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Philosophical Bases of Scientific Ethics in Adherence to Scientific Method

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Abstract: Considerations on scientific ethics for science student are exposed which are required in order to achieve an adequate formation consistent with the intelectual nature of the pursued scientific investiture. This situation is analyzed from the philosophy of science perspective which in this case is strongly supported on the empirical basis of scientific praxis. The philosophical bases for understanding ethics are explained remarking the influence of various philosophical doctrines or schools of thought and underlyning the confusion between moral and ethical perspectives. Consequently, scientific ethics requires handling a proper concept of science, and of scientific method including the debate on its non-existence which lacks basis on philosophy of science. Thus, questions such as: why am I a scientist? what is science? what is scientific method? why do we publish? and, what scientific ethics actually is and how it influences science students? should be considered and coupled with the philosophical doctrines that led us to the praxis of a scientific calling, such as romanticism, existencialism, positivism, rationalism, and empirism, among others. That is, it is an ethical requirement to recognize and consider the philosophical bases of science for the praxis of scientific research. As corolary, it is pertinent to state that ignoring ethics and its philosophical bases may constitute a deficiency in education of science students.

Keywords: Philosophical Doctrines, Philosophy of Science, Praxis, Science Ethics, Scientific Method

1. Introduction

For starters, it has to be understood that Ethics is a highly complex subject that is ussually handled lightly as it occurs also with Logic, not only on a daily basis but also within academic and scientific ambits. Most of the time it is overlooked that these disciplines comprise extensive fields of knowledge and that in order to properly support other fields a minimum of formal knowledge about them is necessary. For example, popular sayings like “being demoralized” would not be so loosely expressed and instead “being discouraged” would be used. Because, even though the former meaning is accepted what it refers to has nothing to do with moral. Thus the first consideration that comes into mind is that, most times when somebody refers to an ethical issue it is most likely that it is not, and it is being confused with moral, regulatory, or legal situations. In the official scene this is exemplified by the so called ethic codes emited by certain institutions, which are actually conduct or regulation protocols, strongly directed towards highlighting the various harassment situations, mainly gender or sexual. These so-called ethical mis-behaviors are beyond the ethical ideals based on philosophical grounds and should be classified as rule-breaking and even criminalistic actions, and thus subject to *ad hoc* retaliation. Needless to say that the above include rules, or regulatory measurements that abide legally and are ment to be enforced, and when broken are frequently settled in courts.

My previous efforts for addressing ethical issues in the scientific venue have been done indirectly as part of the philosophical support suggested for science students during their carreers, mainly through publication of assays [1] and in the *ad hoc* course Philosophy of Scientific Research. In both instances the main approach stems from understanding the philosophy that supports scientific research to address the ethical conception that grants its epistemological basis. On a wider scene, the axiological thesis stablished by Merton [2] offers an idealistic and romantic platform by which researchers seldomly abide, conforming more to financial, economic, and political dispositions. Whilst, ethical mis-

behavior in scientific circles such as plagiarism, different forms of cheating, and other fraudulent mal-praxis generally addressed as ethical issues, surpass the ethical ideals based on philosophical grounds and should also be classified as rule-breaking and criminalistic.

2. Ethics

Ethical precepts are freewill guidelines that derive from education in the socratic sense, i.e., a virtue that is drawn-out from an individual and balances the instictive behavior. This is ussually a process that takes place at home, and later within social circles and hopefully at school. Hence, there is a catch for the latter, philosophical training (that should always be welcome) is required, inasmuch Ethics is a philosophical discipline that has to be formally studied, such as in the case of Logic, whereas in both cases they are in general taken for granted confused with moral and common sense, respectively. Thus, in order to escalate moral guidelines into ethics, these have to be questioned on the basis of experience and deontological and axiological principles which are seldom considered when inculcating moral. Just as with logic techniques that are rarely referred to when demanding rationality, such as analysis, deduction, induction, or syllogisms.

Unlike other animals whose behavior follows instinct, ethical driven conduct in humans is determined by intelectual potential, hability, fitness, and preparation for making decisions. Our deontological background indicates us what should be done on the basis of common wisdom, while axiologically we refer to recognized values which we examine analytically [3]. In this way we are prone but prepared to make judgement calls, and we are able to chose between alternative courses of action, and prepared to anticipate consequences for our own doing. Thus, it is obviously more feasible to conform morally and follow the paradigmatic established guidelines that grant us acceptance in society without questioning, than trying to assimilate a whole new disciplinary philosophical basis to understand the alternative, which by the way, deems us heretic and not always as acceptable members of a given group. Notwithstanding, although significatively more subtle, ethics goes a long way and the precepts that it stands for actually bring us closer to the ideals of science as conceived in the philosophical doctrines that underly it.

As indicated above, here by praxis it is ment correct doing, and in general when dealing with dishonest procedures in science they are refered as unethical behavior or malpraxis. This is frequently observed within academic environments, in spite of the cultural baggage of the actors, where pressure becomes unmanageable with the side applying pressure clouding or ignoring the possible acceptable alternatives. So ethical failure starts here, and then causes a chain reaction that only stops when one of the parts wills it to. In a society where a two faced or hypocritical morality guides peoples lives, it is practically impossible to find anyone that has not committed an ethical fault, which even he/she recognizes given the opportunity.

The above applies also within scientific communities where, besides the disconfort to their conformed criteria, pride and arrogance preclude access to an adequate understanding of ethics because it obliges to procede autocritically. This is where the philosophical background makes it possible to pursue ethics, inasmuch it grants us the intelectual resource to appreciate the meaning of self-criticism on the basis of recognizing our own limitations [4]. Thus, it is not strange that ethics within the scientific community is an overlooked issue, because, if philosophy of science is not properly addressed neither will scientifc ethics be. It is easier, although wrongly assumed that we are automatically gifted with an ethical resource through popular experience and moral references. Ambiguous use of the terms cause confusion that make it difficult to perceive distinctions between ethics and moral, a problem that extends into the academic and scientific communities and eventually precludes ethics from fullfilling its intended purpose, which it shows in unjustified cultural limitations in scientists, including semiological (semantics) misconceptions, as in the case of the term scientific observation [5] and methodology, frequently synonimized erroneusly with scientific method, but mainly in ignoring the philosophical basis of their own scientific calling [4].

So, it has become necessary to write an updated *ex professo* synthesis recalling the previous efforts (several published in spanish) seeking to reach a wider audience, and complementing recent ones in a rethorical intent based on the above explanation on what ethics is and the problems around its conception. And the first thing worth rescueing is that, regardless of how scientific ethics is analyzed it addresses a philosophy of science that should be supported on scientific praxis acquired through experience in scientific research. This in agreement with the statement “The philosophy of science that is not thaught by scientists to science students is much of a farse” [6]. Even though said experience has been gathered in the particular field of marine ecology, it comprises both teaching and scientific research for several decades that, however, refers very little to particular methodological issues, but tackles the wider scientific perspective: philosophy, philosophy of science, scientific method, general methodology, and ethics. In this way, it is expected that this pensive reflection may be found useful by science students and scientist with different fields of interest in research.

In what follows it should become clear why recognizing and understanding the philosophy of science by scientists and science students is unquestionably an ethical issue. It starts with questions such as: why am I a scientist? what is science? what is scientific method? why do we publish? and, what scientific ethics actually is and how it influences science students? It is a matter of knowing convincingly why are we scientists and what makes our research scientific [4] so that we may carry on a conscious praxis or correct action when doing it. This includes being able to come up with definitions of what science is, based on a

formal concept, and consequently to know what it is meant by scientific method, instead of resorting to cliché definitions or taking sides with unfunded positions such as "there is no scientific method" or "there are many scientific methods" [7] which are only superficially and thoughtlessly grasped, having sidesteped the epistemological basis that the concept implies. Instead, colleagues may choose to see in this a convenient uncompromising alternative that, when faced with the need to reasonably explain, resort (cinically) to authoritarian attitudes that underestimate philosophy. Unfortunately this commonly occurs and should be deemed unethical. It thus has to be understood that when we adequately adhere to scientific method we access scientifc philosophy even though we may not be fully aware of it. It is an ethical obligation to find out why and how, because we practice a *modus vivendi* that is intelectual, that etymologically means to understand.

3. Science and Philosophical Doctrines

As with ethics in general, ethical principles by which our scientific endeavour abides are not automatic nor independent but are structured on the basis of various philosophical attitudes and doctrines. Examples of the former may be machiavelism and calvinism, and of the latter, stoicism, cinism, rationalism, pragmatism, and of course positivism that serves as platform to much of scientific thought. As a whole these doctrines guide us through life and grant us the potential for argumenting decision making during scientific research. Thus, it is highly recomended that science students resort to philosophical bases that may guide them towards an understanding of what ethics is and its transcendental meaning.

Analyzing scientific thought will show that many philosophical schools of thinking or philosophies are included and it is useful to identify them. So it is clearly an obligation to know what they are, what they consist of, and how they relate to our scientific activity through teaching, without leaving it to chance that students eventually access these issues. Event though its quite feasible to recognize the many philosophical doctrines that influence our scientific work and should not be bypassed [4], these constitute bases derived from celebrated doctrines such as materialism, empirism, positivism, and even Popper's falsacionism, inasmuch these define rigorous methodological procedures required in any study so it can be deemed scientific. For starters, underlying our scientific calling we find a (misinterpreted) philosophical doctrine in romanticism, a way of thinking that inclines us to understand certain (if not all) phenomena. For example, the laws of nature (Physics) or the study of what life is (Biology), which can only be integrated under a philosophical perspective through doctrines such as reduccionism, emergentism, mecanicism, organicism, and evolutionism, because these force us to resort to especific fields of knowledge within chemistry, physics, biology, paleontology, geology, at the least. Needless to say that, if not, our opinions will be unfounded, and we would be unqualified to make scientific statements under penalty of being unethical, even if falling into a paralogism, (unintentional erroneus deduction or abduction), because the lack of preparation does not ethically justify making wrong statements.

By integrating the basic principles of the above philosophical doctrines into the formation of scientists ensures said preparation having better chances of assimilating correctly other philosophical proposal steming from science in general. In this way science students will develop potentially richer criteria on topics relating to evolutionism, darwinism, lamarckism (and its modern versions), vitalism, reduccionism, or holism that have molded biological thought [8] and permeated into society. As well as others, such as deductivism, inductivism, continuism, discontinuism [9], which should be part of daily thinking in science students, inasmuch these analyze the way in which knowledge is generated and theories are constructed, resorting to both rationalism and empirism. On the other hand, our confidence on scientific knowledge is founded on the grounds of materialism, realism, and positivism, the main doctrines on which our confidence relys when carrying on scientific research.

Consequently, scientists inclined to embrace spiritualism in the form comprised in creationism are flirting with "metaphysical materialism", an oxymoron product of an extreme syncretic conception of reality. And although this is morally accepted it is clearly contradictory. The ethical compromise for science students and scientists is to gather notions on all the above thinking modes since our intelectual challenge requires it to develop an eclectic philosoply of our own that corresponds with reality (positive) and the scientific purpose of generating objective knowledge.

4. Bypassing Scientific Ethics

According to the above, it is an unavoidable requirement of adhering to scientific method in order for an investigation to be deemed scientific, and to warrant the epistemological basis and objectivity expected from science [9]. Consequently, it is an ethical issue to have a concept of what scientific method actually is. In this sense, one of the most frequent controversies implying the formation of science students deals with the hypothesis issue. In general, the use of hypothesis in aledged scientific tudies has been neglected, with a refusal to meet this requirement or forcely comply with it [10, 11]. This in spite of the epistemological structure it grants a study, that is shown in the correspondent report where illation can be recognized between theory, the study problem, aim, and hypothesis [12]. But most of all, it is an structural element of scientific method and can not be bypassed. So, intenting to find excuses or motives to justify its omission shows intelectual slacking which is already an ethical flaw.

An analog to the former case can be found within general methodology implicating the use of statistics. Although most of the time it is complied with the contrasting of hypothesis

and null hypothesis through significance testing, said significance level is seldomly trusted, say 0.05, or 0.1 in Biology [13], whilst instead the default significance output of the running program is embraced. Ethical positions require conviction for understanding how these test work. Furthermore, the aesthetical atraction for complex numerical techniques or multivariate statistics lures science students into using them as problem solvers, frequently awaiting an exploratory type output, instead of considering it as a means of hypothesis testing. This negligence to compromise can be deemed unethical specially in postgraduate students, since it delegates an intelectual work to a programed numerical technique.

Another methodological matter in biological research that has ethical connotations, also in the use of statistics, has to do with the type of data that it is collected and whether it is suited for applying parametric techniques. This includes having the minimum size sample, that the measuring scale for the data be adequate, abscence of extreme values, and that values fit a normal distribution. Most of the time, lured by the atractive power of parametric statistics students bypass these assumptions, risking the certainty of what ever they are testing [13-16], sometimes with the approval of their mentors. This and even the underestimation of the above requirements constitutes malpraxis, inasmuch it undermines the promised epistemological support of their study.

Moreover, scientist and science students alike have the general responsibility on problems derived from scientific activity, much of which poses risks that are difficult to predict, not only in the sense of Bioethics which is strongly influenced by moral issues and not enough by the rationality of ethics. Besides the many risks of being drawn into pseudoscience by lacking the concept of scientific method, the urge to stand out and give into sensationalism, scientist have to forsee consequences of their own research, and examine the proper way to present results and other findings. For example, say you have analyzed heavy metal contents in beach sand in order to determine the possibility of contamination level concentrations. But, along with these measurements gold is detected in profitable quantities. These last data shouldn't be released until appropiate management regulations are found to be in order for the studied area.

Likewise, when successfully finding evidence to support our hypothesis it is unethical to consider it proven, disqualifying further findings that do not agree with it. Disenting and impartial criticism of scientific proposals enrich scientific theory and should never be lacking, and less, out of mere conformism or some excuse. However, when not having directly participated in the generation of theory (scientific knowledge), our scientific and philosophical principles require us to be utterly skeptical and critic about the actual impacts of phenomena affecting life worldwide. A philosophical approach is needed to assess the certainty of the statements released publicly or officially. For example, the highly questionable anthropological global warming ideology (AGW) that, nevertheless, is not questioned and has many followers among the scientific community, whilst the few skeptic scientific disidents are efficiently banned authoritatively. It is so embedded morally and legally that most members of the scientific community do not question any of it, while others take disqualificative measures against dissidents, transgressing along the way several of the most revered values of scientific comittment such as systematic skepticism [2] and criticism. Sadly, both values have been deteriorated by morality giving them byassed meanings, as detractors to the former and to the latter as systematic reproval, that permeate into the scientific community. But returning to the AGW, ethical misconduct in this case is occurring twice and can actually be found to happen a third time, i.e., when examining their arguments which do not include any inquiry or timely (historically) questioning of the imposed theory, that would have exposed its pseudoscientific construction (see The Great Global Warming Swindle) [17]. This type of authoritarian imposition of a paradigm is clearly unethical, either in its official (political) character or in the submissive acceptance by the scientific community.

Another case having a similar scenario concerns the sensationalism surrounding the general idea about harmful algal blooms (HAB) for which we may find frequently remarks such as: "Harmful Algal Blooms (HAB) are becoming an increasing problem to human health and environment (including effects on natural and cultured resources, tourism and ecosystems) all over the world. In Mexico a number of human fatalities and important economic losses have occurred in the last 30 years because of these events. The increase in cases of toxic and harmful marine phytoplankton and microalgae is an issue that must be assessed to understand the consequent impact to human health, fisheries and tourism" [18]. Because it is our ethical obligation when being familiar with these phenomena to examine the certainty of these statements an opportunity was seized to do it. The final outcome showed that much of what is said on the subject is sensationalistic and demerits the true scientific effort that research on HAB actually contributes [19]. Needles to say that, although the scientific contribution is recognized, much offense is taken due to this statement, and retaliation is swift, even before publication. This is also a clear ethical issue, albeit a more complex one, because it requires the disenting parties to present reliable data, and one of them to be open-minded to the weight of the facts, instead of ending any form of eristic dispute by blunt imposition.

A final example deals with highly confusing issues relating humanism, morality, and ethics. Several decades ago I saw a documentary on TV in which behavioral scientist studied a tribe of primates. During their filming the animals became plaged by ticks and the young became illed and eventually died while the researchers only watched and observed. They did nothing to rid the studied animals of the infestation. Let nature take its way had been their thinking, which is the scientific posture, for the sake of science? For the sake of their personal interest in the research? An impossibility to do

something? Or the situation simply did not concern the purpose of the study? This requires much discussion in order to reach a consensus of what would the consequences had been if there had been any intervention. However scientific the outcome was, interpreting it as that only a portion of the population was affected but not the species, it seems inmoral (machiavelic), but clearly ethical. On the other hand, there are several cases concerning preservation of species, that should not be automatically applauded, but examined. As with the vaquita, *Phocoena sinus*, endemic to the Gulf of California, Mexico for which much attention, effort and financial support have been directed in an intent to stop its inevitable extintion, i.e., crisis is over, its dissapearance is imminent. So why assigne all that support to its preservation? While other research proposals not related to this topic may be considered of less priority and are sidesteped during grant distribution. Because it is a charismatic species. However, unlike with other charismatic species like the pandas, this species can not be saved; their numbers are way below the scientific critical size for the remaining population. On ethical basis the corresponding debate should consider the evolutionary perspective, deprived of moral sympathy and blackmail. Meanwhile the scientific study of the remaining population risks stressing vaquitas precipitating the inevitable [20, 21].

Ethics is about recognizing proper or correct procedure, and observing mistakes in order to avoid repeating them, it is not about retaliation of punishment. In the above examples it is seeked to remind science students that scientific thinking is freewilling, deprived of authoritarian impositions or ideologies, but requires adequate education, training and preparation. Our particular ideas should be supported by in depth, critical analysis of the related theory, no matter how diverse these are, becasue it is the esence of scientific creativity. On the other hand, heterogeinity within the scientific community currently precludes stablishment of communitary ethics, whereas morality represents an ideological resource that abides by obedience and conformity. Scientific ethics follows consensus that is founded on philosophy of science.

5. Conclusion

Philosophy of science may be addressed from two different perspectives, both on the basis of well recognized philosophical doctrines. In the first one we find the overall acceptance of science and its potential, being supported by Romanticism, and its commitment to realistic results, that is mainly related to Materialism, Realism, Positivism, and Empirism, all of which warrant the promised objectivity of scientific research. An ethical position requires in turn congruent way of thinking when a researcher commits to scientific work. This may be perceived within the following definition of science, which constitutes a significative structural element for constructing a course on the subject: Science is an intelectual-empirical, collective activity directed toward understanding nature (reality, the universe), by performing analytically through pre-set fields of knowledge on the basis of a dynamic, heuristic and autothrophic thinking structure, where work is called investigation and the form of proceeding through is (the) scientific method, in order to generate reliable and objective knowledge (purpose). Likewise, the second perspective probes into the epistemological basis of how scientific knowledge (theory) is generated in order to be found reliable, i.e., scientific method, which may be defined as: Our intelectual work for generating objective (reliable) knowledge by seeking answers to concisely raised questions (aims or objectives) derived through observation when analyzing the current theory critically and skeptically, and constructing hypotheses and contrasting them through methods, techniques and strategies implemented *ex profeso*, using them systematically, critically and logically (Methodology) in a particular field of knowledge, for gathering evidence (data) and making further observations on the phenomena of interest (empirical basis) to refute or back the proposed hypothesis and, with the result, refute or support (enrich) the initially analyzed theory. However, *Homo sapiens* do not think exclusively by reasoning, inasmuch non-logical elements such as imagination, inventive, and intuition, but mostly creativity, permeate into this intelectual structure throughout the evolution of our ongoing research [9] or scientific carrer. In fact, the lack of creativity in a study has to be considered ethically as not adhering to scientific method.

Even more, how does the need to publish fits into de scientific method scene? Science is a collective endeavour, so whatever knowledge gets published is attributed to the scientific community and has its support. Of course, this happens only after passing the rigorous peer review process, which has to be considered also part of scientific method which goes on. The individual prestige on the side is deemed utterly important but in the philosophical sense it is the overall scientific relevance what counts, so the ethical component becomes equally relevant. Published scientific results are not deemed definitive. Being objective obliges us ethically to undertand that the generated knowledge, although having epistemological basis, is still hypothetical and consists of conceptual models that aspire to represent reality as closely or faithfully as possible. Consequently, it is an ethical issue for scientists and science students to have a notion regarding the concept of scientific method in congruence with the intelectual investiture that is represented.

As corolary, it may be said that ignoring ethics and its philosophical basis may be considered a deficiency in the education of science students.

Finally, although during this essay self citation throughout the text stands out, this it is not intended as a matter of using it as evidence but to refer other essays where the topic in turn can be found more extensively addressed and from a different perspective. This thesis is intended to awaken controversy and not as a definitive stand, and hopefuly will be of aid in clearing the scene for restless students, while finding due reciprocity.

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