

THE HISTORICAL DIMENSIONS  
OF SCIENCE  
AND ITS PHILOSOPHY

When we think about our way of seeing, appreciating and understanding the different forms and manifestations of the life of the mind in human civilization, we become aware of a rather surprising fact. We are ready and spontaneously inclined to place them in a historical perspective and consequently to judge them according to a “historical consciousness”, with practically only one exception, that of science. No one finds it difficult to admit that the poetry of Homer, Virgil, Dante, Goethe or Baudelaire has always been an authentic poetry, attaining the heights of absolute value and even at times being incomparable, all the while recognizing that to understand this poetry, to appreciate its nobility and penetrate its meaning the effort must be made to put *it* within its historical context (and ideally to put *oneself* within that context) rather than

Translated by Jeanne Ferguson.

to judge it according to the modes and forms of the poetry of our own day. What we have just said regarding poetry also applies to music, the fine arts, philosophy, law, social and political institutions, ethical concepts, religions and customs. In the case of science, on the other hand, such a historical consciousness is almost entirely lacking, even among cultivated people: the history of the sciences is not normally a part of the store of knowledge of these people, but this situation, far from being the cause of such a lack of historical consciousness, is rather the consequence. This is because we are unconsciously persuaded that science is not properly speaking a historical phenomenon; we have the impression that it has not had a real history.

This statement calls for some clarification. In fact, all those who have received what is known as compulsory education and have been encouraged to study some mathematics or some science have necessarily come across the theorems of Pythagoras, Thales and Euclid; the Cartesian coordinates; the principle of Archimedes; Newton's law. They have probably heard the Ptolematic and Copernical system of the world mentioned, or Darwin's theory of evolution (and naturally they also know that these individuals belong to a more or less remote past). That suffices to show us that there is a certain "past", because these different names always appear to us linked to a certain isolated "discovery" that finds its place in an orderly exposition according to logical, systematic, didactic or other criteria, but in any case outside of any historical interest. These names play a role that is almost solely mnemonic and facilitates the reference to a certain statement whose meaning and value are entirely determined by the place it occupies within a contemporary scientific discipline. Thus it is not difficult to understand the current view of science: it is seen as something that has only a present (it could be defined as the present state of our knowledge), while a part no longer belongs to it since, if there were something in this past that deserved to be saved, it is already incorporated in the present (it is therefore still present). The rest has been forgotten and is no longer of interest or importance.

Certain stereotypes easily appear in such a perspective: we believe that science properly speaking only appeared in a very recent epoch, having been preceded by some isolated and almost accidental discovery, coming fortuitously from an intellectual con-

text that was still confused and primitive, with the sole exception, perhaps, of Greek mathematics, for which we willingly recognize an elevated degree of logical rigor. More important, however, the brevity of this course, which should make the undertaking of a historical reconstruction easier, does not arouse the necessary intellectual interest precisely because such a history would be reduced to a sort of catalogue of “truths” and “errors”, the former of no use because they are already collected and preserved in present science and the latter just because they are errors. We clearly see, then, why in the case of science the tendency is to judge the past in the light of the present and, in any case, to “rid” ourselves of it, differently from what happens with other forms of mental life.

What is the reason for such an astonishing difference? A first answer to this question (or, more modestly, a first part of a possible answer) may come to us from the consideration of the historical period during which the “sense of history” developed as a fundamental constituent of European culture, that is, the Romantic Age, dominated by a historicism that was expressed in the thought of its philosophers as well as in the work of its artists, men of letters and, especially, its historians, who no longer limited themselves to political history but engaged in the reconstruction and interpretation of all forms of human culture.

For these men, history was essential not only for the authority of facts; it instead appeared as an exigency of the conscience to which it offered a new dimension that went beyond the simple rational analysis in which the men of the Enlightenment had put all their hopes. History became an interrogation of the past that nourished the present, a dialogue of the present and the past that also contained inspiration for the future; it was a great reservoir of meanings that could play the role of a revelation and a promise. For this reason, we recognize the greatness of each century, and the task of the historian is to glean from each an interior knowledge that grasps it as it really was. Each period deserves to be considered in itself, because it is a testimony that humanity renders itself throughout time. That is the true meaning of Ranke’s famous statement that the task of the historian is that of showing “what really took place”: it does not express the program of a positivist methodology (which arrives on the scene much later) claiming to present historical “facts” in their neutral and uninterpreted bare-

ness but rather the opposition to this “progressist” philosophy of history characteristic of *Aufklärung* and also present in Hegel, who saw the past as oriented to produce the present, finding its perfection and meaning in it (a veritable deformation of the historical movement that had the illusion that it understood it).

However, parallel to this historicist atmosphere, another line of thought developed in the same decades of the 19th century, namely, the positivist movement that responded in its way to the “progressist” movement of the philosophy of the preceding century. Auguste Comte proposed that for each sector in which man attempted to know the real, three steps were involved: theological, metaphysical and positivistic. The last corresponded to the moment in which a certain branch of knowledge became science and, in that way, achieved its definitive maturity. At first glance, we would say that here we have a historical comprehension of the advance of human thought, but we soon see that in reality the movement of history is brought under an *a priori* interpretation, abstract and arbitrary, bearing an essentially negative judgment on the past, considered as a phase of immaturity with an inadequate view of things that should be surpassed and forgotten, once the light of scientific knowledge liberated us from the gropings and phantoms of other more primitive forms of knowledge. The affinity of this position with the Hegelian concept of a history of thought that culminates and ends in its own system, or with the Marxist concept of a history destined to end with the coming of the classless society guaranteed by the dictatorship of the proletariat, strikes us immediately. But differently from Hegelism, which was questioned and “surpassed” even before the death of its creator, and from Marxism that, having situated the advent of a classless society in an indeterminate future could give itself a practically unlimited waiting period, positivism had the advantage of declaring itself the champion of science at the moment in which it was celebrating its triumphs (and it would continue to celebrate even more spectacular ones for a long time to come). Under these conditions, it is not surprising that European culture let itself be convinced that science has no authentic history, that what went before was not the course of its internal evolution, that it was a matter, so to speak, of a pre-history with no real importance.

The discourse we have developed up to this point is open to a

possible objection that we are now going to consider. It could be objected that the theses of Comte, while being too schematic in their totality, emphasized a fact that meets with a general agreement, namely, that the sciences of nature “in the proper sense” began their progress only in the 17th century and that many “human sciences” began theirs only in the 19th century. That does not imply, however, that they do not have a history: it is simply a matter of a “recent” history. For there to be a history, it suffices that there be change, succession, growth in time, and this is certainly the case with the sciences.

I reply that the simple setting down of a future, a change and a growth in time is not enough to establish a historical consciousness. That implies that there be a present interest in understanding the past event, in the meaning it had at the moment it occurred and that, this way, we can recognize its true value, independent of the fact that it may still keep a meaning and a value (which would be different in every case) within the context of our age, while probably helping us to understand better (usually thanks to the differences rather than to the similarities) certain events of our own time. As we have pointed out, that has become normal for almost all the manifestations of culture except for science, and we formulated the hypothesis that, for the latter, the obstacle to its inclusion in historical consciousness results from the fact that it is a prisoner of the anti-historical schema of positivism.

However, there are certainly other reasons worth exploring. One of the most important is found in the task that is usually assigned to science: that of giving us a faithful and objective picture of the different sectors of the reality it deals with without mixing it up with interpretations, judgments and evaluations. Now in the case of the arts, philosophy, law, religion and customs, we are willing to recognize that they are representations of human subjectivity, that they represent the products of the creativity of man, the richness of his sentiments and his intuitions, and we are thus spontaneously inclined to evaluate them for what they are in themselves, to see them as testimony of an inexhaustible wealth that is always of interest to us, that may inspire and at times guide us, but which usually attracts us in a disinterested way. In short, what makes these manifestations of the past interesting to us is precisely the presence of those elements of subjectivity that we

insist be *eliminated* in the discourse of the sciences. The multitude and variety of expression that appear to us as fecundity and richness in those areas become in the case of science an intolerable situation that must at all cost be avoided in order to arrive at a univocal image of reality: that which reproduces its true structure, that is one and only one, and with regard to which no liberty may be taken. Consequently, a scientific proposition has only two possible destinies: it is either true (because it describes reality as it is) and then becomes an enduring part of the patrimony of science, or it is false and will be rejected as soon as it is recognized as such. The historical moment in which a true proposition was formulated does not influence its value, which consists entirely in its ability to give a faithful description of reality; the fact that it was discovered a century earlier or a century later does not change its position and its meaning within science (at the most it may enhance the prestige of that century). In this perspective it is clear that any proposition or scientific theory having one sole value (that is, a “truth value”) has no historical meaning, it is ahistorical and, consequently, all science is deprived of historical dimension. To give it a history would be to make a catalogue of the truths and errors we have mentioned, which would have a documentary interest and would respond to a desire for erudition but would not constitute a historical perspective. We have used the conditional tense here, but it must be said that most of the histories of science that have been published up until recently are exactly of that type.

We should not be scandalized by this fact, because we must recognize that the spasmodic tension toward an objective knowledge of the real has dominated modern thought from the moment it discovered, with Descartes, the centrality of the subject. To the minds confronted with this discovery and concerned with breaking the circle of subjectivity, “modern” sciences seemed to offer a concrete example for success in such an undertaking. Thus it was not a chance that Kant was inspired by the mathematical physics of his time to work out his solution to the problem of knowledge which brought at the same time the elimination of the individual subject and that of the history of the framework of objective knowledge. The pure receptivity of feeling on the one hand (which excluded an “intromission” of the individual subject in the act of

knowledge) and the reduction to a purely formal unifying function of the activity of the intellect (also conceived at the transcendental level and thus going beyond individual subjectivity) allowed Kant to furnish a theory of knowledge, phenomenal but objective, of which science was the purest incarnation. We cannot then be surprised if this ideal of perfect knowledge, asubjective and ahistorical, dominated European culture and led it to think of science as an activity outside the sphere of historicity.

Since the first years of our century, the idea that science is a “true” and unshakeable knowledge of nature has entered into a profound crisis. However, that has not contributed to its acquiring a dimension of historicity, because the conception that has gained ground has been that of an essentially pragmatic value of science (further facilitated by the great successes of technology seen as “applied science”). In the framework of such a conception there is still less interest in taking into account the scientific propositions and theories of the past: if we abandoned them because they were no longer of use, there is no reason to return to them. A science conceived as the repertory of knowledge that is useful to us *now* obviously has no conceptual space to attribute a significance to (claimed) knowledge, become useless, of the past.

There, then, are some reasons that explain the lack of historical perspective that still today characterizes the way of conceiving the sciences.

However, one essential thing escapes from this way of conceiving science: it cannot be conceived as the progressive, systematic and complete discovery of an unknown country but rather like the interpretation of a complex musical score. In this case, the notes are all exactly “given”, and the indications for their execution is furnished by the composer.

Yet we find it normal that each performer gives us a personal “interpretation” of a score that remains the same for all; we are even willing to recognize that there may be two, three or four interpretations that sometimes radically differ from each other but still appear to us superb and “faithful” to the score. Obviously, here it is not a question of the natural disposition that we have to admire the originality of the artist and the strength of his creativity, since in the case in question he is not allowed to produce something new (namely, a new musical composition) but to acquaint us

with something that is already accomplished, and if he seems to us to have gone beyond the limits of faithfulness to the score in an excess of originality in his interpretation, we judge it as poor quality. With regard to the said "fidelity" it must be pointed out that this does not consist in a so-called correspondence to "what the composer meant" (as some affirm) but rather consists in the discovery of expressive dimensions that are "objectively" in the score, while requiring the intervention of the interpreter's aesthetic sense in order to be revealed. There then is the bipolar status of these dimensions: they are born, so to speak, from the meeting between a "point of view", an intuition on the part of the interpreter on the one hand, and the concrete structure of the composition on the other, so that without the intervention of the interpreter they would never be revealed. But we realize that this way of putting it is still insufficient to express the substance of the phenomenon in question, since the said dimensions were not there like diamonds hidden underground, thus already formed and only waiting to be brought to light; they only "potentially" exist (never as in this case do we perceive the pertinence of this Aristotelian notion) like the infinite cuts that can be made in a solid body, each of which is entirely determined as soon as the plan for dissection is chosen but beforehand is only an undetermined possibility. With a musical composition we may thus have a scrupulous performer without talent who limits himself to a faultless reading of the notes of the score, but we may also have different interpreters who, while respecting the minimal demand to play "without errors" and in addition that (much more difficult to define) of not betraying the meaning of the composition "in its totality", give us more or less interesting "cuts" of the content of the work.

Now, the dynamics of scientific knowledge approaches this model of artistic interpretation much more than has been suspected. In fact, the concrete reality of things faces us like a musical score, and the knowledge of its intrinsic richness requires the employment of many interpretations, because it also is a wealth of "cuts" that cannot pass from possibility to action without the intervention of a "point of view" that reveals them. We must be careful, however, not to reduce this intervention of interpreter to the level of a transcendental structure of the forms of consciousness: if this structure exists (and it seems difficult to deny its



existence, even though we cannot effectively determine of what it consists) it is something that ideally intervenes “before” the cuts we have mentioned. To use our example, this structure is the one that allows us to read the notes of the score correctly and that finds its equivalent in the knowledge of the real that we have at the level of ordinary experience. Just as the musical interpretation begins with the correct reading of the score and always with the obligation not to betray it, so the different sciences begin with ordinary experience and are obliged not to contradict it (therefore, they use and presuppose the transcendental conditions of our knowledge); however, they are distinguished by the fact itself of going beyond the level of ordinary experience; this occurs because each of them has a particular “point of view” of the real. Now, it is precisely this point of view that no longer has the characteristics of a structural *a priori* of reason or of a transcendental condition of knowledge but of an “interpretation”. Consequently, all science effects its own “cuts” within the reality of “things” corresponding to its point of view and develops all its potentialities. What we have called here “point of view” may be denoted by more technical philosophical terms such as “criteria of intelligibility”, but they run the risk of leading us toward the plane of pure transcendental conditions, while our interest lies in what is added to this plane.

On other occasions, I have presented this conception that scientific knowledge is constituted by the creation of domains of “objects” that are none other than the “cuts” of the “things” of ordinary experience obtained with the help of concepts supported by operational procedures. Therefore, I shall not go into a repetition of those theses here but instead dwell upon the nature of interpretation that belongs to such a constitution of the domain of scientific objectivity. Unfortunately, the notion of interpretation has been considered as totally foreign to the exact sciences, since there is the tendency to tie it to the idea of a basic uncertainty and to that of a double subjectivity: in fact, we see in interpretation the work of a subject that tries to understand the undeclared intentions of another subject and which, because of that, can never issue from a basic state of uncertainty. From this comes the aspiration to make of the exact sciences a discourse in which “interpretations” are put aside in order to hold to the prudence of “descriptions” and, at the most, to the logical and empirically guaranteeable solidity of “ex-

planations". What escapes from this perspective is that the end and result of an interpretation are quite simply the production of a "comprehension" of something and not necessarily the intentions of a certain subject. This elementary fact has probably been obscured by the famous (but equivocal) distinction between comprehension and explanation (*Verstehen und Erklären*) that was introduced a century ago as the basis for distinction between the natural sciences and human sciences and whose basic weakness is the non-realization that in both cases it is necessary to understand as well as explain. But there is something else: in reality, explanation can only occur within a context of comprehension; first, for the good reason that we cannot claim to explain what has not yet been understood and, second, because explanation, being fundamentally a process of logical inference, necessarily uses concepts, predicates and categories furnished by the constituting elements of statements in which the explicative inference is articulated and which, therefore, must precede it. In conclusion, we can envisage in the following way the broad lines of the itinerary leading to the constitution of a scientific discipline or of a certain theory within a given discipline: confronted with the situation of "common knowledge" (which, according to the case, may be the totality of everyday knowledge or that consolidated within an already-constituted science) a new perspective emerges, a new way of seeing things, which makes us notice aspects that were previously unperceived or underestimated and that now appear like nuclei around which a new interpretation of our knowledge is organized. These aspects are the referents of new concepts, ideas and models of comprehension that stimulate us to look for effective means of translating this new reading of experience into propositions to which we may attribute without ambiguity a "value of truth" (it is precisely on this point that the scientific enterprise is characterized with regard to other forms of interpretation).

If this effort is crowned with success, we may begin a "description" of the experience in terms of the concepts thus introduced and the means of "concretization" found for them. This makes it clear that there is already description within an interpretation and that it is not something primitive and unconditioned, because in reality it depends on two orders of conditions: the conceptual "cadre" making up the interpretation and the concrete (operation-

al) means to apply it to experience. On this base is then set up the explanation of what we have been able to describe, and this phase also depends on the interpretative cadre, since the statements given as hypotheses for “proving” what has been described also use concepts characteristic of this cadre (and different from those that were “operationalized”). Moreover, each interpretative cadre also comprises a way of conceiving the explanation that varies (or may vary) from one discipline to another and that also brings differentiated possibilities of conceiving the modalities and procedures of the explicative reasoning.

At this point, we are in a position to evaluate the ingenuousness of the positivist (and neopositivist) conception of a science limited to giving back unaltered the intrinsic structure of the real due to a scrupulously neutral use of purely sensory experience and the formal and tautological transformations of logic (including mathematics). While acknowledging that the tools of scientific knowledge must remain empiricism and *logos*, we must admit that these are never pure but are inscribed and nuanced according to the contexts of interpretation within which they operate. It is useful for us now to return to our analogy with musical interpretation. The amateur, the performer without talent who is only able to read “correctly” the score, represents, as we said above, the stage of “common knowledge”, while the true interpreter goes beyond this stage to give a comprehension of the composition based on a certain “interpretation” corresponding to the stage of the construction of a scientific theory. But here our analogy exhausts its usefulness, because there is an essential difference between the interpretation of a musical score and that which comes into play in the sciences, since in the first case the global viewpoint involved is eminently individual and subjective in nature, while the interpretative cadre that determines the intellectual space of a discipline or a scientific theory is of a supra-individual and, more precisely, historical nature (while still containing certain elements of individual genius). In other words, the ideas and criteria of intelligibility that determine the interpretative context within which arise through a process of specialization the empirical and theoretical concepts of a scientific discipline are the expression of a historically-determined cultural milieu and, even when one individual has coordinated these elements into a new synthesis, it cannot provide

a new scientific theory until it is accepted by a community (at least by what is called the scientific community). We must also add that the operatory procedures that permit the empirical “concretization” of the view points thus achieved are also bound to the historical context (since they are generally offered by the technical possibilities available at a certain period within a certain epoch). The same is true of scientific explanations, since they generally respond to what in a given epoch is considered to be a good explanation, a rigorous argumentation, and also to the technical means (belonging to what we may call the “techniques of reason”, such as systems of logic and mathematical theories) available to effectively present the desired explanations. Elsewhere, I have called this set of conditions the “historical determination” of scientific objectivity, and the remarks that have just been made certainly suffice to justify the affirmation that science has the same status of historicity as do other manifestations of the human mind. Before going further into this subject, we believe it opportune to profit by the preceding clarifications to dissipate certain equivocations circulating today among those epistemologists who have been able to disregard some of the factors we have discussed.

It should be stressed that the context of interpretation, the interpretative cadre we have mentioned, has a global and holistic nature, that it is still mainly undetermined, that it can develop in several directions, depending on the particular concepts it presents and the operatory procedures that are associated with some of them. For this reason, it would be inexact to confuse it with a “theoretical context” in the proper sense. The correct name we could use to designate it is thus rather that of hermeneutic context and, as we have seen, it is at the same time pre-empirical and pre-theoretical with regard to the specialized type of empiricity and theoricity appearing in the sciences. We thus return to a conclusion to which we have already referred, namely, that every science has a *hermeneutic* dimension that cannot be eliminated (be it a natural or a human science) since it is indispensable to its constitution.

One consequence of this realization is that the data of experience serving as a basis in the sciences has never had an “absolute” value. Now, this exact affirmation (which in the most recent epistemology has been validated by Popper and his followers) has been construed into the much less correct and actually false affirm-

ation according to which even empirical statements or those of observation are affected by an indispensable and unprecise coefficient of theoreticity. This is the famous thesis of “theory-ladenness” of any scientific statement, whose most striking consequence has been the thesis of the impossibility of comparing rival scientific theories and thus being able to evaluate the “progress” of knowledge in the sciences. This fallacious solution of a correct problem comes from the fact that we have not grasped the actuality of the non-absolute nature of the data of experience in science. We may synthesize this by saying the data in question are never “pure” facts but always “interpreted” facts. However, this does not mean that they are always and necessarily interpreted by means offered by the scientific theory within which they act as “empirical basis”. On the contrary, they are necessarily interpreted within the hermeneutic context within which the theory in question is totally inscribed. Only a small part of their significance is enriched by the specific theoretical context into which they enter. The difficulty with the problem is that any concept in a scientific theory is bound to all the others by logical ties that precisely state the specific meaning in a global manner, so that its significance “depends” on those of all the others, particularly theoretical terms themselves. All that cannot be denied, but it does not keep us from distinguishing that part of the signification that an empirical term draws from the simple “hermeneutic context” in which it is placed (and which belongs to it even before it is used in whatever specific theory), of that “supplementary” and variable part that is added as “theoretical context” (or contexts) of which it may become a part. This possibility to distinguish exists and (as I have shown elsewhere with the necessary details) rests on the fact that the terms acting as constitutive elements of the empirical statements are directly attached to the operator procedures I have mentioned. Now, what seems to escape the partisans of the *Theory-Ladenness* is that the terms do not entirely involve their significance in no matter what usage is made of them and that therefore there may well be cases (and there are) in which only one part, and precisely the one that is independent of the “theoretical context” is used. For example, to say that a certain man weighs as much as a big rock, I do not need to consider that the man is living, that he possesses reason, that he is a political animal, and so on, differently from the rock, since all

these differences of signification of the two terms “man” and “rock” do not enter into account when both are weighed. Thus the conclusion: it is not true that theory predetermines, circularly, the type of experience that should justify it. On the contrary, theory and experience collaborate in the explanation and exploitation of the framework of intelligibility furnished by a certain *Gestalt*, equipped with operational procedures having adequate controls, which make up their common hermeneutic context.

To synthesize the results of the preceding analyses, we must say that a critique of scientific reasoning cannot be limited to a critique of pure reason (which could only suffice to specify the transcendental conditions of knowledge in general) nor integrated by a critique of linguistic reasoning (which would confine us within the paradoxes of “theory-ladenness”). It must still be completed by a critique of hermeneutic reasoning and historical reasoning, because, in the construction of the sciences, reason operates not only according to its conditions of intrinsic functioning but in the context of certain linguistic and hermeneutic *a priori* that bear the signs of historical determination.

One more remark seems necessary: we would not wish to give the impression that this flood of *a priori* conditions implies that scientific theories are a sort of necessary and predetermined result of this complex structure. Actually, there is a circuit of feed-back among all these elements: the internal dynamics of experience and logical argumentation may lead us to the abandonment of one theory for another within the same hermeneutic context, but it may also happen that the dynamics of the different sciences leads to a modification of a certain hermeneutic context and sometimes to the revision of certain *a priori* linguistics or even of a transcendental order. The history of science is there to prove it but this, far from denying the historical nature of the sciences, confirms it, since once more they show that they have the same kind of effect on the evolution of the human mind and culture as other manifestations.

Our last remarks with regard to the intrinsic exigencies of a “critique of scientific reasoning” lead us to the discourse of the forms that must be adopted by a philosophy of sciences that would be in proportion to its own objective. It is quite easy to affirm that, if science has a profound dimension of historicity, no valid philosophy can be made for it if this dimension is ignored. What exactly

does that admit? In the first place, it allows us to understand the limits of an epistemology that is exclusively attentive to structural problems—in particular, logico-linguistics and methodologics—such as the *Philosophy of Science* of analytical and Anglo-Saxon inspiration that has dominated the scene up until now. We do not deny the importance of the work and the results achieved by this school, but we must note that it fell into the equivocal by considering contemporary science or, to put it better, a highly idealized schematization of physics as the only “science”. But this is not the most serious objection: we must add that, since this structural analysis acts only in the logico-linguistic domain, it could not solve the problems that go beyond this plane and find no solution if we try to reduce them to questions of logical compatibility or confrontation between theory and experience. In fact, we have seen that this same confrontation cannot be understood if we forget the hermeneutic context that underlies it and, in the end, is its reason for existing. Otherwise, a philosophy of the sciences lacks its “critical” nature, the only one that can make us understand why some theories have been able to hold their own in spite of a lack of clarity in their logical connections or certain difficulties in their agreement with empirical data.

There is still another reason: if the philosophers of science do not wish to come under the same accusation that many of them have made of “metaphysics”, that is, to be a discourse that “floats” in the world of ideas without an effective contact with the real world, they must demonstrate that their models of scientificity correspond to an approximation that is acceptable to the world of science as it is and not as it is imagined or postulated. In other words, there is an obligation of “empirical control” for the philosophy of the sciences itself, and such control can only be found by considering a history of the sciences that does not claim that the forms of science (past or present) not corresponding to the model are not really scientific. On the other hand, a consideration of this kind is not easy, because the models set up by analytical epistemology are not satisfied by a good number of present sciences nor, for even stronger reasons, by the sciences of the past. The only exit from this *impasse* is to recognize the existence of different hermeneutic contexts (or criteria of intelligibility) that characterize the great variety of contemporary scientific disciplines and direct their

choice of empirical criteria, the empirical and theoretical concepts they employ and the models of explanation they adopt. By doing this, we are already beginning to “historicize” science (that is, we are putting it into its “contemporary” historical context); to that must be added, but the step is no longer difficult, the awareness of a historical dimension that also extends into the past. If we complete this awareness, we open up the possibility of understanding the science of different ages according to the hermeneutic contexts that characterized them: we can glimpse the ties between the sciences and philosophy and affirm how they have translated certain conceptions of the world and of man, how they have contributed to their modification and evaluation. In short, they can be inserted as a vital constituent in the development of human civilization.

We certainly do not wish to suggest that the philosophy of science must be resolved within the history of science; we only affirm that a philosophical understanding of science as a construction of human thought and of the different sciences as the articulation of this construction aiming at the knowledge of certain sectors or aspects of the real cannot do without an awareness and examination of the ideas and ways of conceptualizing that have determined the elaboration of scientific theories in time. In saying this, we also hope to avoid the impression that a philosophical comprehension of the sciences must “submerge” them in their historical and social context: such a dissolution would be incorrect as far as the pure and simple history of the sciences is concerned and even more so for that which concerns their philosophy.

The philosopher of the sciences as such does not need to reconstruct the genetic pathways that have led to the formulation of certain scientific ideas or principles, or to the construction of certain instruments; however, he is obliged to pay attention to those ideas, principles and material or mental techniques from the moment when all that becomes truly a framework for the construction of a scientific theory (namely, by furnishing the hermeneutic context for the selection of its basic concepts, or the ensemble of technical possibilities for making its instruments and procedures of observation and measurement operative or, again, the ensemble of the logical and mathematical constructions that underlie the theoretical architecture of a discipline).



Thanks to this historical awareness, the philosophy of the sciences will be able to rid itself of a certain number of false problems that greatly disturb present discussions and have led to dispositions whose effect has been to discredit the philosophy of science. I refer especially to the aforementioned question of the comparability of scientific theories and the possibility to admit progress in scientific knowledge. We know that some epistemologists currently in vogue deny the possibility of establishing a true comparison between scientific theories and that in itself negates the possibility of establishing a preference among rival theories, thus of recognizing a “progress” when one theory is replaced by another. The result is considering as naive and illegitimate the common belief according to which, thanks to the development of the sciences, our present knowledge is quantitatively and qualitatively greater than that of our predecessors. But this general belief is also that of scientists who today have the tendency to view with scepticism an epistemology that seems unable to justify the most fundamental reality. Formerly, scientists had a certain sympathy for the philosophy of the sciences, because, while still considering it too schematic and distant from effective problems that the “working” scholar finds, they saw in it an attempt to understand the structure of scientific knowledge. Today this sympathy and this interest are rapidly disappearing. This is then the ironic situation: the philosophers of analytical science ended by studying an imaginary science through a lack of sensitivity and historical information. Now many philosophers of science, who continually refer to the history of the sciences in their written works, equally finish by presenting an image that is artificial and rejected just as much by people with plain common sense as by the scientists. How can all that be explained?

To me, the answer does not seem too difficult to find: the thesis of the non-comparability of scientific theories was born, as we said, within a logico-linguistic consideration that led to the confirmation of “theory-ladenness” of the empirical concepts themselves, and it is in the light of this preconceived thesis that we have too often wished to read the history of science in order to compel it to give this confirmation. If on the other hand we try to be more attentive to the true lesson of history we can receive a much richer impression of it. First, we can ascertain that many so to speak “fundamen-

tal” hermeneutic frameworks exist that have often inspired scientific conceptions throughout history; each of them lasted only for a certain time, but the hermeneutic framework that inspired them proved capable of leading to other scientific conceptions in later epochs (thus these frameworks have a historical stability that goes beyond the precariousness of their specialized “concretizations”). For example, the atomist intuition or that of continuity in the view of the physical world, the conceptions of potential and actual infinity in mathematics, the role of chance and necessity in natural phenomena, the paradigms of final and efficient causality as models of intelligibility in the various domains of knowledge are only some of the basic conceptions we could cite, not to mention more specific examples, such as the different ways of conceiving space or time. Now, the history of the sciences gives us a return and evolution of these general conceptions, of an interest comparable to that offered by the historical development of certain intuitions of Plato or Aristotle in the history of philosophy, or that of the idea of democracy in the history of political institutions or, again, the forms of property rights throughout the history of judicial systems. In conclusion, just as the philosophy of law was nourished by the history of law, political philosophy and the philosophy of art nourished by the knowledge of the history of politics and art, so the philosophy of the sciences finds in the history of the sciences concrete realizations on which to reflect, since they are stages in the maturation of science which, while being consigned to the past, keep a meaning for the present even though they are not directly utilizable. Just as we study Dante, Beethoven or Roman law, not with the intention to write poetry in Dante’s style or Beethovenian compositions or to introduce into our judicial system the forms of Roman public law but to have a better understanding of the nature of poetry, music and law (and even to cultivate our poetic, musical and legal sensitivity), a more than superficial knowledge of the history of the sciences greatly helps our comprehension of this fundamental dimension of human civilization and may even be profitable for our scientific education.

In addition, we must not overly vulgarize the importance of the scientific “results” that have been achieved in the past and that maintain a validity that we may consider as definitively established. What we must avoid is to “flatten” them in the simplistic

view that claims that everything of value in the science of the past is preserved in the science of today. The most correct way to evaluate these results is to understand that, throughout its history, science has made several of those “cuts” we mentioned above and that, within them, many “objective” truths have been established. These are lastingly acquired for the patrimony of human knowledge (this is why within the “cut” that corresponds to elementary geometry all the theorems of the *Elements* of Euclid remain valid within the very limited domain of its “objectivation”). We must not lose sight of the fact that the introduction of new domains of “objectivation” do not depend solely on the constitution of new hermeneutic cadres but also on the development of techniques, which make new possibilities for “operationalizing” certain concepts available to scientists. Now, this “progress” in technique (regarding which there seems to be no doubt) brings with it a “progress” in sciences that corresponds to its “cumulative” nature and even helps us to understand the kind of cumulativeness that may and must be recognized for scientific knowledge. In general, we have considered such an accumulation following two antithetical schemas: we see it as a prolongation of the old theories that keep what they have made known adding other subjects that they did not contain, or we see it as the result of a “falsification” of the old theories that rids us of their errors and, in a new conceptual framework, recuperates the parts of truth they contained and adds new truths. Once we are liberated from the myth of the non-comparability of theories, we see that in the history of science one or the other of the two modes of accumulation exists, but a third form seems to be still more important: that of letting old theories stand with the partial but authentic truth they possess without insisting that new theories be “substitutes” for the old, by encompassing them or eliminating them. In this perspective, the cumulativeness has a much richer dimension, that of the co-presence of several truths that are compatible because they concern different objective areas, namely, the aspects of the real that have been presented and explored thanks to interpretative cadres and differentiated instruments of research, according to an effort that has involved the work of many generations and is still able to arouse our admiration.

A comparison may help us to better understand this point. When

in a specialized museum we look at the scientific instruments that have served the researchers of past centuries we are often astonished at the beauty, perfection and fine workmanship of these tools; they keep all their intrinsic value, their ingenuity, even though we would never think of using them today, because we have more "perfect" ones. On closer look, however, we see that this perfection is linked partly to pure and simple technical progress and partly to the fact that we have gone on to study other domains of research in which they would no longer "serve" us (the pragmatic side of science is therefore involved here). But if we wish to fully understand the science of a certain age we are obliged to take its instrumentation into account and even at times repeat the observations and experiments that were then possible by using these instruments.

Only by again reaching this level of consideration can we give back to science all the spiritual and cultural value that is its due: just as we can admire Roman law, Michelangelo's statues, the Temple of Jerusalem, without thinking of being able to "use" them for the concrete necessities of our age and yet feel that they belong to us as a living part of our history, in the same way we must adopt the same attitude toward the history of science. In addition, only in this way can we justify an intuitive conviction that we all share, namely, that geniuses such as Euclid, Archimedes, Galileo, Newton and Maxwell are on a scale of grandeur that goes beyond that of many of our Nobel laureates, and that they have contributed to the building of our civilization to a degree that is not inferior to that of the great geniuses of the arts, letters, philosophy, law and religion. Through such a realization we can hope that contemporary science may play this role in the building of our culture, a role that is lacking today precisely because we have considered it as a simple collection of provisory knowledge having an interest and meaning confined to their practical utility.

Evandro Agazzi  
*(Université de Fribourg, Switzerland)*