometimes a myth naturally crumbles from the inside, or is forgotten. But other times the only way to undermine a myth is by seeing the myth from the outside. We gain an outside perspective by inventing stories that may become competing myths. This is the core of Feyerabend’s “principle of proliferation,” which states that “*the validity, usefulness, adequacy of popular standards can be checked only by research that violates them*” (1975, 234). This requires imagination, because we must invent stories about other ways the world might be. Galileo, for instance, uses tricks to obscure the fact “that the experience on which Galileo wants to base the Copernican view *is nothing but the result of his own fertile imagination*” (1975, 65 emphasis added).

One we have imagined a new story capable of transforming into an attractive worldview, we must then support it with evidence and arguments. To do this effectively might take decades

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<sup>9</sup> This is presaged by Vico, who claimed that education which emulates the “geometrical method” of physics (1709, 21) “benumbs...[the] imagination and stupefies...[the] memory” (1709, 42). Feyerabend was aware of Vico, since he mentions him in a letter to Lakatos on 24 September 1970 (reprinted in Motterlini 1999, 216), but I have no evidence that he knew of this particular idea.

or centuries. Because of this, Feyerabend endorses a “principle of tenacity” to complement his principle of proliferation. The principle of tenacity tells us that we need to agree on a theory (myth) to get work done in science, so we should pick one that has “the most attractive features and that promises to lead to the most fruitful results” (Preston 1997, 138). Once we’ve chosen a new story, the principle tells us that we should stick with it, for example, by not discarding it when presented with refuting evidence. “It is rational to do so because theories are capable of development, can be improved, and may eventually be able to accommodate the difficulties which they were originally incapable of explaining” (Preston 1997, 95).

The principle of tenacity also requires imagination: “theoretical frameworks need to be detailed and criticized and reformulated. The endorsement of tenacity allows scientists to violate any of the reasons methodologists have given for rejecting theories (recalcitrant facts, logical inconsistencies, lack of theoretical virtues, etc.) because the theory can evolve to become highly successful in any way one construes ‘successful’” (Shaw 2017, 15).

In sum, a dominant myth is morally and epistemologically problematic because it stifles our imaginations, which makes us less human and less able to proliferate tenaciously. TEs are tools that amplify the power of the imagination, allowing us to fight back.

### ***Thought Experiments***

If TEs are stories, they can make us more tenacious, improve our language, and much else. But the main function of stories that I will discuss, because of its centrality to Feyerabend, is that which allows us to proliferate “as the only efficient antidote against dogmatism” (Hoyningen-Huene 1994, 290).

Galileo’s TEs “defused an important argument against the idea of the motion of the earth. I say ‘defused’, and not ‘refuted’, because we are dealing with a changing conceptual system as

well as with certain attempts at concealment” (1975, 55). They did this by changing our “natural interpretations.” A natural interpretation is a mental operation that we perform on a sensation, which occurs so naturally and automatically that we barely notice we’re doing it. For example, when we re-interpret what appears to be a bent stick in the water as a straight stick, we are applying a natural interpretation.

Natural interpretations partially determine our experience and therefore our evidence about the world. Thus they are relevant to our knowledge claims, and must be investigated just as the reliability of our scientific instruments must be. But it is impossible to have a sensation without an accompanying natural interpretation. So how can we investigate them? There is only one way: an “external measure of comparison” that we achieve by inventing new natural interpretations (1975, 61). For example, “the Copernican view is not in accordance with ‘the facts’. Seen from the point of view of these ‘facts’, the idea of the motion of the earth is outlandish, absurd, and obviously false, to mention only some of the expressions...still heard whenever professional squares confront a new and counter-factual theory...Let us therefore turn the argument around and use it as a detecting device that helps us to discover the natural interpretations which exclude the motion of the earth... We first assert the motion of the earth and then inquire what changes will remove the contradiction” (1975, 61).

This is Feyerabend’s famous “counterinduction,” in which we take a hypothesis that we believe is false, and try to find evidence for it. This is necessary because natural interpretations determine what we experience and what we take to be true. This is why “*we need a dream-world in order to discover the features of the real world... We must invent a new conceptual system that... confounds the most plausible theoretical principles, and introduces perceptions that cannot form part of the existing perceptual world*” (1975, 22-3).

Without going into the details of Feyerabend's views on counterinduction and their philosophical reception, I want to consider the specific role of story telling in successful counterinductions. Feyerabend writes that

the whole rich reservoir of the everyday experience and of the intuition of [Galileo's] readers is utilized in [his] argument, but the facts which they are invited to recall are arranged in a new way, approximations are made, known effects are omitted, different conceptual lines are drawn, so that *a new kind of experience arises, manufactured almost out of thin air*. This new experience is then *solidified* by insinuating that the reader has been familiar with it all the time...[Galileo] established fake connections with the perceptual elements of this cosmology which are only now being replaced by genuine theories (physiological optics, theory of continua), and that whenever possible he replaced old facts by a new type of experience which he simply *invented* for the purpose of supporting Copernicus. (1975, 121)

Galileo's TEs produce imagined experiences that create new natural interpretations, and then work out the consequences of these new natural interpretations for physical theory. But more than this, they give the impression that the new experiences and theory are indeed very natural, even obvious. They do this "by tricks, jokes, and *non-sequiturs*" (1975, 115) and other methods which we would (then and now) consider "irrational." They are good stories because they are interesting, appealing, revealing, comprehensible, coherent and surprising. But how do they work? One way concerns an assumed "naturalness," which Feyerabend characterizes with Hume in terms of habit and acculturation. Galileo has to "defuse" old Aristotelian habits and "enthroned" new Copernican ones (1975, 77). When performing Galileo's TEs "we have the impression that this readiness was in us all the time, although it took some effort to make it conscious. This impression is most certainly erroneous: it is the result of Galileo's propagandistic machinations" (1975, 72).

Why think that it is the propagandistic elements of Galileo's stories that cause the conceptual change, and not something else? "Experience', i.e. the totality of all facts from all domains, cannot force us to carry out the change which Galileo wants to introduce. The motive for a change must come from a different source" (1975, 71). As we will see, this change does not come from logic either, but our desire to see "the whole [correspond] to its parts with wonderful simplicity" (Galileo quoting Copernicus, 1975, 71). The desire for simplicity and coherence is a desire that is satisfied by stories. Of course it is also satisfied by mathematical axioms. But we desire more than just simplicity and coherence.

Once it has been realized that a close empirical fit is no virtue and that it must be relaxed in times of change, then style, elegance of expression, simplicity of presentation, tension of plot and narrative, and seductiveness of content become important features of our knowledge. They give life to what is said and help us to overcome the resistance of the observational material. They *create* and maintain interest in a theory that has been partly removed from the observational plane and would be inferior to its rivals when judged by the customary standards. It is in this context that much of Galileo's work should be seen. This work has often been likened to *propaganda* - and propaganda it certainly is. But propaganda of this kind is not a marginal affair that surrounds allegedly more substantial means of defence, and that should perhaps be avoided by the 'professionally honest scientist'. In the circumstances we are considering now, *propaganda is of the essence*. It is of the essence because interest must be created at a time when the usual methodological prescriptions have no point of attack; and because this interest must be maintained, perhaps for centuries, until new reasons arrive. (1975, 118)

Galileo's TEs are a special kind of story that can help to demolish a dominant myth and instigate a new one through the use of propaganda to change our habits. Changing the habits

of others using only words is hard; it requires appealing to the audience's sense of what is interesting, appealing, revealing, comprehensible, coherent and surprising. This position does not necessarily reduce to subjectivist or relativist epistemologies of science insofar as some of the success conditions of stories are objective (perhaps coherence, revealing the truth, etc.). Is this a new or useful position? Let's see how it connects with recent work on TEs.

### **3 Feyerabend in the Current Context**

It would be interesting to compare Feyerabend's views with earlier views on TEs, but for considerations of space I will focus only on two connections to the contemporary literature.<sup>10</sup>

First, Feyerabend's account of stories provides a new set of arguments against John D.

Norton's account of TEs, according to which the epistemology of TEs/stories is exhausted by examining their logical reconstructions (Norton 1991, 1996, 2004a, 2004b). Second, while no

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<sup>10</sup> Historical connections would certainly include Mach, Popper and Kuhn. One perhaps unexpected connection is to Lichtenberg's earlier work on "experiments with thoughts and ideas." Whether Feyerabend read Lichtenberg, we can only guess. But here are three tantalizing links. One important (and Feyerabendian) purpose of TEs, for Lichtenberg, is to "think up new errors." Second, for Lichtenberg, TEs "are not a method in the strict sense of a path to knowledge, but the best we can do without a method of scientific creativity" (quoted in Fehige and Stuart 2014, 183). This is echoed by Feyerabend's epistemological anarchy. Finally, for Lichtenberg, observation is mediated by concepts whose meanings can become "frozen" and stagnant, and TEs can "melt" such concepts by breaking the rules of grammar, forcing together ideas that do not naturally come together, or forcing naturally conjoined ideas apart. This parallels Feyerabend's idea that TEs "tear down large pieces of common idiom" and revise language to reverse natural interpretations (Hoyningen-Huene 2006, 630).

one who currently focusses on the narrative component of TEs makes reference to Feyerabend, we can fruitfully re-cast Feyerabend's work as part of that tradition.

### ***Reconstructing TEs***

John D. Norton claims that thought experiments are just arguments. He argues that all TEs can be reconstructed as sets of propositions with logical connections between them. We evaluate the reliability of TEs by reconstructing them this way, and if there was a TE that we couldn't reconstruct, we wouldn't think it was reliable. Thus, we should identify TEs as arguments, and pursue the epistemology of thought experiments as the epistemology of arguments. We do this by identifying and evaluating TEs using logic, which is our general tool for categorizing and explaining the epistemological justification that the premises of an argument lend to its conclusion.

Feyerabend would strongly object to Norton's account. When his assistants in Berlin wanted to "learn how to think" they bought logic textbooks. Feyerabend was outraged, "as if logic has anything to do with *that*" (1995 132). For Feyerabend, the introduction of logical reconstructions into philosophy of science tends merely to create "intellectual tumors grown by philosophers." Instead of clarifying, they translate science into "some form of pidgin logic" (1995, 142) as a way of avoiding real problems. "One would have thought that the philosopher of science would be most interested in picking out and analysing in detail those moves which are necessary for the *advancement* of science. Such moves, I have tried to show, often resist rational reconstruction" (1975, 116 fn. 9).

More substantially, we can extrapolate at least four distinct arguments from Feyerabend against Norton's account. The first focuses on clarification, which is one of the supposed benefits of logically reconstructing a TE. Feyerabend asks whether this is really a benefit.

To ‘clarify’ the terms of a discussion does not mean to study the *additional* and as yet unknown properties of the domain in question which one needs to make them fully understood, it means to fill them with *existing* notions from the entirely different domain of logic and common sense, preferably observational ideas, until they sound common themselves, and to take care that the process of filling obeys the accepted laws of logic. The discussion is permitted to proceed only *after* its initial steps have been modified in this manner. So the course of an investigation is deflected into the narrow channels of things already understood and the possibility of fundamental conceptual discovery (or of fundamental conceptual change) is considerably reduced.

(1975 193)

For Feyerabend, clarification converts the object of our investigation into something common-sounding which fits into familiar logical schemata. This does not reveal anything new about it. Rather, it mutilates it into something less interesting.

A second criticism focuses on Norton’s identification of good TEs as logic-approved arguments. For Feyerabend, TEs can be counterinductive, meaning they defend hypotheses “in the face of plain and unambiguous refuting facts” (1975, 113). This would make them unsound, at least relative to contemporary knowledge. And because it can take centuries before the fruits of a new idea are fully harvested, “the inventor of a new world-view... must be able to talk nonsense until the amount of nonsense created by him and his friends is big enough to give sense to all its parts” (1975, 194). If “talking nonsense” involves breaking contemporary rules of valid reasoning (perhaps to be rescued in the future by new rules of valid reasoning), this is what they must do (1978, 117). Perhaps this is why “logical principles not only play a much smaller role in the (argumentative and non-argumentative) moves that advance science, but that the attempt to enforce them would seriously impede science” (1975, 197). Thus, “the barren and illiterate logician” is one “who preaches to [scientists] about the

virtues of clarity, consistency...tightness of argument...and so on,” while the right thing to do is for the scientist to disobey that logician and “imitate his predecessors in his own field who advanced by breaking most of the rules logicians want to lay on him” (1975, 197).

A third criticism begins by asking *which* logic defines the quality of TEs. Different logics exist, and they will sometimes disagree about the logical quality of particular TEs.

Occasionally Norton allows that we might have to wait for a future logic in cases where current logic cannot decide. But this assumes a future where only one “logic myth” reigns.

Feyerabend would urge against any such future, since the domination of a single myth would entail the cessation of progress in logic. In a healthy state of logic there will be more than one myth, and in this case we will not be able to decide which TEs are good or bad in any objective sense, again, because there will be different and competing logics which will disagree about the quality of some TEs.

Lastly, Feyerabend claims that logic is not a top-down practice separate from science. Logic can judge the practice of thought experimenting, but logicians can also use TEs to judge this or that logic. In the final analysis, there is only one practice (1975, 232). This view is now called “anti-exceptionalism” about logic, and for Feyerabend, it tells against any view, like Norton’s, which attempts to outsource the epistemology of scientific reasoning to logic. If we take such outsourcing seriously, then logical reconstruction is how we should evaluate all inferences. But then, to actually evaluate an inference, we need its logical reconstruction, and then a logical reconstruction of the thinking of the logicians who reconstructed it, and then reconstructions of the inferences made by those who reconstructed the logicians’ reasoning, *ad infinitum* (1975, 224).

To avoid this regress, Feyerabend suggests looking at actual scientific (and logical) practice *anthropologically*. “Things change when we use scientific practice or cultural reality and not logic as our informants, in other words, when we engage in sociological research, not in

reconstruction. We then discover that scientific concepts...are ambiguous in the sense that decisive events can affect their appearance, their perceived implications and, with them, the ‘logic’ they obey” (1975, 208). This accords well with those philosophers and cognitive scientists who study TEs by looking inside the classroom and laboratory (for a summary of such work see Hadzigeorgiou 2016; Stuart 2017).

### ***The Philosophy of Stories***

Let’s take Feyerabend’s positive suggestion seriously and investigate the stories told by scientists as an anthropologist would. Feyerabend’s general idea – that open-ended dialogical styles can expose confusions and dogma while other styles (like lectures) create dogma – can be found in thinkers ranging from Plato to Zen Buddhists.<sup>11</sup> But the particular notion that *science* has a narrative component that is necessary and cannot be captured by logical reconstruction, seems to originate with Feyerabend (at least in the “analytic” tradition of philosophy of science).<sup>12</sup>

I cannot identify anyone currently working on narrative in science, whether in philosophy, history, cognitive science, or science education that makes reference to Feyerabend. Yet his ideas should be seen as an important precursor of work that is now flourishing. For example,

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<sup>11</sup> E.g., when stories in Zen “are detached from the actual situation and written down in a text as encounter dialogues, the situationality of the story dissipates and the cases themselves turn into dead language that inspires a chain of interpretations” (Park 2002, 224).

<sup>12</sup> A possible counterexample is Hans Vaihinger, who had claimed that invented fictions were necessary for thought and science (Vaihinger 1911, 134). However, for Vaihinger, fictions are *constructs* (like THE THING IN ITSELF or GOD), not stories. Feyerabend also speaks of fictions as objects, like point masses or incompressible fluids (1963). In any case, such fictions need not figure into a story, as stories may be fictional or non-fictional.

Nancy Nersessian was probably the first to explore the narrative form of TEs in depth (1991a, 1991b, 1992a, 1992b), and she did so using the tools of history, philosophy, and cognitive science. Nersessian insists, just as Feyerabend did, that we must use the methods of cognitive science to understand how the narrative framing of a TE affects its epistemological powers without resorting to logical reconstruction.

For Nersessian, TEs are dynamical mental models that scientists create, run, and draw inferences from. They have a narrative form, which is created separately, and which enables others to perform the same cognitive actions as their creator. The narrative “calls upon the reader/listener to imagine a dynamic scene” (1992b, 295) and gives instructions that govern what will take place in the imagination. “In constructing and conducting the experiment, we use inferencing mechanisms, existing representations, and scientific and general world knowledge to make realistic transformations from one possible physical state to the next” (1992b, 297).<sup>13</sup>

Peter Swirski explicitly follows Nersessian’s lead, using results from cognitive science to argue that we think in stories rather than through formal analysis (2007, 111). Stories are emotionally and rhetorically powerful, and are remembered and understood more easily than formal presentations of information.

One extension of Feyerabend’s insight concerns the variable powers of different *kinds* of stories. For example, Swirski points out that texts employing symmetries like rhyme, meter and alliteration are more powerful than their less catchy cousins (2007, 112). Given that

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<sup>13</sup> Nersessian’s suggestion here is comparable to one made also by Kendal Walton, which has since been used by others to focus on how a story’s text constrains what can and should be imagined in the TE (Walton 1990; for development see Meynell 2014, 2018; Salis and Frigg 2020).

scientists are now explicitly telling stories to make their findings digestible,<sup>14</sup> an interesting question to ask is: what, if anything, would scientists gain (or lose) by employing these symmetries as well? Could we use the tricks of these trades to create stronger TEs?

I'll close this section with another, perhaps more radical direction that the current literature on narrative in science could take from Feyerabend. This concerns the use of stories to increase the *human* aspect of science. Scientific publications often portray scientific results as produced objectively, as if by science itself. This can be frustrating to students, who can feel that they are being discouraged from imagining (Stuart 2019). The later Feyerabend was deeply invested in “the human need for mystery, reverence, and love” (Martin 2016, 129), believing these to be essential for both science and human happiness. Since explicitly literary styles are a more “human” way to pursue knowledge, perhaps lurking here is a new argument for the intentional inclusion of story-telling in science. Rather than the usual cognitive-epistemic argument for the use of narrative in science, we here receive an ethical/political argument: TEs and stories should be used in science for ethical reasons, to make it more human.

#### **4 Conclusion**

I have tried to show that Feyerabend has much to offer those interested in TEs, and I am confident that more historical research into Feyerabend's later writings could further inform current debates. I close the paper with a number of questions that this historical study has prompted for me.

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<sup>14</sup> E.g., a recent paper written by climate scientists argues that telling stories is more efficient for conveying the concrete implications of a warmer climate to others (see Shepherd et al 2018).

- Suppose TEs can, and occasionally should, function through ignorance, “pigheadedness” (1975, 197), prejudice, lies, and propaganda. Does this imply that we can only identify and account for successful TEs of this kind from a future, backwards-looking standpoint?
- Feyerabend’s claim that we should approach science anthropologically could be taken *even more seriously* in the context of TEs. For example, who gets to produce TEs, and when? How are funding, patronage and social norms (e.g., those maintaining laboratory power hierarchies) involved?
- The modern debate on TEs focuses on how TEs produce new knowledge. But knowledge isn’t the only epistemic desiderata that stories can produce – there is also *understanding*, which is the more natural product of narrative explanations (Morgan and Wise 2017). How would an epistemology of TEs that focused on understanding rather than knowledge (e.g., Elgin 2014; Stuart 2016, 2018; Wiltsche forthcoming) cohere with Feyerabend’s epistemology?
- Feyerabend sees a continuum between science, philosophy and art. “Rationality is either defined in a narrow way that excludes, say, the arts; then it also excludes large sections of the sciences. Or it is defined in a way that lets all of science survive; then it also applies to love-making, comedy and dogfights. There is no way of delimiting ‘science’ by something stronger and more coherent than a list” (1975, 246). If this is true, do stories overturn myths in philosophy and art as well, and are there differences in the ways they achieve this?
- Modern authors who write on TEs typically take Kuhn to be the starting point of the modern debate, since he focused on TEs in scientific revolutions and framed the central epistemic question (Stuart et al 2018, 9). But the modern debate about the epistemology of TEs could have started with Feyerabend instead. Here is the

beginning of a potentially fruitful TE: what kind of debate would we have now, if that had happened?

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