Clarification of the Method for the Historical Sciences

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Abstract

In 1795 James Hutton, in *Theory of the Earth,* laid out two key elements of the scientific method for the Historical Sciences. Firstly, that narratives should result in what we observe in the present, in his words: "Let us now proceed in endeavouring to decide this important question, viz. By what active principle is it, that the present state of things, which we observe in the strata of the earth, a state so very different from that in which those bodies had been formed originally, has been brought about?" (Vol 1, Chap 1, Sec 2) Secondly, that narratives must align with the established regularities of nature, in his words: "no action to be admitted of except those of which we know the principle" (Vol 2, Chap XIV).

Earlier naturalists may have provided similar statements and later philosophers of science may have referred to Hutton, but what I find interesting is that with 230 years of this knowledge being available to us, we are still trying to achieve a clear scientific method for the Historical Sciences. There are numerous modern papers on the philosophy of the historical sciences. The ones I reference in this paper make similar statements to Hutton, but none of them reference him. However, the goal of the modern commentators is more about demonstrating the distinctions between the historical sciences and experimental/applied sciences, rather than providing a user-friendly method for practicing historical scientists. My goal in utilising some specifics

of these papers and incorporating Hutton's insight from 1795 is just to extract a straightforward and practical scientific method for the historical sciences with a feedback loop that enables iterative improvement and increased reliability of the historical sciences. My goal is not philosophical prowess, but rather, as in my career as an Aerospace Engineer, my goal is just to highlight what scholars have already provided for us to 'get it right' as is paramount in engineering.

The Distinctions Between The Historical and Experimental Sciences

(To clarify, the following papers referenced are not talking about the field called History where we have eyewitness records, nor are they talking about past scientific experiments where we have science reports on the outcomes (such reports are very reliable due to the direct scientific observations). Thus, in an attempt to clarify this, throughout this paper you will notice I use terms like "pre-historic events" to distinguish from History and past science experiments/observations.)

We are in this situation because there has been little written on the philosophy of the historical sciences compared to general philosophy of science. Cleland was one of the first to widely promote and engage the discussion of the philosophy of the historical sciences and how they were distinct when she said (2001, 987): "In contrast, historical research involves explaining observable phenomena in terms of unobservable causes that cannot be fully replicated in a laboratory setting." She shortly followed up with an emphasis for more discourse (2002, 475): "A more general understanding of the methodology of historical science and its differences from classical experimental science is badly needed."

Jeffares took up the challenge and wrote his doctoral dissertation on this topic and published a paper (2008, 475), within which he observed: "The tools required to make claims about the past are the same as the tools required to make predictions about the future."

Some comments in the discussions, as often happens, are a little sensational, like Gunn (2007) saying that Cosmology is not science because repeatable experiments cannot be carried out, or Cleland (2011, 566) saying that Jeffares made a mistake in his 2008 paper (which I analyse in detail later). Either way, this type of debate is always healthy.

Direct Observation Limitations

Jeffares (2008, 470) brought helpful clarity when he made the following distinction: "The historical sciences then have two difficulties to overcome. They can't directly confirm their hypotheses about the past with observations due to the lack of access to the past. They can't confirm their hypotheses with contemporary observations because they are unique hypotheses about particular times or places. The result is a problem of confirmation. With no ability to observe their objects of enquiry, to repeat observations, or to intervene in processes, there is seemingly no way directly to confirm hypotheses. What I want to show in this paper is that… the historical sciences do utilise regularities… in overcoming these problems… the historical sciences seek regularities in the world, and have to do so in order to secure their claims about the past."

In a nutshell, the historical sciences use present artifacts and the established regularities of nature to infer past events. Michael Turner (2009) described Cosmology as a "historical reconstructive science" and then Cleland (2011, 552) also pointed out that the historical sciences are different to experimental science because they target long-past, token events, upon which controlled experiments cannot be conducted. Forber and Griffith (2011, 2) highlight a limitation that we are not able to "reproduce or observe repetitions of most historical events… unlike testing of regularities." And Currie (2017, 929) shared his agreement with this when he said: "bygone eras are often beyond the reach of repeatable experiments." Therefore, we need clarification on what scientific method should be used to increase reliability in the historical sciences.

Experimental Limitations

Experimental science makes predictions that can be tested by future observations of the natural world or in controlled lab experiments. Since we cannot go back in time to observe pre-historic events occur it would be nice if we could repeat the events in an experiment. However, as Jeffares (2008, 470) points out: "The historical sciences lack the ability to intervene in events in the same way as the experimental sciences for a further reason—that of scale. Repeating processes that take hundreds of years, or duplicating [large] processes like uplift of tectonic plates, is simply undoable." Currie (2018, 229) agrees saying: "Historical targets tend to be at large spatial and temporal scales – not easily admitting of experimental treatments."

To illustrate, think of the series of pre-historic events that led to the formation of the first star. Those events are unique events, because once the first star exists the following stars will never be the first one. And if following stars are near the first, then it influences them, presenting another set of unique events. This is also different to what we observe today with trillions of stars affecting each other. Star formation is one of many events with the problem of large spatial scale. Other pre-historic events have large temporal scale, for example biological evolution, as Popper (1978, 32) said: "natural selection, is difficult to test... really severe tests of the theory of natural selection are hard to come by, much more so than tests of otherwise comparable theories in physics or chemistry."

The other problem with setting up lab experiments is that it is no longer purely natural, as Skell (2005) notes: "Darwinian evolution, whatever its other virtues, does not provide a fruitful heuristic in experimental biology." Similarly, Mayr (2009) points out that: "Evolutionary biology, in contrast with physics and chemistry, is a historical science—the evolutionist attempts to explain events and processes that have already taken place. Laws and experiments are inappropriate techniques for the explication of such events and processes." Some proposed pre-historic events can be replicated in analogous experiments because the proposed event is of a small physical scale, and covers a short time scale, like the chemical processes involved in fossilisation and the processes in abiogenesis. Some other examples are the bacteria long-term evolution experiment (LTEE) and fruit fly experiments. These small-scale experimental results are then used to infer the large scale pre-historic events. This is what Darwin did in *On the Origin of Species* and what Hawking did in *The Large Scale Structure of Space-Time.* However, this method is still distinct from the experimental sciences because the final proposed narrative still cannot be tested in an experiment.

It is clear then that, often, proposed unique pre-historic events in and of themselves cannot be observed and cannot be tested and verified with experiments. This explains why Cleland and Jeffares propose an alternative scientific method for the historical sciences to verify or falsify proposed pre-historic narratives.

Limits on Proposing New Regularities of Nature

The scientific revolutionaries showed us that observation and experimentation are key to discovering and establishing the regularities of nature. Therefore, since we do not have direct observations of the deep past and cannot directly experiment on the deep past, then we cannot use the deep past to discover new 'laws'/regularities of nature. This is why James Hutton (1795, Vol 2, Chap XIV) said: "no action to be admitted of except those of which we know the principle."

Jeffares (2008, 470) explains: "The historical project is to come to conclusions about general processes; the regularities of the experimental sciences. This is both a means, necessary to secure claims about the past, and an end in itself… The historical sciences use background theories—theories about regularities—to secure the relationship between a hypothesis and a past cause… the historical sciences seek regularities in the world, and have to do so in order to secure their claims about the past."

Cleland (2011, 566) responds to this by calling it a mistake, but I propose that this label was not meant to be as clear cut as it seems. For example, she agrees with Jeffares in her own previous analysis (2002, 481): "But Wegener's hypothesis had a major defect. There was no known causal mechanism for horizontal continental motion." In other words, if a historical narrative is not based on a known mechanism/regularity of nature then it is defective. I propose that Cleland did not mean that Jeffares' entire proposal was a mistake, but rather just an emphasis of it, because Cleland also admits that (2011,

566) “[established regularities of nature] are not the targets of historical research but rather useful tools…” and then she says the tools are required (2011, 567): “The basic idea behind narrative explanation is to construct a story—a coherent, intuitively continuous, causal sequence of events centering on a precipitating event and culminating in the phenomena (traces) in need of explanation.”

If one wishes their historical narrative to be described as coherent and intuitively continuous, then a key feature will be that the narrative aligns with the known/established regularities of nature, otherwise the narrative could be called fanciful of defective. I therefore suggest that the description of Jeffares work as a mistake was just regarding emphasis. What we see here is that there are in fact two key aspects of the method and both need equal emphasis. One aspect is showing how the narrative explains the trace phenomena/artifacts, while the other is showing how the narrative aligns with the established regularities of nature.

Grim et al (2013, 2369) succinctly show emphasis on both: “In cases in which simulation is used for retrodiction, it is the input conditions that are read for new information. If the output conditions correspond to the current state of the world, and if the simulation’s mechanism plausibly corresponds to ways in which we know the world to work, the input conditions indicate a possible previous state of the world.” They clearly show how both aspects work alongside each other to achieve a reliable historical narrative. Thus researchers should describe/infer the past by using the established regularities of nature to show how initial conditions cause a series of events that result in the formation of the present world around us, including artifacts like fossils.

Brustein and Kupferman (2012) also describe a science strategy for unique pre-historic events (like the origin of the universe) and they propose using modern computer simulation technology. We now have powerful computers that can simulate the change over time of the universe in Cosmology and Nelson (2016, 1695) points out, "Mathematical models are widely used in modern evolutionary biology."

From the above assessment of what has been written about the laws/regularities of nature, it can be seen that the historical sciences only use established regularities of nature to construct narratives (like a type of applied science) and thus the historical sciences do not propose new regularities of nature. In contrast, the experimental sciences use test outcomes to reveal new, not yet noticed, regularities of nature.

Verifying Hypotheses About Pre-Historic Events: A Methodology

While discussing distinctions, potential for a scientific method for the historical sciences becomes apparent. Firstly, though, it is important to note that even though historical science is distinct, it must continue to uphold the pre-eminence of the experimental sciences. Because historical science is a type of applied science it is completely dependent on experimental science defining what established regularities of nature are available for application (just like in engineering, medicine etc…). In other words, historical science cannot go off on its own tangent. It is completely subject to and limited by what is established by the experimental sciences via the traditional scientific method of hypothesis-experiment-results-revision. This recognition of the authority of the established regularities of nature over historical science cannot be emphasised enough.

It is well established that a key characteristic of science is that it concerns the regularities of nature. These regularities, once we have established reliable descriptions of them, enable us to use them to reliably predict the future in the context of applied science in fields like engineering, medicine etc... Leading up to this reliability have been centuries of experimentation. Generally, a proposed description of a regularity of nature made by the scientific revolutionaries came with a proposed prediction of the future outcome of a particular experiment or observation. The accuracy of the prediction was then assessed by comparing the actual outcome to the prediction and then the description/theory was adjusted/rewritten accordingly. This feedback loop process (Summers (1998), Justus (2005), Blachowicz (2009), Elliott (2012)) enabled descriptions to arrive at the level of extreme reliability we enjoy today. These are what are often called the established regularities of nature. It is the utilisation of a feedback process that increases the reliability of science, and this leads to Kuhn's (1996, 65) "precision of the observation-theory match."

Some theories, of course, are still in the experimental phase and these theories are not yet applied in engineering, medicine etc. They are not yet 'established' and pose too high a risk of causing harm to people. This is generally why applied science must only use established regularities of nature so that the predictions/applications are reliable and reduce the risk of causing harm to people.

The key then is that reliable descriptions of the regularities of nature are established by utilizing the feedback loop process of the traditional scientific method and iteratively moving towards reliability. Any proposed scientific method for the historical sciences must then also exhibit this feedback loop feature. Narratives about pre-historic events must *only* include mechanisms that align with the established regularities of nature. Hutton (1795, Vol 2, Chap XIV) said it this way: "no action to be admitted of except those of which we know the principle." In other words, we cannot just make up any old cause for events. Jeffares (2008, 470) clarified it with: "The historical sciences use regularities [of nature] - to secure the relationship between a hypothesis and a past cause." A secure relation is exactly Cleland's (2011, 567) "coherent, intuitively continuous, causal sequence of events". To clarify further we see the meaning in Cleland's (2002, 481) analysis of Wegener: "But Wegener's hypothesis had a major defect. There was no known causal mechanism for horizontal continental motion." So it is clear these authors agree that narratives proposing pre-historic events must align with the established regularities of nature, otherwise it is defective.

This foundational methodology is perfect for utilization as a feedback system because a theoretical analysis of a narrative can reveal any violations of the established regularities of nature. This feedback can then be used to revise the narrative, which can be theoretically analysed against the established regularities of nature again giving us feedback. This means this method satisfies the requirement for a feedback loop and will enable iterations to increase reliability of narratives about pre-historic events.

The second aspect of the method is also included in James Hutton's (1795, Vol 1, Chap 1, Sec 2) work where he pointed out, that: "the present state of things, which we observe" is what the 'predictions' of the model/narrative must align with and explain. Jeffares (2008, 472) describes it this way: "Foreground theories make quite explicit claims; they effectively make predictions about what we should see in the record of the past." And Cleland agreed (2011, 567) that narratives should "culminate in the phenomena (traces) in need of explanation." This second part of the method can also be utilized as a feedback loop because if these 'predictions' do not align with what we observe around us, then the narrative can be revised until it does align. This loop again enables iterations to increase reliability.

Therefore, both aspects of the method can be utilised as a feedback loop, similar to experimental science. Currie (2018) referred to it as "virtual experiments". Evans and Thébault (2020, 9) offer a similar analysis in the context of inaccessible phenomena (similar in the sense that unique pre-historic events are also inaccessible phenomena): "In principle, it is thus perfectly possible for theories regarding inaccessible phenomena to be taken to be well supported or established based upon a suitably externally validated experiment and (where necessary) inductive triangulation strategy."

So, in the context of narratives that propose pre-historic events the externally validated 'experiment' is the mathematical model/simulation and it can be revised in at least two feedback loops. One looking at alignment with the regularities of nature and the other looking at alignment with the world we see around us.

Reliability and Risk

Karl Popper (1959, 316) famously said: "In so far as a scientific statement speaks about reality, it must be falsifiable." This has been debated by philosophers of science ever since, but the key is attempting to progress towards reliability. The historical sciences have that goal too. So, if a narrative about pre-historic chains of events is theoretically found to have events that do not align with the established regularities of nature, then the narrative can be said to be 'falsified'. With this feedback, the narrative is adjusted and re-analysed. In this way the feedback helps scientists to move towards more reliable theories.

Experiments are usually conducted with the intent to increase the accuracy and reliability of our descriptions of the regularities of nature. A key reason for this is that the established regularities of nature are used to improve the quality of human life and activity, in fields like engineering and medicine, so they must be reliable enough to be safely applied without causing harm.

Generally, societies have universal societal laws that require us to do no harm, so it is also the expectation that applied science also avoids causing harm to the highest standard possible. A scientific prediction about the future for example in engineering, medicine etc…, if it is wrong, can cause harm to people. How does science avoid causing harm? Applied predictive science uses only the established regularities of nature and designs are tested extensively before being used by the public. Similarly, experiments on unestablished theories are conducted under strict safety protocols.

With the concept of safety risk in mind, we can now review the risk environment of narratives that propose pre-historic events. The narratives do not make predictions about the future and as such they are not used in engineering and medicine; therefore, they do not carry any risk for humans in the future. Interestingly this means that narratives proposing pre-historic events can be completely wrong and still will not pose any risk to humans. Note this is subtly different to inductive risk, Douglas (2000). In fact, regarding inductive risk, narratives that propose unique pre-historic events carry the highest inductive risk of all sciences because we cannot observe the deep past or experiment on it. For example, Odenwald (2022, 23) recently published a summary of the state of play regarding the origins of the universe and concluded: "Of course, this entire story is highly speculative, even fanciful. It is based on theories or pieces of theories that remain largely unproven - or perhaps, one shudders to think, even unprovable." Odenwald openly admits the extremely high level of inductive risk by using the words "speculative", "fanciful" and "unprovable".

Thankfully we humans are very clever at contextualising and quickly judge that if a narrative about pre-historic events is speculative, it still does not endanger us. And so, like we do in all areas of human life, if there are no severe consequences or safety risk, we do not impose special safety protocols. So, the situation is that narratives that propose pre-historic events can be completely wrong without consequence. Awareness of this situation will help motivate researchers to employ the special scientific method for the historical sciences.

The Best Explanation

After all the feedback loop iterations are complete or approach an asymptote then of course there is no reason to not move on to utilize Cleland's (2011) common cause explanation and comparison of competing theories to find that elusive 'best explanation'. The founders of modern Philosophy have paved the way for science to flourish by asking that we begin investigations by doubting everything, as René Descartes (1644, 3) said: "That whoever is searching after truth must, once in his life, doubt all things; insofar as this is possible." It is from such a position of doubt that investigation can take place with perfect scientific freedom. Betini, Avgar and Fryxell (2016, 4) remind us of a barrier to perfect scientific freedom that Platt, Chamberlin and Bacon wrote about in their time: "Chamberlin was concerned with the tendency of some scientists to put more weight on evidence that supports favoured ideas more than other evidence that is available, which is today known as confirmation bias."

Experimental science is very robust in resisting bias and dogma because we can weed out erroneous preconceived ideas by conducting experiments and tests. However, narratives about unique pre-historic events are not so robust. We cannot conduct experiments and the inductive triangulation strategies (presented above) carry high inductive risk and are subjective to expert analysis. There is a myriad of experts who conduct the analysis, each one slightly different to the other, each with strengths and weaknesses. To make historical science robust, we should debate and compare competing theories as Betini, Avgar and Fryxell (2016, 7) say: "The use of multiple working hypotheses to gain strong inference is widely promoted as a means to enhance the effectiveness of scientific investigation… Debate among researchers with different points of view is crucial for the development of any scientific field."

This process can then reveal the best narrative, Cleland's (2011) "smoking gun". Therefore, scientists with different expertise and perspectives should collaborate across the vast array of all the different fields of science and have input into the narratives. We need to ensure that all theories have an opportunity to be analysed and compared to determine which theory is the best, to see if any violate a regularity of nature and to see which one explains more of what we observe. Comparing competing theories also contributes towards inductive triangulation (Evans and Thébault (2020), Wylie (2020), Chapman and Wylie (2016)) which will help the historical sciences move towards reliability.

Conclusion

The historical sciences are distinct because we cannot go back in time and observe the proposed events and generally, we cannot replicate the events in the present. Furthermore, I have clarified that the historical sciences, in their purist form, do not make predictions about the future and this has two key outcomes; one, the historical sciences do not discover new regularities of nature and two, narratives about the past can be completely wrong and still do not pose any future safety risk to humans. Because of these distinctions the historical sciences must have their own scientific method to enable narratives to be reliable. Extraction of key elements in philosophy of the historical sciences reveals a user-friendly method that has two necessary elements that allow the historical sciences to be reliable. One; researchers writing narratives about pre-historic events must show that the narratives only use and are theoretically consistent with the established regularities of nature and two; researchers must theoretically show that their narrative 'predicts' the world we see around us. This twofold method enables a feedback loop process, like we already have in the experimental/predictive sciences, which allows historical scientists to iteratively improve their narratives and increase reliability of the historical sciences. With this clarification in hand we can now proceed with Ron Gray's (2025) call: "Equipping students with the tools of historical reasoning is not only an educational priority, it is a democratic imperative."

A note on nomenclature

It is possible that referring to the historical sciences as Retrodictive Science might be a clearer way moving forward. Jeffares (2008, 470) says: “The historical sciences seem to make retro-dictions— claims about the past.” The Oxford Dictionary of Philosophy (2024) defines Retrodiction as: “The hypothesis that some event happened in the past, as opposed to the prediction that an event will happen in the future.” And Merriam-Webster (2024) define Retrodiction as: using present data to infer past events.

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