DOI: https://doi.org/10.56550/d.3.1.2		Original research article
Received on: January 25, 2024	Accepted on: September 21, 2024	Published on: October 21, 2024

Niccolò Covoni
University of Urbino Carlo Bo/
Università della Svizzera Italiana
n.covoni@campus.uniurb.it

Gino Tarozzi
University of Urbino Carlo Bo
gino.tarozzi@uniurb.it

EMPIRICISM AND REALISM RECONCILED IN AGAZZI'S CONCEPTION OF SCIENTIFIC OBJECTIVITY

Abstract

Evandro Agazzi has shown the possibility of a reconciliation between logical empiricism and realism through the proposal of his conception of scientific objectivity, which replaces the notion of entity with that of object, conceived as a structured set of properties. This conception, on the one hand, has been developed from a more empiricist perspective, according to which the reality of the object is shifted to one of its predictable properties, and on the other hand, has produced his fruitful criticism of the orthodox interpretation of quantum mechanics and his demand for a realist interpretation based on the introduction of new non-classical concepts.

Keywords: scientific objectivity; logical empiricism; realism of entities; realism of properties; realistic interpretation of quantum mechanics

EMPIRISMUS UND REALISMUS VEREINT IN AGAZZIS KONZEPT DER WISSENSCHAFTLICHEN OBJEKTIVITÄT

Zusammenfassung

Evandro Agazzi hat die Möglichkeit einer Versöhnung zwischen dem logischen Empirismus und dem Realismus aufgezeigt, indem er sein Konzept der wissenschaftlichen Objektivität vorschlug, das den Begriff der Entität durch den des Objekts ersetzt, das als strukturierte Menge von Eigenschaften verstanden wird. Diese Konzeption wurde einerseits aus einer eher empiristischen Perspektive entwickelt, der zufolge die Realität des Objekts auf eine seiner vorhersagbaren Eigenschaften verlagert wird, und hat andererseits seine fruchtbare Kritik an der orthodoxen Interpretation der

Quantenmechanik und seine Forderung nach einer realistischen Interpretation hervorgebracht, die auf der Einführung neuer nicht-klassischer Konzepte beruht.

Schlüsselwörter: wissenschaftliche Objektivität; logischer Empirismus; Realismus der Entitäten; Realismus der Eigenschaften; realistische Interpretation der Quantenmechanik

***

According to Mario Alai's contributions to the special issue of the journal *Isonomia* (2009), edited for Evandro Agazzi's honorary degree in philosophy by the University of Urbino and to his *Festschrift*: *Science Between Truth and Ethical Responsibility* (2015), neo-positivism was not completely excluded from the possible forms of realism in his philosophical perspective. He, while pointing out the limits of the neo-positivist conception, stressed that it did not renounce the objectivist presupposition and the thesis of the cognitive value of science.

> The epistemology of neo-positivism, though it was deeply influenced by Mach's thought, it ended up accepting, more or less explicitly, a realist view of science. We are not interested here in discussing how coherently this could have happened: it is enough to note that such an outcome was imposed by the cultural programme of the whole movement, which was characterised by the justification of science as the only authentic source of knowledge. […] The obsession with which neo-empiricism sought to impose the most absolute fidelity to experience and the reducibility to it of the very theoretical components of the sciences can also be seen as an effort to ensure that science had a solid link with reality. (Agazzi 1986)

At a variance with this last philosophy, he assumed a more critical attitude towards scientific theories, which is as much a consequence of his claim for a substantial autonomy of philosophical analysis from scientific research, which neo-positivism seemed to lack.

Against this possibility of a reconciliation between logical empiricism and realism, however, there is the refutation given by the exponents of the former, of the main theses of traditional philosophy, regarded devoid of cognitive significance, being neither true nor false, insofar as they generally correspond to propositions of existential content which are not empirical and for which there is no method for determining their truth. The theses of realism were subjected to such a process of refutation both by Rudolf Carnap in the last part of his *Der Logische Aubfau der Welt* (1928), devoted to the elimination of the pseudo-problems of philosophy, with his argument of the two geographers and some years later, by Alfred Ayer, in his *Demonstration of the impossibility of metaphysics* (1934), presenting a similar argument, provided a refutation of metaphysical realism considered decisive. In his critical discussion of realism, Carnap considered two geographers, one a realist and the other an idealist who went on a scientific expedition in search of a mountain to be found somewhere in Africa. According to Carnap at the end of the expedition, the two scientists would have agreed about the empirical properties of the mountain, of course, if they had really found it, but their opinions would have completely differed from a philosophical point of view: whereas the realist would have maintained that the mountain had, in addition to its empirical properties, the one of being also real, the idealist would have denied the reality of the mountain assuming that only our or his own perceptions and conscious processes were real. In a similar way, Ayer supposed that after the discovery of a painting attributed by its finder to Goya some experts of art history are invited to examine the picture. The experts having also studied philosophy, do not advance only arguments in favor or against the attribution of the picture, but would raise a further point of dispute about the question of whether "the picture is a collection of ideas or rather its colours are objectively real" (Ayer 1934), according respectively to their idealistic and realistic point of view.

It followed from both arguments that the theses of realism and idealism were beyond experience and had no factual content since the question of their truth or falsity could never be posed.

On the other hand, it is true that in the English translation of the *Aufbau* (Carnap 1967), which appeared over thirty years later, Carnap acknowledged that:

> The rejection of the thesis of reality was not generally accepted. Wittgenstein has not explicitly included this thesis among the metaphysical doctrines that were to be refuted; Schlick called himself a realist and accepted my position only later; Reichenbach did not share it at all. (Carnap 1967)

Nevertheless, in his *Replies and Systematic expositions*, included in the volume in his honor edited by Schillp in 1963, Carnap stated that he was "not aware of any refutation, nor of a complete critical discussion" of his arguments. His refutation of 1928 therefore remained, in his opinion, a decisive and unsurpassable argument even many years after its formulation.

As is well known, the verificationistic theory of the meaning of neo-positivism derives from the operationalist conception elaborated by Bridgman, starting from Mach's program of eliminating metaphysics from physics, which had led to the foundation of Einstein's relativistic theories by the rejection of the concepts of absolute space, time, and simultaneity. The operationist doctrine, according to which the meaning of a physical and scientific concept is completely determined by the methods for its measurement, was transferred by neopositivists from the concepts of physics to the principles of philosophy through their principle, which identified the meaning of a statement with the possibility of its verification.

Now, as we shall see, the objectivist conception of Agazzi has its roots in a similar empiricist instance, assuming that the connection between knowledge and reality is guaranteed by the operational character of the relationship between subject and reality.

His analysis begins with the problem of determining whether an objective value can be attributed to a scientific theory, an idea of which he distinguishes three different meanings: "objectivity as intersubjectivity, as invariance and as correspondence to objects" *(*Agazzi 1969). He shows, through a rigorous analysis (Agazzi 1969 and 1979), that these three meanings can be identified.

The assumptions that make it possible from an epistemological point of view the coincidence of intersubjectivity, invariance, and correspondence to objects are essentially three.

1) The operationalist foundation of scientific concepts and the fact that, although they are based on operations, they cannot be reduced to a purely operationalist dimension;
2) the observation that the meaning of scientific concepts is essentially contextual;
3) the fact that scientific objects, constituted by properties objectively established by operations, do not represent a mere aggregate of properties but a well-defined structure of relations between these properties.

As we shall see, these three points are most closely related, especially in the case of those scientific concepts that are expressed by the so-called theoretical terms, i.e. those terms which are not directly observable. Let us briefly analyze each of these points.

Scientific theories are constructed on the basis of theoretical terms, but their purpose is to provide explanations of facts of immediate experience that can be described in empirical (or observational) terms. This raises the problem of how to ensure that theoretical concepts can maintain a link with empirical ones (Agazzi 1969). According to Agazzi, "a theoretical concept such as 'electron' is a theoretical construct around which we group many operationally definable properties" (Agazzi 1969). And it is precisely this operational aspect that allows theoretical concepts to maintain contact with experience and thus to have a physical meaning (Agazzi 1997). However, such theoretical terms cannot be reduced to operational terms that directly denote spheres of action:

> …we do not even dream of saying that theoretical concepts can be reduced to operational concepts: whoever would claim this would be doing exactly the same as whoever would claim to reduce the house to the bricks that make it up. (Agazzi 1969)

The various combinations of empirical (operational) terms give rise to constructs (the theoretical terms) which are themselves no longer directly operational. This point provides the philosophical basis for being able to attribute physical reality to an object, even if not directly 'observable' or measurable, that is, even if it cannot be directly defined in operational terms. However, it will be necessary to be able to associate this theoretical entity with some detectable property.

From what has just been said, it follows that the meaning of theoretical concepts is always contextual.

> Is not equivalent to saying that the physical meaning comes to them from the observational terms thanks to a context […] but comes precisely from the context in which the observational terms are present, but not by themselves, since the context is made up, authentically, also of all the logical and mathematical connections that link together the various concepts, observational and otherwise. (Agazzi 1969)

The context in which theoretical terms take on a definite meaning is nothing other than the theory in which they appear and which they help to constitute. Only the theory as a whole can be interpreted empirically and, thus, can be related to possible observations.

As we have already mentioned, scientific objects denoted by theoretical terms present themselves as relational structures of operationally definable properties, which nevertheless cannot be completely reduced to such properties. This last assumption is closely linked to Agazzi's conception of the contextual character of theoretical terms:

> ...the object is always a structure, a structure of relations, most of which may be the result of operations, but whose 'being together' cannot be justified by any operation, even if it were objectively ascertainable. (Agazzi 1969)

Now, the attempt to reconstruct this structure is precisely the main task of scientific theories, since

> ...the structure is not what 'lies beneath' the experimental determinations and objectifiable characteristics but is what is constituted by them: it is, precisely, the object. (Agazzi 1969)

On the other hand, it is precisely this structure that makes the world what it is, and this means that our theories, as attempts to reconstruct this structure, can be wrong in so far as they assume a structure that is not that of the world or of the universe of objects that constitute the domain of the theory.

This conception of scientific objectivity had a profound influence on the research into the foundations of quantum mechanics, which one of the present authors had initially undertaken from a logical empiricist perspective; this had led him to try to prove the meaninglessness of realism by showing the redundancy of the EPR principle of physical reality in the proof of the famous paradox and of Bell's theorem. Since philosophical principles were meaningless according to the logical empiricists, it should not have been possible to derive testable or confirmable empirical consequences from the assumption of one of them, or at least its elimination would have led to the same conclusions. These attempts led unexpectedly to the opposite result, showing that the EPR principle of reality was a necessary condition both for deriving their paradox (Tarozzi 1981) and for proving the theorem (Tarozzi 1980-81). This principle, as is well known, identified predictability with certainty through the very mathematical laws of quantum mechanics, which corresponds to a strong form of scientific objectivity, with a sufficient condition of reality, just as Agazzi had argued in his *Philosophy of Physics*, where he stated that

> ...the position of correct realism is [...] that which sees a relation of inclusion between the objective and the real: everything that is objective is real, even if not everything that is real is objective. (Agazzi 1974)

Now, since predictability refers to the properties or attributes of an object, and not to the object itself (and not even to the existence of an object, since, as Kant had already pointed out before the neo-positivists, existence is not a property of an object), a radicalization in an empirical sense of Agazzi's position led to a form of property realism capable of satisfying the requirements of factual meaning of neo-positivism.

This profound convergence and consonance between property realism and his scientific objectivism was already evident in its original formulation

> …when we assert the reality of the predictable attributes or properties of an object, we maintain implicitly also the reality of the object itself, assuming once more a shape of independence of our perceptions. (Tarozzi 1980)

And was later confirmed by Agazzi himself:

> …two comments that we want to propose about the issue of the realism of properties will shorten very much its distance from a form of entities realism, by dissolving the ambiguity inhering to the concept 'entity' itself. The first step will be the replacement of the term 'entity' by the term 'object' […] in such a way that it consists in a 'structured set of properties', and from this follows the consequence that attributing 'reality' to properties amounts to attributing reality to the object as well. (Agazzi 2014)

The doctrine of scientific objectivation has had other important consequences in the debate on the foundations of quantum mechanics, since many problems in the interpretation of this theory arise from the attempt to apply concepts derived from classical physics to the objects of quantum mechanics, like in the case of the wave particles dualism, whose solution cannot consist, according to Agazzi's point of view, in some combination of the classical concepts of particle and wave, in contrast of the contextualistic character of theoretical concepts:

> Not only can we, but we must say that 'it is not the same particle', 'it is not the same wave' that is spoken of in classical mechanics and quantum mechanics, because the contexts are different. (Agazzi 1969)

Hence the need to search for truly new concepts to overcome the open problems in the interpretation of quantum mechanics.

> New not only, as is already the case, by the mere fact of resulting from the combination of classical concepts in a new way, but even by the fact of replacing all or part of these classical 'components' with something truly new. (Agazzi 1988)

In the history of quantum mechanics, there have been remarkable attempts, clearly influenced by this sharp philosophical analysis, to satisfy this need, which have led to various proposals for experiments aimed at detecting the properties of these new concepts. We are referring in particular to the concept of empty or quantum wave (Selleri 1969 and 1971). Agazzi endorsed this proposal, as based not only on the rejection of Bohr's complementarity, and to its contradictory mutually exclusive recourse to the classical particle or to the wave-like representation, but also on the improvement on the de Broglie semiclassical theory of the pilot wave, coexisting and endowed of the same level of reality of the (piloted) particle.

> The essential novelty of this concept is represented by the acceptance of the de Broglie realist interpretation of the wave-particle duality but not of the symmetrical nature of this dualism. In Selleri's approach both particles and waves are simultaneously real, but the latter can be characterized only with relational properties with the particles: the observables properties of producing interference and stimulated emission. Such a possibility would imply an ontological priority of particles over waves, which would therefore belong to a weaker level of physical reality, containing objects which are sensible carriers of exclusively relational predicates. (Agazzi 1988)

References

- Alai, M., Buzzoni, M., and Tarozzi, G., eds. (2015). *Science Between Truth and Ethical Responsibility: Evandro Agazzi in the Contemporary Scientific and Philosophical Debate*. Springer, Berlin.
- Alai, M. (2009). "Il realismo di Evandro Agazzi", in *Il realismo scientifico di Evandro Agazzi*, *Isonomia*, special issue ed. by M. Alai, pp. 77-96.
- Agazzi, E. (2014). "Realism of properties and realism of entities" in *Gino Tarozzi Philosopher of Physics*, V. Fano ed., Franco Angeli. Milan, pp. 22-32.
- Agazzi, E. (2014) *Scientific Objectivity and Its Contexts,* Springer, Berlin.
- Agazzi, E. (1997). "Thought and ontology: the meaning of a correlation", in *Thought and ontology*, M. Sainsbury ed., Franco Angeli, Milan, pp. 13-22.
- Agazzi, E. (1988). "Waves, particles, and complementarity", in *The Nature of Quantum Paradoxes: Italian Studies in the Foundations and Philosophy of Modern Physics,* G. Tarozzi and A. van der Merwe eds., Kluwer, Dordrecht, pp. 53-74

- Agazzi, E. (1979). "Proposta per una nuova caratterizzazione dell'oggettività scientifica", in *Problemi di epistemologia contemporanea,* E. Agazzi ed, Itinerari, Lanciano, pp. 31-61.
- Agazzi, E. (1969). *Temi e problemi di filosofia della fisica,* Manfredi, Milan.
- Ayer, A. J. (1934). "Demonstration of the Impossibility of Metaphysics", *Mind*, 171, 43, pp. 335-345.
- Carnap, R. (1967). *The Logical Structure of the World*, University of California Press, Berkeley.
- Carnap, R. (1963). "Replies and systematic expositions" in *The philosophy of Rudolf Carnap,* P. A. Schilpp ed., Open Court, LaSalle.
- Selleri, F. (1971). "Realism and the Wave-Function of Quantum Mechanics", in *Foundation of Quantum Mechanics*, B. d'Espagnat ed., Academic Press, New York.
- Selleri, F. (1969). "On the Wave Function in Quantum Mechanics", in *Lettere Nuovo Cimento,* 1, 17, pp. 908-910.
- Tarozzi, G. (1981), "On the essential Role of the Realist Hypothesis in All Derivations of EPR-Type Paradoxes", *Epistemologia,* 4, pp. 407-422.
- Tarozzi, G (1980-81), "On the Relevance of the Realist Assumption in the Proof of Bell's Inequality", in *Mem. Acc. Scienze, Lettere e Arti di Modena*, 6, 22-23; pp. 80-86.
- Tarozzi, G. (1980), "Realism as a meaningful philosophical hypothesis", in *Mem. Acc. Scienze Bologna,* 13, 7, pp. 89-98.