Dynamics of Reason

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The Idea of a Scientific Philosophy

My theme is the relationship between science and philosophy. The two have been intimately related, of course, throughout our intellectual history. They were born together in the Greece of the sixth through third centuries before Christ, and flowered together once again in the late medieval, renaissance, and early modern periods of the thirteenth through seventeenth centuries, which ushered in the rise of both modern science and modern philosophy as we practice them today. Unlike today, however, in both of these earlier periods there was as yet no sharp differentiation between philosophy and the sciences. Just as the schools of Plato and Aristotle made fundamental contributions to mathematics, astronomy, biology, natural history, and meteorology, as well as to philosophy, so such early modern thinkers as Descartes and Leibniz, for example, made similarly fundamental contributions both to what we now call philosophy and to the emerging new sciences of the time. That what we now call physics was still called natural philosophy at this time is a very clear indication of the absence of a sharp distinction between them.

Soon thereafter, however, the boundary lines familiar to us today began to form. To be sure, there continued to be individuals – such as Hermann von Helmholtz, Ernst Mach, and Henri Poincaré in the nineteenth century, for example – who made important contributions to both areas. And even in the vastly more specialized climate of the twentieth century, scientists whose work has had a particularly revolutionary character have continued to be involved with fundamental philosophical problems as well. In the case of Albert Einstein, for example, there is a volume of the Library of Living Philosophers devoted to him (alongside of such figures as John Dewey, George Santayana, Bertrand Russell, Ernst Cassirer, Karl Jaspers, Rudolf Carnap, Martin Buber, C. I. Lewis, Karl Popper, Gabriel Marcel, and W. V. Quine), entitled *Albert Einstein: Philosopher-Scientist.*[1] Nevertheless, the professional

1. Schilpp (1949).

boundaries were now clear – Helmholtz, Mach, and Poincaré were clearly professional scientists rather than professional philosophers, for example – as well as the intellectual boundaries: in the Library of Living Philosophers Einstein's is the only volume entitled *Philosopher-Scientist* (a label that would never have appeared, as such, in the time of Descartes and Leibniz, say).

With the formation of these now familiar boundary lines came new intellectual problems, particularly for those who were now professional philosophers. Since philosophy was now clearly demarcated from science, at least professionally, what should be its relation to the sciences? Should it continue to maintain very close relations to the natural and mathematical sciences, as it did in the time of Descartes and Leibniz, say, or should it rather forsake these ties in favor of closer connections to more humanistic disciplines such as history, politics, religion, or the arts? (For one important aspect of the increasing specialization of the nineteenth and twentieth centuries is that it now appeared difficult, if not impossible, to maintain equally close ties with both.) Should philosophy, despite its professional demarcation from the sciences, nevertheless strive to imitate them intellectually? Should it strive, for example, to assimilate itself within the sciences, as a branch of psychology, say, or mathematical logic? Or, failing this, should it at least strive to make itself "scientific," by replacing the traditional endless strife of metaphysical systems with a new approach to philosophical problems capable of achieving the same degree of progress, and the same degree of consensus, that are found in the sciences themselves?

By considering some of the key historical episodes in the development of this situation, these are the questions I hope to shed light on here. In particular, I will consider a number of answers that have been proposed to these questions within a tradition that became known as "scientific philosophy." Although my focus is on the special relationship between philosophy and the sciences, our discussion will, I hope, have more general implications as well. For the question of such a relationship has become a troubling one within the humanities more generally during the same period, and for some of the same reasons. It was also in the context of the increasing specialization and professionalization of the late nineteenth century, for example, that the rift C. P. Snow later characterized as an opposition between "the two cultures" first arose, in the differentiation, within *Wissenschaft* in general (which term has a much more general meaning in German than our own term "science"), between the *Naturwissenschaften* and the *Geisteswissenschaften*. And the sense of tension and unease in the relationship between these two areas of course persists today. For many in the humanities, for example, Thomas Kuhn's *The*

Structure of Scientific Revolutions brought a welcome sense of relief and vindication. Since Kuhn has shown that science has no special or privileged intellectual standing after all, so the argument goes, but is simply one more "disciplinary matrix" or intellectual community within our culture, we in the humanities need no longer worry about the presence or absence of a "scientific" foundation for our own disciplines. Indeed, since it is we in the humanities who have "culture" for our particular object of study, it is we, and not the scientists themselves, who are most competent to discuss the question of the ultimate "justification" or "legitimation" of the sciences. This line of thought has of course led inevitably to the recent "science wars," where even some scientists now feel themselves both intellectually and professionally on the defensive.

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The concept of a "scientific philosophy" (or *wissenschaftliche Philosophie*) first developed in the mid nineteenth century, as a reaction against what was viewed as the excessively speculative and metaphysical character of post-Kantian German idealism. One of the primary intellectual models of this movement was a celebrated address by Hermann von Helmholtz, "Über das Sehen des Menschen," delivered at the dedication of a monument to Kant at Königsberg in 1855 (Helmholtz at the time was professor of physiology at Königsberg.) Helmholtz begins by asking, on behalf of the audience, why a natural scientist like himself is speaking in honor of a philosopher. This question only arises, he says, because of the current deplorable climate of enmity and mutual distrust between the two fields – a climate which is due, in Helmholtz's opinion, to the entirely speculative system of *Naturphilosophie* that Schelling and Hegel have erected wholly independent of, and even in open hostility towards, the actual positive results of the natural sciences. What Helmholtz is now recommending, however, is a return to the close cooperation between the two fields exemplified in the work of Kant, who himself made significant contributions to natural science (in his nebular hypothesis put forward in 1755), and, in general, "stood in relation to the natural sciences together with the natural scientists on precisely the same fundamental principles."[2] And it was this recommendation that was enthusiastically embraced within the emerging "back to Kant!" movement, where it led to the idea that all metaphysics should be replaced by the new discipline of "epistemology" or

2. See Helmholtz (1865/1903, vol. I, p. 88).

"theory of knowledge" (*Erkenntnistheorie*), so that philosophy itself would now become "scientific." This movement then found its culmination in a new journal, the *Vierteljahrsschrift für wissenschaftliche Philosophie*, founded in 1877.[3]

Now the charge that Helmholtz – and, following him, the rest of this "back to Kant!" movement for a scientific philosophy – leveled against the *Naturphilosphie* of the early nineteenth century is no doubt fundamentally unfair. Not only were the *Naturphilosophen* trying to respond intellectually to some of the key scientific developments of their time, developments in chemistry, electricity and magnetism, and energetics, for example, but it is also arguable that some of these key developments, including Helmholtz's own formulation of the conservation of energy in 1847, were themselves significantly influenced by *Naturphilosophie*.[4] But what is of primary interest, from our present point of view, is the nature and character of the new scientific philosophy that was now being explicitly opposed to *Naturphilosophie* in particular and post-Kantian idealism in general. What relation is philosophy now supposed to bear to the sciences, and what does it mean for philosophy to become scientific in this way? What exactly is being recommended when we are told that philosophy should stand "in relation to the natural sciences together with the natural scientists on precisely the same fundamental principles"?

For Helmholtz himself this means that philosophy – that is, epistemology or the theory of knowledge – should work in cooperation with the latest psycho-physiological research in inquiring into the nature of the representations of our senses, and the relationship between these representations and the actual world to which they correspond. And it is for this reason that the body of his 1855 address is occupied almost exclusively with reporting on some of his own work in the psycho-physiology of vision, which he had begun as a student under Johannes Müller in Berlin. As he makes clear in his most mature presentation of his epistemology in "The Facts in Perception" of 1878, it is Helmholtz's view that philosophy considers the relationship between our representations and the external world from the inside out, as it were, while natural science – in this case psycho-physiology – considers the very same relationship from the outside in. Philosophy thus consider our knowledge

3. For discussion of the development of neo-Kantianism and the "back to Kant!" movement see Köhnke (1986/91).

4. For discussion of the discovery of the conservation of energy, in particular, with some remarks about the influence of *Naturphilosophie* on a variety of scientific developments of the period, see Kuhn (1959/77).

from the mental or psychological side, while natural science considers it from the physical or physiological side:

> The fundamental problem, which that time placed at the beginning of all science, was that of the theory of knowledge: 'What is truth in our intuition and thought? In what sense do our representations correspond to actuality?' Philosophy and natural science encounter this problem from two opposite sides; it is a common task of both. The first, which considers the mental side, seeks to separate out from our knowledge and representation what originates from the influences of the physical world, in order purely to establish what belongs to the mind's own activity. Natural science, by contrast, seeks to separate off what is definition, designation, form of representation, and hypothesis, in order purely to retain what belongs to the world of actuality, whose laws it seeks.[5]

In both cases, however, our inquiry rests wholly and completely on the latest empirical findings of psychological and physiological research, and so, in the end, philosophy, for Helmholtz, is itself an empirical natural science – a branch of empirical psychology. In this way, Helmholtz anticipates the conception, popular in some circles today, that philosophy should become absorbed into cognitive psychology.

Helmholtz is thus being somewhat disingenuous in invoking the authority of Kant, and, more particularly, in recommending that we return to the close relationship between philosophy and natural science as Kant envisioned it. For Kant himself held that philosophy has a special "transcendental" status that sharply differentiates it from all empirical science, including, and indeed especially, empirical psychology. For example, in leading up to a characterization of "transcendental logic" – another name for what he is here calling "transcendental philosophy" – Kant explains that logic "as pure … has no empirical principles, and hence borrows nothing (as one has sometimes supposed) from psychology, which thus as no influence at all on the canon of the understanding." And a few pages later Kant makes a remark which, as he says, "extends its influence over all the following considerations, and which one must bear well in mind":

5. See Hertz and Schlick (1921/77, p. 111/pp. 117–8).

> [N]ot every a priori cognition should be called transcendental, but only that through which we know that and how certain representations (intuitions or concepts) are applied wholly a priori, or are possible (that is, [through which we know] the possibility or the a priori employment of the cognition). Therefore, neither space nor any a priori geometrical determination thereof is a transcendental representation, but what can alone be called transcendental is the knowledge that these representations are not at all of empirical origin, and the possibility that they can nevertheless relate a priori to objects of experience. (A56/B80-1)[6]

Philosophy, as a "transcendental" inquiry, is not only distinct from all empirical science, but it is also distinct from those elements of pure a priori knowledge, such as geometry, for example, which are present in the sciences themselves. Whereas each of the first-level sciences, whether empirical or a priori, has its own characteristic objects, philosophy, as a second-level or meta-level discipline, has no such objects of its own, but rather concerns the nature and possibility of our *representations* of these objects. The distinctive subject matter of philosophy is thus our *knowledge* of these first-level objects. As Kant puts it elsewhere (B25): "I term all cognition transcendental which occupies itself in general, not so much with objects, but rather with our mode of cognition of objects, in so far as this is supposed to be possible a priori."

Indeed, this Kantian distinction between first-level scientific inquiries and the distinctively philosophical "transcendental" inquiry is actually the historical source for the intellectual differentiation between philosophy and the sciences which is now familiar today. The rationalist philosophers of the seventeenth century, such as Descartes and Leibniz, had distinguished between physics or natural philosophy, on the one hand, and metaphysics or "first philosophy," on the other. But they by no means meant by this a distinction between two essentially different types or levels of inquiry in the Kantian sense. Rather, just as physics or natural philosophy studies the visible or corporeal part of the universe, metaphysics or "first philosophy" studies the invisible or incorporeal part – that is, God and the soul. And it is precisely by articulating the structure of the invisible or incorporeal part of the universe that "first philosophy" or metaphysics can then provide a rational foundation

6. All references to the *Critique of Pure Reason* are given by the standard pagination of the first (A) and second (B) editions. The earlier cited remark about the purity of logic occurs at A54/B78.

for physics: a rational foundation, that is, for the new mathematical natural philosophy to which these rationalist philosophers were themselves making vitally important contributions. In their intellectual enterprise – that of articulating the rational structure of the universe as a whole – "first philosophy" and natural philosophy are thus entirely continuous.

Kant, by contrast, is breaking decisively with this tradition. For him, (theoretical) rational knowledge of incorporeal objects, and, in particular, of God and the soul, is completely impossible for us.[7] The only possible objects of our human knowledge are "appearances," that is, objects in space and time interacting with one another in accordance with the causal laws of the new mathematical natural science. So metaphysics or "first philosophy" in the sense of seventeenth century rationalism is also entirely impossible. What can replace this hopeless enterprise, however, is a new "transcendental" inquiry into the *conditions of possibility* of our first-level knowledge of objects in space and time (the only genuine objects of knowledge there now are) supplied by mathematical natural science. In this way, by renouncing all claims on the supersensible, and redirecting our attention rather to the necessary conditions which make possible natural scientific knowledge (the only genuine knowledge of objects we now have), philosophy or metaphysics can finally leave behind the "mock combats" of the schools, and itself enter into "the secure path of a science."[8] In this way, too, philosophy can give a rational foundation, but in an entirely new sense, for the natural scientific knowledge whose conditions of possibility it investigates.

Kant's new concern with what he calls conditions of possibility is fundamentally shaped by the scientific context of the eighteenth century – the age of the triumph of Newtonianism. The rationalist thinkers of the seventeenth century had acted as contributors, apologists, and propagandists for the mechanical natural philosophy: the inspiring vision, fueled by Copernicanism and the example of Galileo, of a precise mathematical description of all of the phenomena of nature under a single set of mathematical laws uniting the earth and the heavens, to be achieved by an atomistic or corpuscular theory of matter that reduced all natural changes to the motions and mutual impacts of the constituent particles. But the rationalist defense of the mechanical philosophy was also highly programmatic in character, in so far as nothing even approaching such a unified mathematical description was actually produced.

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7. Kant does believe, however, that we have *practical* access to the supersensible through our experience of the moral law. This is the point of his famous dictum that he "had to destroy *knowledge* [*Wissen*] in order to procure a place for *belief* [*Glauben*]" (Bxxx).

8. See note 11 below.

Only with Newton, in fact, was even the very first step of this program, the synthesis, under a common set of dynamical laws, of celestial astronomy with aspects of terrestrial physics (namely, those due to gravity) actually achieved.

Yet this Newtonian synthesis also raised serious conceptual problems. In the first place, it portrayed gravitational interaction as an immediate action at a distance across arbitrarily large empty spaces, thereby breaking with the fundamental tenet of the mechanical philosophy that all action should take place by contact. So it appeared that we were either left with a commitment to just the kind of "occult quality" that the mechanical philosophy had dedicated itself to overcome (a primitive *attraction*), or forced to acquiesce in a merely empirical and phenomenological physics that renounced all inquiry into "true causes." In the second place, however, and even more seriously, Newton's physics was deliberately and self-consciously erected on the concepts of absolute space, time, and motion. These concepts were also entirely unacceptable to the seventeenth century rationalism which fueled the mechanical philosophy – on the basis of the sharp division, noted above, between the visible or corporeal part of the universe and the invisible or incorporeal part. For absolute space and time appeared to occupy a completely untenable intermediate position, as incorporeal but nonetheless physical. (And it was precisely this intermediate status that led to the traditional puzzles about the relationships between space, time, and divinity.)

In the eighteenth century, then, Newton's physics was an unqualified success in both mathematical and empirical terms, but there remained serious conceptual problems concerning whether and how this brilliantly successful theory actually made rational sense. Kant's problem, accordingly, was not to sketch a program for a new mathematical physics, but rather to explain how our actual mathematical physics, the mathematical physics of Newton, was itself possible in the first place. And his answer, in the briefest possible terms, is that the concepts of space, time, motion, action, and force do not function to describe a metaphysical realm of entities or "true causes" lying behind the phenomena. Nor are they simply abstractions from our experience, which we can then apply to the phenomena because we have already found them there. Rather, such concepts as space, time, motion, action, and force are a priori forms or constructions of our own, on the basis of which alone we can coherently order the phenomena of nature into a unified and law governed spatiotemporal totality. Absolute space, for example, is not a metaphysical entity, a great empty "container," existing behind the phenomena independently of all material content. Yet, as the success of Newton's physics dramatically shows, we cannot simply dispense with it either, as an empty concept with no empir-

ical application. On the contrary, we apply this concept empirically in constructing *approximations* to a privileged frame of reference at absolute rest – as a first approximation, for example, Newton, in the *Principia*, has himself constructed the center of mass frame of the solar system.[9] And action at a distance, despite its violation of the strictures of the mechanical philosophy, is a similarly necessary concept, in its realization by universal gravitation, for empirically establishing the temporal *simultaneity* of arbitrarily distant events.[10]

For Kant, then, Newtonian physics is not simply a pragmatically successful scheme for ordering and predicting the phenomena. It also counts as a model or paradigm for the coherent rational comprehension of nature, because it injects a priori forms, constructions, or categories of our own – which, for Kant, express universal capacities of the human mind – into our experience of nature. It is in this way, and this way alone, for Kant, that we can rationally explain how such pragmatic empirical success is actually possible in the first place. And it is in this way, too, that we can finally set what was previously called metaphysics or "first philosophy" onto "the secure path of a science," where we leave behind its former condition of "random groping," "mock combat," and utter lack of unanimity:

> With respect to the question of unanimity among the adherents of metaphysics in their assertions, it is still so far from this that it is rather a battle ground, which seems to be quite peculiarly destined to exert its forces in mock combats, and in which no combatant has ever yet been able to win even the smallest amount of ground, and to base on his victory an enduring possession. There is therefore no doubt that its procedure has, until

9. For Kant this procedure is then continued indefinitely: from the center of mass of the solar system to the center of mass of the Milky Way galaxy, from there to the center of mass of a system of such galaxies, from there to the center of mass of a system of such systems, and so on. For discussion of Kant's analysis of Newtonian physics with special attention to the problem of absolute space, time, and motion see Friedman (1992, chapters 3 and 4).

10. Kant's Third Analogy of Experience depicts the most general conditions for establishing the temporal relation of simultaneity (whereas the First and Second deal with duration and succession respectively). In the *Metaphysical Foundations of Natural Science* (1786) the Third Analogy is realized or instantiated by the Newtonian third law of motion – the equality of action and reaction. Universal gravitation is then an even more specific realization of this last principle. For further discussion see Friedman (1992), and compare also Part Two, section 2 below (in particular note 23).

> now, been a merely random groping, and, what is worst of all, among mere concepts. (Bxiv–v)[11]

By renouncing all claims to a special, as it were, "supernatural" domain of objects of its own, and rather confining itself to the articulation of the necessary conditions of possibility of the natural and mathematical sciences, philosophy, although not itself a science in the same sense, can nevertheless achieve stable and definitive results, and thus finally become, in this sense, scientific.

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Let us now move forward to the year 1921, the centenary year of Hermann von Helmholtz's birth. Helmholtz's remarkable and wide-ranging scientific achievements, in energetics, physiological psychology, the foundations of geometry, electrodynamics, and epistemology, were celebrated in a variety of memorial addresses, journal issues, monographs, and the like, including an address given by the philosopher Moritz Schlick at the University of Berlin, entitled "Helmholtz als Erkenntnistheoritiker." Schlick had earlier earned a doctorate in theoretical physics under Max Planck at Berlin, but soon thereafter decided to pursue a career in philosophy instead. His Habilitation in philosophy, on "The Essence of Truth in Modern Logic," was published in 1910 in the *Vierteljahrsschrift für wissenschaftliche Philosophie und Soziologie* (which the *Vierteljahrsschrift für wissenschaftliche Philosophie* had turned into in 1901). Schlick then became the leading philosophical proponent and expositor of Einstein's new theory of relativity with the publication of his extremely influential monograph, *Space and Time in Contemporary Physics*, which went through four editions between 1917 and 1922. In 1922, largely on the strength of his work on the philosophical significance of the theory of relativity, which had been enthusiastically endorsed by Einstein himself, Schlick was named to the Chair for the Philosophy of the Inductive Sciences previously occupied by the scientists Ernst Mach and Ludwig Boltzmann at the University of Vienna, where he became the leader and guiding spirit of what we now know as the Vienna Circle of logical positivists. We might say, in this sense, that Schlick was the very first professional scientific philosopher.

11. In the preceding pages Kant describes how logic, mathematics, and natural science have been placed on "the secure path of a science," and in the succeeding pages he explains how metaphysics can now be placed on this path in a similar fashion ("by a single and sudden revolution") through precisely his own revolution in philosophy.

Just as Helmholtz, in his dedicatory address on human vision of 1855, invokes the authority of Kant on behalf of his own conception of scientific philosophy, Schlick, in his memorial address of 1921, invokes the authority of Helmholtz, and the example of Helmholtz's 1855 address, on behalf of his conception of the relation of science to philosophy. All great scientists, according to Schlick, "think every problem with which they are concerned up to the end, and the end of every problem lies in philosophy." By beginning with special problems of the special sciences, we ascend step by step to "the ultimate attainable principles … which, because of their generality, no longer belong to any special science, but rather lie beyond them in the sphere of the general theory of science, in philosophy, in the theory of knowledge." Physics, for example, "penetrates only … to certain ultimate concepts and presuppositions – such as space, time, causality … whose illumination and justification must remain left to philosophy."[12] Yet, as Schlick makes clear elsewhere, this does not mean that philosophy is a separate discipline from the sciences:

> Philosophy is not an independent science that would be placed next to or above the individual disciplines. Rather, what is philosophical is found *in* all the sciences as their true soul, in virtue of which they first become sciences at all. Every particular field of knowledge, every special form of knowing, presupposes the most general principles into which it flows and without which it would not be knowledge. Philosophy is nothing other than the system of these principles, which branches out and penetrates the system of all knowledge and thereby gives it stability; it therefore has its home in all the sciences.[13]

Philosophy, for Schlick, does not have any special relation to psychology. It is not, as it was for Helmholtz, especially concerned with the psycho-physiological mechanisms of human sense perception. Philosophy is rather concerned with the foundations or ultimate principles of each and every science, whereby each of the special sciences takes its own particular place in the total system of knowledge. Philosophy, we might say, supplies the foundational and systematic core of each of the special sciences; it is neither a meta-science (as it was for Kant) nor particularly connected with any individual special science (as it was for Helmholtz).

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12. Schlick (1922/78, pp. 29–30/p. 335).
13. Preface to *General Theory of Knowledge*: Schlick (1918/85, p. vii/p. v).

Nevertheless, the ultimate scientific principles with which Schlick was himself especially concerned, as he indicates in his 1921 address, are the principles of Einstein's new physics – principles of "space, time, causality." And, with respect to these principles, it is not too much to say that Schlick aimed to do for Einstein's physics what Kant had done for Newton's, namely, to explain and exhibit the special features of this physics that make it a model or paradigm of coherent rational knowledge of nature. One central implication of this new physics, however, is that Kant's conception of natural knowledge, as framed by universal forms or categories of the human mind, taken to be rigidly fixed for all time, cannot, after all, be correct. For it is precisely the Newtonian conceptions of space, time, motion, and interaction that Einstein has now rejected and replaced; and so these particular ultimate principles in no way have the status Kant had attributed to them. Yet this does not mean, as Ernst Mach would have it, for example, that physics can simply be abstracted or generated from sense experience and from sense experience alone. On the contrary, we still need superordinate and highly mathematical first principles in physics – principles that must be injected into our experience of nature before such experience can teach us anything at all. But these principles do not express a priori fixed features of the human mind, as Kant would have it. They rather have the status of what Henri Poincaré, in his own work on the philosophical foundations of geometry, called "conventions" – free *choices* of our own needed to bridge the irreducible gulf between our crude and approximate sensory experience and our precise mathematical descriptions of nature.

So things stood for Schlick in 1922, when he moved to the University of Vienna. In the discussions of what we now know as the Vienna Circle, however, Schlick's earlier conception of philosophy, as the foundational core, as it were, of all the special sciences, underwent a radical transformation. For one of the first orders of business of the Circle was to assimilate and appropriate the new advances in mathematical logic due to Gottlob Frege and Bertrand Russell, as these advances were philosophically articulated and interpreted by the *Tractatus Logico-Philosophicus* (1922) of the young Ludwig Wittgenstein. But here Schlick and the Circle encountered the following ideas:

> The totality of true propositions is the whole of natural science (or the totality of the natural sciences).
>
> Philosophy is not one of the natural sciences.
>
> (The word "philosophy" must mean something that stands above or below the natural sciences, not beside them.)

> The aim of philosophy is the logical clarification of thoughts.
> Philosophy is not a doctrine but an activity.
> A philosophical work consists essentially of elucidations.
> Philosophy does not result in "philosophical propositions," but rather in propositions becoming clear.[14]

A proper understanding of the new mathematical logic shows, according to the *Tractatus*, that the only meaningful propositions – propositions that can be meaningfully said to be true or false – are those of the individual natural sciences. And there can be no "ultimate principles" of these sciences whose articulation and formulation would belong, as its special province, to philosophy. All philosophy can do is analyze the logical form or logical structure of the propositions of the special sciences, whereby it issues in no propositions – no "ultimate principles" – of its own, but simply in the activity of logical clarification itself, an activity that does not involve the formulation or articulation of further meaningful propositions in turn.

Indeed, it is precisely the misconstrual of philosophy as a body of doctrine that is responsible for the confusions, and in fact utter nonsense, of traditional metaphysics:

> The correct method of philosophy would properly be the following: To say nothing but what can be said, that is, the propositions of natural science – and thus something that has nothing to do with philosophy – and then, whenever another wanted to say something metaphysical, to demonstrate to him that he had given no meaning to certain signs in his propositions.[15]

If the scientific philosophers of the Vienna Circle truly wanted to avoid metaphysics, it now appeared, they would also have to give up the idea that philosophy could be a science in *any* sense. Philosophy, on Wittgenstein's conception, is not even a theoretical discipline at all, but simply the (non-theoretical) *activity* of logical analysis.

Here the Vienna Circle, and their ideal of a scientific philosophy, were clearly caught in a most uncomfortable position. To the rescue, as it were, came Rudolf Carnap, ten years younger than Schlick, who had joined the Circle at the University of Vienna in 1926. Carnap, like Schlick, had focussed in

14. Wittgenstein (1922, §§ 4.111–4.1112)
15. Ibid., § 6.53.

his graduate education on theoretical physics which he studied under Max Wien at the University of Jena, where he studied Kantian and neo-Kantian philosophy as well, and, perhaps most significantly, also the new mathematical logic under Gottlob Frege. Since the physics faculty found his plans for a doctoral dissertation on the axiomatic foundations of relativity theory to be too philosophical, Carnap ultimately wrote an interdisciplinary dissertation combining physics, mathematics, logic, and philosophy, which was published in 1922. In this dissertation he arrived at an analysis of the new concepts of space and geometry that were largely in harmony with, and indeed significantly influenced by, the conclusions Schlick had reached in 1917. He agreed with Schlick, in particular, that Kant's original conception of the fixed and necessary status of Euclidean geometry must be replaced by Poincaré's idea that the geometry of physical space rests rather on a *convention* freely chosen on the basis of the simplicity of our overall system of geometry plus physics.[16]

But Carnap's original contributions to the Vienna Circle concerned mathematical logic. For it was he, at least among the professionally philosophical members, who had the deepest understanding of, and appreciation for, the rapidly accumulating results of this new discipline. In the late 1920s, in particular, he became deeply immersed in the program of David Hilbert, perhaps the greatest mathematician of the twentieth century, to create a new logical discipline called *metamathematics*. Here we view logic and mathematics purely formally, as mere syntactical systems of sentences and proofs, and we then apply this new point of view in investigating mathematically the logical – or rather meta-logical – relations within such a system: we investigate notions like derivability, definability, consistency, completeness, and so on. In his *Logical Syntax of Language* of 1934 Carnap urged that we should extend Hilbert's method from logic to the whole of philosophy. Scientific philosophy should now become *Wissenschaftslogik* – the meta-logical investigation of the logical structures and relations of the total language of science. And in this way, as Carnap explicitly argues, we finally have an alternative to what he took to be the "mystical," and therefore fundamentally unscientific conception of philosophy of the *Tractatus*, according to which logical form or syntax is ineffable and unarticulable – describable by no meaningful propositions of its own. On the contrary, *Wissenschaftslogik*, the meta-logical investigation of the logical syntax of scientific language, is itself a perfectly precise and rigorous system of logico-mathematical propositions. Philosophy is a branch of mathematical logic:

16. Carnap (1922). For discussion see Friedman (1999, chapter 2).

> The alleged peculiarly philosophical point of view, from which the objects of science are supposed to be considered, is abolished, just as the alleged peculiarly philosophical stratum of objects was already previously eliminated. Aside from the questions of the individual special sciences, the only questions that remain as genuinely scientific questions are those of the logical analysis of science – its sentences, concepts, theories, etc. We will call this complex of questions *Wissenschaftslogik*. … Taking the place of the inextricable tangle of problems that is known as philosophy is *Wissenschaftslogik*. Whether, on the basis of this conception, the designation "philosophy" or "scientific philosophy" should be applied to this remainder, is a question of expedience, which is not to be decided here.[17]

For Carnap, then, philosophy or logical analysis is a meta-science, as it was for Kant. In contrast to Kant, however, it is also a branch or part of science as well – this time a branch of *formal* or a priori (as opposed to empirical) science.

We obtain a fundamentally new understanding of the character of philosophical problems in this way. Traditional philosophical debates, such as the debate between "realist" and "idealist" conceptions of the external world, for example, do not concern matters of fact concerning which one can possibly be either correct or incorrect. Viewed in this way, as the history of metaphysics amply demonstrates, there is absolutely no possibility of resolution. Such philosophical "doctrines" should rather be viewed as *proposals* – as proposals to construct the total language of science in one way rather than another. The "idealist" proposes to formulate the language of science beginning with a basis in sense-data or private experience, for example, while the "realist" proposes to begin with a basis in the concepts of physics. Both languages are perfectly possible, for both can be represented as alternative formal systems or axiomatizations, as it were, within logical syntax. And each such language or linguistic framework, axiomatized in its own particular way, yields its own particular standards of logical correctness and thus truth – standards that define what Carnap calls *internal* questions relative to a given language or linguistic framework. The question of which language or linguistic framework we should adopt, by contrast, is an *external* question. And here no question of

17. Carnap (1934/37, section 72). Carnap sharply differentiates himself from Wittgenstein's doctrine of the inexpressibility of logical syntax – explicitly taking issue with the ideas cited in note 14 above – in the following section.

correctness or truth can arise at all, but only purely conventional or pragmatic questions of suitability or appropriateness for one or another given purpose.[18]

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Let us now move forward once again, this time to the year 1962. Many of the leading members of the logical positivist movement, including Carnap, have long since become established in the United States, where they emigrated to escape the Nazi regime in the mid to late 1930s. (Schlick, although he had visited the United States in the late twenties and early thirties, was murdered at the University of Vienna by a former student in 1936.) In the comfortable climate of American pragmatism and common-sense empiricism, however, the positivists lost much of their revolutionary fervor. No longer militantly crusading for a reform of philosophy as a whole, for a new type of scientific philosophy, they instead became respectable (and domesticated) practitioners of a new sub-discipline called philosophy of science. And, despite the impressive gains in clarity of some of the logical analyses thereby produced, this sub-discipline had reached a relatively unexciting period of stasis by the late 1950s and early 1960s. In 1962, however, Carnap and the American pragmatist philosopher Charles Morris (who had been instrumental in bringing many of the positivists to the United States) published, under their joint editorship, a new volume of the *International Encyclopedia of Unified Science* (which had become the official monograph series of the logical positivist movement in 1938) by the young American physicist turned historian of science, Thomas Kuhn. This, of course, was *The Structure of Scientific Revolutions*. We know, from Carnap's correspondence with Kuhn at the time, as well as from his own unpublished notes, that Carnap himself was extremely enthusiastic about Kuhn's work.[19]

There is considerable irony in this, of course, for *The Structure of Scientific*

18. The distinction between internal and external questions is first made explicit in Carnap (1950/56), but the fundamental idea is already clearly present in *Logical Syntax*. There it is applied primarily to the current dispute in the foundations of mathematics between logicism, formalism, and intuitionism – each of which is reinterpreted as a proposal to formulate the total language of science in accordance with one or another system of logical rules (with or without the law of excluded middle, for example). The "realist"/"idealist" debate is also reinterpreted in this way during the same period, which actually extends back to the *Aufbau* (1928). For further discussion see Friedman (1999, chapter 9).

19. For discussion (together with reproductions) of these materials see Reisch (1991), Earman (1993).

Revolutions is often taken to represent the death-knell of the logical positivist philosophy of science represented by Carnap. Indeed Kuhn himself, in a state of blissful but perhaps forgivable innocence of the positivists's early work on the revolutionary import of the theory of relativity, uses that very theory to make his own case, on behalf of his conception of "the nature and necessity of scientific revolutions," *against* what he calls "early logical positivism."[20] But I do not want to dwell further here on this particular irony of history. Instead, I want to explore what we can now learn about the idea of a scientific philosophy, against the philosophical background we have briefly sketched above, from Kuhn's theory of scientific revolutions. In particular, I want to use Kuhn's theory of scientific revolutions, supplemented by a parallel consideration of the concurrent developments taking place within the discipline of philosophy, to show that none of the conceptions of the relationship between philosophy and the sciences we have so far considered is fully satisfactory – although each, as we shall see, contains a part of the truth, and, taken together in this way, they can serve to point us in a more fruitful direction.

The first point to notice, in this connection, is that, although Kuhn's book, as I noted at the beginning, is often taken to support the idea that there is no fundamental difference between the sciences and other areas of intellectual and cultural life, the book actually begins by delineating just such a fundamental difference. In the first full chapter, entitled "The Route to Normal Science," Kuhn outlines how the disciplines he calls sciences – or better, mature sciences – emerge from the "pre-paradigm" state. Such a transformation occurs, according to Kuhn, when a number of diverse and competing schools of thought within a discipline or area of inquiry are replaced by a single model or paradigm that is "universally received" within this area of inquiry as the basis for a "firm research consensus" – a consensus or agreement on a single set of rules of the game, as it were, which set the parameters of inquiry for all practitioners of the discipline from that point on (at least for a time).[21] It is only when such an at least relatively enduring consensus is achieved that we have what Kuhn calls normal science, and it is only against the background of such an already existing state of normal science that we can then have a scientific revolution – which occurs precisely when one such enduring stable consensus is replaced by a different one. Mathematics and

20. This famous discussion of the relationship between special relativistic and Newtonian physics occurs in Kuhn (1962/70, chapter 9), where Kuhn rejects the view, "closely associated with early logical positivism," that the latter theory can be logically derived from the former. (Kuhn does not actually cite any of the early logical positivists by name here.)

21. Here, and in the rest of this paragraph, see Kuhn (1962/70, chapter 2).

astronomy, Kuhn suggests, reached this state of normal science in antiquity; what we now call mathematical physics, however, reached it only with the great events of the sixteenth and seventeenth centuries that culminated in the work of Newton; chemistry achieved this status even later; biology still later; and so on. It remains an open question, Kuhn adds, "what parts of social science have yet acquired such paradigms at all." And in the humanities, he scarcely needs to add, it is completely clear that a state of normal science is never achieved: perpetual competition between mutually opposing schools of thought is the name of the game.

I want now to consider the particular case, among the humanities, of philosophy. I want to consider, more specifically, how the historical evolution of philosophy as a discipline, although very different from that of the sciences, is nonetheless intimately connected with the development of the sciences. What I find unfortunately lacking in Kuhn is precisely such a parallel historical treatment of philosophy. Indeed, in Kuhn's book philosophy is treated quite *ahistorically*, and in an entirely partisan and polemical manner, as what everyone else supposedly thought before Kuhn himself arrived on the scene.[22]

In philosophy the most we ever achieve is temporary consensus on which figures or doctrines set the philosophical agenda – for the moment, that is, and within a relatively circumscribed setting. With the publication of the *Critique of Pure Reason* in 1781, for example, Kant set the agenda for German philosophy. This did not result, however, in anything like a paradigm in Kuhn's sense, a single set of generally agreed upon rules of inquiry.[23] On the contrary, we immediately saw the rise of differing, and mutually hostile interpretations of Kantian transcendental philosophy, culminating in new versions of such philosophy, the systems of post-Kantian German idealism, that radically revised and even rejected some of Kant's most basic principles. This movement, as we have seen, was then countered, in turn, by a reaction in favor of a new type of "scientific philosophy" aiming to return to what it took to be most important in Kant. And scientific philosophy itself fragmented

22. A particularly striking and exuberant example of this occurs in Kuhn (1962/70, chapter 10, p. 126): "But is sensory experience fixed and neutral? Are theories simply man-made interpretations of given data? The epistemological viewpoint that has most often guided Western philosophy for three centuries dictates an immediate and unequivocal, Yes!"

23. Here we have an interesting application of the well-known ambiguity of the term "paradigm," where it can mean both an exemplary work or contribution and a set of common standards for "normal" research consequent on the acceptance of a given work or contribution as exemplary. In contrast to the (mature) sciences in Kuhn's sense, in philosophy (and in the humanities more generally) the first sense of "paradigm" is typically *not* accompanied by the second. (I am indebted to discussion with Michael Dickson on this point.)

once again, into neo-Kantianism, on the one side, and what then became logical positivism, on the other. Never, not even within this relatively circumscribed world of post-Kantian German philosophy, is anything like a stable consensus on a common paradigm attained. We see only a constantly shifting dialectic of thought, now fragmenting and dividing, now momentarily coalescing, between similarly shifting philosophical positions and schools.

Yet the constantly shifting stream of philosophical thought is inextricably entangled, as we have also seen, with the very different evolution of scientific thought portrayed by Kuhn: an evolution which moves from a pre-paradigm state of conflicting schools to a universal research consensus on a single paradigm, proceeds in an enduring stable state of normal science for a significant time, and finally, through the accumulation of anomalies, is punctuated by a scientific revolution – a comparatively rapid transition to a second relatively stable paradigm – whereupon we return again to a state of normal science, and so on. Thus, at the same time that he set the agenda for the mechanical natural philosophy, involving a new paradigm for physics based on corpuscularianism and action by contact, Descartes simultaneously set the agenda for modern philosophy by radically revising and reorganizing the wider system of philosophical concepts and principles bequeathed to western thought by Scholasticism. And after the physical paradigm of the mechanical natural philosophy was itself radically transformed by Newton, Kant found it necessary to venture a new fundamental reorganization of knowledge, where, for the first time, the discipline of philosophy became definitively separated from the sciences, as an essentially "transcendental" inquiry aiming to explain the necessary conditions of possibility of the new paradigm for mathematical physics created by Newton. Scientific thinkers of the nineteenth century, such as Helmholtz and Poincaré, for example, finding Kant's necessary conditions of possibility too restrictive, and responding to the stresses and strains that were developing at the time within the Newtonian paradigm itself, then struggled to articulate new types of scientific philosophy. These struggles eventuated in Einstein's formulation of the theory of relativity, where a new physical paradigm for the study of space, time, motion, and interaction was finally created. This new paradigm led, in turn, to the philosophy of logical positivism.[24] And so on.

24. These central examples will be further discussed in the remainder of the Lectures; Part Two contains a particularly detailed discussion of the nineteenth century philosophical background to relativity.

Indeed, we can go further. For, at moments of scientific revolution, the scientific transitions themselves (the transitions to a new paradigm) are actually quite inconceivable without the parallel developments in philosophy taking place at the same time, and, as it were, on a different level. In normal science we operate within the context of a generally agreed upon framework that defines the norms and standards, the rules of the game, for a given area of inquiry. These standards, in normal science, are not themselves called into question. On the contrary, it is they, taken simply as given, which then make the problem solving activities of normal science possible in the first place. (In Carnapian terms, they constitute the rules of a given linguistic framework definitive of a given set of internal questions.) During periods of deep revolutionary change, by contrast, it is precisely such a formerly agreed upon set of standards that has now been called into question; and so we no longer have such standards at hand to call upon in motivating and supporting the transition to a new paradigm. (In Carnapian terms, we are here faced with an external question concerning the replacement of the rules of one linguistic framework by a very different set of rules.)[25] In making this kind of transition, therefore, we are no longer dealing with purely scientific questions in the same sense – that is, we are no longer operating wholly within normal science – and it is precisely here that characteristically philosophical considerations come into play. And it is precisely this, in my opinion, that we still must add to Kuhn's picture.

The adoption of the mechanical natural philosophy by the scientific thinkers of the seventeenth century, for example, was not simply motivated by the mathematical and empirical success it had achieved. For, as noted above, the reach of this new intellectual movement far exceeded its grasp. One here aimed at nothing less than a precise mathematical description of all of the phenomena of nature, to be achieved by an atomistic or corpuscular theory of matter, and nothing even approximating such an atomistic reduction was actually achieved until the late nineteenth and early twentieth centuries – when, we might add, it was achieved using entirely new and hitherto entirely unforeseen mathematical and physical concepts.[26] In the seventeenth century itself, however, this new physical paradigm remained almost entirely programmatic. And the new paradigm was motivated and sustained, especially

25. Compare note 18 above. It is because of precisely this parallel, of course, that Carnap was so enthusiastic about Kuhn's work (note 19 above). (And this, in turn, is closely connected with the actual assimilation of the theory of relativity by the "early logical positivists": see note 37 below.)
26. The necessary concepts to make atomism actually work turn out to be precisely those of relativity and quantum mechanics. Compare Part Two, section 5 below, especially note 66.

during its first fifty years, not so much by mathematical and empirical success, but by the inspiring philosophical vision of a radically new approach to the understanding of nature self-consciously crafted by Descartes and Galileo against the background of late medieval Scholasticism. Similarly, to take a second example, in the relativistic revolution wrought by Einstein purely mathematical and empirical considerations again played a decidedly secondary role. For, at the time of Einstein's initial formulation of the special theory of relativity in 1905, there was on the scene a fully developed competitor theory – the Lorentz-Fitzgerald theory of the "aether" – which was, in an important sense, both mathematically and empirically equivalent to Einstein's theory. Einstein's great innovation was rather a conceptual one – the recognition of a new item, as it were, in the space of intellectual possibilities: namely, the possibility of a relativized conception of time and simultaneity. And it was motivated and sustained by a similarly new philosophical conception developed against the background of the nineteenth century debate between Kantianism and empiricism in the philosophy of geometry – namely, the insight of Henri Poincaré (whom Einstein was intensively reading at the time, and who was also deeply concerned with the foundations of Lorentzian electrodynamics) into the possibility of viewing geometry, not as uniquely forced upon us by either reason or experience, but rather as resting on a free choice, a convention of our own. Einstein, in the special theory of relativity, then applies this insight to the concepts of time and simultaneity.[27]

Science, if it is to continue to progress through revolutions, therefore needs a source of new ideas, alternative programs, and expanded possibilities that is not itself scientific in the same sense – that does not, as do the sciences themselves, operate within a generally agreed upon framework of taken for granted rules. For what is needed here is precisely the creation and stimulation of new frameworks or paradigms, together with what we might call meta-frameworks or meta-paradigms – new conceptions of what a coherent rational understanding of nature might amount to – capable of motivating and sustaining the revolutionary transition to a new first-level or scientific paradigm. Philosophy, throughout its close association with the sciences, has functioned in precisely this way. (And I would imagine that parallel points can be made, *mutatis mutandis*, in the case of some of the other humanities.)[28]

27. For discussion of Einstein's reading of Poincaré in 1905 see Miller (1981, chapter 2). This example is further discussed in Part Two, section 4 below.

28. See, for example, Edgerton (1991) for very interesting suggestions about the relationship between the development of renaissance linear perspective and the (seventeenth century) scientific revolution.

From this point of view, it is folly for philosophy to attempt to incorporate itself into the sciences (as a branch of psychology, say, or mathematical logic), for its peculiar role is precisely to articulate and stimulate new possibilities, at the meta-scientific level, as it were, and it cannot, on pain of entirely relinquishing this role, itself assume the position of a normal science. For the same reason, it is also folly for philosophy to attempt to become "scientific," in the sense of finally leaving behind the traditional conflict of opposing schools for a new stable consensus on generally agreed upon rules of inquiry. We never know in advance what new paradigms (and philosophical meta-paradigms) might be needed at a given moment of revolutionary science, and so, in philosophy (and, *mutatis mutandis*, also in the other humanities), it is always to our advantage to let a thousand flowers bloom. Finally, it is folly as well for philosophy (and for the other humanities) to regret this lack of scientific status, and, even worse, to seek compensation by attempting to strip away such status from the sciences themselves. We should rather rejoice, along with the sciences, in our fundamentally distinct, yet mutually complementary contributions to the total ongoing dialectic of human knowledge.