Introduction

Vittorio Hösle

The Notre Dame Institute for Advanced Study was founded in 2008 in the belief that every research university needs a place where scholars come together so as to be inspired by colleagues in disciplines different from their own. There is no doubt that the subdivision of universities into departments is reasonable: given the increase of knowledge in every discipline, controlling the quality of work in a given academic field presupposes expertise in that field. At the same time, the dangers connected with this departmentalization of knowledge are various. For example, people may simply ignore what occurs outside of their own fields. Sometimes this may not affect the quality of their research; sometimes, however, this leads them to miss opportunities to connect their own studies with those of others and thus achieve more general insights. This danger is particularly menacing whenever basic insights are ignored that have repercussions for more applied research. As physics cannot progress without mathematics, so also the humanities, to give only one example, inevitably operate with basic philosophical categories, such as meaning or value; the lack of an explicit reflection on these concepts does not mean that they are not presupposed. On the contrary, the less reflection occurs, the more likely the concepts used are imprecise and

perhaps even inconsistent. But the disconnect of philosophy from the other disciplines is due not only to the specialization of those disciplines: philosophy itself has, to a considerable degree, given up its ambition to address a larger audience and withdrawn into very technical problems that are of interest only to "specialists of the universal," as one could call such philosophers. The decline of public intellectuals, the topic of the Institute's 2013 annual conference, which was organized by Michael Desch, who will edit the corresponding volume, is a necessary consequence of this development—one with dangerous consequences for politics: without the advocacy of public intellectuals, the political system is far more likely to be manipulated by populists and those *terribles simplificateurs* in the mass media who care more for advertising revenue than the truth.

Its three inaugural conferences in 2010, 2011, and 2012 were, together with the residential life of scholars working on research projects that deal with questions both interdisciplinary and normative, the two foci of the Notre Dame Institute for Advanced Study. These three conferences addressed the three concepts that have often been considered by the philosophical tradition the most fundamental—namely, beauty, goodness, and truth—by bringing together scholars from as many disciplines as could fruitfully interact in three days. The first two volumes, *The Many Faces of Beauty* and *Dimensions of Goodness*, appeared in 2013 with the University of Notre Dame Press and Cambridge Scholar Publishers respectively; this volume on conceptions of truth and the unity of knowledge completes the trilogy. The participants of the three conferences did not overlap—with the exception of myself: as founding director of the Institute from 2008 to 2013, I contributed to these three volumes three essays that complement one another. Those invited to the conference on truth were chosen to represent philosophy—including epistemology, logic, and ethics—theology, mathematics, chemistry, biology, psychology, literary criticism, historiography, and architecture. They hailed not only from the United States but also from Israel and various European countries such as France, Germany, Italy, Poland, Spain, and the United Kingdom, and one essay deals with the Chinese contribution to the concept of history. The essays in this volume are collected in five parts, the first dealing with the historical development of the tree of knowledge; the second with the foundational disciplines of

epistemology, logic, and mathematics; the third with explanation in the natural sciences; the fourth with introspection and understanding in those disciplines dealing with humans; and the fifth with the contribution of art and religion.

Some of the common, overarching questions that the contributors to this volume address are these: By which different methods do the various disciplines achieve knowledge of truth? What is common to their methods, and what distinguishes them? Are some disciplines more foundational than others, that is, can they be understood on their own while the others presuppose them? Which forms of knowledge influence each other, and which disciplines have very little overlap? Are there different ontological realms connected with the various epistemological activities? And since it is impossible to give up the belief that the various disciplines contribute to an ultimately coherent vision of reality, how should we imagine this tree of knowledge?

Vittorio Hösle's essay, "How Did the Western Culture Subdivide Its Various Forms of Knowledge and Justify Them? Historical Reflections on the Metamorphoses of the Tree of Knowledge," gives an overview of how Western culture has grouped its various disciplines from antiquity to the present, often under the metaphor of the tree of knowledge, which points to the common roots and thus to the underlying unity of all knowledge. It starts with reflections on the budding of new and the withering of old branches of that tree, partly due to the uncovering of unsuspected strata of reality and partly thanks to the development of new theoretical tools—tools that occasionally allow the unification of disciplines that earlier were regarded as independent. The development of the tree is not always caused by empirical discoveries: shifts in philosophical categorization based on purely theoretical arguments also help to explain the various shapes that the tree of knowledge has assumed in its history. Within ancient philosophy, the first insight into different types of knowledge comes with the Eleatic school's distinction between the way of opinion and the way of truth. Plato builds upon this distinction and connects it to the subdivision of the mathematical disciplines—even while pointing to a fundamental difference between philosophy and mathematics. A thinker as early as Xenocrates proposes

the subdivision of philosophy into logic, physics, and ethics—a subdivision that would become canonical within Stoicism—but it is Aristotle to whom we owe the most elaborate system of knowledge of antiquity: theoretical knowledge encompasses physics, mathematics, and theology; practical knowledge, ethics and politics; and poietical knowledge, poetics and several other less important subdisciplines. Logic, however, is difficult to fit into this tripartition: in Hugh of Saint Victor's *Didascalion*, it will form a fourth part. The two main works from the Middle Ages analyzed in the essay are Bonaventure's *De reductione artium ad theologiam* and Ramon Llull's *Arbor scientiae*. Important in Bonaventure is the attempt to include the trivium of grammar, logic, and rhetoric into this system as well as the insertion of economics—that is, the discipline of the management of a family—between ethics and politics. The climax of all knowledge is a theology based on the fourfold interpretation of scripture. In early modernity, Francis Bacon proposed the most articulate and influential system of disciplines based on the three faculties of memory, imagination, and reason. However, his system is soon challenged by Descartes's radical separation of the knowledge of extended substances from that of thinking substances, which splits any science of humans in two and raises the difficult question of how we may have knowledge of other selves, since introspection is limited to oneself. In the eighteenth century, Giambattista Vico proposed the idea of a new science that addresses human culture, understood as a realm beyond those of nature and the mind. The essay then explores the subtle alterations of the Baconian system in Jean Le Rond d'Alembert's introductory "Discours" to the *Encyclopédie* and delves into Kant's epistemological challenge and his idea of a new systematization of knowledge, which was elaborated by the greatest encyclopedist among the German Idealists, namely, Hegel, who recognizes, against Bacon and d'Alembert and anticipating Frege and Husserl, the irreducibility of logic to any other discipline. Hegel's subdivision is finally contrasted with the almost simultaneous one by Auguste Comte, who had an enormous impact on the structure of nineteenth-century universities by conceptualizing the peculiar status of engineering and having his doctrine of the sciences culminate in the new discipline of sociology.

It is one of the paradoxes of our search for truth that, while knowledge has grown exponentially in the last few centuries, epistemology has not been able to answer in a satisfying way its most basic problem, which a thinker as early as Plato addressed at the end of his *Theaetetus*. Some of our knowledge is inferred from other knowledge, but this inference process cannot go on forever. But how do we grasp the ultimate premises of our inferences? Is there an immediate knowledge—is there, that is, what some have called "intuition"? But how, then, do we react to those who do not share our intuitions, which may be either conceptual or perceptual? If we try to justify our intuitions, we seem to deprive them of their immediacy and thus of their evidence, which must not depend on anything else. If, however, we refuse to do so, we seem to give up a basic demand of rationality. Therefore, coherentism has been developed as an alternative to foundationalism: there are, it holds, no basic premises from which to start, and so it is only the coherence of our whole set of beliefs at which we should aim. But does this not imply either a circular "justification" or an infinite regress? The quarrel between foundationalists and coherentists is old: Hegel may be regarded as paradigmatic coherentist, Husserl as quintessential foundationalist.

In his essay, "Intuition and Coherence in the Keystone Loop," Keith Lehrer, one of America's leading epistemologists, tries to pave a middle ground between foundationalism, which for him is symptomatically exemplified by the eighteenth-century Scottish philosopher Thomas Reid, and coherentism, as whose champion he regards the twentieth-century American thinker Wilfrid Sellars: "It may be that intuition and coherence must be joined to yield the kind of evidence required for knowledge." In fact, Lehrer tries to prove that Reid is less of a foundationalist than he seems at first glance, for he teaches the dependence of the principles of intuition on each other and on what Lehrer calls "the First First Principle," to wit, "that our faculties by which we distinguish truth from error are not fallacious." This principle, furthermore, vouches not only for the other first principles but also for itself—like light, which reveals itself as well as other objects. (Lehrer calls such principles "keystone principles.") But this means that other first principles are not by themselves maximally evident,

since they are justified by the First First Principle. Sellars's rejection of the myth of the given is based on the insight that a person who has sensory states does not necessarily have a conception of them. But an intuitionist could counter that, while this is true, it does not yet show that the evidence connected with the conception has to be inferential, for "not every transition from one state to another is an inference." Still, for Sellars evidence of truth is explained by a system, while for Reid immediate convictions are "born justified." Lehrer then discusses the challenge that skepticism represents to both the foundationalist and the coherentist. He recognizes that the skeptic cannot be confuted without begging the question—but also that this does not endanger any claim to knowledge: "we can know what we suppose we know, even though we cannot prove this to the skeptic." Lehrer insists, furthermore, that the explanation of how we can know something is not a premise in the justification of that belief; therefore, we may have "an answer to the question of how the justification of all beliefs can be explained though some beliefs are noninferentially justified." Lehrer avers with Sellars that all our beliefs are subject to revision. Reflections on the difference between primitive and discursive knowledge, of which only the second may reply to objections—as well as on the nature of exemplarized exemplars, which are instances of themselves—conclude the essay.

In "What Is the Nature of Inference?" Robert Hanna, author of the standard work *Rationality and Logic*, discusses in detail the nature of the process that was the basis of the earlier epistemological investigation. He divides the issue into four separate questions regarding inference—which can be deductive, inductive, or abductive: he investigates its metaphysics, its purpose, its justification, and its mechanism before proposing as a solution what he calls "Contemporary Kantian Moralism about Inference." Concerning the first, he defends transcendental mentalism in opposition to both psychologism—which does not capture the objectivity, necessity, and apriority of inferential facts—and Platonism—which is supposed to be incompatible with the causal triggering of human knowledge. With regard to the second, he subsumes the theory of inference under the metaphysics of morals, for it deals with the summum bonum of reasoning. (He later speaks of a "special logico-practical *ought*.") Emotivism and instrumentalism (or pragma-

tism), on the other hand, imply that "anything goes," provided that everyone shares the same feelings and good results are produced from the standpoint of human interests respectively. Third, he deals with the old problem that the inferential principles to be justified are themselves presupposed in the process of justification. Hanna rejects noncognitivist, holist, and inferentialist strategies as unable to warrant the objectivity, necessity, and apriority of our inferential principles and defends categorically normative logical laws. (He does not investigate, however, the problem of the plurality of logics.) The mechanism of inference finally rests on the causal power of my intentional act of inference. Inference requires both consciousness and consciously free willing—an "inferential 'zombiehood'" is doomed to fail. In his conclusion, Hanna characterizes his idealism as liberal and natural, not scary. It simply states that fundamental mental properties are co-basic in nature with fundamental physical properties.

The discipline in which inference plays the most exclusive role is doubtless mathematics—excepting, of course, logic itself. Laurent Lafforgue, Fields Medalist and one of the world's leading mathematicians, honored the conference with his presence and delivered an essay, fascinating in both its content and its literary quality, titled "Speculation and Narration in Mathematics." Lafforgue starts from the fact that truth cannot simply be seen, but must be lived, for otherwise the concept of truth would be pornographic rather than nuptial. And so he offers a confession of what it means to live a mathematician's life, even if mathematics seems the most impersonal of all disciplines. But he begins his exploration with an approach, as it were, from outside: a nonmathematician who observes a department of mathematics will first notice the far higher proportion of people to equipment than in most other settings and then find out, "not perhaps without feeling a degree of terror," that they use incomprehensible words. If he then ventures to open one of their texts, he will discover that it is "as if it told a story in chronological order and . . . as if the specific story . . . were part of a general step in mathematical science and in the history of that onward march." At the same time, the mathematical text uses only the present tense and in fact refers to timeless structures of logical implication. The tension between the narrative and the speculative element is what

constitutes mathematics; this tension may generate the erroneous belief that implication is a form of causality.

However, a mathematical text is not only a temporal manifestation of something eternal: if we consider the mental life of the individual mathematician, it occupies a place within the history of mathematics as well—as becomes obvious when one considers those theorems named for the mathematicians who discovered them. Lafforgue distinguishes two ways of employing the combination of speculation and narration peculiar to mathematics: one can either use old methods in new analyses or explore mathematical terrain that is entirely new. Paradoxically, Lafforgue notes, mathematicians speak of events in their mathematical texts: something "happens" in mathematics when a new vista opens through the development of a new concept or the solution of an old problem. Regarding the inner motivation of mathematicians, Lafforgue recognizes the striving for recognition and honors as a common motive. But far more important is the desire to share precious things, such as mathematical insights—even if this leads to an overproduction of texts that are ignored by almost all human beings; in fact, even the most famous mathematicians "are not sheltered from self-doubt and despair." Therefore, another motive is the desire to write to oneself: "a mathematical narrative is like a travel story in which, in fact, the journey consists of the narrative itself." The enormous effort in concentration, so Lafforgue ends his analysis, seems to go hand in hand with the experience of inspiration, and even if few mathematicians reflect on the author of these inspiring words, "they find their only joy in becoming servants to these words."

Truth can be found not only in logic and mathematics but also in the natural sciences—those that deal with the physical world, not with ideal entities. Pure thought does not suffice to get at truth in this realm; experience is indispensable. Within nature, one class of objects is of particular importance: humans. Of all the animals known to science, it is humans alone who seem to be able to grasp truth, and this is due—at least in part—to some of their biochemical and biological properties. In "A Molecular Glimpse of How Mother Nature Can Regulate Our Being," the biochemist Thomas Nowak addresses both the criteria that a scientific theory has to satisfy in order to be taken seriously in its

claim to approach truth and some specific regulatory mechanisms that keep organisms alive. While a valid inference guarantees the transfer of truth—if the premises are true, then also the conclusion must be true—logic cannot answer the question of which premises should be affirmed as true. For science, it is clear what is needed in order to determine the truth of premises: observation and experimental data. Like logical positivism, Nowak sharply distinguishes between evident data (which he calls "objective truth") and its interpretation, which, though it aims at and sometimes approximates truth, remains inevitably subjective. Interpretations of data are called hypotheses or theories, and they can achieve a very high degree of plausibility: for example, "virtually all credible scientists believe in the phenomenon of evolution." Still, Nowak insists that the evolution of one species into others is only a hypothesis, not itself an immediate datum. The problem in moving from data to theories is that there are almost always many reasonable explanations of the same data. True enough, further experiments may help eliminate some of the competing explanations, for "hypotheses that are inconsistent with the data are clearly incorrect." But since the choice of experiments depends, among other things, on the technology available and the technology of one age will always be surpassed in accuracy by that of the next, absolute certainty cannot be gained. No less important than technology in devising new experiments is the imagination of the scientist using that technology. Laws of nature, according to Nowak, are nothing other than hypotheses that have withstood experimental challenge for a long time. Nowak then gives several examples where doctrines once cherished, such as Stahl's phlogiston theory, were dropped during the evolution of science: echoing Thomas S. Kuhn, Nowak speaks of paradigm shifts, such as those that led to relativity and quantum theory. He then focuses on his own research, the study of a key step in the regulation of glycolysis: "this study reflects the asymptotic process of better understanding the details of how a specific regulatory process occurs." He chooses this specific metabolic pathway because it is critical to life and virtually ubiquitous in living things. Among the regulatory mechanisms devised by nature to respond to physiological challenges, two alternative ones are paramount: an on/off process in which the catalytic reaction is active or inactive or

a determination of the speed of the reaction rate by an enzyme. Light switches and rheostats are, respectively, the technological equivalents of these biological mechanisms. Modifications of the enzymes can be reversed; the secretion of metabolites and hormones may trigger a cascade of regulatory steps. Nowak then analyzes in detail the mechanism of regulation of the enzyme pyruvate kinase, discussing, among other things, the feed-forward activation, in which a metabolite formed early in the pathway activates an enzyme farther down the pathway. The relevant hypothesis was exposed to both kinetic and thermodynamic studies, and since it proved consistent with the information provided by the experiments, it continues to be held—and will be until "the results of further studies become inconsistent with the current theory."

One might voice against Nowak's reflections on the nature of science three possible objections: first, the demarcation between data and hypotheses is not easy, since, at least in modern physics, many data are gained through experiments that already presuppose theories. Second, one could try to defend certain basic principles of the natural sciences, such as conservation laws, as a priori valid because, without assuming them, experimentation itself would not be possible. Third, in the case of living things, there are certain constraints on the chemical processes that occur within a given organism that follow from the nature of that organism—specifically, from its need to survive and reproduce. Do such constraints, one might ask, allow us to exclude a priori certain possibilities that in themselves would be logically possible?

Francisco J. Ayala is one of the most famous biologists of our time, former president of the American Association for the Advancement of Science, member of many national and foreign academies, and recipient of both the National Medal of Science, in 2001, and of the Templeton Prize, in 2010. His essay, "What Light Does Biology Shed on the Social Sciences and the Humanities?," probes the question of how the disciplines that deal with that very unique species of animals, namely, humans, can benefit from the most complex natural science, biology. After discussing both the origins and the distinctive anatomical traits of humans—such as our bipedal gait, opposing thumbs, cryptic ovulation, large brains, and vocal-tract modification—he looks at our behavioral traits—such as abstract thinking, symbolic language, and

toolmaking—which, together, led to a new form of evolution, cultural evolution. Within human culture, Ayala focuses on ethical behavior and investigates the issue of "whether ethical behavior was directly promoted by natural selection or has rather come about as an epigenetic manifestation of some other trait that was the target of natural selection." Ayala points to Darwin's account in the third chapter of *The Descent of Man*, whose two basic points are these: moral behavior is the result of human intelligence and thus of biology, even if it is only indirectly promoted by natural selection, but concrete moral norms are culturally determined. Ayala then touches upon post-Darwinian evolutionary ethics, such as the theories of Herbert Spencer and Julian Huxley, and rejects the idea that the evolutionary process is itself pointing toward progress: from a biological point of view, the success of bacteria is no less impressive than that of vertebrates, including humans. To return to the evolution of moral behavior (the justification of which belongs to a discipline other than biology), Ayala compares the issue at stake to language: clearly, humans have an innate capacity for symbolic language, but the particular languages are a result of culture. Analogously, the moral sense is a result of the biological capacities of anticipating the consequences of one's own actions, of passing value judgments (which presupposes the capacity to abstract), and of choosing between alternatives. (Later, empathy is added.) These conditions come about after crossing an evolutionary threshold; thus, there is a radical breach between humans and other animals, even if we can hardly know exactly when in hominid evolution morality emerged. Ayala contrasts his theory with that of Richerson and Boyd, gene-culture-coevolution, which "would rather lead to a more nearly universal system of morality." According to Ayala, the obvious differences between the moral codes of various nations are due to cultural evolution. Still, he recognizes that some concrete moral norms must have a biological basis, because they are ubiquitous and are clearly conducive to biological fitness—think of parental care—while other norms are even contrary to fitness. Finally, Ayala delves into the peculiarities of cultural evolution—peculiarities more Lamarckian than Darwinian—such as its horizontal transmission and its capacity to incorporate elements from different cultures. The norms of morality are clearly the product, then, of

cultural evolution, even if civil authorities and religious institutions may reinforce them. (Of course, these institutions are themselves the products of cultural evolution.)

Zygmunt Pizlo works both in the Department of Psychological Sciences and in the School of Electrical and Computer Engineering at Purdue University and is thus doubly qualified to address the other great source of knowledge beside inference, namely, perception—even if he shows how much inference is involved in perception itself. In his essay, "What Is the Nature of Perception?" he shows, among other things, a great familiarity with the historical reflections on the problem, especially those of the nineteenth century. Pizlo defends a form of innatism—one based on strong empirical evidence. He starts by distinguishing, with Gustav Fechner, three different types of phenomena, which are causally connected: distal stimuli (physical objects or events described in the language of physics), proximal stimuli (a distribution of light, mechanical, or chemical energy on the surface of receptors), and finally percepts (i.e., mental phenomena). The problem is that sensory data are never sufficient to describe the external object, as becomes obvious when we reflect on how people construct out of a two-dimensional retinal image the corresponding three-dimensional object. While the mapping from object to image (the so-called direct problem) is many-to-one, the inverse problem, mapping from the data to the object, is one-to-many. But how, given this problem, do we succeed in having veridical perceptions—the existence of which Pizlo asserts, rightly pointing to the fact that even radical skeptics use and presuppose the functioning of their senses in experiments purported to show the unreliability of perception? But Pizlo does not follow Reid's commonsense assumption of the trustworthiness of perception: he is closer to Kant in asserting the existence of hardwired intuitions of space, time, and causality—even if Kant's concept of the synthetic a priori does not imply innate knowledge.

In order to know how other people perceive, science must start from public events—that is, phenomena that all can observe—and infer from them private perceptions. It is crucial to separate response biases from perceptions, which can be achieved by the signal detection methodology. Pizlo shows by means of the Müller-Lyer illusion that