PREFACE

This book is in honour of Otto Neurath and it is about some themes and problems that constitute what we may call 'his legacy'. Why go back to Neurath? This is not a rhetorical question because present-day philosophy -especially philosophy of science- has a rather negative view about the most prominent theses of the Vienna Circle. As Bacon and Descartes did in their time, modern thinkers initiated their essays with severe criticisms to scholastic essentialism, just as almost all contemporary handbooks on philosophy of science start condemning logical positivism and its theses, although the social ideas that inspired the members of the Circle are usually recognized. (i) Theories are the necessary final target of every scientific enterprise; (ii) Scientific laws can be captured in simple classical logical formulas; (iii) Scientific theories will be finally gathered –*via reductionism*- in a super theory; or (iv) In principle, we will always be able to support all our general knowledge on protocol sentences. These four are the theses on which it would be very hard to find just one supporter today. By slightly modifying M. Horkheimer's[1] expression in his criticisms to logical positivism, we can say that (i)–(iv) should be included in the *index sententiarum prohibitorum.*

Apparently, there are additional and even stronger reasons to think that going back to Neurath's thought makes no sense, except for the possibility of exploring the history of 20th century philosophy. What scenery does science offer today? *At first sight*, a multiplicity of completely or partially opposite theories, schools, methodologies, and styles! Physics is still looking for a confirmed theory capable of unifying quantum theory and general relativity. Highly speculative hypotheses and cosmologies -some of them quasi-philosophical- on the origin and form of the universe and matter, multiply. Behavioural sciences, i.e., social sciences, lack unifying models and the relationships among all of them could be described by the Latin adagio *bellum omnium contra omnes!* So, the field of Psychology shows a menu of theories in which the corresponding associated therapies struggle side by side. Cognitive, systemic and psychoanalytical therapies are just a few alternatives.

Biology is located in a very special place among scientific disciplines because in it lays the subtle link that connects natural and behavioural sciences. The assertion of the preponderant place of Biology as a bridge between the natural and social world is practically shared by all scientists and philosophers. Unfortunately, Biology constitutes another example of disunity offered *sometimes* by the scientific scenery. Those who observe this discipline from the outside naïvely assume that there is just one theory

for the biological processes of change. According to them, this theory –the Darwinian theory- would be shared by all biologists. Nevertheless, from the inside, things look quite different because at least three theories are struggling today under the honourable title of 'adequate evolutionary theory'. Needless to say, each one has good reasons, but also recalcitrant anomalies, in Lakatos' terminology. Darwinism, symbiotic, and spontaneous order formation theories -and even others such as structuralism- are part of the landscape that the observer can verify in that midway discipline. Thus, to speak of the unity of biological thought today –an ideal of the 40's- is not a realistic discourse. Finally, with regard to methodological questions, it can be noted that the gap between hermeneutic thought and traditional methods of explanation (probabilism, hypothetical deductivism or inductivism) has grown because of the influence of historical and sociological views in the 60's.

Therefore, why should we go back to the *Encyclopaedia* and the idea of unity of science? Many thinkers and philosophers have been consequent with the sceneries described above and have assumed the idea of an irreducible diversity of sciences, together with the rejection of Neurath's project and the tradition behind it. In this sense, *The Disunity of Science*[2] can be mentioned as the paradigmatic work of the last years. After reading the many valuable contributions contained in it, it seems that the expression 'unity of science' is just a common place to quote at the beginning of our annual meetings of science and philosophy. In conclusion, it is necessary to give an answer to the abrupt question posed at the beginning of this *Preface*, i.e. to give good reasons to go back to Neurath. At the same time, we will be able to give an answer to this other question: Why the series *Logics, Epistemology, and the Unity of Science* from which this volume is part? We should establish the timeliness of Neurath's *Encyclopaedia* project, beyond the fact that it is an ideal with which only a few disagree. In order to explain this point, we will follow two steps. First, we will explain what the Encyclopaedia was for Neurath himself. Second, we will point out some results in Philosophy, especially in logic, which support the statement that *we are on the way to the Encyclopaedia;* even more, *that crucial steps have been given in this direction*, probably steps that Neurath never imagined. But before we proceed with this, let us briefly reflect on what was said on the disunity sceneries.

There is no doubt that many cases of struggle and opposition among theories, methodologies, and styles exist! This is a fact and *contra facta non sunt argumenta*. But we should not exaggerate and think that everything aims in that direction in science. First, we should consider that science is a dynamic process, whereby many new phenomena -or new

characteristics of the phenomena already known - are identified and described year after year in every field. Nevertheless, the final assimilation of these materials and their subsequent organization –so to speak- in the scientific corpus takes place slowly. Thus, it cannot be a surprise to observers that the disunity is dominant and the unity is recessive in the whole scenery, for using genetic language. In other words, the input of new experimental and empirical data is much faster than their subsequent incorporation to pre-existing theories.

In addition, an exaggerated view of disunity overlooks the many disciplines and theories that have included knowledge from other fields, and, thanks to this incorporation, they have reached an enormous success in basic and applied sciences. Two examples of this are game theory and information theory. By means of the first, social sciences and ethology of superior animals can predict actions and strategies that would otherwise be paradoxical without such theory. By means of the second, biologists can measure the exact complexity contained in biomolecules -proteins and nucleic acids-, a fact that allows knowing whether the evolutionary mechanisms proposed are enough to explain the order found in living nature. It is true that there are sceneries of disunity; however, there are also many sceneries of successful integration. Remember, for example, the crucial role played in physics by Pierre Fermat's principle of minimum time and Maupertuis' principle of least action. Unity or disunity in science depends fundamentally on where you put your eyes.

Finally, and before making some brief comments on Neurath's idea of Encyclopaedia, we should emphasize that, although disunity is sometimes a reality, it is not permanent because science is essentially an active process. As genially perceived by Kant, human reason has the unavoidable tendency to unify knowledge. At present we witness the efforts of scientists as well as philosophers for reaching unity. So, they aim theories capable of joining up-to-now independent domains, such as the classical and quantum realms. Perhaps it might sound rather awkward to hear that there are 'philosophers working for the unity of science', because it seems that the construction of theories and hypotheses is a job for scientists. However, many historical cases, such as Leibnitz' or von Neumann's -who noticed that matrix and wave mechanics were equivalent formulations for quantum theory- contradict the presumption of the irrelevance of the philosophical work for unity. As we already mentioned by J. Symons and S. Rahman in the first volume of this series, if Quine is right (*pace* Hintikka) and there is no essential distinction between analytic and synthetic statements, then philosophers can do more than just contemplate sciences.[3] Thus, in the first volume of this series, we see the efforts of Professor Gintis[4] to offer a

common underlying model of individual human behaviour in order to provide some unity to social sciences.

'An International Encyclopedia of the Unified Sciences'[5] written by Neurath is probably the most revealing text about the nature of the encyclopaedia that he attempted to write. Some of the theses presented there are closely related to other works included in the manuscript 'Unity of Science and Logical Empiricism. A Replay', published for the first time in this volume. This last manuscript was meant as a response to the exaggerated criticisms to the Vienna Circle made by M. Horkheimer in his article 'Der neueste Angriff auf die Metaphysik'. Going back to Neurath's first article, it is possible to detect in it that his idea of encyclopaedia was not that of a unity of organized scientific laws. In contrast, at that time, R. Carnap saw things differently because he believed in a set of organized theories. However, such a system was an ideal not possible to pre-suppose even for him. As it was pointed out by Rahman and Symons in their already cited article of the volume launching the series *Logic, Epistemology and the Unity of Science*, Neurath's building of an encyclopaedia was not conceived as a general system of science. As noted by Creath: 'Neurath never speaks of reducing one science to another but talks instead of symmetrical relations such as connecting, building bridges between, and filling gaps between various branches of science'.[6] If we pay attention to this, it is easy to see that Neurath's project of an encyclopaedia was close to the ideas of his French predecessors, Diderot and D'Alambert, and far from the rationalist tradition of Llull, Descartes, and Leibnitz. What did Neurath had in mind with regard to the encyclopaedia? The answer is relatively simple: to build a useful tool for reciprocal cooperation and understanding among scientists. Therefore, the encyclopaedia should be an organized formulation of all scientific research, but not –as it was expressed above- a super-system of theories and laws. Neurath had perceived that in order to carry out his project, the creation of a language common to the scientific community was a necessary condition; i.e. a kind of lingua franca for scientists. How Neurath thought that lingua was is something that has been accurately summarized by U. Moulines: 'Neurath's long-term aim was a universal jargon, a sort of scientific Esperanto, by means of which all kinds of scientific ideas and results could be expressed.'[7]

Four of Neurath's key words related to scientific activities help to enlighten his encyclopaedia and lingua franca project: 'communication', 'cooperation', 'interdisciplinarity', and 'interaction'. For us it is crucial to observe that, when Neurath speaks of a lingua that makes it possible to optimize the activities meant by those terms, he does not think only in terms of nouns, e.g. 'structure' should have the same sense for all scientists

all over the world and, therefore, the same reference. He also considers that there are logical questions involved. The following quote is very revealing in this regard: 'It is not within the scope of this work to describe the achievements of particular disciplines. Instead, to the extent possible, it will present the many branches for science as a whole. *In particular, it must be seen to what extent logic-scientific analysis can be put in the service of the unification of science'* (italics are ours). It is here where we encounter the deep connection between Neurath's thought and tangible and present progress in philosophy, especially in logic. As mentioned above, this progress encouraged us to take up the encyclopaedia project; at the same time, it supports the idea behind the series *Logic, Epistemology, and Unity of Science.*

Certainly, when Neurath spoke about the scientific analyses of science he was thinking about classical logic (CL), with which he, as well as the other members of the Circle, was familiarized. However, his proposal and that of the Vienna Circle –perhaps a proposal that constitutes one of their most important legacies- can be now formulated in the form of a question: Has logic produced new tools to optimize communication between scientists since the 1935 *Congrès International de Philosophie Scientifique*? And even more important: Have logic and philosophy of science created new ways of analysis, which can help in the development of sciences? If the answer is yes –and it certainly is-, then we are in the way paved by him and those who conceived the encyclopaedia as a task for coining instruments for powering the progress of sciences rather than for unifying theories or laws.

'One of the purposes of this volume is to encourage philosophers to recognise the potential richness to be found in recent work on logic, for instance in the plethora of non-classical logic…' So begins the cited article by Rahman and Symons to the first volume of this series and, for sure, it is not an unnecessary advice because this should warn many thinkers –philosophers and non-philosophers- that things have changed in logic and philosophy of science. The 60's witnessed the irruption of history, sociology, and psychology of science *within* philosophy of science, at least in some important aspects. Certainly, this movement was positive; however the irruption of those new perspectives was often accompanied by severe attacks to logic (CL) and philosophy of science. With regard to this fertile but confusing period, it is necessary to make a clarification, unnoticed to many historians. Now, in retrospect, we can appreciate it: the criticism to the logical analysis of science –very common in the 60's- should have been understood as this: CL was *the only* tool for that task. However, the so-called 'extensions of classical logic' have today refuted this assertion. In

other words, classical logic is one branch of logic, but not *the* logic. If this distinction is not kept in mind, then the revolutionary period becomes misunderstood.

To make our arguments concrete by means of examples, let's remember two opinions that were very common during that revolution; opinions that, even today, many people repeat without criticism. Briefly, they can be formulated in the following terms: (i) Philosophy of science is unable to analyse social sciences properly because there are no strictly universal social laws in these disciplines. Without universal laws, explanations are not possible according to the classical doctrine. In addition, statistical explanations can only point out correlations and, therefore, should remain only at the phenomenical level. (ii) Contradictions are part of the life of sciences. Far from being exceptional episodes, contradictions are normal situations and, moreover, they are engines for the development of sciences. But CL is unable to manage these situations. We think that philosophers such as W. Dray and P. Feyerabend might respectively sign (i) and (ii). Certainly, if CL was still our unique formal tool for analyzing sciences, then (i) and (ii) would remain as challenges not overcame for one of the most traditional and important task of philosophy of science, that is, the logical analysis of sciences. Nevertheless, this is not the case after the arrival of the extensions of classical logic. These new logics were *in status nascendi* when that famous revolutionary period emerged

With regard to (i), today it is possible to analyze terms essentially involved with the social sciences and also with other disciplines derived from the new logics. Modifiers such as 'usually', 'normally', 'rather', generally', 'many', etc. can receive a satisfactory treatment from logic for qualitative reasoning and normic logic.[8,9] Thus, it can be appreciated how the progress in logic allows philosophy of science to carry out the analysis of social sciences that are adequate to their nature, so to speak. *Alio modo dicto*, the long repeated sentence that 'logic and traditional philosophy of science use the *Procutus lecti* when they analyse social and soft sciences', is now totally mistaken. With regard to (ii), paraconsistent logic by S. Jaskovsky, N. Da Costa[10], G. Priest, and others, provides instruments for managing inter and intra-theory contradictions. In this way, paraconsistent logic protects theories from the mortal arrows, which could proceed from the famous dictum *ex contradictione sequitur quodlibet.*

A new era for philosophy of sciences has arrived. Its progress and innovation gets support from logic. The majority of these achievements were conceived in the 60's. At that time, many revolutionaries announced the death of rationality because of the limitations of CL –that they

attributed to *logic* without any further distinction- for analysing sciences. However, and as expressed by Rahman and Symons in the first volume, 'we are not witnessing the burial of logical positivism but rather the last days of the movements that claim to have surpassed the spirit of the Vienna Circle'.

As shown in the arguments above, there are solid reasons to carry out the program of the unity of science, at least in Neurath's spirit. These reasons rest on the amazing innovations and advances made in the field of philosophy, especially in logic. However, some previous clarification is convenient in order to avoid the some usual confusion. Moreover, some historical comments on the program background shall be added.

First, it calls our attention the great disorder of theses and perspectives around the problem of the unity of science. These usually appear in books and meeting journals compiled in such a way that they remind us of that short story written by Jorge Luis Borges about the classification on animals in a Chinese encyclopedia:

'On those remote pages it is written that animals are divided into (a) those that belong to Emperor, (b) embalmed ones, (c) those that are trained, (d) suckling pigs, (e) mermaids, (f) fabulous ones, (g) stray dogs, (h) those that are included in this classification, (i) those that tremble as if they were mad, (j) innumerable ones, (k) those drawn with a very fine camel's hair brush, (l) others, (m) those that have just broken a flower vase, (n) those that resemble flies from a distance'[11]

Contributions on very different themes -many of them overlapping- accumulate around the unity of science. Among others, we find *methodology, reductionism, encyclopedia, holism, emergency, incommensurability, natural and artificial languages, realism, instrumentalism, hermeneutic, unity, unification*, etc. Sometimes we wonder if all those who say to speak about the unity of science are, in fact, speaking about the same subject. In an attempt to put some order within this *mare magnum*, it is convenient to analyze the notion of *unity* and for that, we should take a look at the old tradition. For the Aristotelians *unity* was a negative notion, which was applied non *simpliciter*, but *secundum quid*. Unlike Platonics, for Aristotelians diversity was a basic fact, whereas *unity* always involved a certain previous abstract activity, i.e., finding some common factor among a given plurality. Also for us, the diversity of sciences is a fact, whereas their unity demands a certain demonstration.

When Galileo assumed that nature was written in mathematical characters, he was setting out the bases for a methodology *common* to all natural sciences, one that would reach its plenitude during the Newtonian period. Also Stuart Mill, with his inductive methods as unavoidable tools for social and natural sciences, introduced a cohesive element for the unity into the sciences of his time. In the same way, but from a different perspective, K. Popper and K. Hempel tried to demonstrate that the hypothetical-deductive methodology, which transcended the differences between natural and social sciences, was the dominant factor in scientific research. Contrary to them, F. Schleiermacher, W. Dilthey, M. Weber, and W. Windelband by emphasizing the difference between *Naturwissenschaften* and *Geitswissenschaften* set the basis for the thesis of the disunity of science. Even today their doctrine is a basic premise for the hermeneutic stream. However, the important thing here is to notice that the assessment of a common methodology for sciences is just *one* way of affirming the unity, at least for the way in which knowledge is justified or acquired. Metaphysical presumptions such as causality –mentioned by T. Kuhn as a condiment of paradigms- are other possible factors of unity, despite the fact that might exist an irreducible plurality with regard to methodologies.

As it can be observed in classical philosophy, factors of unity among sciences can derive from the way in which one acquires knowledge or the purposes for which sciences are cultivated. The Aristotelian division in speculative, moral, and productive sciences corresponds to this last criterion. Certainly, if for the unity of sciences it is enough to find a common element among them -as intrinsic or extrinsic-, then it seems that it will always be possible to assess such unity. It could be objected that in this way the question of the unity of sciences became something trivial, because sentences such as ‘sciences are human products’ or ‘they are socially estimated’, among others, could always work as elements for their unity. The answer to this should be that it all depends on the aspect being considered; if this element is irrelevant, then the unity assessed will be irrelevant too. But, certainly, the existence of common methods used to justify knowledge is not something trivial. This is the reason why discussions on the unity of science were, by and large, centered on the question of common methodologies.

Second, the crucial distinction between the notions of *unity* and *unification* should be continuously emphasized in any discourse of the unity of science. Whereas for unity the identification of a common element among sciences is enough, for unification it is much more demanding because it implies the integration of theories and, probably, the reduction of all of them to one basic super theory. In his famous work *The Structure of*

Science, E. Nagel, was a pioneer for the 20th century in the analysis of the logical and epistemological requirements for a successful unification. However, and from a historical point of view, the thesis of the unity of science -through the integration of all disciplines into a super discipline- was already a well-defined doctrine in the Middle Ages. F. Suarez explains the doctrine of Egidio, Miranda and other scholastics, who thought that there was just one science –metaphysics-, within which other sciences could be distinguished, but only for teaching and learning reasons.

'Qui consequenter affirmat caeteras scientiea non esse a metaphysica totaliter diversas, sed esse partes eius, seu potious omnnes esse partes unius scientiae; communi autem usu distingui et numerari ut plures propter commoditatem et usum earum in addiscendo, quia ita docentur et addiscuntur, ac si essent distinctae, idque propter rerum varietatem'[12]

The thesis of unification of scientific knowledge reappeared in Leibnitz, who sailed in the wake of Petrus Ramus and Raimund Llul

'Le corps entier des sciences peut être considéré comme l'océan, qui est continué partout, et sens interruption ou partage, bien que les hommes y conçoivent des parties, leur donnent des noms selon leur commodité'[13]

Der logische Aufbaut der Welt by R. Carnap launched the thesis of the unification in the 20th century, but it was an ideal that he left some years after. Then, P. Oppenheimer and H. Putnam transformed Carnap's ideal of unification into an empirical hypothesis about the real tendency of sciences towards unification.

Third, it is interesting to see how the question of unity and unification of sciences is present in discussions about realism and idealism. As advanced by Kantian's doctrines, the unification of knowledge does not necessarily imply the unity of reality because, in the case of idealism, the unity of reality derives from our way of knowing and organizing our sensations. Notice that Aristotle himself approached the topic of the unity of science from a perspective that today we might call 'cognitive'. Due to his theory of intellectual habits, Aristotle gave a negative response to the question whether sciences can be fused into one, as Leibnitz and other claimed many centuries after. In other words and taking into account the distinction between unification and unity, Aristotle rejected the unification, but he accepted the unity by postulating the same method for the justification of any speculative knowledge: the scientific syllogism.

Fourth, if we understand the unity of sciences as a synonym for unification (but we shouldn't), then the question of the nature of reality becomes crucial. If reality is (i) composed by a unique primary element to which all

entities and processes can, in principle, be reduced to and (ii) if we can find the laws governing such primary element or ἀρχή, then the construction of a super theory becomes a superlative work for scientists and philosophers, as one capable of joining general relativity and quantum mechanics. From this perspective, Greek atomists should be considered as the pioneers in the unification thesis. As it was argued above, it should be emphasized that the unification of sciences implies their unity, but the opposite is not necessarily true. The unification of theories demands for philosophers to create the logics able to express languages as different as those used by physical sciences and biology.

Finally, by making a distinction between unity and unification, it is possible to clarify a frequent confusion related to T. Kuhn's position with regard to the topic of the unity of science. It is evident that the thesis of incommensurability, even in its weakest form –incommensurability as incompatible taxonomies- excludes any possibility of theory unification and *a fortiori* science unification. However, Kuhn's known scheme of the development of disciplines, that is, the pattern *normal science* → *crisis* → *revolution* → *normal science* , provides a common factor in natural sciences. In addition, when he conceives that theories are instruments for solving problems, he is giving us a cohesive element for the unity of scientific knowledge as a whole.

The Editors

References:

[1]Horkheimer, M: 'Der neueste Angriff auf die Metaphysik', *Zeitschrift für Sozialforschung*, VI, Heft I, p. 4 ff.

[2]Galison, P. and Stump, D. J. (eds): (1996), *The Desunity of Science. Boundaries, Contexts, and Power*. Stanford U. Press, Stanford Ca.

[3]Rahman, S. and Symons, J. (2004), 'Logic, epistemology and the unity of science: an encyclopedic project in the sprit of Neuraht and Diderot'. In *Logic,Epistemology and the Unity of Science*, Rahman, S. et al. (eds), Kluwer Academic Publishers.

[4]Gintis, H.: (2004), 'Towards a unity of human behavioral sciences'. In *Logic, Epistemology and the Unity of Science*, Rahman, S. et al. (eds), Kluwer Academic Publishers, 25-39.

[5]Neurath, O.: (1936), 'An international encyclopedia of the unified sciences', *Actes du congrès international de philosophie scientifique*, Translation by J. Symons and R. Alvarado, in *Logic,Epistemology and the Unity of Science*, Rahman, S. et al. (eds), Kluwer Academic Publishers, 2004.

[6]Creath, R.: (1996), 'The unity of science: Carnap, Neurath and beyond'. In Galison, P. and Stump, D. J. (eds): (1996), *The Desunity of Science. Boundaries, Contexts, and Power*. Stanford U. Press, Stanford Ca, p. 161.

[7]Moulines, U. C.: Unified science? Does scientific progress necessarily leads to a unified science?' See in this volume.

[8]Schurz, G: (2004), 'Normic-laws, nom-monotonic reasoning, and the unity of science', in *Logic, Epistemology and the Unity of Science*, Rahman, S. et al. (eds), Kluwer Academic Publishers, 181-211.

[9]Veloso, P. and Carnielli, W.: (2004), 'Logics for qualitative reasoning', in *Logic,Epistemology and the Unity of Science*, Rahman, S. et al. (eds), Kluwer Academic Publishers, 2004, 487-526.

[10]Da Costa, N. and Krause, D.: (2004), 'Complementarity and paraconsistence', in *Logic,Epistemology and the Unity of Science*, Rahman, S. et al. (eds), Kluwer Academic Publishers, 2004, 557-568.

[11]Borges, J. L.: *Others Inquisitions*, translated by Simms R. Washington Square Press. 1965

[12]Suarez, F.: *Disputationes Metaphysicae*, D. I, S. II, 2: '[They] assert consequently that the other sciences [Physics and Mathematics] are not entirely different from Metaphysics. Rather, they are part of it and even of a unique science. However, the common use distinguishes and numerates them as if they were many for reasons of utility and convenience in order to their learning'.

[13]Leibnitz, G.: *Philosophischen Schriften*, edited by Gerhardt, Georg Olms, Hildesheim, 530-531.