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Gnothi seauton (Know Thyself) an Essay on the Philosophy of Scientific Research for Science Students

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Abstract: In this essay philosophical bases for knowing why am I scientist are observed as having an unavoidable ethical connotation which aid in sizeing the romantic definitions of science and scientific method. The aphorism *Gnothi seauton* inscribed on the entrance of Apolo's temple at the oracle of Delphi in ancient Greece appealed to the individual's wisdom so that they may try to find the answer to the question that worried them. Likewise, currently it is recomended that science students and young scientists alike to ask themselves, What is science? Why practice science? What makes me scientist? Why study to be a scientist? What is scientific research? What is the scientific method? What is philosophy of science? Do I know what scientific ethics are? Of course, the answers to the above question are not easy nor simple and require comitment and conviction. Access to them demands an intelectual reflective process that begins with our scientific carreer and goes on for as long as it lasts. In return, science students will, as it should be, develope an adequate temper to legitimately question current stablishments that rely more on authority and propaganda than in scientifically based wisdom, such as anthropogenic global warming, acidification of the oceans, non-existence of scientific method, etc.

Keywords: Ethics, Philosophy of Science, Philosophical Schools, Scientific Logic, Scientific Method

1. Introduction

The aphorism *Gnothi seauton* (γνῶθι σεαυτόν) " know thyself" inscribed on the entrance of Apolo's temple at the oracle of Delphi in ancient Greece appealed to the individual wisdom of those who seeked to consult the deity, maybe in an intent that they may find the answer to the question that worried them. An aphorism is a saying or sentence that is used a philosophical guide for life or in a significant human activity. Young and established scientists alike may recall from the movie *Matrix,* when the chosen one arrives to consult "the oracle" (a heavy smoking computer program) and she shows him the inscription *Temet nosce* which is latin for know thyself also. In either case, a modern existencialist doctrine or school of thought is perceived. This in the sense of Sartre, who recognised the process for the development of all people from an individual being born up to becoming a person. Analogically, we can view ourselves as being born as cubs, either male or female, that have to be molded to actually become men or women. Thus, education in the Socratic sense has to start at home, to rescue the better human part of an individual, then, with school comes instruction and training (intelectual). All this provides us with the preparation to perform adequately in life, within society or not, resorting to our answers to questions such as who am I? what am I? and to other existencialist issues.

Likewise, it should be recomended that science students and young scientists alike to ask themselves, What is science? Why practice science? What makes me scientist? Why study to be a scientist? [13] What is scientific research? What is the scientific method? What is philosophy of science? Do I know what scientific ethics are? Thus, in order to find answers for the above questions it is also necessary to make introspective analysis in our formation as scientists and to recognise the philosophical basis that support it. With that, the answer to the question, what is philosophy of science will be concomitantly found. Of course, the answers to these question are not easy nor simple and require application and conviction. All this demands an intelectual reflective process that begins with our scientific carreer and goes on for as long as it lasts.

Study programs within any scientific carreer should contemplate courses on said philosophical topics, which they rarely do, and then more rarely even an experienced scientist with philosophical formation is not available to teach it. Consequently, said subject is asigned in the best of cases to teachers that do not practice research, so, as Bunge [2] stated "Philosophy of science that is not thaught by scientists to science students has a lot of farce". Eventually, the problem worsens, for example, following the "popperian fashion" many biologist declared themselves rationalist and supporters of falsifiability but would eventually proceed in an anarchist way [9]. Not withstanding, Popper's [12] empirical falsifiability, although confusing inasmuch it refers to plausibility of a theory, does serve a purpose when trying to construct null hypothesis [15]; needless to say that Popper did not practice science. In a more extreme case, certain colleagues praise Feyerabend who in his "Against Method" professes the inexistance of a Scientific Method and an anarchic approach to scientific praxis [7], which he never practiced.

2. Practical Consequences of Ignoring What Philosophy of Science Is

A common problem closely related to the lack of formation in philosophy of science in graduate students, which can be extended to their mentors, is their underestimation and rejection for constructing hypothesis. Seeking congruence with the concept of Scientific Method, caveats have been made in several forums on the relevance of using hypothesis in all scientific research [5, 8, 15-17]. In all occasions, the ongoing argument is that the hypothesis is an element within scientific method that is seldom given the deserved attention when training scientists, who should understand that even non-logical perceptions such as serendipitious observations may be rescued scientifically through the adequate construction of hypothesis [18]. Most of the time, however, to avoid this inferential process, various pseudoarguments are wielded, rejecting along the implicit and explicit scientific rigor of its logical structure [16]. This deficiency in science student formation is a common problem not only in developing countries but it has been denounced also in more advanced ones [4, 8, 10], all implicated in this complex problematic generated by lack of preparation in philosophy of science which extends towards the loss of confidence in the scientific community [19].

It is also unfortunate that, although philosophy of science makes due reference to the field on which scientist actually perform, most researchers bypass it and develop a negative opinion of it. Whereas an elemental ethical position obliges us to be well informed in order to launch a funded opinion. Instead of taking unethical positions such as "I don't know what it is but it is a lost of time". Whilst a rationalist perspective shows us that by knowing us better, *i.e.*, identifying what makes us scientists will allow us to perform better in our work and cast a more realistic and reliable image of what we represent. Philosophy of science grants us arguments to guide ourselves by eclectic philosophy instead of a syncretic one, which is often the case.

3. What Scientific Method Is

In spite of the unquestionable technical training most researches have, their meager philosophical training precludes from taking adequate sides in controversial and transcendent issues such as the one about The Scientific Method. Whilst, otherwise, by resorting to philosophical basis, acts of speach such as "There is no scientific Method", or "There are many scientific methods" [11] can be recognised as unfunded and pose no worry to science students. In turn, however, a reflective understanding of what scientific method stands for (which is not synonymous with methodology) is required.

Thus, an epistemological approach and especifically according to Rationalism, to abide by Scientific Method in doing research, is: to do it with active, intelectual comitment for generating (new) knowledge (pourpose), by finding original questions that are to be concisely and eloquently posed (aim or objective), deriving them through the critical and skeptical analysis of theory (which should be *a priori* mastered), and seeking the answers (currently unavailable), while concomitantly testing hypothesis or forecasted answers derived through (abductive) reasoning [15, 17] using *ex professo* selected techniques, methods, and strategies, while assuming a heuristic, logical and systematic attitude (Methodology), and complementing with observations from the generated data on the phenomenon of interest (empirical basis) as evidence for achieving an objective assessment of the hypothesis (to prove/disprove it); then contrasting said result with the beginning theory in order to refute, back, or enrich it (Discussion and Conclusions). For this exercise a semiological perspective, basically semantics, is required for properly adopting the previous definition, as suggested by the words in parentheses, with the intention of constructing a concept around it.

4. What Science Is

In the case of a concept of Science, efforts have been made to show it in a didactical manner as Chalmers [5] tries to do it in a similar way that I intend it in my graduate lectures. Although I disagree when he synonymyzes observation with seeing, inasmuch observation is a different thing, i.e. rather remark or note either visible, audible, or to the touch. Thus, a blind person is capable of observing.

On the other hand, popular definitions of Science have emerged under various philosophical doctrines, e.gr., Romanticism, by philosophers [6] "Science is the objective and rational explanation of the universe...it describes the various forms in which existing processes manifest, distiguishes successional phases and...unravels its internal bonds and conections with other processes; it discovers interactions and determines conditions for the eahc process to occur… albeit with a dash of utilitarianism…it finds the means and possibilities for human intervention"

Humanism, by philosophers of science [3] "Science is a style of thinking and doing, the most recent, universal and rewarding, …in which work is called research and result is knowledge"

Realism, by Romantic scientists [14]: "Science is much more a way of thinking than a body of knowledge. Its aim is to discover how the world works, to detect irregularities, perceive links between things: elemental particles, live organisms, human communities, the cosmos"

Following either one of said definitions should rely on a minimum philosophical basis, so that they can be adequately interpreted into a functional reference. Whereas, in congruence with the above definition of Scientific Method, the following definition of Science is in hand, also as an intent to support a concept rather then just a definition: Science is …The applied collective intellectual activity for the understanding of nature, that develops through disciplinary fields of knowledge, driven by the dynamic, heuristic, and autotrophic nature of inquisitive thought, defining a form of action (research) and procedure known as Scientific Method, intended for the generation of knowledge in the form of theoretical models that represent nature.

5. Philosophies, Attitudes, and Scientific Talent

Various colleagues have expressed their acceptance for philosophical topics in science, but excuse themselves for their lack of knowledge on the subject. How real is this aledged limitation? Their accomplishments actually show philosophical basis besides their fine technical training, but they are not aware of the semantic referentials (terminology, schools of thought or doctrines, logic techniques and other philosophical resources) that would allow them to expressly recognise the philosophy within their scientific praxis. Consequently, under the above premise I appeal to the initially launched aphorism "Know Thyself" in an effort to identify the philosophical components that inclined us towards the scientific calling, and from then on rationalize the philosophy of science (epistemological) components, which should be cultured and refined in order to nurture our scientific thinking to reconstruct our scientific logic (epistemology) that will support our scientific ideas.

Thus, by analyzing our scientific talent (calling) an intelectual complex can be recognized, shaped by innate curiosity, or heuristic spirit focused on the understanding of nature: A systematic skepticism that supplies rigor in gathering evidence that reliably answer our questions or test our hypothesis; an analytical reasoning (logical components) supported on rationalism, coupled with a tendency to frequently use inductive-deductive-abductive inferential components. Where abduction [1, 15-17], invoked when constructing hypothesis is often associated to intuition, a non-logical component. Creativity is also an important non-logical component in this equation, but will only reach scientific relevance while combined with the previous components. However, it is because of it that our scientific contribution may standout from many others.

As a scientific candidate, is it feasible to take reference on the above? Although an exercise poses interest it is something that is proposed as a constant autocritic throughout our scientific carrer. But most important is that existentialist and romantic problems are detected which will require answers to Why study to be a scientist? Why do I want to do scientific research? and What is a scientist? The initail detection of our scientific calling inclines us to access an *ad hoc* carreer, where comes the necessary rapport with the scientific paradigm and the study of the theories that give structure to our scientific discipline of our preference, i.e., making it objective (positivism) and thus realist (realism). It is then that we identify ourselves with topics that fascinate us and stimulate both our creativity and performance. This is not a lesser issue, inasmuch it promotes enthusiasm which in turn nourishes creativity and lessens the risk of automating research and turning it into technique, "me too science" or even pseudoscience.

Much of what it is intuited early in our lives about what science is has its origin on positivism whose contribution holds such inertia that often leads to scientificism, a *cuasi* ideology wrapped in exacerbated romantic beliefs of science and the scientist character, frequently associated to pseudo-scientific notions. So, to avoid falling in these type of errors, philosophy of science provides certain forms of thinking such as rationalism, empirism, skepticism, among others that allows to question said beliefs. In this manner science students build up a philosophy of their own by choosing matching philosophical approaches (eclecticism), that shapes their personality, while discarding incompatible forms of thinking that seem convenient a a time (sincretism). Albeit, the latter are more at hand in our surrounding corrupt morality and, due to a lack of philosophical basis, they pose real risk. In this case, philosophy of science promises a much needed catharsis for those who wield scientific talent. As corolary, this would the path to assuming an ethical posture, thus becoming inmoral in an estrict sense, but ensuring a scientific praxis.

6. Conclusion

For science students to answer questions such as, do I know what philosophy of science is, all of the above holds much to think about and represents a promising start to acquire a satisfactory answer. In fact, through analysis, said genral question is fractioned into subordinate questions whose answers will add to the general one, i.e., Do I know what science is? Do I know what scientific research is? Do I know what scientific method stands for? What is scientific ethics and what does it imply? For starters, ethics in science imply seeking the answers to the posed questions.

On the basis of the above science student is sure to recover confidence on all learning. For example, they will be able to identify sophisticated processes that can be dealt with in simpler ways, sometimes even resorting to basic principles as Occam's (Ockham) razor, i.e., *Under equal conditions, the*

simplest explanation is always the most probable. In science, it is interpreted as: *When two theories under equal conditions describe a phenomenom in a different manner, the simplest one has a higher probability of being correct than the more complex one.* This may serve as a suggestion when selecting techniques or a working hypotheses [17], inasmuch the natural simplicity can be easily bypassed [8] attracted by the aesthetic appeal of high technology or multivariate statistics with which we pretend to solve a certain problem, i.e., risking to substitute scientific creativity with the use of complex techniques (sophistication) instead of doing it logically [4, 19].

Also, in return, science students will, as it should be, develope an adequate temper to legitimately question current stablishments that rely more on authority and propaganda than in scientifically based wisdom, such as anthropogenic global warming, acidification of the oceans; or even non-existence of scientific method [11], etc. The first-two clearly related to *instrumentalism* which is more of a political strategy, demagogy, or act of speach taking cover under aledged scientific theories, but that are really abiding to international economic agendas. Philosophical basis will let science students try these issues on for size.

7. Recommendation

As scientists we must follow the path traced by scientific thought instead of the technical-scientificist ideology. It is an ethical issue, especially when with some effort these philosophical, logical, non-logical, and scientific components can be identified as part of an innate scientist personality, and it suits to address them directly to continue their development. Preferably, all during the scientific carrer in order to be kept watchful and productive within an ethical frame. In this way, both science students and young scientists will be able to know themselves (*Gnothi Seauton/Temet nosce*), recognising their limitations as well as their potential, compensating for the former and excempting the latter by resorting to the developed philosophical abilities.

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