

The site for an instrument in the holistic versions of science

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Abstract

The paper discusses contemporary attempts to build holistic (or dialectical) models of the relationship between experiment, theory and instruments. These models are intended for the replacement of 'classical' schemes in which the ingredients of science are subordinated according to theoretical preferences for conceptual (positivism), social (relativism) or natural (realism) order.

I am going to consider some of holistic interpretations of science in order to discuss the role that their authors assign for *an instrument*. My thought is that in holistic conceptions of science *an instrument* serves as a 'medium term' that connects the experiment-as-method-of-knowledge with the experiment-as-action-of-the-very-nature.

Introduction

Today my subject will again revolve around my favorite theme that is a contraposition of atomistic and holistic ontologies and of epistemological consequences of these ontologies.

This time I intend to consider the role that representatives of holistic epistemology assign to an instrument (a technological device) in making of scientific knowledge. I will briefly compare their positions with the realists' treatment of an instrument on the one hand and its relativistic interpretation on the other hand. My conclusion will be that holism tries to occupy the intermediate space between those two extremes.

It has to be mentioned that instruments play a leading part in modern science which from its earliest steps appears as technoscience and invents/discovers the world via an experiment (it is enough to refer to a telescope and microscope, a pendulum and barometer) (Ihde 1991; Hacking 1983). Therefore, an interpretation of instrument becomes one of the dominant themes in modern epistemology that is epistemology of scientific knowledge.

What is holism?

First is a couple of words concerning holism. Holism is an ontological model which is diametrically opposed to atomism. Atomistic ontology starts with isolated entities and tries to gather them into the whole the properties of which entirely conform to the properties of its parts. Contrary to this point of view holism maintains that the whole has emergent qualities that can not be exhaustively reduced to the sum of its elements.

While in Modern age the domination of atomistic ontology was nearly absolute (that secured successes of classical physics), in twentieth century the very natural sciences were faced with the ‘enigmatic’ properties of the whole (especially in quantum mechanics) and turned to theories in which so called ‘co-operative effects’ came out on the forefront.

Changes on the side of ontology affect epistemology in which more and more theories of knowledge take an interrelation between human and the world as a starting point and, thus, try to keep a strong balance between the ‘outer world’ and a ‘knowing subject’. What is the role of instrumentation (that is neither the world nor a subject) in this framework?

Realism versus relativism: what do instruments do?

I’ll start with a traditional treatment of scientific instrumentation that is a heir-at-law of the ‘subject-object’ model of modern thought.

An indispensable consequence of the subject-object division is that the universe contains primary and secondary qualities. Primary qualities belong to reality as it is in itself, and secondary qualities belong to a subject and are states of his/her mind. If a subject stops observing an object, then secondary properties disappear but primary properties remain invariable. However, modern science never observe nature in its natural course; its method is an experiment that is not just a descriptive observation but an inquiring observation, in other words, it is an instrumental trial of objects. Only hand and eye that armed with instruments are able to penetrate into the secrets of nature.

Because of the split into the primary and secondary qualities the status of instrument immediately becomes ambivalent. On the one hand an instrument is an extension of sense organs and, thus, it serves for an intensification of secondary qualities (for example Galileo’s telescope that gives a possibility to see the surface of the Moon or Hooke’s microscope using which a scientist can see the smallest organisms). On the other hand an instrument eliminates perceptual data translating them into measurable quantities and, therefore, it provides an access to primary properties. Such are all of the measurement instruments that give an information on the length, width, weight or temperature of object.

In the same way as new natural science in general, all of instruments turned out to be involved in this burdensome gap between a visual (or acoustic or any perceptual) illusion and reality that was ‘out there’ (and could be only mathematically comprehended). A further interpretation of the role of instrumentation depended on what kind of epistemology was at stake – realism or constructivism in a mutually exclusive sense.

Realism that opposes itself to constructivism can be called ‘objectivism’ because it subtracts a subjectivity from reality and at the same time consider reality to be cognizable.

Consequently, an objectivist interpretation of instruments emphasizes their transparency in reference to objects, so that instruments are able to supply us with the core ‘objectivity’ of objects that is expressed by numerical relations. Let’s take, for example, a measurement of blood pressure. A patient feels unwell and thinks that his blood pressure is higher than normal but an apparatus shows one hundred twenty and eighty that means that he is ‘in actual fact’ in good health. Or vice versa – a patient feels OK but the apparatus shows one hundred seventy and one hundred ten that forces doctors to conclude that a patient is ‘in actual fact’ seriously ill even if he/she doesn’t know about that. In this framework, however, so called ‘white coat syndrome’ becomes a problem: if a patient feels anxiety seeing the doctor armed with an apparatus and his/her blood pressure is high due to nervous tension, then what about the measurement result doctor gets – is this subjective or objective? Doctors are usually puzzled concerning situations like this because a ‘subjectivity’ of ‘object’ resists an elimination and affects the result.

A mirror reflection of objectivism is a constructionist tradition (in the widest sense: from Kant through Carnap to Kuhn or Bloor). It does not talk about primary qualities at all leaving them beyond our experience and knowledge. Hence, it keeps its eye on simulation or illusionist role of instrumentation depending on the type of a subject from which it comes from. The heirs of idea of transcendental subject (as a bearer of universal consciousness) emphasize a modeling role of instruments that translate sense data into necessary linguistic and mathematical structures. Thus Rudolf Carnap deeply appreciates a measurement function of instrument which allows a subject to go up from the individual-empirical level to the level of universal mind (Carnap 1966).

A different picture arises when philosophers refuse a universal Ego and concentrate at a historical, collective and bodily subject. Here the illusionist role of instruments comes to the fore. An instrumental context appears as a cultural frame in which ‘scientific facts’ represent not reality but socio-historical conditions or the lifeworld practices. Such are social constructionists’ treatment of instrumentation or, for example, Don Ihde’s model of instrumentally embodied science with the focus on praxis and cultural perception (Ihde 1991).

Now to the holistic attempts to keep objectivism and subjectivism united.

A holistic treatment of instrument: Whitehead, Stengers, Pickering

What distinguishes a holistic approach from above mentioned ones is a different ontology and, consequently, a different understanding of ‘object’. Holism (as I see it) does not fear metaphysics and objectivism, it does not fear to start with an ‘object’ but it gives back to objects what has been amputated by Modern thought – namely, a ‘subjective’ perspective in its initial sense of *telos* and a teleological behavior. So there is no need for holism to divide primary from

secondary qualities: probably, everybody knows the famous Whitehead's expression that distinguishing between primary and secondary qualities is a bifurcation of nature.

Let's trace what happens if we follow Whitehead and hold an objectivity for secondary qualities. Then, a rose really smells, a nightingale's song really inspires a poet, and Schroedinger's cat (in a black box) is really neither dead nor alive. Consequently, the world consists not of things and perceptions but of events in which a subjectivity and an objectivity are interwoven. This concept forbids us to see instruments as neutral devices adding nothing to objects in themselves but it equally forbids us to consider instruments as 'only constructions' that just extend (to some degree) a prison cell of our perceptual experience.

Holistic version of instrumentation emphasizes its transforming or constructing role but this transformation is deeply original, it belongs to the world. Creating knowledge instruments at the same time create the world. 'A fresh instrument, – says Whitehead, – serves the same purpose as foreign travel; it shows things in unusual combinations. The gain is more than a mere addition; it is a transformation' (Whitehead 1963). Thus the surface of the back side of the Moon (observed only in 1959 by means of complicated technological devices) exists as an emergent object, a function of instrumental situation which includes the Moon, a sky-lab, photography, a perceptive organism and an interpretation.

Isabelle Stengers puts such a position as a 'correlation of mode of existence and mode of achievement' (Stengers 2004). The mode of achievement of a new object (the back side of the Moon, for example) is highly instrumental, hence, the mode of its existence is emergent and historical, even occasional. However an occasion belongs to the core of being: it is what we produce when we interact with instrumentally prepared portions of the environment. Using Prigogine's words, instruments 'create the difference between past and future', and since this difference matters, it is irreversible (Prigogine & Stengers 2001).

In current STS Andrew Pickering is one of the scholars who try to keep a holistic trajectory in interpretation of scientific instruments (Pickering 1995). He focuses on an interaction between experimenters, their apparatus, and the natural world. He describes scientific practice as a tense dialog (if not a struggle) between a scientist and the world where an instrument is a place of a meeting of human action and nature's action. The moment of meeting is the very whole that is more than mere a sum of its parts. That is why its contours can hardly be determined in advance: the behavior of experimental device is often unexpected and forces a human agent to change his/her initial purposes and calculations. The process of mutual tuning results (as Stengers comments it) in 'a double emergence of a disciplined human agency and of a captured material agency' (Stengers 2004).

Another attempt to re-think of instruments from a holistic perspective belongs to Hans Radder who ties here and now conditions instrumental practice with its non-local patterns (Radder 1996). The latter implies that instrumentally created objects cannot be understood solely as artifacts or social constructions, they refer to both human and natural conditions. Exploring instrumental practices Radder defends so called ‘referential realism’ that occupies a position between transcendental realism (objectivism) and constructivism.

Conclusions

To conclude – the recognition of interventionist character of instrumental science does not necessarily entail unrealistic epistemology. A human intervention can be joined with realism in the frame of ontology in which natural and human modes of being are strongly related to each other. As Proclus, one of the most famous dialecticians, put it: those who want to ‘imitate’ must know both an ‘archetype’ and a ‘demiurgic art’.

A genre of compact conference paper does not permit to go deep into several aspects of instrumental mediation in modern science so, it is only a brief sketch of the problem and various approaches to it.

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