

# A Caveat for Science Students on the Misuse of the Term Observation When Referring to Scientific Observation

David Alfaro Siqueiros Beltrones

Department of Plankton and Marine Ecology, Interdisciplinary Center of Marine Sciences, National Polytechnic Institute, La Paz, Mexico

**Email address:**

[dsiquei@gmail.com](mailto:dsiquei@gmail.com)

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**Abstract:** Within scientific speeches, especially those by science students, expressions that synonymize the terms see and observe are frequent. That would imply that a blind person would be unable to make observations, a mistake that is made when trying to emphasize that something is being watched closely or inspected with certain intention, hence, observing. However, the term observation, does not derive etymologically from visual perception but from conserve, which in turn derives from *servare*, as *observare*, meaning: to look out, guard, save. Moreover, besides comprising other forms of perception such as hearing, smell, touch, observing in scientific (epistemological) terms consists rather of an inferential process coupled to the perception, that remarks or highlights something, i.e., a relation, a pattern, a constancy, a regularity, or a tendency, etc., detected in data or while inspecting a phenomenon. In this way, observation in the sense of an element of Scientific Method implies a logical action that recognizes, within a heuristic process, that something is missing in the available theory (research problem), or that indicates evidence for or against theoretical premises or hypotheses. The ambiguity in the use of the term observe has an inertia that permeates even the speech of science philosophers. However, to science students it represents an ethical challenge to identify and correct this type of ambiguities during their scientific endeavour which can be better approached with an adequate philosophical background.

**Keywords:** Deduction, Induction, Inference, Perception, Scientific Method

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## 1. Introduction

In over 20 years attending philosophical issues in the scientific endeavour within marine science, including linguistic and semiological aspects, I never considered that it would be necessary to address the case of the scientific observation as carrying a real concept problem. The ambiguous understanding of the many meanings of the term observation is reflected in a generalized misuse of said term by most students and many colleagues within a scientific context. I. e., it is not used according to the intended meaning according to Scientific Method.

Said problem commonly arises when trying to emphasize that something is being watched or looked at closely (being inspected) with certain intention. In this case it is said that it's being observed. Similar meanings for the word observe are found in both English and Spanish dictionaries, e. gr., in the Cambridge Dictionary [3] and the Royal Spanish Academy dictionary [10] where several meanings for the

word observe are found:

- 1) To carefully examine, i.e., to inquire, investigate, scrutinize, etc.
- 2) To save or to exactly abide by whatever is order or commanded to do.
- 3) To notice or point out.
- 4) To watch carefully, or cautiously.

## 2. The General Problem

A caveat is here made on understanding how the term Scientific Observation should be used in order to clearly and precisely show what is intended to (be noticed) in a scientific report. To do this, a brief linguistic layout about the term observation is in hand, together with the epistemological basis for using it as part of the Scientific Method.

According to the *Latin* etymological origin of this word [5], the term observation does not relate to visual perception but derives from *servare*, as *observare*, meaning to guard, look

out, save, or examine carefully, and it is related to conserve rather than to see. Thus, the first three definitions above show certain relation, and it may be synonymous with one of the multiple meanings of the third one. While only the fourth one, that actually means to inspect (from the Latin *spectare*), relates to seeing. However, it is with this last one that greater confusion exists, inasmuch it is frequently used as synonym of observe.

The above stated situation actually goes unnoticed on a daily basis, especially because dictionaries provide multiple meanings for all words according to their general or popular use (or misuse). But, let's exemplify, it is commonly said that: I'm observing the stars; or, observing the sunset; or while observing the boys play football. As if it were synonymous with seeing, looking, or watching, while maybe it is not, even if doing it closely or carefully. For if it were, a blind person would thus be unable to observe, which of course is incorrect. And also, because daily there are hearing observations, such as noticing that a sound is rhythmic. Or tactile observations, when noticing a fine texture, as well as tasteing observations, i.e., that something is too bitter or too sweet, or by smelling (stench). All these are related to the perception of natural properties of things not implying vision. In contrast, the term see, either in Spanish or in English, has more than twenty accepted meanings apart from sight-perception, perceive, observe, examine, prove, consider, etc., including that of intellectual perception, and many other comprised within expressions of particular context [3, 10]. Consequently, any kind of imprecision that occurs daily becomes irrelevant, although paradoxically contributes to the rhetorical-discursive enrichment.

### 3. The Problem with Science Students

As in the above, during scientific speeches especially (though not exclusively) in oral presentations of graduate science students, it is frequent to hear expressions such as: samples were observed; observing fish larvae; observing phytoplankton; by observing the plot it can be seen; environmental variables can be observed; observing the gathered values, etc. In these expressions the term observe is being incorrectly synonymized with seeing (look, watch), concomitantly demeriting a scientific intellectual process. Also, reflecting a slacking in the precise use of the language and thus overlooking the actual activity of visual perception (examining, inspecting, watching, seeing). In contrast, correct expressions should read: observing a great diversity of fish larvae; or, we observed that phytoplankton was scarce; a correspondence between variables can be observed; observing a temporal variation; or, a significative correlation is observed. Inasmuch in these expressions something that has been noticed is highlighted, i.e., observed, which is concomitant to the act of inspecting, seeing, or watching when visual perception is required. In such case, what is omitted or ignored is the fact that something is inspected, which means looking into a phenomenon or the respective theory that models it, and we follow by inferring an

observation conditional, i.e., outlining a premise (theoretical), or highlighting a certain constancy, regularity, or tendency in whatever we are perceiving.

Moreover, in many cases a type of perception is converted analogically into a visual perception. For example, when systematically measuring temperature there is the intention of establishing or to confirm either a regularity or a pattern, which leads to an observation that poses evidence to it or not. We can certainly see that on a numerical value scale (interval) gathered by the way we measure it, but only by analogically converting the detected heat using an ad hoc instrument (thermometer), i.e., creating a model for the actual temperature. We thus transit from a thermal sensation perception to a visual numerical one that allows us to make the respective observation: high, low, or constant temperature.

In agreement with the latter, and in contrast with what the cited dictionaries say, a philosophy dictionary defines observation as "confirmation or verification of a fact, whether spontaneous or occasional, either projected or methodical" [1]. In either way, this concept of observation may be considered correct while agreeing with the one posed here, and differs from what it is usually noted in the aforementioned scientific speeches that refer to visual perception.

### 4. The Problem According to Philosophy of Science and Scientific Method

When we resort to the term observation as an element of the Scientific Method (SM) any ambiguity in its meaning has to be filtered for the sake of precision. Much of the cause for questioning an existence of said SM [6, 7] actually derives from misunderstanding what it actually stands for. However, the once popular view of the SM as the protocol observation, hypothesis, experimentation, and tesis or conclusion, actually referred also to observation in the sense of carefully seeing or watching. Albeit, introducing later the induction process that leads to an induction principle, which is really as a synthesis an observation. It is surprising that even celebrated science philosophers use the term observation as visual perception when addressing SM. For example, Feyerabend [6] (p. 60-65) even though referring to observable events, does suggest also a more precise meaning of the term. While, Bunge [2] immediately after using the to-notice meaning of the word (p. 43) goes on to mention the "unobserved or unobservable events, such as the dark side of the moon, light waves, atoms, etc., whilst many observations can be actually inferred on these phenomena. Or, Popper [9], who writes "the observer is convinced that he is observing a rock" (p. 69), after accurately indicating that when we observe we somehow distort the reality we have accepted as reference on the basis of common sense (p. 42). And even though establishing earlier that scientificity is actually of deductive nature [8], albeit referring to the use of hypothesis (abductive), whilst his conjectures should have been aimed to the intellectual nature of observation.

Interestingly enough, the formal use of hypothesis as an estructural element of SM has also been frequently underestimated [11-13]. This is why it is imperative to understand the philosophy supporting the concept of SM in order that the actual meaning of its structural elements be properly understood. And finally, Chalmers [4] (p. 40-41) approach to this issue deserves especial attention, inasmuch he directly tackles the observation conception. However, he fails to detach the overwhelming influence of the sensorial meaning (visual) and gets biased towards the subjectivity of the perceived images, instead of linking it to the inferential process.

The adequate use of the term observation allows also to relate the non-logical process of creativity which gives rise to new scientific ideas, with the logical processes of induction, deduction, and abduction. Moreover, when looking to express the process and results of a scientific study with adequate precision and semantic correspondence, the correct use of the words has to be considered so that a linguistic structure corresponds with an epistemic structure. This aids in coupling with precision the generated model with the reality or objectivity that is being pursued, i.e., the essential epistemological attribute of generated knowledge. In this way, within scientific idiom the term observe, as with its etymological meaning, should be used with the meaning implied in the conceptual definitions of Science, Scientific Method, Scientific Logic, and Philosophy of Science. That is, to highlight something, to notice or point out, realize or verify something. This as part of an inferential process when directly inspecting a phenomenon or the generated data that allows us (through observation) to discover or invent problems of knowledge in the form of original questions. During praxis, this is preceded by the demarcation of (regularities) theoretical premises or reaching inductive principles (observational synthesis) that we commonly derive through the analysis of the theory from where we also abduct hypothesis. Thereafter, by alluding to the raised questions, we resort to experimentation and/or the experience, for making observations on the plausibility of our hypothesis, on the basis of the gathered data (evidences) and their ad hoc processing, i.e., for contrasting it [12, 13]. This implies that, both in daily life as in scientific activity, any hypothesis is preceded by an observation and followed by another.

## 5. Conclusions

According to the above, when someone (incorrectly) expresses that in a certain research proposal a hypothesis is not required or it is not appropriate because the study is solely observational [12, 13], besides showing a lack of a correct concept of hypothesis as an element of Scientific Method, she/he also manifests an inadequate understanding of what scientific observation actually is. Concomitantly, he/she overlooks another (popular) accepted meaning of the term observe, i.e., to abide by Scientific Method. Inasmuch it requires to observe or the observance of certain precepts that warrant the epistemological basis of a research that will

generate (new) knowledge. In general, evidence for the lack of bases on Philosophy of Science.

## 6. Recommendations

All of the above should be considered a consequence of lacking an adequate background in Philosophy of Science and missing its romantic, rationalist, and pragmatic approaches to scientific research [11, 15]. And also a product of philosophical intents which lack actual scientific support (experience) that make teaching of Philosophy of Science a farse [2]. Consequences of said practice bring about a re-invention of Philosophy of Science as cuasi ideologic postures that cheapen intelectual effort. For example, promoting that Science is an enterprise, or a tool, or underestimating the epistemological structure of scientific reports and their purpose in abidance to Scientific Method, by reducing them to meere messages. Whilst, an adequate training in Philosophy Science in science students aids instead in the acquisition of ethical notions on the existential basis on what it means to be scientist [14]. Unquestionably, this provides a science student a better preparation and, with it, conviction for performing plausibly, inasmuch said student will be conscious of having considered the epistemological fundaments of the scientific praxis, which will be invoked throughout her/his carrer.

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