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Science's Voice of Reflection

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Historical epistemology as a meta-reflection between science and philosophy

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*“The most incomprehensible thing about
the world is that it is comprehensible.”*

Albert Einstein

1 Theoretical premise: critical rationalism and the teachings of Banfi

1.1 Kant and the discovery of the transcendental

The fine and acute scholar Mario Dal Pra once observed that speaking of the theory of reason developed by Banfi entails making reference to some of the “most solemn voices in the whole tradition of thought”. In fact, in Banfi’s masterpiece *Principles of a Theory of Reason* (hosted and published in 1926 in the collection directed and promoted by Banfi’s mentor, Piero Martinetti), it is explicitly evident that Banfi’s critical rationalism coincides “substantially with a unitary critical rethinking of Kantianism and Hegelianism”.¹ Reference to Kant implies, of course, the reference to the “critical problem” especially addressed by Kant, with the critical warning, however, that “if the critical problem is the soul of Kantian philosophy, the discovery of the transcendental is the soul of that soul.”

Transcendentalism, therefore, as a discovery and critical-epistemological awareness that human knowledge never constitutes an absolute unveiling of reality as such, but rather consists, if anything, in the strenuous and never guaranteed conquest of an objective knowledge which is developed and established, to say it with Husserl, within a precise, always delimited and circumscribed, “ontological region”, within which knowledge is constructed by intertwining the principles of pure rationality with the complex plane of experimental verification. From this hermeneutic perspective, the Kantian transcendental coincides exactly with the well-known “Copernican revolution” expressly thematised and claimed as its own achievement by epistemological criticism, since every “reality” to which a physical theory cognitively

¹M. Dal Pra, *Kantismo ed hegelismo in Banfi* in Autori Vari, *Antonio Banfi (1886-1957)*, Reports of the conference *Antonio Banfi: le vie della ragione*, University of Milan, 28 February 1983, Edizioni Unicopli, Milan 1984, pp. 21–35; the quotations that appear in the text are taken, respectively, from p. 21, p. 23; p. 24, pp. 25–26. On the work of Dal Pra within the “Milan school”, see *Mario Dal Pra nella “scuola di Milano”*, edited by F. Minazzi, Mimesis, Milan-Udine 2018.

refers has never to do with a mythical unrelated and absolute reality (that is, free from any constraint), but is constructed - and constituted - within a precise and finite theoretical context, with respect to which knowledge is always structured in the light of certain experimental procedures of verification. In short, to put it differently, according to the approach of Kantian criticism, human knowledge is always and only constructed within precise theoretical and experimental constraints.

For this reason, the Kantian discovery of the transcendental implies a decidedly and programmatically anti-metaphysical position, by virtue of which human knowledge relinquishes its aspiration to be able to establish absolute and metaphysical knowledge, at the same moment when it instead gains an objective knowledge which proves to be such only and within the limits defined by a given theoretical apparatus and in dialectical connection with an equally defined and precise experimental apparatus. Just this phenomenal knowledge generates the possibility for human beings of achieving some objective knowledge through which they begin to know, in a finite and always partial way, the world in which they live. As Dal Pra writes,

the discovery of the transcendental is in essence the discovery of reason itself; in fact it is not the world of knowledge grasped in its infinite contents, in the endless multiplicity of its data, but identified as the result of the working of the form of that structure of which the germ of reason itself seems to properly consist.

Which naturally leads Kantian critical rationalism along a very specific path, the one in which knowledge can only be configured as a task that is always open, critical and procedural, never definitive, programmatically anti-metaphysical precisely because it is able to rediscover an internal “critical metaphysics” constitutive of all objective knowledge.

1.2 How can we think about reason from a historical perspective?

For this theoretical reason, Banfi, explicitly referring to the Hegelian lesson, thinks that it is also necessary to have the ability to grasp and historically understand “also the universal principles” of the theory itself, since it is necessary to know how “to think of reason historically. If therefore reason is form according to Kant, it is also in Hegelian terms a structure constructed over time” (my italics). To understand this intrinsic dynamism of rationality, Banfi thus looks, with decidedly Hegelian eyes, at the fruitful Kantian transcendental dialectic, having the ability to understand how Kantian ideas do not represent in the least an object given and codified, but constitute “the line of a rational process”, always open and integrable. If indeed Kantian ideas express, according to the classic and traditional Kantian formulation of the Critique of Pure Reason, “the aspiration to the totality

of the conditions of a given conditioned”, thus by configuring an evident metaphysical impossibility (which, in the illusory transcendental dialectic, ends up, in fact, passing off as “absolute” a knowledge that is in reality always circumscribed and finite), it is therefore necessary to associate, as can be deduced from the Hegelian lesson, the Kantian concept of limit with the idea itself. In this way, Dal Pra observed with great exactness,

the concept of limits reinforces in a certain way the concept of idea, in the sense of opening it towards a reference to what goes beyond it; and if we take into account that already the concept of the idea does not represent an object, but ‘the line of a rational process’, the concept of the idea-limit reaffirms, so to speak, within the same line of the rational process, the reference to the further development of the process itself, its further tension. In short, the concept of the idea-limit strengthens and consolidates the process and removes any dogmatic limit from it.

In this way, the intrinsic critical processuality of knowledge is placed in the heart of Kantian criticism itself, making it possible to delineate a critical, problematic and open rationalism, which in this singular intertwining of Kantianism and Hegelianism, is actually capable of going beyond the lesson of the two great classic German philosophers, in order to delineate a new and more plastic, problematic, critical and hermeneutic horizon. Precisely this new and fruitful horizon constitutes, at the same time, the theoretical program² of philosophical, cultural and civil research inaugurated by Banfi’s teachings in the context of the European culture of the first decades of the 20th century.

1.3 Banfi and the pure theoretical significance of knowledge

In this way the double critical fusion of Kantianism and Hegelianism successfully performed by Banfi in *Principi di una teoria della ragione* (*Principles of a Theory of Reason*) to outline his new critical rationalism, extends, as Dal Pra wrote,

²Regarding the critical use of the term “theoretical”, often used by Banfi in a declaredly programmatic way, it should however be remembered that, not many years ago, there was a preliminary, dogmatic and programmatically uncritical resistance in the university of Milan often expressed with arrogance and remarkable verbal violence, by some exponents, then *à la mode*, of the so-called new epistemology (Lakatosian and/or Feyerabendian) of Popperian inspiration. According to them, in reality, there would not be any “theoretical” dimension because everything would be reduced only to the “theory”. In which we can feel, already on a lexical level, the intrinsic theoretical poverty of these traditional “sunflowers of philosophy” (to say it with the philosopher Erminio Juvalta). Since I graduated in the early eighties of the last century with Giulio Giorello on the immanent procedural transcendence of knowledge, I have had to defend the permissibility of the usage of the term “theoretical” which was systematically dismissed and usually replaced (in a clearly erroneous way) with “theory”...

the horizon of reason beyond the limits marked by Kant, accentuating its procedural disposition, beyond any closure, both psychological-subjective and historical, and moreover in the sense of consolidating its function and autonomy.

For this precise theoretical reason Banfi began in his *Principles* by stressing that knowledge should be understood

in its pure theoretical meaning, as mere knowledge, or, if we want to proceed to the determination and transcendental analysis of the idea of knowledge, as a law for which in every concrete cognition, the infinite task of theoreticality is immanent, as the synthesis of certain elements.³

For this same reason too, Banfi could then state that his theoretical research is and remains authentically

transcendental, and the actuality of knowledge, the ways of its concrete determination in the plans of experience became for [him] a problem that presupposed the transcendental analysis of the idea of knowledge, but cannot be resolved by it, since for a solution it required rather a previous recognition of the nature of theoreticality, its relationship with reality, and, specifically, with the spiritual reality to which facts and cognitive relationships belong.

The concept of the transcendental is therefore assumed here by Banfi in the precise sense imposed and deployed by the famous “Copernican revolution” inaugurated by Kant with the discovery of the transcendental as a “moment of autonomous legitimacy which founds the unitary structure of experience and is independent of its determined aspects.”

But at the very moment when Banfi referred to the critical heart of Kantian transcendentalism, he nevertheless accentuated, as mentioned before, “the transcendental analysis of the idea of knowledge itself”, developing, on the one hand, the typical direction of rationality and denouncing, on the other hand and at the same time, the traditional dogmatism that absolutises the different constituent moments of the transcendental structure. For this reason, in Banfi’s analysis, knowledge is

considered and subjected to a transcendental analysis in its pure conception, with respect to the universal law according to which it dominates and give sense to the relationships and aspects in line with which it intersects with the reality of spiritual life.

³A. Banfi, *Principi di una teoria della ragione*, Editori Riuniti, Rome 1967, p. 8, while the quotations that follow in the text are taken from the following pages respectively: pp. 8–9; p. 11; p. 13; p. 19; p. 20; p. 21; p. 23; p. 40; p. 44.

The dual structure of the subject-object antinomic relationship itself, which structures the idea of knowledge, thus represents for Banfi not an original datum of consciousness, but a product of his own critical procedural investigation:

the subject-object relationship is not given originally to consciousness; it develops rather and rises more and more clearly as the theoretical sphere and the cognitive activity gain autonomy in cultural self-awareness.

Also in this case Banfi is not interested in defining knowledge according to one of its different and multiple phenomenological positions, since his aim is, if anything, the opposite, to investigate and critically clarify knowledge by fully bringing out “its pure universal theoretical structure, its typical formal relationship”, enabling us to understand how “the transcendental character of the subject-object gnoseological relationship, makes it absolutely correlative in nature”, since “subjects and objects are not such according to their being determined, or to a content that characterises them, but only as a function of their correlation, of the unity itself which is precisely knowledge”: “this pure relationship of subject-object correlation, this transcendental synthesis of the two terms constitutes the essential form or the idea of knowledge.”

1.4 Banfi and the transcendental law of knowledge

In short, this correlation constitutes

the transcendental law of knowledge, which dominates and directs the infinite process and development of the action of knowing”. Therefore the subject-object gnoseological relationship does not constitute the expression of an empirical or metaphysical order, because, if anything, “in the transcendental synthesis of the two terms, for which these have their pure gnoseological value, it expresses the theoretical requirement that characterises knowledge and that constitutes the law of its development in its various aspects.

On the other hand, these two antinomial moments of knowledge, precisely because they always take root on an open plane of immanent procedural transcendental, refer to a plurality of ideal correlations that

can only be valid as transcendental moments. Transposed into reality, on this plane, their own ideal unity becomes the principle of their irreducible antithesis. This typical situation can be defined as the universal problematic of knowledge.

Consequently, Banfi’s critical rationalism starts from the radical, inspirational, Kantian and Hegelian theoretical assumption, according to which

“the problematic nature of every knowledge appears here as the law of its infinite development”. This allows us to understand the intrinsic critical radicality of Banfi’s perspective which broke with all absolute metaphysical rigidity, while re-proposing the intrinsic problematic nature of knowledge as such, underlining its intrinsic *Copernican* character, because within this critical-transcendental perspective it is no longer possible to “naively and metaphysically” explain the extent of knowledge on a plane of purported absolute domains. Banfi specifies that:

the formula of truth as *adaequatio intellectus et rei* expresses precisely this need, but as long as the *intellectus* remains such and the *res* remains *res*, i.e., determined on the basis of extra-cognitive relationships, their relationship cannot be simplified ingnoseological *adaequatio*, that is, in the cognitive synthesis, but rather represents an unsolvable alterity. Moreover this *adaequatio*, which is inconceivable as long as the intellect and the thing are considered as concrete and absolutely determined aspects of reality and knowledge as a concrete relationship occurring between them, takes place in the process of knowing itself, as a transcendental synthesis, in which the two terms resolve, in the theoretical form, their being in themselves, in order to be valid as the two ideal poles, in whose relationship the cognitive relationship develops and the transcendental form of theorecticality extends to the whole content of experience.

In the cognitive relationship, the subject-object synthesis thus constitutes an ideal immanent law and an infinite term of a process that is always critically open. Kantian criticism, thanks to the Hegelian lesson, is therefore radically historicised and open to the processuality of historical knowledge, while, on the other hand, Hegelianism, thanks to the Kantian formalism concerning the transcendental structure of knowledge, is instead critically problematised on the level of mere formality which, in fact, structures every possible knowledge, every *logos*.

1.5 Banfi and the intrinsic problematicity of knowledge

In this theoretical perspective connected with the transcendental principle of knowledge, the two ideal poles of subject and object, of ego and of particular objects are not then taken

as a fundamental dogmatic presupposition, but simply as they are, given relatively in experience. All knowledge presupposes precisely a being given of a mutual determination of the two terms: the ego and things are among themselves in a system of relationships that can be the system of physical reality or that of cultural reality, or rather it is both the one and the other at once, and in this intertwining they are mutually determined.

Therefore, at least in concrete and effective knowledge, variously codified within a specific and particular technical-cognitive heritage, the specific determination of the two correlated extremes of subject and object

dissolves, and is in principle dissolved, and therefore concrete knowledge is the recognition and development of their full relativity, which in the theoretical sphere extends to its universal form.

The conclusion of this critical-rationalist approach can only be identified in the underlining of the *intrinsic problematicity of knowledge as such*:

The problematic nature of knowledge thus expresses, in each particular act of knowing, the immanent transcendental of the theoretical synthesis, which turns knowledge into an infinite process and does not allow it to stabilize and exhaust itself in a particular relationship between aspects determined by experience. And, precisely because this problematicity does not allow the determined positions of reality, and their partial and determined relationships, to be considered as absolute, it is the formal condition for highlighting the complexity of the relationship structure of reality and this results in a system of relationships theoretically detectable. In other words, this problematic nature of knowledge is the only guarantee of the universal development of the theoretical sphere, because every limitation to the theoretical sphere is stated as problematic, as a function of particular data of experience.

2 The neo-positivist epistemology and its image of rationality

If one considers the overall epistemological debate of the twentieth century, one cannot deny that the tradition of logical empiricism, which arose firstly from the lesson of the *Wiener Kreis* developed from the teachings of Moritz Schlick and of his best known and most valid collaborators (from Rudolf Carnap to Friedrich Waismann, from Otto Neurath to Hans Hahn and Philipp Frank, not to mention, then, the original position of Hans Reichenbach, etc.), ended up largely by characterising the philosophical reflection on science in the past century.⁴ As is known, the original Viennese

⁴In this regard, we can naturally think of the classic Viennese “manifesto” of neo-positivism, *The Scientific Conception of the World: The Vienna Circle* (Ernst Mach Society, 1929) authored by Hahn, Neurath and Carnap et al. (Italian edition edited by Alberto Pasquinelli, translated into Italian by Sandra Tugnoli Pattaro, Laterza, Rome-Bari 1979), which can be read together with the interesting and emblematic text by Moritz Schlick, *The Vienna School and Traditional Philosophy*, in Moritz Schlick, *Philosophical Papers*, Vienna Circle Collection 11/II, edited by H.L. Mulder and B. F. B. van der Velde-Schlick, Reidel, Dordrecht, Boston and London (1979) pp.491-498. Italian version: *La scuola di Vienna e la filosofia tradizionale*, curated by Federico Filippo Fagotto, La Tigre di carta-La Taiga, Milan 2019, which helps to better position the neo-positivist research program in relation to the previous western philosophical tradition.

approach owed much, in its turn, to the *Tractatus Logico-Philosophicus* by Ludwig Wittgenstein, which in the Viennese context, however, was largely misinterpreted. The basic intent of Wittgenstein's powerful masterpiece was in fact rooted in a very precise ethical (and metaphysical) conception that its author expressed well in the seventh proposition, which symbolically concludes the *Tractatus*: "Whereof one cannot speak, thereof one must be silent." Precisely in relation to this closing sentence, which was both peremptory and emblematic, the neo-positivists ended up by misinterpreting its metaphysical and philosophical meaning. In fact, the Viennese thinkers believed that with this affirmation Wittgenstein wanted to abolish and also cancel the possibility itself of referring to the ethical, moral and metaphysical dimension which had to be necessarily confined to the context of the "silence" with respect to which, in fact, we cannot say anything. And precisely for this reason from their neo-positivist perspective it had to represent a secondary dimension to be neglected programmatically. Thus of the *Tractatus* the neo-positivists retained above all that authentic "war machine" with which Wittgenstein had divided sentences into two classes: the significant and the insignificant (coinciding with pseudo-sentences). The former, as is well known, were divided, in turn, into two other subsets: on the one hand, the one formed by analytic propositions (typical of logic, mathematics, algebra and, more generally, of all disciplines based on deductive inferences) which were reduced precisely to tautologies which were true by virtue of their logical form; on the other hand empirical or synthetic propositions that to be true, since they refer to the world, must undergo a rigorous verification process capable of confirming them and, precisely, of "verifying them". The famous verificationism of the Vienna Circle, a scandal and torment for the classical metaphysical tradition, precisely because it was presented by the Viennese neo-positivists as a sort of actual "philosophical club" with which one could quickly silence any other metaphysical tradition (as well as any potential opponent to neo-positivism) is rooted in the "epistemological war machine" built by Wittgenstein in his *Tractatus*, which for this very reason was then revered by Viennese thinkers as their true Bible. However, as Wittgenstein himself also came to realize at a certain point, things seemed much more complicated and intricate than the "happy" epistemological war machine of the early Viennese neo-positivism suggested. From this particular point of view the history—truly emblematic—of logical empiricism, considered in all its phases and in all its very fruitful movements, would finally mature in the "American phase" of this movement of thought, which would find its emblematic expression in the *International Encyclopedia of Unified Science*, (Chicago, 1938). But the history of this movement of thought can be correctly made to coincide precisely with the three different formulations of the verification princi-

ple formulated by neo-positivists.⁵ Logical empiricism thus passed from a “narrow” formulation of the verification principle which distinguished the *Wiener Kreis* of 1928, to his first “liberalisation” which coincides substantially with Carnap’s physicalism (1936-37), and then it reached the phase of “broad” empiricism, which characterised the American developments of this movement during the post-war period. Through this fruitful development of continuous critical analysis

logical empiricism snapped many hoops of the metaphysical barrel in which it had been sealed by the positivism originating with Mach or Russell or Wittgenstein. The relation between theoretical discourse and experience became more dynamic and therefore more fluid: the fruitful tension between syntax and factuality, which constitutes the truly progressive element of science, received its first recognition in theory; it paved the way for the elaboration of the logical techniques for the languages of the empirical sciences.

In other words, with the strict rethinking of the verification principle, the neo-positivists begin to realise, epistemologically speaking, that between heaven and earth there are more things than they initially imagined. If in fact in the initial phase of the *Wiener Kreis* they had been lulled in the (metaphysical!) dream that all scientific statements could be reduced, without unaccounted residues, to the verified “facts”, in the second half of the 1930s, neo-positivists began to realise that the relationship between statements and verification is more complex than they had previously imagined. In the American phase, this critical awareness is articulated even further without, of course, ever abandoning the privileged empiricist horizon of reference. In this regard, Preti rightly observed that

the new logical empiricism responds by further ‘liberalising’ the preceding empiricism making it even more markedly empirical. It takes to an extreme the dual conception whose seed had been sown by Reichebach and which Neurath had also glimpsed in his dispute with Schlick. Every scientific discourse consists, or may consist when it achieves a certain ideal of rigour, of an uninterpreted system of deductive symbols and an interpretation that establishes a correspondence, or rather an association, of at least some statements of the theory (which could be taken as the set of the consequences of the theory), and therefore usually of at least some concepts of the formal system. These concepts are normally not primitive but complex

⁵From this point of view, the critical examination carried out by Giulio Preti in his acute essay is still emblematic. *Le tre fasi dell’empirismo logico* (*The Three Phases of Logical Empiricism*) appeared originally in Mario Dal Pra’s journal “*Rivista Critica di Storia della Filosofia*” (year IX, January–February 1954, fasc. I, pp. 38–51) and subsequently re-issued in G. Preti, *Philosophical Essays*, edited by Fabio Minazzi, translated by R. Sadleir, Peter Lang, Brussels, 2011; quotations appearing in the text are taken respectively from pp. 176–177, from p. 177 and from p. 178.

conceptual formations within the system, with empirical statements, in their turn consist both of predicates of observation and empirical constructions (protocols). What in this way becomes ‘testable’ is the whole system: its fertility in explanations, applications, forecasts—in a word, its operativity, by which the system itself stands or falls. Needless to say, no system is absolute or definitive. The empiricist is well aware of this, and his concern is to ensure the indefinite progressiveness of knowledge rather than to attribute some supposedly absolute value to it.

In short: in the first phase of the Vienna Circle, for neo-positivists a statement makes sense if and only if, in principle, it is verifiable. In the second stricter phase, an utterance turns out to be meaningful if and only if, in principle, it is interpretable, that is translatable, through some operations, into an observational statement. Thirdly and finally in the American “liberalised” phase of neo-positivism, it is stated that a theory has its own factual sense if and only if, again in principle, a particular set of statements (that is, the set of its consequences) is associated with a set of observational statements. Naturally between these three different formulations of the verification principle there are also precise logical connections, since the third formulation implies the previous two as its particular cases, while the second version also includes the first formulation as a much more delimited and circumscribed case. From this point of view, observed again Preti,

we have come to distinguish *more or less* three degrees of *empirical certainty* which in some sense parallel the ‘degrees of rigour’ that some contemporary mathematical currents distinguish in mathematical propositions.

But, Preti adds conclusively,

note that in spite of the empirical requirement, our discourses should ultimately relate to empirical observations and operations, and that they find only in them any value as factual knowledge—this requirement, I say, remains unchanged through all these phases. By giving way to these enlargements of the field of admissible scientific discourses, empiricism has not denied itself—it has only become gradually more ... empiricist.

3 Hempel and the epistemological dissolution of logical empiricism

However, it could be objected, this sort of fruitful and progressive “critical maturation” of empiricism was achieved also by challenging the “metaphysical nucleus” of the great tradition of empiricism, that is, its utopian desire of being able to reduce, *without residues*, the theoretical statements

on a factual plane. Certainly the reference to the dimension of actuality is always very present - and on this point Preti is completely correct to observe how logical empiricism became increasingly ... empiricist; however, the empiricism we are now considering was profoundly different from the factual horizon to which the *Wiener Kreis* initially referred. But in what was it different? Exactly in the awareness that the mythical verificationist principle, which initially was employed to attack traditional philosophy and, in particular, metaphysics is, actually, mythical. Against this mythology of empiricist derivation, a very different and much more sophisticated epistemological and philosophical awareness was developed. This was well expressed by Carl Gustav Hempel, who in *Fundamentals of Concept Formation in Empirical Science* (1952) and *The Theoretician's Dilemma* (1958) has managed to understand

concept formation in science cannot be separated from theoretical considerations; indeed it is precisely the discovery of concept systems with theoretical power which advances scientific understanding; and such discovery requires scientific inventiveness and cannot be replaced by the certainly indispensable but also doubtless insufficient—operationist or empiricist requirement of empirical import alone.⁶

In fact, thanks to this mature reflection by Hempel, the tradition of logical neo-positivism came to unveil the fundamentally twofold nature of the scientific undertaking, fully realising—on a purely epistemological level—

that an interpreted scientific theory cannot be considered equivalent to a system of propositions, whose extralogical constituent predicates are all either observational terms or obtainable from such predicates through reductional propositions: *a fortiori*, no scientific theory is equivalent to a finite or infinite class of statements describing potential experiences.

In short: science must naturally take into due and fundamental consideration the empirical dimension and the horizon of experimental verification as well as that of its possible experimental falsification. However this level, although indispensable, does not completely explain the intrinsic complexity of the scientific enterprise which, to unfold and develop, it also requires *ideas, thoughts* as well as the ability to know how to build abstract theories through which we are able to try to improve the knowledge of the world in which we live. Which, however, after more than three centuries of almost undisputed epistemological domination of modern empiricism (from Hume's formulation to the neo-positivists' development) leads us, paradoxically, to rediscover the Galilean roots of scientific knowledge that Galilei had

⁶Carl G. Hempel (English edition), *Fundamentals of Concept Formation in Empirical Science*, University of Chicago Press, Chicago 1965, p. 47, while the quotation which follows in the text is taken from p. 37.

well identified and clarified in his methodological masterpiece, *The Assayer* (1623) in which he rightly insisted on highlighting how scientific knowledge arose from the critical intertwining of “sense experiences” and “necessary demonstrations”.

Exactly within this complex and articulated dual perspective, within which the technical-experimental dimension always plays its own precise and indispensable role, scientific knowledge is thus built, which, if it cannot disregard the experimental verification or falsification procedures, on the other hand also needs the ability to build theories *ex suppositione* precisely because the mathematical scientist (*filosofo geometra*),

must always be capable of ‘deducing’ the material hindrances, but to do so he must also be able to *think* the world by building scientific theories which enable him to discern significant aspects of a reality which, in itself, has also its own specific ‘deafness’ that critical intelligence must know how to penetrate in a fruitful way.⁷

Hence from this critical perspective the continuous development of the principle of empirical verification produced by logical neo-positivism can also be configured as a process by which this tradition of thought, as it managed to elaborate an increasingly sophisticated and critical epistemological reflection, compromised, however, the very foundations of its epistemological research programme. In this way, paradoxical as it may seem, the progressive critical maturation of logical neo-positivism ended up by coinciding with its own self-dissolution. In other words, it is precisely the underlying theoretical honesty of this movement of thought that ultimately determined its overall disappearance from the horizon of contemporary philosophical reflection. For what reason? Precisely because, as has been mentioned, this movement, by elaborating three different increasingly critical and sophisticated formulations of its verification principle, finally came to understand—through Hempel’s reflections—that the verification principle itself, which was the fundamental tool for grasping the very essence of the scientific enterprise proved to be a blunt instrument. And albeit not useless, however, it required a profound change in its epistemology. Within this dramatic, purely theoretical (and constitutive) dilemma, neo-positivism thus ended up by dissolving itself at the very moment when it comprehended and criticised the limits of its own innovative and original research programme. This is also what constitutes, of course, the nobility and the undoubted theoretical greatness of this movement of thought, which constantly analysed, in depth and critically, its own point of view, and finally developed

⁷On the complex and articulated epistemological conception of scientific knowledge developed by Galileo Galilei, I may be permitted to refer to my volume *Galileo “filosofo geometra”*, Rusconi, Milan, 1994, in which I have analytically discussed many Galilean pages in which Galilei shows that he devised a sophisticated critical-epistemological vision of our knowledge of the world.

also the theoretical power to dissolve it in order to recognise the specific complexity and autonomy of the cognitive problem addressed. If we now look at the whole extraordinary critical parable—both from a historical and a theoretical point of view—of neo-positivism, we cannot, however, avoid asking a decisive question: what was the idea of rationality adopted by the philosophers of the Vienna circle? A question that naturally leads us to face the same problem also with regard to the reflection of Wittgenstein and Russell. Now, considering only the *Tractatus*, one has to investigate what conception of rationality Wittgenstein defended and proposed within the theoretical construction of his work, whose qualifying theses are almost “nailed” (almost “by oracular force”) to the admirable overall texture of his masterpiece. Well, if we approach Wittgenstein’s work from this particular point of view, it is easy to understand how the author of the *Tractatus* leaned towards a substantially algorithmic image of rationality. An algorithmic image of rationality which systematically reduced it to the formal and specific dimension of the logical form of tautology. In this logical-mathematical view of the rationality clearly derived from Russell, what is absolutely lacking is precisely the intrinsic plasticity of human reason. There is really no trace of this plasticity in the *Tractatus*, which, consequently, reflects a deeply weakened and impoverished idea of human reason, so much so that for Wittgenstein in science there is nothing mysterious, complex and extraordinary, since in his opinion in the field of science if a problem can be posed then its solution must necessarily be found. As Wittgenstein himself wrote in proposition 6.5 of the *Tractatus*

for an answer which cannot be expressed the question too cannot be expressed. The *riddle* does not exist. If a question can be put at all, then it can also be answered.

For this precise reason, Wittgenstein also declares (in proposition 6.52 of the *Tractatus*):

We feel that even if *all possible* scientific questions be answered, the problems of life have still not been touched at all. Of course there is then no question left, and just this is the answer.

An answer which therefore leads us beyond language, to the area of “silence” dominated by the awareness, as we have seen, that “Whereof one cannot speak, thereof one must be silent.” (Proposition 7). And indeed, for Wittgenstein “Not *how* the world is, is the mystical, but *that* it is.” (6.44).⁸ In this way, scientific rationality is separated from a purely instrumental and almost “trivial” function, because human rationality is only

⁸L. Wittgenstein, *Tractatus Logico-Philosophicus*, Kegan, Trench, Trubner & C., London, 1922, pp. 89–90, the italic in the text is always Wittgenstein’s.

concerned with understanding *how* the world is structured, while mystical reflection points to a much higher and unfathomable goal, the one that most directly concerns the *existence* itself of the world. The pictorial theory of language developed by Wittgenstein in the *Tractatus* constitutes a confirmation of a unidimensional image of rationality that reduces it to its merely formal dimension, depriving it of any plasticity and even of any creative originality. In fact, in Wittgenstein's work, as well as in that of his faithful Viennese "followers", this merely formal and "empty" image of human rationality emerges. As in the game of chess, the meaning of each piece is reduced to its legitimate moves, in a similar way for all these authors human reason is only a powerful algorithmic tool of inference and nothing more. Thus, while a scientist like Galileo was well aware how mathematics was able to "give wings" to human thought, critically opening up knowledge of spaces and dimensions never before imagined, for these authors it is precisely this sort of springing creativity of thought (also of mathematical thought) that is denied, precisely because they can see only the operational, algorithmic, functional and "mechanical" aspect of human reason. Thus, while Galileo, in his famous initial lines of his *Discourses and Mathematical Demonstrations Relating to Two New Sciences* openly polemicised against a traditional alienating vision of mechanics that systematically reduced it to a dimension devoid of any "creative spirituality" and even devoid of any "fruitful originality", these authors in line with Wittgenstein, Russell and the neo-positivists, ended up by subscribing to a weakened, formalistic and empty interpretation of human reason. If a great mathematical logician like Leibniz still perceived the power of the form, for these twentieth century authors this dimension was instead hopelessly lost just because they saw mathematics only from an algorithmic and technical perspective which deprives it, continuously and paradoxically, of any conceptual dimension. In this sense, these authors were then victims, paradoxically, of a mathematical formalism which progressively removed from mathematics any authentically *conceptual* dimension.

4 Verificationism and falsificationism: two sides of the same coin?

While neo-positivism carried out, with great "organisational" spirit, its fruitful research project, exercising its undoubted and significant hegemony, both in Europe and internationally (partly because of the Nazi occupation of Europe which forced many scholars to emigrate to the United States), however, there were some other authors in the field of epistemology, connected with a very different tradition of thought, who were capable of outlining a different and alternative idea of scientific knowledge and technical-scientific research. However, these different voices remained very isolated or (and

at the same time) did not have the “organisational” capacity to create a sort of “common front” to defend and develop a different critical examination of the scientific enterprise. In this context I do not intend to refer particularly to Karl Popper’s falsificationist epistemology which, too, was created in Vienna, with the publication, promoted directly by the *Wiener Kreis*, of his masterpiece *Logik der Forschung* (1934) in an editorial series directed by Moritz Schlick. I will not focus on this epistemological current for several reasons. *Firstly*, because the international resonance of the approach of falsificationism materialised itself only after the end of WW2, in the middle of the Cold War, when the “political” Popper was clearly used by Western forces in order to have an important liberal thinker who could convincingly oppose the Marxist tradition defended by eastern countries such as the USSR, the pivot of the socialist bloc. It is not surprising that it was the “political” success of Popper as a “philosopher of politics” and a staunch defender of the Western liberal tradition, the author, in particular, of *The Open Society and Its Enemies* and *The Poverty of Historicism*, which undoubtedly helped or facilitated the republication of his epistemological masterpiece which, not surprisingly, was subsequently reissued in a new English edition which appeared with the slightly modified title of *The Logic of Scientific Discovery* published in 1959, when Popper was teaching at the *London School of Economics*. *Secondly*, on a more strictly epistemological level, Popperian falsificationism—beyond what Popper himself claimed (he loved to present himself as the “killer” of neo-positivism), in reality owes much to the Viennese epistemological approach, to which it is linked by various features. The principal of these is his radical insensitivity to the history of science, which in his reflection always had an eminently “auxiliary” role in relation to epistemology. So if the Viennese neo-positivists wanted to find a definitive definition of science that would be able to explain, once and for all, the very “essence” of science as such (therefore considering it as completely detached and separated from the history of science), Popper also shared the same myth, since he was totally convinced that his falsificationism offered, finally, the real and authentic solution to the same problem, exquisitely epistemological, posed forcefully by neo-positivists. *Thirdly*, it cannot be ignored, that both in the Viennese verificationist reflection of neo-positivists and in the Popperian falsificationist one, no attention was ever paid to the problem, role and epistemological function of technology and technologies within the scientific enterprise. In this way, if one critically distances oneself from the ideological “trap”, (inspired by pure “epistemological propaganda”), of the open opposition between neo-positivist verificationism and Popperian falsificationism, in reality, their deep (and

tacit) correspondence can be recognised, rooted, as it is, precisely in the peculiar philosophical culture of the “Greater Vienna” in which both these epistemological theories actually matured.⁹

5 Bachelard and a new conception of the activity of reason

Therefore, if we analyse the European epistemological debate, leaving in the background both the neo-positivist and the falsificationist movements (which in any case was “fruitful” only and solely after the end of WW2, for the reasons already mentioned), some traditions of thought can be outlined that coalesced around authors who in those same years started some interesting and original investigations of scientific knowledge. In this perspective we could mention the work of the Italian Federico Enriques, or that of Gaston Bachelard in France, or, again, that of Ferdinand Gonseth in Switzerland and also the particularly remarkable output of Ludwik Fleck in Poland. It is, of course, not possible here to present the whole of this articulated framework from which, however, the presence of different voices and different traditions of thought emerged, which had the merit of underlining some original or completely neglected aspects of the scientific enterprise, developing perspectives for research that are still fecund and rich in different results. Since I find it impossible to outline this general European framework (which is still under-researched), therefore I will focus, in

⁹In this regard, I would like to refer to my essay *Popper neopositivista deterioro?* published in the volume written by various authors, *Riflessioni critiche su Popper*, edited by Daniele Chiffi and Fabio Minazzi, Franco Angeli, Milan 2005, pp. 43–81, without however neglecting one of the very first critical reviews of *Logik der Forschung*, i.e. that by Ludovico Geymonat published in his well-known *Logica e filosofia della scienza*, “Rivista di filosofia”, 3, 1936, pp. 250–265, in which the young Geymonat, also employing a precise critical suggestion communicated to him by letter by Moritz Schlick himself, highlighted a *constitutive fallacy* in Popperian falsificationism, since, even admitting the existence of an asymmetry between verifiability and falsifiability, one can always argue, to put it in the words of Popper himself (*and it was* 1959!), that it is still impossible,

for various reasons, that any theoretical system should ever be conclusively falsified. For it is always possible to find some way of evading falsification, for example by introducing ad hoc an auxiliary hypothesis, or by changing *ad hoc* a definition. It is even possible without logical inconsistency to adopt the position of simply refusing to acknowledge any falsifying experience whatsoever. Admittedly, scientists do not usually proceed in this way, but logically such procedure is possible; and this fact, it might be claimed, makes the logical value of my proposed criterion of demarcation dubious, to say the least. (K. Popper, *The Logic of Scientific Discovery*, Routledge, London, 2002, pp. 19–20).

For the correspondence of Geymonat with Schlick in which we can read this interesting letter by the founder of the *Wiener Kreis*, see my volume *Ludovico Geymonat epistemologo. Con documenti inediti e rari (un inedito del 1936, il carteggio con Moritz Schlick, lettere con Antonio Banfi e Mario Dal Pra)*, Mimesis, Milan-Udine 2010, passim. Last but not least I would like to mention the beautiful little volume by Geymonat should not be forgotten, *Riflessioni critiche su Kuhn e Popper*, Dedalo Edizioni, Bari 1983.

particular, on the epistemological work (produced during his daytime activities!) of a fascinating thinker: Gaston Bachelard. Bachelard made his debut in the world of studies with an extraordinary book, the *Essai sur la connaissance approchée*, (published by Vrin, Paris, 1928), which even in the title stands out for its epistemological originality. The publication of this work constituted a sort of “meteorite” that appeared, quite suddenly, in the context of the philosophical and epistemological debate of the time. The title reveals the apparent “anomaly” of this new and unusual examination of the scientific enterprise. If, in the common perception, scientific knowledge is always seen as endowed with an almost absolute and undisputed rigour, on the contrary Bachelard instead wished to underline precisely the “approximate”, precarious, always critically integrable, nature of scientific knowledge, making of *approximation* the very foundation of scientific knowledge. Which, of course, implied a radical reversal of some consolidated (and dogmatic) epistemological “commonplaces” (belonging, therefore, not just to common sense).

In the final pages of this book Bachelard stated, with a naturalness derived from his laboratory research, that in his opinion “approximation is the only fecund movement of thought”,¹⁰ precisely because he understood how the increase in human knowledge follows a growth curvature not unlike the one achieved by a vegetable during its development. Indeed, Bachelard writes:

Let us consider life in its most distant and simplest form, that of the vegetable. We will notice that this kind of life achieves its adaptation only by somehow increasing its energy in an inventive and necessarily unexpected effort. Dr. Devaux points out the eminently active nature of mutations. Their origin ‘would be due to a simple reaction of a plant when it is placed in the imperative condition of acclimatisation. This reaction is also active, which means that a plant, just like an animal, can occasionally free itself from the tyranny of the environment: and new acquired characteristics will be stable and hereditary precisely because they are not results imposed by the environment; this is equivalent to saying that all truly acquired characters are conquered characters’. Life, and perhaps all reality, is a progressive conquest of freedom. Its evolution adopts the very principle of rectification; in the assimilation, it accumulates the infinitely small advantages developed by the already realised organization: it deforms without breaking the shape; it normalises the accidental.

This attention by an epistemologist to the plant world certainly does not

¹⁰G. Bachelard, *Saggio sulla conoscenza approssimata*, translated and edited by Enrico Castelli Gattinara, Mimesis, Milano-Udine 2016, p. 269, while the other quotations that follow in the text are taken from pages: p. 279, p. 287; p. 48; p. 50; p. 51; p. 54; pp. 54–55.

constitute a very common stance, also because Bachelard looks at a discipline such as botany, to which the most committed neo-empiricist epistemologists would certainly prefer the hard sciences, i.e., physics and mathematics in the first place. Bachelard's unusual and important perspective reflects, moreover, his self-education, when he started teaching mathematics and physics in high schools, after having lived for some years as a post-office employee and worked in laboratories for years, accumulating a great and rich experimental experience that convinced him that the cognitive process, rather than being the result of a brilliant insight, *à la* Kuhn (which is said to arise suddenly, in the middle of the night),¹¹ is, if anything, the result of a minute, partial and continuous work, within which the knowledge of the world is built up slowly through an almost uninterrupted succession of continuous rectifications which assimilates the various elements within an uninterrupted adjustment. Exactly as happens in the plant world, where the growth of a plant presents a morphological development that arises precisely from this slow, tenacious and constant, continuous "adaptation" to an environment that in this way is originally and creatively "built" and variously "shaped" by the plant. Plants, in fact, in their very long evolutionary history, not only constantly adapted themselves to their environment, but built and shaped it creatively. Over the four billion years of their existence they have shown that they were capable of surviving different mass extinctions, from which they have always emerged with renewed vitality. Furthermore, Bachelard writes:

How can we not be struck by the rectifying trend of a thought? Nothing is clearer and more fascinating than this conjunction between the old and the new. Rectification is a reality, or rather it is the real epistemological reality, because it is thought in its act, in its profound dynamism. Thought cannot be explained through the inventory of its acquisitions, because a force runs through it that must be accounted for. On the other hand, a force is well explained by indicating its meaning, its purpose. The goal to which the experimental determinations aim can be stated already when they apply to the scheme of an approximation. Approximation means unfinished objectification, but it is a prudent, fruitful, truly rational objectification, because it is aware at the same time of its own insufficiency as well as of its progress.

Rectification therefore proceeds just like a plant which, instant after instant, assimilates and transforms inorganic matter creating a new reality based on

¹¹Thomas S. Kuhn, *The Structure of Scientific Revolutions*, The University of Chicago Press, Chicago & London, 2012, p. 90: "The new paradigm, or a sufficient hint to permit later articulation, emerges all at once, sometimes in the middle of the night, in the mind of a man deeply immersed in crisis."

life, while always remaining faithful to itself and to the tenacity of its own growth which is exercised *within its limits*.

Conceiving scientific knowledge as an “indefinite rectification” Bachelard not only showed that he was well connected with the actual development of experimental research, as it is carried out in every laboratory, but introduced into the very heart of knowledge that *intrinsic historical dynamism* of knowledge that the other epistemological currents (one need only mention neo-positivism and also falsificationism) never gave due consideration or that they certainly marginalised, pursuing the mythical objective of being able to define, once and for all, precisely *unhistorically*, the supposed and mythical immutable essence of science, the “quiddity” of science as such. On the contrary, for Bachelard “the differential equation of the epistemological movement” is provided precisely by the “continuous rectification of thought in the face of reality”, which constitutes, as he himself programmatically declared in the first chapter of his work, “the only true subject of this book”. In this perspective, “functional assimilation, which is the most indisputable principle of evolution, in short, continues its work in utilitarian knowledge. In its deepest sense, rectification perfectly matches the progress of this assimilation. It must face the future by slowly flexing the past. At the root of the concept there is therefore an adaptable life, capable of preserving and capable of conquering. Knowledge, grasped in its lower dynamism, already implies an approximation in the process of improvement.” If we then proceed to higher levels, it is easy to realize how “functional assimilation is thus continued by intentional assimilation, that is to say, by an active choice.”

This enabled Bachelard to highlight the decisive role that the *conceptual dimension* always carries out within scientific knowledge: “the concept, which is the element of a construction, has its full meaning only within the construction itself; and it is through a proposition that it is possible to naturally express the minimum knowledge of which it can be the object.” Bachelard’s insistence on concepts is also important and decisive, because it places his philosophy of science on a quite different and alternative epistemological position than that of the tradition of modern and contemporary empiricism. As we have seen, this great tradition of thought in fact pursued an unattainable utopia, namely that of being able to reduce, *without any residue*, knowledge to the factual dimension. On the contrary, Bachelard realised instead that scientific knowledge is always rooted in a specific and peculiar *conceptual dimension*, through which the real—continuously adjusted by continuous approximations—is precisely “conceived”, i.e., transformed into conceptual reality. Einstein himself defined scientific knowledge just as “the mental grasp of this extra-personal world”¹² and with this ex-

¹²“Out yonder there was this huge world, which exists independently of us human beings and which stands before us like a great, eternal riddle, at least partially accessible

traordinary expression he managed to express, in an admirable way, the decisive role and heuristic function performed by the conceptual dimension within scientific research.

This decisive and fundamental *conceptual dimension* was instead systematically removed and never taken into due consideration by the epistemology of empiricist and verificationist theorists (as well as by falsificationism). Showing an evident Husserlian phenomenological influence, Bachelard distinguished “predicates from the act that unites them” and observed that

the fact of determining as a subject a coherent synthesis of predicates is no longer attributable, according to an inverse analysis, to the knowledge of the attributes separated from each other. The synthetic judgment that defines a concept must avoid tautology, otherwise there would not really be any synthesis.

In disagreement with Wittgenstein and also with the *Wiener Kreis*, the conceptual dimension of scientific knowledge thus became the privileged terrain in which it is possible to achieve that continuous rectification of thought that allows us to build an approximate knowledge of the world and reality. While for the traditional verificationist epistemology (and the same observation also applies to the falsificationist epistemology) the famous Newtonian expression that force equals mass times acceleration was interpreted as the expression of a formula that summarizes, in universal and necessary terms, an almost infinite number of experiences experienced (and experimentable), on the contrary for Bachelard, $f = m \cdot a$ translated and constituted a specific *conceptual approach* from which a determined and circumscribed objective “approximation” of the world can be developed, which, thanks to its heuristic mediation, we want to get a knowledge of. In this new and original Bachelardian epistemological perspective “its definition, when actually conceived, is the translation of a real epistemological movement”. In any case, Bachelard further explained, “if we consider knowledge in its full endeavour, we must always consider concepts as developed on a synthetic judgment in action”.

to our inspection and thinking. The contemplation of this world beckoned as a liberation, and I soon noticed that many a man whom I had learned to esteem and to admire had found inner freedom and security in its pursuit. The mental grasp of this extra-personal world within the frame of our capabilities presented itself to my mind, half consciously, half unconsciously, as a supreme goal. Similarly motivated men of the present and of the past, as well as the insights they had achieved, were the friends who could not be lost. The road to this paradise was not as comfortable and alluring as the road to the religious paradise; but it has shown itself reliable, and I have never regretted having chosen it.” (Albert Einstein, *Autobiographical notes*, Open Court Publishing Company, La Salle, Illinois, 1996, p. 5.)

6 Bachelard's dialectical "suprarationalism"

But what is then the characteristic of a concept according to Bachelard? In his view, "a concept is in fact an arrest [*arrêt*] in analysis, an actual decree by which the features outlined for a given object are considered sufficient to recognise it". An epistemological analysis must naturally always consider this characteristic of concepts that "arrests" our own possibility of thinking about reality, and must do so by always paying attention to the interlocking nature of the scientific knowledge of the world, contemplating carefully the two different poles within which this knowledge is always built: "on the one hand things with their more or less visible differences, on the other hand the spirit with its discriminating power. And the latter will prevail. Our agreement is due much less to the similarity of objects than to the uniform way in which we react to their presence. Conceptualisation will undoubtedly be an effort of objectivity, but on average it will develop in an unexpected sense: in fact, the object is not able to invoke the purification of the concept, as its needs are always minimal since at the very least a single feature would be enough to designate it: instead it is the spirit that projects multiple schemes, a geometry, a construction method and even a rectification method. This last aspect translates the need for novelty, for creation, which is undoubtedly a spiritual need, no less essential than assimilation. Conceptualisation, in its final form, is the search for an end. In fact, if conceptualisation is examined at the end of Duhamel's ternary process (comparison, abstraction, generalisation), an authentic teleological force is captured in it when it returns to reality as a general voluntary form applied to a new subject. A concept strives towards generalisation. To do this, it will reproduce itself into multiple domains, going so far as to rectify its data in some aspect. Speculative thinking has a tendency to become normative."

The quotation above allows us to better understand how Bachelard fully grasped the Galilean duality of the progress of scientific knowledge, while he also realized that thought, by its intrinsic nature, cannot be reduced to a general and abstract scheme (as empiricism would do instead), because, on the contrary, it always lives and develops within a precise *dynamic conceptual network*: "Thought begins only with a verb, and is contemporary with the connection between concepts". Seen in this perspective, "synthetic judgment is necessarily a creator, but it must be so progressively, by slow assimilation". Science, therefore, walks with a "sailor's gait", relying on both the conceptual and the experimental dimensions: "in its first momentum it is a discovery full of uncertainty and doubt. Cautious judgments are at its roots; verified cases are its successes." A success that often "fossilises" the act of knowing in a consolidated mechanism whose true nature always springs, however, precisely and only from that tension and that cautiousness

by which a concept, passing through doubt and uncertainty, builds knowledge *in fieri*, which is always approximate and always correctable, because research, as Popper also said, is always open and endless. Of course, we should not overlook the difference between Popper and Bachelard regarding this intrinsic “openness” of research. For Popper, “openness” is rooted in its own radical conventionalism, *à la* Xenophanes,¹³ by virtue of which all human knowledge would be nothing more than an extremely large web of “conjectures” that at best can be partially “corroborated”, until they can be finally falsified. The Popperian “openness” of research therefore refers to his exquisite cemeterial conception of history.¹⁴ On the contrary, the “openness” of which Bachelard speaks is a ‘plant openness’ which benefits from continuous rectification, precisely because it constitutes a path of continuous and equally tenacious growth, thanks to which humanity is actually able to delineate a technical-scientific heritage of knowledge and of operating practices. His, as we have seen, is also a *teleological* openness which has a profoundly different meaning from the Popperian one, because it does not imply at all a leap from a falsified theory to a forthcoming “corroborated” theory, to be falsified in the near future, but rather implies a continuous adjustment of growth and construction which, thanks to an infinite succession of continuous approximations, allows us to conceptually assimilate the world into an increasingly objectified reality, although we are never able to grasp the real world in an exhaustively metaphysical way.

Starting from this innovative, intrinsically dynamic image of scientific knowledge, Bachelard always recognised his theories in a form of open, dynamic and “supra-rationalist” rationalism. In fact, for Bachelard it is necessary to have the ability to abandon the traditional form of “closed rationalism”, typical of the metaphysical tradition which, especially in the modern age, has forged the great rationalist reflection of authors such as Descartes and Spinoza, to mention only two emblematic names, to make room for an “open rationalism”: “the happily unfulfilled reason can no longer fall asleep in a tradition; it can no longer rely on memory to recite its tautologies. We should challenge reason and challenge ourselves tirelessly. Reason is in combat with others, but first of all with itself. This

¹³In this regard, however, it is worthwhile to refer to the beautiful chapter dedicated by Popper to Xenophanes of Colophon, which can be read in his posthumous volume *The world of Parmenides* (an authentic and extraordinary “Essay on the Presocratic Enlightenment” as the subtitle of the English edition rightly describes it. Conversely the Italian publisher, with the opposition of the translator, opted for a vaguer description: “Discovery of the Presocratic Philosophy”), edited by Arne F. Petersen, with the assistance of Jorgen Mejer, Routledge, London, 1998. The title of the chapter is already emblematic: *The unknown Xenophanes: an attempt to establish his greatness*.

¹⁴In this regard, see Fabio Minazzi, *Riflessioni critiche sulla filosofia di Popper*, “Epistemologia”, XIII, 1990, pp. 221–236, as well as my monograph *Il flauto di Popper*, Franco Angeli, Milan, 1994.

time, it has some guarantee of being incisive and young.”¹⁵ From this point of view, for Bachelard science is “one of the most irrefutable evidence of the essentially progressive existence of thinking beings. Thinking beings think thoughts which try to know. They do not think existence.” In fact, “thoughts which try to know” means thoughts which strive to understand reality conceptually by objectivising it, while thoughts that are supposed to be able to conceive existence are ingrained in the traditional metaphysical ontology that from Parmenides to Heidegger claimed that it was able to grasp the concept of Being as such. Against this metaphysical ontology he referred to the “permanent rationalism” which distinguishes almost the whole western tradition, underlining the “dialectical condition” of scientific thought. To illustrate the “dialectical” nature of scientific thought, Bachelard started from the classical *Études galiléennes* by Alexandre Koyré (originally published in Paris, Hermann, 1966), which allowed him to grasp a double movement—ascending and descending—present within scientific reflection and its intrinsic dynamism. In general, the empiricist tradition has always emphasised the decisive role of the experimental verification of theoretical propositions. However, Bachelard observed, relying on some subtle reflections by Koyré, that there is also an inverse movement which is proper and typical of modern thought since “it is necessary [...] that a fact, to be truly scientific, is *theoretically verified*”. The experimental verification of theoretical statements is therefore not enough, because the latter must necessarily intertwine with the theoretical verification of facts themselves. But what can this theoretical verification be if not the conceptualisation through which a certain and partial aspect of reality is made meaningful within a specific theory with which, precisely, the world can be thought in order to be known? In this way, for Bachelard a specific dialectic, always open and progressive, of scientific thought is implemented which is thus able to constantly intertwine the pole of theory with that of experimentation, putting in place a complex movement of thought and action. Naturally, the open rationalism theorised by Bachelard was a kind of rationalism that tended towards improvement, precisely to experience the actuality of its time, which finds in science its inevitable reference point for progression. In the famous discussion *On the Nature of Rationalism* promoted by the “Société française de Philosophie”, in the session of Saturday 25 March 1950, with an extensive report by Bachelard, he had the opportunity to return to the specific nature of his applied rationalism and stressed again that the truth of his “suprarationalism” had its roots “in the work of experience through rational activity” precisely because his is a

¹⁵Translated from the Italian edition of Gaston Bachelard, *L'impegno razionalista*. Preface by Georges Canguilhem, edited by Francesca Bonicalzi, Jaca Book, Milan 2003, p. 29, while the quotations that appear later in the text are taken, respectively, from the following pages: p. 54; p. 60 (italics in the text); p. 75; p. 149.

“rationalism at work”. A rationalism that lives on the dialectic of thought itself, which is realised in the scientific work within which the “specialisation” itself can only expand and enrich the spirit of research and our own reflections. For this reason, for Bachelard “to be a rationalist, one has to go and look for [...] rationalism where it is: in scientific thought”. It is precisely the analytical study of the technical-scientific heritage, captured in all its intrinsic articulation, that allows us to develop a Bachelardian “regional rationalism” which is deeply in accord with the identification of the different “regional ontologies” already identified and thematised by Husserl in his classical and emblematic phenomenological recognition of knowledge entrusted to the pages of its first *Logical Investigations*.

So if in the sciences (physics, chemistry, but not only, *of course!*) the rational organisation and experimental experience are always intertwined and in critical “constant cooperation”, as Galilei observed, it is then inevitable to note that in Bachelard’s reflection the history of science cannot fail to acquire a primarily privileged and decisive position. Why? For the simple but decisive reason that “a scientific truth is a truth understood. A true idea, understood as such, cannot be turned into a false one. The temporality of science is an increase in the number of truths, an improvement of the depth of the coherence between truths. The history of the sciences is the story of their growth and development.” For this underlying reason in Bachelard’s opinion the decline of civilisation is fundamentally alien to the spirit of the history of science, precisely because “the history of science is always described as the history of a progress of knowledge. Readers moves from a state where we knew less to one where we know more. To think historically about scientific knowledge translates into the description from less to more. It is never the reverse: from more to less. In other words, the cornerstone of the history of science is clearly oriented towards a better understanding and a wider experience.” For this reason, the history of science must fulfil some obligations which do not apply for those who deal with historical research as such. A historian must in fact be exempt from expressing a judgment, because if anything, he must help us understand the reasons that account for a specific historical situation in its own dynamic. On the contrary, for Bachelard, a science historian should always be able to make “value judgments”: “the history of science is at least a fabric of implicit judgments on the value of scientific thought and discoveries. A science historian, who clearly explains the value of each new thought development, helps us to understand the history of sciences.” For this reason, the history of science can only be an *assessed* history, “assessed in the details of its development, with a meaning that must be continually refined through the values of truth.” A science historian should thus be able to highlight “the lines of progress” in his documents. Naturally, in order to produce an evaluation

of the past, science historians cannot exempt themselves from competence in sciences in actuality: “in order to evaluate the past, science historians must know the present; they should learn, as best they can, the science on whose history they want to report. From this point of view, the history of sciences is therefore strictly connected “to the actuality of science”. In this way, Bachelard’s epistemology thus manages to underline a profound and essential link between the history of science and epistemological reflection by promoting a critical awareness of scientific knowledge, which is instead almost absent from the tradition of empiricist-verificationist epistemology (as well as from epistemology inspired by falsificationism.)¹⁶

7 For a historical-critical epistemology

7.1 The critical split between absoluteness and knowledge

Leaving behind the very synthetic and elliptical overview expounded in the previous paragraphs, we can try to outline the possible features of a future “historical-critical epistemology”. Firstly, a decisive aspect has emerged which directly concerns the most rigorous and correct idea that can be delineated of science and human knowledge itself. From Banfi’s and from Bachelard’s approach the discovery of the *conceptual dimension* of science has emerged, although by following two completely different and autonomous research paths. When we speak of the “conceptual dimension” of science we mean to emphasise how science operates and is develops through its own *style of thought*, which constitutes its fundamental core. In other words, the “conceptual dimension” of science coincides precisely with “scientific thought” and science is such, *in primis* and *ante omnia*, because it produces thought, i.e., *scientific thought*. This observation, which emerges forcefully from both the Banfian and Bachelardian traditions, naturally finds its precise derivation, both theoretical and historical at the same time, in the Kantian discovery of the transcendental, which enabled Kant to elaborate his famous “Copernican revolution” by virtue of which Kantian criticism was able to initiate a plastic and articulated examination of human reason. Not only that: the beginning of criticism also coincided with the radical challenging of every metaphysical claim, since the Kantian transcendental

¹⁶Certainly Imre Lakatos, with his sophisticated falsificationism, underlined the close (*Kantian*) interconnection between the history of science and the philosophy of science: the latter without the former is empty, while the former without the latter is *blind*. However, Lakatos, with his methodology of scientific research programs, is also wants to carry out a “rational reconstruction” of the history of science *in the text*, relegating *to the notes* the real and effective history, in order to show how the latter would have “misbehaved” with respect to rational reconstruction! (See I. Lakatos, *The Methodology of Scientific Research Programmes*, edited by John Worral and Gregory Currie, Cambridge University Press, Cambridge, 1978, pp. 118–120). In this way in the Lakatosian reflection the typical theoreticism derived from Popper’s teachings (see F. Minazzi, *Il flauto di Popper*, op. cit.) which epistemologically engulfs the history of science...

denied a basis to metaphysical ontologism (from Parmenides to Heidegger), i.e., the claim of being able to understand Being as such. *Against* this recurrent and traditional ontological-metaphysical temptation, the Kantian transcendental turn highlights, however, how human beings can never have direct and immediate access to reality, since the latter can only be grasped and known in an ever partial and delimited way. In this perspective, Kantian criticism, relying on the genesis of modern science which undoubtedly constituted a decisive *turning point* in the history of modernity, introduced the notion of *scientific objectivity* determining a development of undoubtedly historical significance. In fact, the “Copernican revolution” (which we could also identify as authentic “Kantian revolution”), to put it in Jules Vuillemin’s words, led to a real split between knowledge and the absolute, a break that Kant generated without denying authentic cognitive scope to human scientific knowledge, thus preserving a precise and determined sense to the question of the difference that exists between reality and appearance, between what is necessary and what is instead contingent and did so within a philosophy which precluded the possibility of talking about things in themselves. But in this respect, it is best to allow Vuillemin to speak for himself:

Si pensée physique et théorie de la connaissance ne font qu’un chez Kant, celle-là éclairera la nouveauté révolutionnaire de celle-ci. Avant Kant, la philosophie classique essaie, une fois ébranlés les systèmes théologiques du Moyen Age, de découvrir un absolu susceptible de fonder la vérité. Par exemple, les concepts de substance, de cause, de force, de nécessité reçoivent ce rôle de substituts de Dieu. L’acte révolutionnaire de Kant dans l’histoire de la pensée, sa “révolution copernicienne”, a consisté, en reprenant l’analyse de ces différentes notions par rapport à la fonction qu’elles exercent dans la connaissance objective, à montrer que, loin de monnayer l’absolu, elles ne conservaient de signification que dans les limites de l’expérience possible, c’est-à-dire si on les coupait de leur contexte théologique. A cet égard, la théorie kantienne de la connaissance est la première théorie conséquente et vraiment philosophique d’une connaissance sans Dieu.¹⁷

This Kantian philosophical theory of knowledge that no longer needed to anchor itself to the notion of divine absoluteness, also freed science from any undue reference to the dimension of absoluteness. Naturally the post-Kantian reflection variously elaborated, misinterpreted and even openly fought and rejected the Copernican approach outlined by Kant, so much so that his own philosophical lesson, decidedly anti-metaphysical, often ended

¹⁷J. Vuillemin, *Physique et métaphysique kantienne*, Presses Universitaires de France, Paris 1987², p. 358.

up by being an almost exclusive property, precisely and paradoxically, of the metaphysical tradition itself. Which also led to the considerable decidedly anti-Kantian hatred of most of the exponents of the *Wiener Kreis*, who in relation to a Kantian philosophy, at the time almost the exclusive prerogative of metaphysicians, then certainly “threw out the baby with the bathwater”, completely disregarding the Kantian epistemological approach that also emerged, with strength and equal fruitfulness, in Marburg’s neo-Kantian tradition, which was probably expressed at its best and in the most original way by Ernst Cassirer’s critical and constructive analysis. In any case, the problem posed by Kant, insofar as it captured a decisive aspect of human knowledge, could not fail to re-emerge also in the later reflection that was often constructed, as happened for example in the case of Bachelard, autonomously and independently of Kant’s teachings. In any case, the problem encountered the Kantian epistemology could not fail to re-emerge in the reflection following his works. And this actually happened to the extent that during the twentieth century the conceptual dimension intrinsic to the scientific enterprise was strongly emphasised. Naturally this recognition of the presence of scientific thought, its relevance and its heuristic function were not recognised by everyone because the other traditions of thought, still rooted in traditional metaphysical ontology, openly fought against this perspective, as happened, for example, with the reflection of Martin Heidegger for whom, as is known, “die Wissenschaft denkt nicht.” In the twentieth century we were thus faced with two different horizons of thought: on the one hand there were those who thought that science is essentially based on the ability to produce its specific decidedly innovative knowledge, fundamental for the human understanding of the world and, on the other hand, there are those who denied this possibility and who opposed traditional metaphysics to scientific thought and to the development of technology, claiming the use of thought as such as an exclusive privilege of traditional metaphysics. Which then is also found in the common sense that pervades our societies, if it is true, as it is true, that generally the scientific dimension is perceived as an eminently “technical” structure which generally denies any specific cultural value, while the meaning of “culture” is arbitrarily restricted to the world of humanistic research only. Which brings us back to the dramatic split between the so-called “two cultures” by which the fruitful link between science and philosophy, which has always existed in the long-term history of Western tradition, is undoubtedly undermined and neglected, to affirm an absolute “split” between the two, which, in part, has been recorded only in the last three centuries of western history.¹⁸ But instead of critically investigating and studying the profound

¹⁸For a serious and systematic critical reflection on the connection between the “two cultures” within western tradition, a reference to the acute volume by Giulio Preti still

and intrinsic reasons for this alleged incompatibility, this “split” is instead exhibited and assumed in a rather partial way and it is often presented instrumentally, as an element that should precisely play exclusively in favour of the humanistic tradition, which allegedly is the only one capable of producing thought. Furthermore, education systems and trainings contribute to the maintenance and social diffusion of this profound distortion of the cultural dimension, which often and willingly insists on presenting the “two cultures” as divided and armed against each other. In the educational field, this split is fuelled by the very way in which the humanities and scientific disciplines are studied: for the former, a decidedly historical approach is used, while for the latter, a decidedly and deliberately ahistorical approach is employed. In this way the school system—from primary schools to universities *included*—does nothing but reinforcing the split between the “two cultures”, preventing us from understanding the fruitful connections that have always nourished the relationship between scientific and philosophical thought.¹⁹ Why? Precisely because scientific knowledge (mathematics, geometry, physics, natural sciences, astronomy, etc.) are taught in a strictly ahistorical way, insisting only on the “technical-algorithmic” aspect, (systematically) neglecting the conceptual dimension of science. On the other hand, the humanities are taught adopting a tendentially historical approach which, however, inevitably weakens them at least to the extent that in our schools there is an increasingly widespread “particulate” teaching based on purely technical education and purely technical training, which no longer educates, but is limited to instructing, neglecting a cultural formation worthy of its name.²⁰

7.2 A new unitary image of human knowledge

Secondly, this epistemological approach, which, as we have seen, fully highlights the *conceptual dimension* of science, must then lead us to review, *ab*

remains fundamental. *Retorica e logica. Le due culture*, Einaudi, Turin, 1968, now available in the new amended and enriched edition, edited with the introduction and notes by Fabio Minazzi, Bompiani, Milan, 2018.

¹⁹The only work, on an international level, that tried to openly combat this avowedly dichotomous approach to culture was the one promoted and largely written by Ludovico Geymonat with the publication of his monumental *Storia del pensiero filosofico e scientifico* (*History of Philosophical and Scientific Thought*), Garzanti, Milan, 1970-1976, 7 vols., Which is still today, worldwide, the only work that endeavored to illustrate the constant and always fruitful link between philosophical thought and scientific thought through the entire course of the history of the western tradition.

²⁰In this regard, see the proceedings of a conference specially dedicated to *La scuola dell'ignoranza* (*The school of ignorance*), edited by Sergio Coltella, Dario Generali and Fabio Minazzi, Mimesis, Milan-Udine 2019), which offers a mercilessly critical examination of the overall degradation of education in Italian schools, which fully mirrors the parallel overall degradation of Italian universities following the reforms of various Ministers for Education (Berlinguer, Moratti and Gelmini.)

imis fundamentis, the very nature of *human knowledge*. Which can happen at least in a double critical sense. In the first place, in fact, it is necessary to critically distance the dimension of knowledge from the horizon of absoluteness, by elaborating a *new conception of the objectivity of scientific knowledge*. This, for example, is the path followed by an epistemologist like Evandro Agazzi who in his most recent volume, *Scientific Objectivity and Its Context*,²¹ addressed the objectivity of scientific knowledge by systematically referring to its different constitutive contexts. In this way, Agazzi's proposal once again allows us to separate the objectivity of knowledge from the dimension of absoluteness, recovering a notion of knowledge that turns out to be true, absolutely true, only within defined, strictly circumscribed areas. In this perspective, scientific knowledge is therefore certainly "relative" knowledge, but it is such only and exclusively within a limited and finite sphere of objectification of the world. Within each cognitive context there is therefore a sort of critical convergence between absoluteness—which allows us, in fact, to distinguish what is actually known, in a correct way, from what does not instead constitute knowledge and is configured, therefore, as an "error" that must necessarily be corrected—and the very relativity of knowledge, which is such precisely because it refers to a limited and circumscribed area.²²

The affirmation of the critical construction of the objectivity of scientific knowledge within its specific contexts also allows us to profoundly modify our overall image of human knowledge. In fact, this can no longer be associated solely and exclusively with the scientific dimension because it is instead necessary to elaborate a much richer, more articulated, plastic and comprehensive image of human knowledge as such. In fact, it cannot be denied that there is knowledge also within traditional "humanistic" fields. For instance, Lorenzo Valla published, in 1440, the *De falso credita et ementita Constantini donatione declamatio*, demonstrating in a *philologically* rigorous way, that the so-called "Donation of Constantine" traditionally exhibited by the Catholic Church to justify its temporal power, was, in reality a "historical forgery". Well, can this writing be regarded as an example of knowledge or not? Historically, the cognitive contribution of Valla's text cannot be seriously denied, even if in this case it is a predominantly negative cognitive contribution, precisely because the Catholic Church itself, *after* the publication of Valla's work avoided again showing the presumed "Donation of Constantine" as indisputable proof to justify its illegitimately

²¹Springer, Cham Heidelberg New York Dordrecht London 2014, Italian translation by Giovanni Carrozzini, Elisabetta Scolozzi and Giulia Santi, with editorial revision and final editing by Fabio Minazzi, promoted by *Centro Internazionale Insubrico* "C. Cattane" and "G. Preti" of the University of Insubria, published by Bompiani, Milan, 2018.

²²On this issue see F. Minazzi, *La riflessione filosofica di Evandro Agazzi*, "Giornale di Metafisica", year XL, 2/2018, pp. 732-737.

exercised temporal power. However, this philological knowledge was built using a methodology and criteria that are profoundly different from those used in the natural sciences. This must then lead us to elaborate a new and more articulated critical image of human knowledge. To do this we can employ the Husserlian suggestion by which each discipline constitutes its own specific “regional ontology”. Moreover, Husserl’s reflection is valuable because it implied a pluralisation of the traditional Kantian concept of the transcendental. If in fact for Kant the transcendental was rooted in the only form of scientific knowledge actually available at the time, i.e., Newtonian physics, on the contrary the increase itself of the contemporary scientific heritage and its increasingly rapid differentiation and articulation allow the pluralization of the horizons of transcendentality, understanding the different levels within which this form of critical meta-reflection on human knowledge can be exercised. In other words, it is necessary to know how to rethink human knowledge in a unitary and, at the same time, very articulated way, in order not to sacrifice all its critical potential without, however, renouncing to provide an overall picture of human knowledge that is built differently within the different areas of cognitive research. In this perspective, in short, we must definitely turn our backs on that tradition that determined a sort of cultural “imperialism” of physics-mathematics that led us to consider research as “scientific” only and exclusively to the extent that it is mathematised. It is necessary to consider how this traditional conception of epistemology actually resulted in a cultural hegemony which, for example, induced a thinker like Kant to argue that a discipline is all the more “scientific” the more it can be “mathematised” with the good result that the more mathematics is present within a discipline, then the more this discipline was “scientific”. This approach then explains why the so-called sciences have been distinguished between “hard” and “soft” sciences using a quasi-“pre-Northern League” lexicon that helps us better understand the possible epistemological deformations that this conception of knowledge can inevitably feed. The alleged ideological rift between the “two cultures” finds in fact its key element in this mathematical approach, in the name of which it then claims to hierarchise knowledge as such, placing the hard sciences at its top and then relegating to increasingly lower levels the other disciplines that cannot be mathematized on an equal formal plane. In this way, mathematics, from a heuristic tool that has increased the physical investigation of the world, risks turning into an engulfing epistemological bond, in the name of which the very attribute “scientific” can be given or denied. Against this dogmatic model of knowledge, it is therefore necessary to elaborate a much more articulated and plastic vision of human knowledge that can actually proceed through different paths by devising different “regional ontologies”, or rather different cognitive “regions” which

are established by inserting themselves into different conceptual traditions, which have elaborated different conceptual tools, specific verification (and falsification) methods, giving rise to specific problems and also to a peculiar tradition able to solve given problems. From this point of view it is then necessary to rework, also in this case *ab imis fundamentis*, the idea itself of human knowledge, referring back the exceptional lesson of Leonardo da Vinci who, not surprisingly, already anticipated, at the dawn of modernity, the power and the strategically decisive fascination of developing another and different unitary culture, able to displace the reifying unilaterality of both scientific and humanistic culture, in order to outline a new and alternative, much richer, more articulated and fruitful cultural synthesis. As Banfi wrote, in his essay on *The humanity of Leonardo da Vinci*, the genius of Da Vinci consisted in fact in being aware of the profound harmony that exists between humanity and nature because in his conception of culture Neoplatonism is stripped of all its traditional idealistic elements in order to re-emerge in its first source, that of Greek naturalism,

purified by the sense of the unity of nature in which human beings live, which is humanity itself. Well, to understand this reality is to recognise this reality. This is the great task of humanity, this is the extraordinary development initiated by Leonardo and it is possible to understand it because we are made of the same substance, because the vibrations, which are present in nature, exist also in human beings, because macrocosm and microcosm correspond to each other and there are two ways to proceed: one is art, the other is science. These are the two ways that make it possible for humanity to discover and to conquer reality.²³

7.3 A new image of the historicity of human knowledge

Thirdly, these considerations forcefully pose the problem of always taking into due account that human beings always live within a specific tradition since they can reason, speak, think and elaborate their own speeches and actions, but they always perform these actions and thoughts in a concrete historical context from which they can never prescind themselves. The same philosophical reflection is fuelled—as indeed happens to science—precisely by this paradoxicality: it aspires to a universal and necessary knowledge, therefore able to ignore the historical concreteness, but to do so it must always start from the particular historical context in which individuals find themselves living, thinking, reasoning and acting. If this historical dimension of tradition is considered, culture, experience and knowledge themselves are transformed into something abstract and arbitrary, precisely because they are considered outside the precise historical contexts that produce and

²³A. Banfi, *Scritti letterari*, edited by Carlo Cordié, Editori Riuniti, Rome, 1970, p. 82.

substantiate them, making them flesh of our flesh and blood of our blood. In fact, languages, problems, categories to which we can refer to reason, reflect and live, do not exist, in Antonio Labriola's words, as "caciocavallo cheeses hung in a deli", but they are born and are always transmitted by human beings through a complex and articulated historical process, through which the languages, the categories, the problems to which we can possibly and primarily dedicate ourselves reach us. Consequently, philosophy has the task of critically reflecting on all these different forms and structures of the various traditions, and also of making explicit all the contradictions as well as their possible various divergences. In this specific perspective it is possible to outline an original form of historical-critical-objective transcendentalism with a logical neo-realist structure such as that theorized by Giulio Preti. In the last phase of his more mature reflection, in fact, he thought that he could delineate

a historical-objective transcendentalism, which surveys the constructive forms of the various universes of discourse through a historical-critical analysis of the ideal languages that serve as models for these universes, from the rules of method that have been imposed historically and still apply in knowledge, etc. In short, it is a transcendental Ontology (or rather transcendental ontologies) which does not claim to understand the forms and structures of a Being in itself, but seeks to determine the way (or ways) in which the category of being is enacted in the historically mobile and logically conventional (arbitrary) construction of the ontological regions by scientific knowledge (in particular) and culture (in general).²⁴

Philosophically speaking, this attitude highlights, once again, the exquisitely critical meta-reflective character of the philosophical activity which ultimately, following *Kant and Husserl*, investigates, first of all, the historical configuration of a tradition assuming it in its actual concreteness, and then develops a reflection that never seeks to unravel the Being of the world, because, more modestly, it limits itself instead to investigate, critically, the various constitutive structures of the different universes of discourse, in order to reconstruct the historical mobility of human knowledge. Certainly, in this perspective the intrinsic *relativity* of human knowledge is clearly perceptible, since

whatever is based on historical experience passes away with that experience. In becoming aware of the relativity of all scientific development, epistemology, which is itself a scientific construct, becomes aware of its own relativity. From the logical point of view, there is no difficulty. Having realised that the notion of the 'eternally true'

²⁴G. Preti, *Philosophical Essays*, vol. I, op. cit., p. 297, while the quotation that follows in the text is taken from p. 70, again in the first volume of this work.

is meaningless, only the notion of ‘historically [hence relatively] true’ has a meaning, and this applies to all knowledge. The difficulty is psychological: epistemology so conceived offers no hope to those who yearn for the eternal, those who see Reason as a factory whose job is to turn out goods that will appease the yearning for eternity, for eternal truth and certainty. But this is the ‘defect’ of all forms of culture that have raised humanity out of barbarism. For those who do not have this yearning, for those who tranquilly accept the possibility of dying, in the fullest sense of the word, but who also lay great importance on forming the clearest ideas possible, the most intersubjective possible, ideas that help to release us and our fellow men and women from nightmares and phantoms of the afterlife and make earthly humanity’s house as comfortable and pleasant as possible—for such people the ‘defect’ is transformed into the highest value.

In this precise hermeneutic and critical-epistemological key, the intrinsic relativity of human knowledge thus becomes a pivotal point by which it is possible to actually construct a critically more appropriate image of knowledge by referring it, precisely, to that “defect” of “relativity” that historically “raised humanity out of barbarism.” Which, in fact, coincides with the actual history of humanity. But when philosophical reflection comes into play, all these levels inevitably become complicated and distinctions must be made, precisely because there are different degrees of reflection and thought. In fact, there is a reflection—which Banfi calls “pragmatic reflection” which generally constitutes a first reflexive and thoughtful reworking of some particular sectors of human experience. At this first level, thoughts produced by pragmatic reflection inevitably undergo all the constraints of a pragmatic reflection that struggles to detach itself from the horizon of life experienced in its practical-sensitive activity. Philosophical reflection instead rises above this level, freeing itself from pragmatic interests in order to investigate the transcendental laws of constitution and also of intrinsic movement of the pragmatic forms of reflection themselves. In this progressive detachment from the pragmatic horizon, different levels can thus be identified, from that of the *moral philosophy* (which systematises and organises the values within which the proper and specific action of the world of praxis takes place) to an even more abstract and higher level, in which a *philosophy of morality* is conceived, which carries out a critical meta-reflection on the universe of discourse of moral philosophy, on its categories and its constitutive structures.²⁵

²⁵For a systematic study of all these issues, however, see A. Banfi, *La ricerca della realtà*, edited by Guido Davide Neri and Gabriele Scaramuzza, with the collaboration of Barbara Cavaleri, Istituto Antonio Banfi-Società Editrice il Mulino, Bologna, 1996, 2 vols., vol. II, with particular reference to the second part *La vita della cultura*, pp. 363–721 and the fundamental essay of 1934, *Sui principi di una filosofia della morale*, pp. 493–558.

In any case, from this perspective, philosophy always takes the form of a reflection on culture, whose *materia subjecta* is never experience (or reality) as such, but the different and multiple cultural forms in which experience (or reality itself) is thought, understood, felt, lived, etc. In this perspective, in Jacques Ruytinx's words, author of *La problématique philosophique de l'unité de la science*, "la philosophie est une *métaréflexion dont le niveau est toujours susceptible d'être déplacé*."²⁶ Within this framework, according to which philosophy "advances" only to the extent that it "steps backward", one can distinguish different specific levels specific to the philosophy of science as such. We can thus identify a first level of reflection on science which coincides with a methodological one, which on the one hand can only bend itself critically on the different ways in which each disciplinary scientific field is constituted, while, on the other hand, it can also try to detach itself from this level to reflect on the logic of scientific discourse, by specifying the logical conditions of scientific nature itself. Rising to this more general level of epistemological reflection then leads to a sort of reflection on the "logic of science" which for a large part of contemporary epistemologists coincides, *de facto* with the philosophy of science *tout court*.²⁷ But on the other hand also this investigation on the "logic of science" tends to become increasingly specialised, transforming itself, in turn, into a sort of technical and scientific discipline in relation to which philosophical reflection can react by rising to a level of greater critical generality that considers the previous level as its own *materia subjecta* in order to build a more general and decidedly more philosophical reflection. Some authors then tend to distinguish these two levels by talking about epistemology for the second level that investigates the "logic of science" and instead referring to philosophy of science for the third level that investigates the nature of science in its most extensive structural generality.²⁸

²⁶J. Ruytinx, *La Problématique philosophique de l'unité de la science: étude critique*, Le Belles Lettres, Paris 1962, p. 339, note no. 2, italics are in the text.

²⁷A good model of this decidedly specialised conception of science as such can be found, for example, in the excellent *Springer Handbook of Model-Based Science*, Lorenzo Magnani, Tommaso Bertolotti eds., Springer, Dordrecht Heidelberg London New York 2017, in which a conspicuous and articulated number of specialists tackles a multiplicity of different, somewhat narrowly delimited themes, with a deliberately technical and specialised language, which seems however, to exclude a possible and different exquisitely philosophical evaluation of the object of their reflections. In this case, epistemology is transformed into a highly technical and specialised discipline that has nothing to envy to the specialisation of other scientific disciplines, even if at times it seems almost that, at least in some more technical and deliberately specialised contributions, the philosophical dimension finally risks, paradoxically, disappearing...

²⁸A critical-systematic reflection on all these different levels of philosophical investigation of science was moreover developed, with the usual acuteness, by Preti in the introductory part of his excellent *Lezioni di filosofia della scienza* (1965–1966), edited by Fabio Minazzi, (Franco Angeli, Milan 1989, pp. 53–61) to which I directly refer.

To these reflections must be added the further consideration that philosophical reflection itself, at least to the extent that it wants to be configured as a proper and specific reflection of a scientific philosophy, finds in the philosophy of science its strategic and emblematic point of reference, so much so that in authors such as Hume, Kant and the neo-positivists themselves, the philosophy of science ended up by identifying itself, not by chance, with the same gnoseology intended, precisely, as general philosophy. Not to mention that science itself, in turn, can naturally be subject to different meta-reflective considerations, because it is configured both as *knowledge* (although, as we have seen, it is then questionable whether it is the only possible form of knowledge), both as a historical element of civilisation (precisely: the civilisation of sciences!) and as a peculiar discipline which is exactly studied and investigated, in its historical actuality, by the philosophy of science as such. The whole plurality of these multiple levels of philosophical investigation of science can and must always be traced back to the peculiar meta-reflective character of philosophical thinking as such. If we do not do it, as often happens today in the international epistemological debate, we will inevitably end up by losing sight of both the specific and the intrinsic cultural value of science (and, consequently, of philosophy of science itself), and also of its distinct theoretical importance as well as its value in the history of civilisation.