Evandro Agazzi on scientific objectivity

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In this important book, the outcome of several decades of intense philosophical activity, Evandro Agazzi offers rigorous argumentation in favour of an original conception of scientific realism and objectivity in science.

The book begins with an analysis of the origin of what the author calls "dualism"—both in its ontological and epistemological versions—in which he correctly locates the source of contemporary relativist and antirealist views on science (29). *Ontological* dualism goes back to the ancient Greeks and divides the world into "surface appearances" and "deep authentic realities". In its *epistemological* version, dualism appears with the birth of modern science in the seventeenth century. Epistemological dualism postulates a dichotomy between our ideas or mental representations, which are supposedly immediately known to us, and reality itself. Such a division raises the question of the faithfulness of our representations to the realities which they are meant to represent (245). But this problem has no satisfactory solution. Once a wedge is driven between ideas and things, we are inevitably drawn to a sceptical attitude with respect to science's capacity to reach knowledge of reality.

By embracing a realist position, Agazzi stands against dualism: science aims at knowing what is real, including some unobservable entities, and manages to do so, *albeit* only partially.

Agazzi distinguishes the *proposition*, which is the sense of a *sentence*, and the *statement*, which is an assertion (4.4.2). Strictly speaking, only a statement can be true or false. It is true when the *state of affairs*, the existence of which is asserted, actually obtains and false when it does not, according to a *correspondence*—or better, *referential*—theory of truth. Truth and falsity are therefore properties of statements. *Meaning* always includes two components: *sense* and *reference* (81). For a statement, its sense is its associated proposition and its reference is a possible state of affairs, the existence of which makes the proposition true.

> We certainly speak about something, this something consists of substances endowed with attributes, and these attributes result from the encounter between our way of investigating reality and what reality is. (231)

For Agazzi, there is no reason to doubt the existence of *things* immediately present in sensory perception. But to verify that some things actually possess the properties we are interested in, we perform some *actions*. In order to know the number of pencils in a box, we take them out to count them. These *operations* aim at determining whether the targeted things possess some specific properties, and thus whether some statements about them are true. In doing so, we "clip out" in things some *objects* (89), which are "structured sets of properties" (284). Only *some* of the properties of a thing play a role in the construction of a concrete object.

A concrete object, as opposed to an abstract object which is an intentional object of thought, has properties rooted in a real thing. An abstract object is a *noema* (in Husserl's sense) which *encodes* properties, to use Zalta's (1988) terminology. When the encoded properties belong to a real thing, the abstract object is exemplified, and we have a concrete object, according to Agazzi. The existence of the thing guarantees that the word which designates the concrete object has a referent since the properties of the concrete object are also properties of the existing thing that exemplifies the abstract object.(Contrary to Agazzi, Zalta's abstract objects are not exemplified by concrete objects. Abstract objects are individuals which both encode and exemplify properties. When a concrete object exemplifies all the properties encoded by the abstract object, it is a physical "correlate" of the abstract object. I'm grateful to Ed Zalta for having clarified this point.)

> Scientific objects exist as abstract objects (i.e. as intellectual constructions) that encode certain properties, while not being purely abstract since they are exemplified (within certain margins of accuracy) by concretely existing objects. (Agazzi,104, n. 48)

Operations play a central role in objectivity. There are different types, and Agazzi does not provide a definition of an operation in general. However, he distinguishes between operations on perceived things and operations on the unobservable entities postulated in science. At the perceptive level, one can ask a human subject to pick up a red pencil in a set of pencils of various colours (76–78). If different subjects agree, we get *weak* objectivity, in the sense of *intersubjective* agreement. But a realist argues that we sometimes have good reasons to believe in the existence of a real thing which exemplifies some properties. In such cases, we reach *strong* objectivity, in the referential sense.

Does Agazzi fall back in~~to~~ the *aporia* of idealistic dualism because it seems that we have to determine whether the object thought, immediately present to the mind, corresponds or not to a real object? No, not at all. An operation does not consist in comparing a representation, which would be the *noema*, with a concrete object, but in operating on real things according to some point of view in order to check whether the properties encoded by an abstract object are instantiated. In performing an operation, we are directly in contact with reality and its outcome allows us (or not) to ascertain the truth of an assertion, *albeit* not without eliminating any risk of error (285). Let me point out, however, that the justificationist power of operations relies on perceptual presence. Indeed, I *see* that other subjects grasp the red pencil when asked to. I am then entitled to assert that they see something which they call “red”, even though it makes no sense to ask whether they are presented with the same red. Even if I am the only one to act, there is no way to eliminate my perception from the outcome of an operation.[1]

Every scientific discipline neglects some properties in things. This process characterises the abstractive *demarche.* Here, we must distinguish between the things we can directly observe, such as certain luminous points, called “planets”, moving relatively to other luminous points which are apparently immobile, called “stars”, and entities such as electrons and viruses whose properties are epistemically accessible by means of measuring instruments only.

For observable things, the question of the reference of the word “planet” does not raise any major difficulty. The intersubjective agreement in multiple conditions of observations permits us to unambiguously identify the real referent of the term “planet”. Next, we must select some properties and measure them. The structured sets of properties determine the objects which belong to a discipline such as astronomy. These properties are denoted by “basic predicates” (89). In classical mechanics, the predicates “mass”, “length” and “duration” are basic predicates to which “protocol criteria” are associated. In the context of a discipline, these criteria allow us to decide which statements are immediately true: the protocol assertions which only contain basic predicates. The protocol criteria are the *criteria of objectivity* relative to a scientific discipline (89).

> We may call criteria of protocollarity those specific criteria which, within a certain science, permit the determination of which propositions are immediately true. (87)

> An object of a certain science is simply an aspect of reality capable of being described by propositions that can be directly or indirectly assigned a truth-value by

> means of the criteria of protocollarity of that science. (89)

These protocol criteria are connected to measuring operations which allow us to affirm if a given thing possesses a given mass, for example. A measuring operation is in general indirect but is, for Agazzi, immediate since the scientist who knows how to interpret the *data* can without delay attribute a property, such as a mass value, to a concrete object.

When the things to which our statements refer are perceptible, as planets are, Agazzi's argumentation is solid. But, when we deal with unobservable entities, our access to their supposed properties is only indirect by means of measuring operations. An unobservable entity is first an *object* described by a theory in which it is reduced to a thought object: a mere concept. It is a set of thought properties which determine the intensional component of meaning, that is, the sense of the term. The other component is the reference.

> We define the term "electron" through a structured set of mathematically formulated properties which together constitute a certain abstract object. But this does not entail that these are meant to be properties of the abstract object; they are meant to be properties of the single electrons which are the intended referents of the mathematical model we have constructed. (113)

For Agazzi, a scientific realist must argue in favour of two main claims:

> (a) science attempts to represent a reality independent of science itself, and is committed to measuring itself on the basis of its success or failure in doing so; (b) what science states is an adequate representation of this reality 'as it is'. (263)

What are the reasons to believe in the existence of objects such as electrons, which possess precise properties of mass, charge and spin?

Agazzi is opposed to radical empiricist views, such as van Fraassen's, according to which scientific knowledge remains limited to observable objects and their sensible properties. Surely, for Agazzi, the justification of our beliefs in the existence of unobservable entities partly rests on our explanatory reasoning. Yet, he does not offer a general theory of explanation, probably because explanation takes various forms in different disciplines. At some places, Agazzi seems to implicitly subscribe to the classical argument in favour of scientific realism, namely inference to the best explanation, especially in its causal version: we have good reasons to believe in electrons because their existence is the only reasonable explanation of the occurrence of some observable and measurable effects predicted by the theory (5.5.3).

We all know that inference to the best explanation (IBE)—which the "no-miracles argument" relies on—has been criticised by both antirealists and some realists, including myself (see Ghins 2002). But Agazzi formulates this argument in an original and also more convincing way on the basis of his central notion of operation. If being guided by the scientific descriptions of unobservable objects we can operate on them or manipulate them to attain certain objectives, then we have a powerful argument in favour of their existence.

> If we succeed in operating on reality, letting ourselves be guided by a science, it follows that this science has picked out some actual properties of reality. (285)

Moreover, the impressive success of technology forcefully adds to the plausibility of a realist position.

> The whole world of technology (…) [is] a gigantic and irrefutable confirmation of the truth of our scientific theories and of the *realist* purport of science. (309)

Yet, Agazzi is aware that successful operations are not enough to prove the existence of some concrete objects. Before Lavoisier, chemists successfully operated on what they called "phlogiston". Larry Laudan warned us against excessive credulity with respect to the existence of unobservable objects which seem to play a causal role in the production of some observed effects. Agazzi replies by advocating the selective strategy, called the *divide et impera* strategy by Stathis Psillos, which requires that only properties that fulfil an explanatory and predictive role can be attributed to concrete objects.

> Only when the postulated referents are characterised through properties which actually play a logical (…) role in explanation and, especially, in prediction, can they be credited with a solid ontological status. (302)

What is this “solid ontological status” conferred to certain objects? For Agazzi, only operational *praxis* allows us to know concrete objects, that is, referents which “reach out” of the context of language and theory. Our operations provide “specific criteria for establishing reference and, therefore, for fixing the stable core of the operational concepts” (133). The intension or meaning of an operational concept certainly depends on theoretical context, but also, crucially, on reference.

> The stable core, or ground intension, of an operational concept is ‘stable’ because it expresses a relation of the concept to something which is external to the theory. (127)

It becomes possible to weight the respective merits of competing theories when their basic operational concepts have the same ground meaning. Since such theories imply statements containing only common operational concepts, empirical data can lead us to decide in favour of one of the theories (135).

On the other hand, when the referents of basic operational concepts are different, the empirical merits of distinct theories cannot be compared, even if the same terms are associated with these concepts. For example, one cannot compare quantum mechanics to classical mechanics. Why? Because their basic operational concepts are different: these theories deal with different objects.

> The operational criteria for testing statements are different in the two domains (e.g. in microphysics one would never measure lengths by using a metre stick, or masses by using scales). (116)

Such a view entails that classical mechanics has not been falsified by quantum mechanics (116). These theories can peacefully coexist because they adopt different standpoints on things (137). Their respective concrete objects both exist.

> Material points exist no less than electrons in the sense that the criteria of referentiality needed for finding them are essentially not different from those needed for electrons. (104)

These criteria are analogous to those which convince us of the existence of a table:

> We can touch the table, move it, sit on it, considering all these features not so much as ways of *perceiving*, but as ways of acting, or of *meeting a resistance*. (183)

For Agazzi, theories are not strictly speaking true or false, but they express a way of seeing, a *Gestalt* on reality (293). On the other hand, theories can be more or less adequate, always according to some perspective adopted on reality.

> A particular theory which turns out not to be adequate from several points of view (…) remains *partially* adequate from certain points of view; and this is enough to afford an understanding of its predictive success. This success depends on those parts of the theory which are adequate. (301)

Yet Agazzi claims that theories also contain assertions which can be taken to be true from the theory's point of view on reality. For this reason, some assertions on material points can be considered to be true in the context of a theory of planetary motions and false in the context of a mechanical theory of rigid bodies. Indeed, scientific objectivity is contextual as the title of the book makes clear.

Agazzi defends a cumulative, but not necessarily linear, vision of scientific progress. If successive theories in a scientific discipline share operational criteria and a domain of referents, we can speak of cumulative and linear progress. Successive theories increase our knowledge about some concrete objects. However, when a new discipline such as quantum mechanics appears, progress ceases to be linear since our knowledge is enlarged to the new domain of microphysical objects.

Agazzi's way of considering scientific progress is problematic when successive theories attribute contradictory properties to the same *things*. Agazzi admits that certain scientific objects such as atoms become things when their existence can no longer be questioned. Atoms belong to the background knowledge presupposed by the community of scientists (183). But quantum mechanics attributes to atoms properties, such as entanglement, which are incompatible with the properties of classical mechanics. Agazzi would reply that these two theories clip out of *things* different properties in order to construct distinct *objects*. Yet, if the concrete objects are abstract objects exemplified in things and if things are supposed to possess the properties of the concrete objects, some things, such as atoms, are endowed with contradictory properties. To solve this *aporia*, Agazzi proposes a version of contextualism which distances him from realism.

> Do we really believe that Ptolemaic astronomy is still true, that the corpuscular theory of light was not disproved (…), that Newtonian mechanics was not disproved by relativistic and quantum mechanics, and so on? Our answer is that these theories have been disproved to the extent that they are believed to speak about 'things'; but they are still true if they are correctly judged on the basis of what they say about their 'objects'. (404)

This conclusion is unavoidable if changes in operational criteria of a theory necessarily entail that we get a new theory which speaks of new objects. By this move, Agazzi pretends to preserve a realist conception of cumulative progress which consists in the succession of theories which increase our knowledge of some objects or enlarge it to new ones.

However, as Mario Alai remarks, it is hard to maintain that the corpuscular, undulatory and quantum theories of light are all partially true given that some properties of their respective objects are contradictory (2015, 62). If the objects relative to a theory are abstract only, there is no problem. But Agazzi claims that the properties encoded by some theoretical objects are also instantiated by concrete objects and thus instantiated by real things. And a thing cannot possess contradictory attributes, unless the meaning of an attribute is reduced to its measuring operations. Agazzi, however, rejects such Bridgmanian operationalism (94).

The only way out for the realist is to develop a theory of the stability of reference through the evolution of theories which does not depend on operational procedures of measurement (Ghins 2013). Granted, we hit on external things such as electrons through operations. But the properties we attribute to them can be abandoned, modified or completed as science moves on. To progress is to know more about the properties and behaviour of things such as electrons. Today we have good reasons to believe in the existence of concrete objects which have precise values of mass, charge, spin, etc., even if those properties do not exhaust the properties of electrons and even if we might err.

Be that as it may, the conception of objectivity defended by Agazzi certainly is a major contribution to the current debate on scientific realism. Moreover, within his realist position, Agazzi also offers new insights on numerous other important philosophical issues: the relation between science and society, science and metaphysics, etc. The scope, erudition, rigour and originality of Agazzi’s book make it essential reading for all philosophers of science.

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[1] I am here indebted to Mario Alai.