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Preface

If the universe had to be condensed in a single concept, I would choose that of *reason*. Reason suggests logic, mechanism, foundation, intelligibility, sequence, connection, order of ideas, etc. I cannot find any concept endowed with a higher intellectual power. And as soon as one contemplates the remarkable amount of knowledge and the wealth of ideas generated by humanity over the last centuries to satisfy our ardent desire for understanding, it is inevitable to pose the following questions: how is it all connected? What bridges can unite the different disciplines?

The present work aims to explore a theory of human knowledge, through a model of rationality combined with some fundamental logical, mathematical, physical and neuroscientific considerations. Its ultimate goal and overarching aspiration is to present a philosophical system of integrated knowledge, in which the different domains of human understanding are unified by common conceptual structures, such that traditional metaphysical and epistemological questions may be addressed in light of these categories. In summary, a system of categories that may reproduce and even expand, by virtue of its explanatory power, the conceptual chain followed by nature and thought (indeed, through the analysis of these categories philosophy could help find new and unsuspected connections between them). Hence, in this system of thought it must be possible to show ^{xii} | *The Integration of Knowledge*

the continuity between all domains of human knowledge and the reciprocity between the elements and rules of inference that compose them. The purpose is therefore to integrate knowledge in order to advance itineraries that may help us overcome the present limitations of our understanding; thus, to integrate in order to increase knowledge, to integrate in order to acquire a deeper consciousness of what we know, particularly in its fundamental character, thereby opening ourselves to new possibilities of broadening the scope of human thinking. For it is always easier to climb beyond a limit when we have a clear idea of where the frontier lies and how it has been reached.

Halfway between the amplitude of an essay and the rigor of a monograph, I have attempted to follow a plausible logical course in the exposition of the principal themes and arguments. Indeed, I have been guided by the conviction that the way in which the contents are ordered is itself a philosophical thesis.

Reflecting on the nature and limits of human knowledge represents one of the main tasks of philosophy. What is generally called “epistemology,” or “theory of knowledge” (*Erkenntnistheorie* in the German philosophical tradition), aims to address the problem of knowledge, that is, the question about how we acquire valid knowledge from sensory experience and rational thinking. Thus, an alternative formulation to this inquiry may be posed as follows: what features of the human mind (and, more specifically, of the way in which rational thinking works) make scientific knowledge possible in its most relevant manifestations, from logic, mathematics and physics to neuroscience and the social disciplines? Of the great challenges confronted by philosophical speculation, we shall probably not find one in which such profound and universal aspects converge. And, certainly, in the act of posing the question about the nature of knowledge, it is essential to examine concomitant problems, true touchstones for human reason, such as the nature of the world and the mind (sources from which we extract all possible knowledge), as well as, in more general terms, the nature of the human being, who undertakes the ambitious project of transcending the specific situation in which he finds himself, his spatiotemporal context, in such a way as to obtain knowledge of universal validity, suitable for revealing the most elusive and recondite details of the universe.

Thus, this work tries to systematize the basic conceptual tools of an ontology and an epistemology capable of adequately integrating knowledge, both in the natural sciences and in the disciplines that study the human world. Therefore, the following chapters can be seen as an attempt to explore the fundamental categories of reason in an effort to organize the results of the different branches of knowledge, inserting them in a broader framework. *Preface* | xiii

From a philosophical perspective, it would be legitimate to argue that this project has the purpose of testifying to the continuity that exists between all levels of reality and knowledge. Without pretending in any way to impose philosophical apriorisms on scientific research (which does not need any metaphysical endorsement in order to expand the cognitive heritage of humanity; indeed, philosophy is not the arbiter of science), our method can be conceived from a formal point of view and from a material angle. In the first case, it consists in identifying those notions endowed with greater explanatory power for each area of knowledge and thought; in the second, it appears as a vast logical and causal mechanism, which aspires to look for explanatory itineraries capable of manifesting the links of continuity between the different areas of nature. To use an analogy inspired by integral calculus, it can be said that the project of integration of knowledge can be visualized as a limiting procedure that approximates the whole “area” of human knowledge by summing over a potentially infinite number of explanatory elements, which nonetheless converge into a finite, and usually small, set of fundamental concepts or categories of explanation. Through them it should be possible to establish meaningful relations that enable to form an articulated system of knowledge, where all concepts, extracted from a diverse array of disciplines, can nonetheless be understood in a unified manner. Thus, if in its most elementary historical formulation a mathematical integral was the conceptual tool that allowed for computing the area described by a function, to integrate knowledge would entail the identification of the area (or space) of concepts that form a unified conceptual system. Hence, by understanding the implications of the truly fundamental concepts of each discipline it should be possible to draw its entire explanatory domain, or the space of concepts of varying degrees of extension and intension that it covers. Then, the goal would be to understand the whole space of spaces, or system of conceptual systems.

In the development of the appropriate formal instruments to undertake this task, the following expository sequence has been adopted. First, we shall discuss the conditions of knowledge. Initially, this section gravitates around the analysis of rationality, thought and knowledge as mental processes that lead to the acquisition and justification of new information. In these pages, the quest for first principles is harmonized with an empirical perspective on human reason. Furthermore, this section contains an exploration of the basic structures of human thinking. Its aim is to illustrate a theoretical framework for connecting the laws of thought and the laws of nature. Later, we shall delve into the ontological continuity that exists between material objects and the human mind. Here a paradigm is proposed for integrating scientific knowledge on the basis of some fundamental categories that xiv | *The Integration of Knowledge*

may link the relevant realms of research. Finally, we shall delve into the principal philosophical dimensions of human activity, beginning with consciousness as the enabler of a “human world,” and addressing a conceptual examination of the scope and limits of the social sciences. In this part, the study of “creativity” will be underlined as a category key to any approach to human action, and the human mind will be characterized by its capacity to formulate an ever-increasing body of questions about nature and thought.

So, we shall start from the mind (in its formalizing dimension) to return to the mind (in its condition of natural and historical object).

Regarding the material elements with which human knowledge is concerned, we have adopted an evolutionary and gradualist point of view. The goal is to link the simplest entities (the physical and chemical realm) with the most complex ones (the biological sphere and the human world, as a subset of the previous one), in such a way as to highlight the profound intertwining of all levels of nature.

This work is philosophical in nature, but our epoch questions the need for philosophical reflection. For many, the ancient metaphysical disquisitions played a precursory role towards the full development of rational thought, as initial gateways to the flourishing of a truly scientific worldview. However, according to this updated version of Comte’s law of three stages, at present the human mind could completely dispense with philosophical speculations, limiting itself to collecting empirical data and to harmonizing them in increasingly sophisticated theoretical models.

Indeed, no one can deny the intimate historical link between the natural sciences and philosophy. Not only did Newton include the term “philosophy” in the title of his *opus magnum*, *Philosophiae Naturalis Principia Mathematica*, of 1687, but also John Dalton, whose *A new system of chemical philosophy*, first published in 1809, paved the way for a revolution in chemical thinking through the elaboration of the modern atomic hypothesis. So did Jean-Baptiste Lamarck in his *Philosophie zoologique* (1809), which, beyond its biological mistakes, represents the first great landmark in applying evolutionary thought to natural history.

Nevertheless, the question refers not so much to such a distinguished history of interlacing premonitions and achievements between science and philosophy, as to the possible meaning of the philosophical enterprise for our days. For, what can philosophy mean today? What can it offer to the human pursuit of knowledge? Has it been entirely replaced by the children that it brought to life and initially nurtured, or does it still enjoy a certain degree of epistemological autonomy?

Absorbed by the progress of the natural and the social sciences, philosophical theories might have lost their legitimacy, given their inability to produce *Preface* | xv

significant advances in knowledge. Entangled in inveterate discussions, fascinated by language and its uses, obsessed with the insatiable analysis of the opinions expressed by past thinkers, the power and richness of philosophical activity would have languished, and today it would not exhibit any clear signs of recovery. Indeed, encircled by the natural sciences on one of its flanks, which penetrate territories that used to be monopolized by philosophy, many may consider that its only redemptive horizon should lie in embracing artistic expression, to become a genre of literature (realistic or fantastic). Thus, once the high scientific pretensions that had been assumed by some of the most egregious thinkers of the past have vanished, philosophy would now be forced to inhabit a no man's land, halfway between the sciences and the arts, without possessing any truly differential content.

Thus, the very notion of a "philosophical problem" will raise many suspicions. Are not these supposed philosophical problems pseudo-questions, which can be approached from a logical and scientific point of view? What is the object of study of philosophy? Its hypothetical difficulties, do they not actually respond to linguistic confusions or to conceptually incorrect perspectives? How should one explain the small progress made in the path towards its resolution?

With the probable exception of ethical problems, where the need for philosophical reflection seems incontestable (since it has not yet been possible to reduce the traditional philosophical examination to a procedure similar to that used by the natural sciences), a great majority of questions so far investigated by philosophy tend to be susceptible of a logical and scientific analysis. Discussing the nature of space, time and the mind—to mention some illustrious examples—is no longer the exclusive domain of philosophy. Sciences like physics and neuroscience have contributed more to the clarification of these mysteries than the countless philosophical speculations devoted to understanding them.

One must not forget, however, both the historical legitimacy of philosophy, which on many occasions has provided a vigorous stimulus for the development of logical and scientific thinking, as well as the persistence of problems that, due to their fundamental nature, their breadth and their interdisciplinary condition, can benefit from philosophical reasoning. This suitability of philosophy is highlighted in traditional problems of metaphysics and epistemology, where the capacity to criticize the assumptions and conceptual frameworks that underlie many scientific results represents an interesting source of value added to a purely empirical treatment. Indeed, the quality of a philosophy resides in its concepts, arguments and modes of articulating concepts and arguments, in order to offer a profound and innovative view of reality. With its combination of analysis and synthesis, with its fusion of the hypothetical and the deductive, with its pretension to connect ^{xvi} | *The Integration of Knowledge*

divergent perspectives and reach the fundamental concepts, philosophy can and should contribute to the resolution of great problems that, given their extension or intension, may overwhelm the specific field of a particular science, so as to require a more integrative perspective.

In this sense, there are no exclusively philosophical problems, just as there is no method monopolized by philosophy. The convergence of creative rationality and empirical selection continues to be, as in the natural sciences, the quintessential strategy towards a reliable understanding of reality. Nevertheless, philosophy does not only aspire to understand, but to edify; it is therefore in understanding the meaning of scientific results for human life and the possibilities which they offer for improving the world where an important dimension of philosophical activity resides. It is, in short, in the totality of human experience where a genuinely philosophical interest shines that, far from being satisfied with contemplating, as separate parts, the different realms of world and history, pretends (naïvely or heroically) to provide an integrating synthesis.

Hence, and although I am fully aware of the deep and painful crisis that philosophy is experiencing, I believe that one of the most pressing responsibilities of what has traditionally been called “love of wisdom” is that of contributing to the synthesis of knowledge. Our knowledge is vast, but we do not always know how to integrate such an extraordinary wealth of knowledge; nor how to extract the appropriate consequences so as to build a more just and humane world. Indeed, I dare to say that this necessity of distilling the really essential elements from an overabundance of information, thereby promoting a spirit of synthesis in parallel to analytic progress, defines one of the major challenges of our age. And a philosophy capable of addressing this challenge will not only capture the spirit of its time, but it will also shape the spirit of the future, by setting a constant goal of exchanging and nurturing ideas and perspectives beyond academic disciplines and cultural traditions.

Information has grown at an astonishing rate in recent decades, but the fundamental principles, the truly revolutionary categories that propel authentic paradigm shifts, the notions endowed with unifying potential in the different domains of knowledge, can be condensed into relatively small sets. The long experience of philosophy in the treatment of profound and abstract problems is indisputable. Therefore, the “love of wisdom” cannot only underline open questions in numerous disciplines and even participate in some of its debates. Rather, it can also elaborate an overall vision that, even without adding new contrasted information (something that, in my opinion, can only stem from the correct use of the scientific method and logical-mathematical reasoning), will broaden at least the *Preface* | xviii

radius of our reflection and help us to discover unsuspected links between realms of thought.

In this way, our method of philosophical research is in a certain sense antithetical to the so-called archaeology of knowledge cultivated by Foucault. In his own words, the French thinker proposed “an inquiry whose aim is to rediscover on what basis knowledge and theory became possible; within what space of order knowledge was constituted; on the basis of what historical a priori, and in the element of what positivity, ideas could appear, sciences be established, experience be reflected in philosophies, rationalities be formed, only, perhaps, to dissolve and vanish soon afterwards. I am not concerned, therefore, to describe the progress of knowledge towards an objectivity in which today’s science can finally be recognized; what I am attempting to bring to light is the epistemological field, the episteme in which knowledge, envisaged apart from all criteria having reference to its rational value or to its objective forms, grounds its positivity and thereby manifests a history which is not that of its growing perfection, but rather that of its conditions of possibility; in this account, what should appear are those configurations within the space of knowledge which have given rise to the diverse forms of empirical science. Such an enterprise is not so much a history, in the traditional meaning of that word, as an ‘archaeology’.”¹ Our inquiry, on the contrary, does not look in the past for answers to the question about the meaning of knowledge; rather, these answers are sought in the present conditions of validity and in their prospects for future progress regarding the creation of a system of human knowledge, which in spite of its inevitable contingency may nonetheless tend to the highest possible degree of necessity.

Furthermore, it should not be forgotten that science allows us to understand the structure and properties of the universe, its past, its present and certain elements of its future, but little or nothing tells us about how the human world can and should be. Conceiving the future is one of the noblest commitments that philosophy can still assume. For this, the evocative combination of imagination and reason that has so often characterized the great philosophical developments stands as an inestimable instrument in this infinite race towards truth.

Beyond the technical complexities that persist in virtually every branch of human knowledge, what matters is the capacity to unveil principles and categories, as conceptually profound as to integrate a variety of facts into a clearly defined system of thought, based upon principles, rules of inference, boundary conditions and legitimately deduced consequences. The supreme triumph of human reason would therefore reside in the possibility of understanding the highest possible number of mental and material phenomena from a simple and small number of

principles. And nowadays we live a renaissance of the possibilities of the human mind to acquire an integrated vision of the world.

In one of the earliest written documents of humanity, *The Epic of Gilgamesh*, we are told that the legendary king of Uruk was “the man to whom all things were known; this was the king who knew the countries of the world. He was wise, he saw mysteries and knew secret things, he brought us a tale of the days before the flood.”² Today, this compelling metaphor of a “man to whom all things were known” resonates with new and vivacious lights. Knowledge may be potentially inexhaustible, and new mysteries will surely emerge before the future eyes of humanity, but the dream of achieving a system of concepts as complete as to encompass the richness and exuberance of the world will probably never fade from our consciousness. We seem destined to searching for unity and totality, dissatisfied with partial and imperfect answers to the greatness of our questions. And perhaps this perennial questioning of reality will actually turn to be our most distinctive feature as human beings.

Notes

1. M. Foucault, *The order of things*, xxiii–xxiv.
2. Table I, column I of the Assyrian text; see Sanders, N. K. *The Epic of Gilgamesh: An English Version with an Introduction*. Penguin Books, 1960.

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Chapter 1: The nature of rationality, knowledge and thinking

The project of integrating knowledge can be conceived as the design of a philosophical system in which all parts are bounded by a common pattern of rationality. It is therefore an attempt at fully “rationalizing” our view of the universe, in connection with the greatest developments in logic, mathematics and the natural sciences. Thus, the question about the meaning of rationality stands as a preeminent challenge for this endeavor. This chapter proposes a concept of rationality as minimization of presuppositions. It then discusses the notions of thinking, knowledge and understanding, addressing some of the traditional philosophical debates. The core of the chapter consists of the proposal of a theory of knowledge based upon two postulates: “Mental contents ultimately reflect the laws and structure of nature” and “No mental content (concepts or categories, propositions, systems of propositions) that is not tautological can be absolutely rigid.”

Keywords: rationality, presupposition, efficiency, elasticity, thinking, knowledge, postulates, imagination.

Chapter 2. The form of thinking

A fundamental question for the philosophical analysis of human knowledge concerns the existence of innate ideas in our mind. This chapter addresses the concepts of “a priori” and “a posteriori” concepts of understanding, and it discusses the role played by logical principles. Further, this section discusses a possible explanation of the origin of our fundamental logical principles, by inserting them in the “logic of nature,” in particular of thermodynamics principles. Thus, it criticizes the idea of “synthetic a priori” judgments and it explores the naturalization of our logical categories, where the power of imagination plays a key role. Later, the chapter reflects on the notion of truth and the problem of its “naturalization” through an evolutionary paradigm, proposing a model in which logical truth and biological efficiency are combined, so as to reconcile an evolutionary understanding and a purely logical approach to truth.

Keywords: naturalization, transcendental, a priori, a posteriori, principles, logic, thermodynamics, imagination.

Chapter 3. The limits to knowledge

This chapter explores the fundamental limits to human knowledge, namely Gödel's theorem and Heisenberg's principle, conceived as analytic and synthetic frontiers to our possibility of knowing the mind and the natural world. Furthermore, it discusses the problem of how to understand physical measurements, and it proposes a conceptual connection between two fundamental physical principles associated with the idea of measurements: the principles of relativity and uncertainty. Thus, after addressing the nature of rationality, knowledge and thinking, in this chapter of the book an attempt is made to reflect on the limits of our rational inquiry into the structure and functioning of the universe.

Keywords: limits, knowledge, Gödel's theorem, Heisenberg's uncertainty principle, relativity, measurement, model, system.

Chapter 4. The epistemological dimensions of the scientific enterprise

This chapter discusses the nature of scientific explanations, regarded by many as the preeminent forms of human knowledge. A scientific explanation is conceived as a model of a mechanism for a given phenomenon. The design of scientific models is interpreted as the fruit of a combination of imagination, reason and experience. Furthermore, the problem of scientific validation is discussed, criticizing both verification and falsifiability as sufficient conditions for characterizing scientific explanations. The second part of the chapter addresses the possibility of constructing an "alphabet" of scientific categories, capable of synthesizing the entire body of our physical, chemical and biological knowledge. The concepts of conservation, selection and unification will appear as fundamental categories in this quest for an integration of human knowledge. Also, a reflection on the ideas of "complexity" and "reduction" leads to the philosophical analysis of nature as a *continuum* that nonetheless admits the existence of critical points.

Keywords: science, explanation, mechanism, verification, falsifiability, alphabet, category, complexity, reduction, continuity

Chapter 5. Mathematical and scientific laws: rationality in thought and nature

This chapter is an essential part of the book. It addresses the question of how to integrate knowledge through an exploration of the basic categories of mathematics, physics and biology. Mathematics is interpreted as a "rationalized form of imagination," and Nature is conceived as "materialized rationality." Three basic patterns of rationality in

nature are discussed: laws, elementary particles and physical constants. The problem of the existence of natural laws is addressed, and its relation to the philosophical problem of determinism. Nature is conceived as a system of laws, or rules of inference applied upon material bodies. Conservation is seen as a fundamental category for understanding physical process, while variation/selection is regarded as the key explanatory tool for comprehending biological phenomena. In light of these considerations, a definition of life is proposed.

Keywords: mathematics, axioms, laws, system, conservation, selection, life, integration

Chapter 6. On the mechanisms of the human mind

Having addressed the fundamental categories of mathematics, physics, chemistry and biology, this chapter penetrates into the essential philosophical dimensions of the human world, certainly the most difficult part to include in a project of “integrated knowledge.” Given the difficulties of understanding the most defining dimension of our humanity, which is our rational mind, this chapter is consecrated to the analysis of the so-called “mind-body problem.” The human mind appears as a frontier for our rational understanding of the world, and its comprehension demands a combination of philosophical and neuroscientific efforts. A framework for the relation between philosophy and neurobiology is discussed, followed by a proposal of rational path leading from “molecules to thinking.” The concepts of representation, perception and consciousness are addressed, to later delve into those of subjectivity and freedom.

Keywords: human, mind, complexity, representation, perception, consciousness, subjectivity, freedom.

Chapter 7. Creativity and the bridge between the sciences and the humanities

The previous analysis of human knowledge and of its insertion within the broader scope of natural laws should allow us to delve into the realm of the social exchange of ideas, of human activity as such. Indeed, one of the most outstanding features of the human mind resides in its ability to create new ideas and frames of reference, which beyond explaining the properties of the surrounding universe contribute themselves to building a new universe of meanings and intentions. This property becomes visible, in a special and vivid manner, when one addresses the historical development of knowledge. Creativity therefore stands as a crucial element for understanding the deepest capacities of the human mind and the acquisition of knowledge as such, which often follows non-linear and non-deterministic paths that offer a valuable territory for philosophical reflection. The

chapter is therefore dedicated to a philosophical exploration of creativity, as a bridge between the natural sciences (creativity as a function of the human mind, and thus of the human brain) and the humanities (creativity as the possibility of inventing ourselves within a certain historical context).

Keywords: creativity, bridge, nature, humanities, imagination, genius, plasticity, learning, analogy, transcendence

Chapter 8. The foundations of the social sciences

The previous pages have addressed fundamental epistemological questions focused on the scope of the natural sciences and their implications for a theory of knowledge. Physics, chemistry, biology and neuroscience, together with logic and mathematics as structural foundations of their rational inquiry, represent our most powerful tools for achieving knowledge endowed with the highest degree of certitude. Nevertheless, the human mind, in its far-reaching aspiration to conquer new territories of knowledge, cannot renounce exploring the realm of the most complex objects available to our experience: the productions of the mind in the form of cultural and social institutions. This chapter addresses the epistemological problem posed by the social sciences, proposing an axiomatic view based on ten principles that may serve as “starting points” for the epistemological discussions on the nature of the social sciences. It also discusses the problem of agency and its “naturalization,” while respecting its “historicity.”

Keywords: social sciences, principles, axioms, naturalization, historicity, analysis, synthesis, method.

Chapter 9. Knowledge and the development of the human mind

This chapter delves into an anthropological reflection on knowledge. The development of the human mind is attributed to the acquisition of new forms of knowledge as its essential driver, and such a process is analyzed in its material and “formal” dimensions. The interplay between material and “mental” development is discussed from a theoretical point of view, examining the relation between technology and ideas from a circular perspective. The human ability to pose new questions that challenge the established order of knowledge and thinking, in an unending chain, is seen as the fundamental source of our development. A brief discussion of the principal landmarks in our intellectual

evolution since the invention of writing is proposed. Imagination, regarded as the capacity to invent new mental frameworks, is conceived as the avant-garde of our rational mind, capable of opening new horizons of reflection that help us solve existing problems and create new ones.

Keywords: anthropology, technology, ideas, imagination, mind, framework, development, progress, invention.

Chapter 10. The possibilities of humanity

The exploration of the conceptual categories that can help us to build a system of integrated knowledge would be essentially incomplete if the realm of artistic creativity remained excluded from our considerations. Indeed, it is clear that one defining feature of the *Homo sapiens* lies in its capacity to produce art, and that artistic creativity has been a constant element in the evolution of our societies. Certainly, art can be regarded as one of the most important factors behind the idea of “humanity.” This chapter examines ways to include art within the system of integrated knowledge. Furthermore, it discusses the role played by knowledge in human realization, and how the infinite scope of questioning may be conceived as the ultimate goal of our rational enterprise. It also addresses the ethical nature of knowledge and its emancipatory capacity. Social progress is conceived as a result of our increasing knowledge of nature and ourselves.

Keywords: art, natura naturans, natura naturata, creativity, questioning, possibilities, social progress, realization.

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