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Claiming the Scientific High Ground: New Frontiers and Ancient Wisdoms in the Age of COVID-19

"Follow the Science" and variations thereof have been oft-heard phrases uttered by politicians and members of the media, accompanied by featured colleagues of the research community in the context of attempts at dealing with the current global pandemic and its impact on all aspects of our lives. We, the Editors of Global Spine Journal, have from our inception onward pushed hard to improve not just our scientific insights through careful selection and quality reviews of research articles but also attempted to provide greater foundational scientific knowledge to our readership by being one of the first journals in our field to provide regular systematic reviews, metanalyses, and also consistently featured in-depth educational articles on basic research methodology. In this context, we felt it apropos to briefly reflect on what the foundations of the so-called "Scientific method" and its applications in the quest for truth in the "Study of Life" actually are, especially as seen in context with the currently propagated "Follow the Science" mantra. Further, it might interest our readership to consider the relationships of scientific methodology relative to the application of real-world experiential methods, including heuristics and empirical decision making.

The Greek Philosopher *Aristotle* (384–322 BC) is commonly credited with having provided the first clear definition of scientific methodology for the "study of life" in his text "Posterior Analytics," featured within a larger compendium titled "Organon."[1] These are four remarkable succinctly-stated principles as outlined in "Posterior Analytics":

1. Is a relationship of an entity (or attribute) to *something* a true fact;
2. What is the reason of this connection;
3. Is the *something* actually real—and:
4. What is the nature and meaning of the *something*?

(literally translatable as (1) that a thing is, (2) why it is, (3) if it is, and (4) what it is.[2]

To be more complete, there are many diverse profound ancient insights regarding the principles of scientific study, formulated in a variety of Indian, Chinese, Arab, Babylonian, and Egyptian texts, as well as earlier Greek sources that separate the formal study of nature from the mythical realm. It is Aristotle's description, however, that seems to have provided the general four-step foundation of the modern era "Scientific Method." Seen in this light, it seems that it was *Robert Grosseteste* (1168–1253 AD) who as faculty of the medieval Oxford University—prior to serving as Bishop of Lincoln—translated and commented on Aristotle's texts including the "Posterior Analytics" among other works in the early 1220s and thus introduced these thoughts to the Medieval European world.[3]

His disciple, the philosopher, scholar, and Franciscan monk *Roger Bacon* (1214–1292 AD) was apparently frustrated with his inability to replicate some of Artistotle's assumptions and identified four main causes of expert's error in his *Opus Majus Part 1*:

1. Reliance on false authority;
2. Reliance on popular opinion;
3. Reliance on personal bias or vanity;
4. Reliance on rational argument.

On the eponymous academic website, he is quoted as saying: "Neither the voice of authority nor the weight of reason and argument are as significant as experiments from which comes peace to the mind."[4] On a more expansive note, Roger Bacon is said to have been inspired by the experimental approach of the Arab physicist *Ibn-al-Haytham (Alhazen)* who published pivotal works on optics in 1021, a field which fascinated Bacon as well. In his works, Roger Bacon is also credited with the insight that there are two methods of knowledge—*one gained by argument (or decree), the other by experience*. His most well-known contribution is the four-step cyclical approach to science:

Observation ("Ask a Question")
Hypothesis ("Form a Hypothesis")
Experimentation ("Test this Hypothesis")
Independent verification ("Report results")

Not surprisingly, this author was banned from publishing his works for large parts of his academic life, even incarcerated and spent too much precious time looking for elusive funding for his scientific work (sound familiar?).[5] The Oxfordian faculty Roger Bacon should not be confused with his

nonrelated namesake *Francis Bacon* (1561–1626 AD), the latter serving as Professor at Cambridge. Professor Francis Bacon undoubtedly deserves timeless credit for creating philosophical refinements to the concept of collaborative scientific effort and discovery by countering the prevailing Aristotelian mindset. A particularly priceless quote deserves special recognition: "If a man begins with certainties, he shall end in doubt; but if he will be content to begin with doubts, he shall end in certainties" Francis Bacon (1605).[6]

Of many other important scholars, philosophers and thinkers who have furthered the theoretical and practical advancement of *Science* over the ages, the recognition of the important role of *skepticism*, with its crucial role of providing counterbalance to dogma of all forms, merit special recognition. This philosophy is credited to the Greek philosopher *Sextus Empiricus* (ca 160–210 AD) as published in "Outlines of Pyrrhonism" by Henricus Stephanus, Switzerland 1562.[7] Without oversimplifying too much, this far-ranging philosophical school asks a reader to suspend judgment and to question among other aspects the integrity and bias of those who are in a position of power to "judge the truth." To the present date implications of these thoughts permeate our academic approach to scientific works—for instance, by insisting on declaring evident or potential conflicts of interests a priori, to encourage robust peer review for every scientific *submission*, allowing for alternative thoughts to be heard and properly discussed, as well as to withhold judgment in absence of perceived "real scientific truth."[8]

This crash romp through the history of the scientific method would not be replete without a brief discourse on the "science of decision making" and its relation to various forms of heuristics. Many interesting insights have been gained in the more recent decades in human psychology on how human decision-making has evolved over time in various forms of implementations, ranging from trial-and-error approaches to attempts at rational decision making. In the confined context of this editorial more elaborate discussions of this subject matter are not possible, but as we approach the age of increasingly deferring decision making to algorithmic logic, it behooves us to become more cognizant of how and why we as human beings, especially as academically minded surgeons, arrive at decisions. The excellent books by the Nobel Prize winner and psychologist *Daniel Kahneman* are recommendable further readings on this important matter.[9] In the context of our focus on the origins of the "Scientific Method," another somewhat controversial English Franciscan friar named *William of Ockham* (ca 1287–1387) deserves recognition. This intrepid thinker apparently was engaged in serious academic battles and endured prosecution and financial hardships, but despite all this published an extensive highly regarded philosophical body of works. From a scientific perspective, he re-introduced the ancient Greek concept of using abductive heuristics (i.e., "what quacks like a duck, looks and swims like a duck probably is a duck") to the ongoing studies of life. He suggested that in a scenario with competing hypotheses, the most meaningful approach might be to simplify one's efforts by resorting to the hypothesis that relied on the fewest and simplest assumptions rather than ones that are compiled of multiple and complex alternatives. This concept of simplicity in a methodological approach has survived to the modern day in many variations (remember "K.I.S.S."?) but it is of course—and here the School of Skepticism again comes into play—not infallible. As a basic scientific principle, at least considering a simple causative option, in keeping with the principles of "Occam's razor," should always remain a viable option.[10]

As we are witnessing continued unraveling of the COVID-19 pandemic and its aftermath, all of us as academic physicians are tasked to provide help and input in many ways that we can and not just abdicate medical care discussions to virologists and epidemiologists. We can help those around us by providing a voice of clinical reason on behalf of our patients but further present our voices, aimed at maintaining academic honesty as we see "Science" having become an everyday click-bait item and media personalities suddenly having ascended to overnight experts in complex and serious scientific transactions. The foundations and controversies surrounding the "studies of life" draw from an arduous and well-rounded academically based education and enable us as clinician scientists to help serve as methodological content and ethics experts beyond pure virological contagion matters. As we reflected on some of the time-honored founders of scientific methodology in the preceding text, one cannot help but acknowledge that "Science" has endured controversy throughout its existence and is an ongoing dialectic endeavor without real endpoint. For those outside of our academic community, an improved reality check on the limits of science might be helpful. For starters, many of our scientific results are not really that clear (as any review of any of our articles in this excellent edition of our journal will repeatedly underscore). In fact, they are subject to iterative discussion and usually conclude with the most overused words in published research: "More research is needed…...". And where an abundance of clarity in research or published expert panels is touted loudly we might be well served to approach such presentations with extra care and some added scrutiny.[11] In reality, scientific clarity frequently arises only over time and after much back and forth robust debating. Paraphrasing Roger Bacon from the 13th century, it does seem to take different input channels and a healthy dose of the tincture of time to separate signal from chaff to achieve deeper lasting insights. With emerging larger data gathering and analytics capacities, well-performed metanalyses derived from meaningful and transparent data-sharing platforms can play an increasingly important role—but as we have seen during the earlier days of COVID-19, they may lead to abuse as well if data sharing and information exchange is hampered.[12] Despite the power of prospective trials in the pharmaceutical sector, empirically derived methods drawn from well-preserved past recorded histories can be helpful, especially if time is of essence—and if applied with some caution. Finally—the hard reality is that there is really *no* "ONE all-encompassing Scientific Method." While the basic ancient

scientific tenants surely are time-honored and meaningful, the present-day reality is so complex that every field of natural science and every geography, culture, and time period demands and creates its own realities with suitably adapted methodologies. In our increasingly digital era, the abuse potential of media and politicians, when intersecting with willing members of the scientific community, has become a frightening new reality, one actually foreseen by our ancient and medieval thinkers in many of their published wisdoms. And it has surprisingly broadened the publication landscape, when lifestyle magazines suddenly publish more serious academic reflections than certain high-end medicine journals.[13]

Sticking to the ancient and medieval scientific wisdoms with their foundational insights, keeping the school of skepticism alive and Occam's razor sharp (where appropriate) was never more relevant than now.

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References

1. Stanford Encyclopedia of Philosophy. 2021. https://www.plato.stanford.edu/entries/Aristotle-biology. Accessed July 7, 2021.
2. Watson J. Aristotle's posterior analytics: I. Demonstration. *Philosophical Rev.* 1904;13:1-15.
3. Zalta EN, ed. *Stanford encyclopedia of philosophy*. Stanford, CA: Stanford University, 2021.
4. The Roger Bacon Academy. 2021. http://www.rogerbaconacademy.net. Accessed July 7, 2021.
5. Clegg B. *The first scientist. A life of roger bacon*. 1st ed. Lebanon, IN: Da Capo Press; 2003.
6. Bacon F *Selected philosophical work. Edited with introduction by Rose-Mary Sargent*. 1st ed. Indianapolis, IN: Hackett Publishing Company; 1999.
7. Sextus Empiricus. 2021. https://en.m.wikipedia.org/wiki/Sextus_empiricus. Accessed July 7, 2021.
8. Popkin R. *The history of scepticism from erasmus to savonarola*. Berkely, CA: University of California Press; 1979.
9. Kahnemen D, Olivier S, Cass S. *Noise. A flaw in human judgment*. New York, NY: Little, Brown Spark; 2021.
10. Keel R. *Occam explained. Open court 1st edition 2019*. Chicago, IL: Carus Publishing Compnay 2010; 2019.
11. The Scientist. 2021. https://www.the-scientist.com/infographics/timeline-when-bad-research-changes-public-health-strategy-67971.
12. Bauer HH. *Scientific literacy and the myth of the Scientific Method*. Champaign, IL: University of Illinois Press; 1994.
13. Eban K. The lab-leak theory: inside the fight to uncover COVID-19's origins. 2021. https://www.vanityfair.com/news/2021/06/the-lab;leak-theory-inside-the fight-to uncover-covid19s-origins. Accessed June 3, 2021.