

The Dynamics of Reason Reconsidered: A Symposium on Michael Friedman's
'Relativized a Priori'

Introductory Essay: Science, Philosophy, and the A Priori ¹

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1. Description and Rationale of the Symposium

Michael Friedman is one of the foremost contemporary philosophers of science. In his book *Dynamics of Reason* (2001) he develops a powerful new way of understanding the historical development of science. In his view, which we may refer to as “developmental Kantianism”, science proceeds as a succession of theoretical frameworks endowed with a clear distinction between two kinds of elements. On the one hand, there are empirical a posteriori elements to scientific knowledge. On the other hand, there are also, according to Friedman, constitutive a priori elements. The latter are necessary for the former to be possible, as would be typically the case in any Kantian or Neokantian account of scientific knowledge. And so, although 20th century science has sometimes been taken to conflict with Kant's theory of knowledge, in particular with Kant's claims regarding the a priori nature of three dimensional Euclidean space and the principle of causality, as a matter of fact – as argued cogently by Friedman – a robust form of Neokantian interpretation of science is still possible, and may even be desirable.

The present symposium collects four papers addressing these and other claims in *Dynamics of Reason*, together with Michael Friedman's response. Earlier versions were

¹ I would first of all like to thank my coeditor, Thomas Uebel, for keeping me to schedule, for his many suggestions, and for all his hard work towards making this symposium a reality. I thank him in particular for his incisive comments on the introductory essay – although it must be noted that I did not always follow his suggestions, and he may not agree with everything I say here. Thomas Uebel and I join in thanking Michael Friedman, Thomas Mormann, Alfred Nordmann and Massimo Ferrari for their patience, and their collaboration in addressing our editorial requests over the last four years.

delivered during a workshop in his honour at Complutense University in Madrid in November of 2007, which included a closing talk by Friedman himself. Those talks, together with the reactions and discussions that ensued, gave rise to the papers collected here – which reflect on the main themes of Friedman’s book, and of his work more generally. The contribution of this special issue to the ongoing scholarship on Friedman’s views is distinct and particular. For instance the essays contained in the recently published volume edited by Mary Domski and Michael Dickson (2011) are focused on the inter-relations between the history of science, the history of philosophy, and the philosophy of science. The explicit aim of that volume was to revitalize the program of integrative history and philosophy of science by focusing on some of the topics and approaches inaugurated by Friedman. The present issue by contrast focuses on Friedman’s philosophical claims regarding the relativized a priori. A few words are then due in defence of this particular choice of focus, as well as providing some summary and discussion of the overall structure of the claims discussed in the present issue.

This introductory essay is divided into four distinct parts. First, I provide my own brief historical review of Friedman’s main contribution leading to his discussion of the a priori in *Dynamics of Reason*. The second part summarises the contents of the four papers collected in this symposium, each addressing Friedman’s developmental Kantianism from a different angle. In the third part I develop my own interpretation of the diverse claims made in these papers for Friedman’s notion of the relativized a priori. The fourth part assesses Friedman’s response in light of this discussion.

2. Michael Friedman and the A Priori

Friedman’s closing talk at the workshop was entitled “Extending the Dynamics of Reason”, and developed in some detail some of the claims made in his contribution to the present issue. It was intended in particular to extend the theses developed in *Dynamics of Reason* from the domain of theoretical science, where they originated, to the domain of applied science and technology. As in his contribution to this symposium, the main example used was the development of the Gregorian calendar. It

was argued that this episode constitutes a revealing instance of the combination of theoretical and practical reasoning that jointly drives the scientific enterprise. Only two days earlier Friedman had also delivered the closing keynote address to the founding conference of the European Philosophy of Science Association (EPSA), entitled “Einstein, Kant and the A Priori”, in which he focused on the role of constitutive relativized a priori knowledge in modern theoretical physics. (The paper has since appeared, as Friedman (2010), as part of the volume that collects some of the papers delivered at the EPSA07 conference.) Thus Friedman’s talks in Madrid provided a startling and very elegant contrast, and a broad and sweeping extension of his developmental Kantianism from the domain of theoretical science (as discussed in his EPSA keynote) towards other areas of culture, including but not restricted to experimental science and technology (the topic of the workshop closing talk).

The outstanding element in both talks is of course also one of Friedman’s most distinguished and notable contributions to recent philosophy of science: his defence of a critically important role for a priori knowledge in science. Friedman contends that such a priori knowledge is indispensable in theoretical science. He thus confronts Quine’s famous dictum against Carnap in “Two Dogmas”, and asserts by contrast that scientific knowledge is not all, nor can it all aspire to be, a posteriori. But his defence of the a priori is unusual in many respects - some of which may have confounded Quine. Friedman, following in the Neokantian tradition that inspired Reichenbach’s earlier work on relativity (Reichenbach, 1920) defends a *relativized* and *constitutive* form of the a priori. I here provide a very brief critical introduction to these two salient features of Friedman’s conception of the a priori.

The relativized nature of Friedman’s notion of a priori may be understood by reference to the logical form of its assertion, while its constitutive character may be understood in terms of its relation to experience. Friedman agrees with the Kantian tradition that at any given time in the historical evolution of a theoretical science there are a priori elements. But he is adamant that this is not to say that these elements are the same throughout the evolution of science. On the contrary changes in theoretical frameworks very often (if not always) involve changes in those elements that are regarded as a priori knowledge. In any assertion that there is a priori knowledge in

science, the order of the quantifiers is of great importance. Quine would have understood the assertion to require the existential quantifier to range over the universal (as in “there is some a priori element P involved in any scientific knowledge S”), and this form of universal apodictic a priori was the object of his critique. By contrast, Friedman reverses the order of the quantifiers, and his assertion places the existential quantifier inside the universal (as in “for any instance of scientific knowledge S, there is some a priori element P involved in it”). The well-known fallacy of a reversal of the quantifiers makes it clear that the two expressions are distinct – in particular Friedman’s notion does not entail the notion of a priori knowledge that was the object of Quine’s critique. The distinction between the two assertions of a priori knowledge is key to most of Friedman’s arguments, but it also brings complications of its own, and the evaluation of the advantages and disadvantages of this *relativity* of the a priori is a common theme running through these papers.

The inversion in the traditional order of the quantifiers is my own way to express such *relativity* of the a priori. In practice it entails that any a priori scientific knowledge may only have this character *relative to a particular theoretical framework*. In this view, which has its roots in Cassirer (1910 / 23) and Reichenbach (1920),² the a priori is not a unique or apodictic notion, but it is rather a dynamical element evolving within and alongside scientific knowledge. Hence, to put it in rough terms, what is a priori in Newtonian mechanics differs from what is a priori in Einsteinian physics, and so on. Reichenbach and Cassirer thus provide Friedman with a novel way to think about the dichotomy between a priori and a posteriori knowledge (and related distinctions such as the analytical and the synthetic). Such a novel way to conceptualize the a priori has consequences upon what analytical philosophers often assume to be the legitimate division of labour between philosophy, on the one hand, and science on the other. For it follows from its relativity that the nature of the a priori can not be apprehended by philosophers in ignorance of science, by abstracting away from its present and past state, as is often thought to be the case. On the contrary, if the a priori is relative in the way that Reichenbach, Cassirer and Friedman think it is, then philosophers must

² Also in Carnap (1934 / 37), as pointed out by Uebel in his contribution to this symposium.

become profoundly involved in the study of science and its history if they are to shed any genuine light on the nature and role of the a priori.

This is one striking claim over which I suspect there would be overall agreement among the contributors to this special issue. It is striking, among other things, because what follows from it for the relative place of the history and philosophy of science among the philosophical disciplines, is by no means trivial. Analytical metaphysicians and philosophers of mind or language who typically, on account of the supposedly a priori character of their disciplines, profess disdain for the state and results of contemporary empirical science should in particular be forced to think twice. If the relativized notion of the a priori is correct – and the contributors to the special issue agree on the overall thrust of the relativity of the a priori, differing among themselves only with regard to either its details, or the consequences for a general conception of science – then no successful study of the a priori can be carried through, entirely, from the armchair.³

Note also (and this is another issue over which I suspect there would be general agreement among the contributors to the special issue) that Friedman's vocal opposition to Quine's naturalism, and in particular to Quine's critique of Carnap's analytic-synthetic distinction, really turns out to be a dispute about the correct or legitimate notion of the a priori. There is no substantial dispute regarding scientific methodology, or even the relationship in practice of science to philosophy in general. Certainly, Friedman has powerful reasons to want to distinguish his Neokantianism from Quine's brand of naturalism, which he considers an inadequate account of scientific *knowledge*. Moreover, Friedman definitely does not think it is a good idea to even aim to convert philosophy into a scientific discipline, or to in any other way replace philosophy with cognitive psychology. Rather philosophy stands as a critical study of the conditions of science at any given time, and as such may not be subject to those very conditions that it studies. However, it is worth mentioning that the implications of Friedman's developmental Kantianism for the labour that philosophy in general must carry out in practice – and in particular the kind of attention that

³ Or, to put it ironically in the reflexive mode, the nature and function of the a priori may not be determined a priori.

philosophers must pay to science if their discipline is to remain cognitively relevant and legitimate – does not differ much from the implications, for the same topic, of Quine’s brand of naturalism. From the point of view of those analytical philosophers who profess disdain for science and its empirical findings, Quine’s naturalism and Friedman’s Neokantianism seem similarly objectionable. The re-introduction of Reichenbach’s and Cassirer’s relativized a priori certainly does not dissolve the a priori / a posteriori distinction à la Quine – far from it - but the role it adjudicates to a detailed study of science for philosophical inquiry in general is very close indeed. ⁴

The second relevant feature of Friedman’s and Reichenbach’s notion of a priori is its constitutive character – in the Kantian sense of constitutive principles that are necessary conditions for the apprehension of empirical knowledge. One useful way to approach the relation of the constitutive relativized a priori to experience is by analogy to Wittgenstein’s notion of a ‘hinge’ proposition. In a given context a proposition P is hinge if and only if, in that context, its truth-value is not determinable on the basis of any possible or conceivable experience, but P’s truth is indispensable for other propositions to be empirically determinable within that framework. Hinge propositions are not necessarily constitutive in the Kantian sense – they may not be necessary conditions for the possibility of empirical knowledge. However, they are analogous in the sense that they are presuppositions of empirical inquiry within a particular context – and therefore while not apodictically a priori, they are not subject to a posteriori empirical testing in the way other empirical propositions are.

Friedman started his career as a philosopher of space-time physics, and his first book was a remarkable achievement in the field, combining first class historical and philosophical scholarship (Friedman, 1983). One of its main novelties consisted in the introduction into the philosophical literature of Anderson’s concept of absolute object – which may be defined roughly as an entity postulated by a space-time theory that is

⁴ It is important to distinguish my claim here from Friedman’s own claim regarding the role for philosophical inquiry in the evolution of science. Friedman’s claim is a thesis about the value of philosophy of science for science; mine is a thesis about the value of science, its history and its philosophy, for philosophical inquiry in general. I argue that with respect to this second issue, Friedman and Quine do not really differ that much – in spite of their very different views regarding the possibility, nature and status of a priori knowledge.

diffeomorphism-invariant or, in plain English, its status is independent of its description in any of the acceptable models of the theory. Newtonian mechanics possesses a large class of absolute objects, including absolute time; special theory of relativity restricts the class of absolute objects to the Minkowski metric; while in the general theory of relativity (GR) there are no absolute objects whatever (Friedman, 1983, pp. 56, 64). Friedman then argued, following Kretschmann (1917), that general covariance is not the distinguishing feature of GR, urging instead a focus on this very lack of absolute objects. It may be thought that absolute objects per se are not *prima facie* candidates for the relativized a priori in space-time theories – since their absence in GR would entail that there is one theoretical framework at least lacking the relativized a priori altogether.⁵ But given that both Reichenbach’s and Friedman’s versions of the relativized a priori originate in their philosophical reflections upon the nature of space-time, there may be some connection – after all absolute objects are entities postulated within a theoretical framework set out for the purpose of empirically testing further conjectures (the universal law of gravitation in Newtonian mechanics; clock dilation and length contraction-related phenomena in special relativity). Since within each framework they are uniquely invariant under diffeomorphism, absolute objects implicitly characterize the framework – and there is thus a sense in which they are *constitutively* a priori within each framework.⁶

The origins of Michael Friedman’s notion of the relativized a priori therefore lie in space-time theories, so not surprisingly the notion is most adequate for this area of scientific inquiry. I shall argue later on that a main thrust of the four papers in this symposium is to raise the fundamental worry that the range of application of developmental Kantianism so far betrays its origin in the context of space-time theories, or perhaps at best scientific theoretical inquiries in general. Although they do not say

⁵ And indeed Friedman (2001, pp. 89-91) identifies the relativized a priori in GR with the principle of equivalence, and a manifold endowed with a Lorentzian semi-Reimannian metric.

⁶ Alternatively, one may consider those entities that remain invariant under the appropriate group of transformations for each theory. Thus in Newtonian physics the Galilean transformations leave invariant the underlying structure of Newtonian space-time; in special relativity the Lorentz transformations leave invariant the structure of Minkowski spacetime; and in GR only the underlying topology and manifold structure are left invariant by the group of all permissible diffeomorphisms (Friedman, 1999a, p. 66).

so explicitly (and their authors may even object to this reading of their papers) each of the papers implicitly or explicitly stresses a particular area of human inquiry that developmental Kantianism has not yet been shown to be applicable to. This is my main claim in this introductory essay, and I shall be developing it in section 4. Before, in section 3, I provide a neutral brief summary of the contents of each paper.

3. Four Approaches to the Relativized A Priori

In the first contribution (“De-synthesizing the relative a priori”), Thomas Uebel compares Friedman’s relativized synthetic a priori with Carnap’s relative analytical a priori. Uebel begins by discussing the emergence of the relativized a priori in Reichenbach, its use in Carnap, and Friedman’s reception of their work before probing whether a combination of Carnapian logic of science and Neurathian empirical studies of science is equipped to ask and answer many (but not all) of the questions that Friedman’s Neokantian approach asks and answers. From the perspective of such a broadened understanding of the left Vienna Circle’s meta-philosophy Uebel calls into question Friedman’s apparent assumption that the ambition of his Neokantian programme to combine historical depth with logical acuity in the understanding of science far supersedes anything that any version or development logical empiricism could offer. Uebel agrees with Friedman that Carnap’s conception of philosophy if viewed as reduced to the logic of science is unable to engage with the historical dimension of scientific theorizing and that Quine’s naturalism is unable to draw the logical distinctions required to isolate the relativized a priori in scientific theories (but also rejects Friedman’s recently lessened criticism of Carnap’s ‘attenuated logicism’). Where Uebel’s revisionary logical empiricism differs from Friedman’s Neokantianism, of course, is in its continued suspicion of the ‘synthetic’ a priori. The final section of his paper thus explores the difficult question whether Carnap’s purely analytic relativized a priori possesses the resources needed to fully comprehend the phenomena for which the relativized a priori was invoked in the first place.

The second contribution (“Between Cassirer and Kuhn: Some remarks on Friedman’s relativized a priori”) by Massimo Ferrari raises a number of issues in relation with

Friedman's analysis and exegesis of Cassirer's work. It focuses in particular upon the use that Friedman makes of the relativized a priori in order to account for Kuhn's paradigm-change in science. Ferrari begins by briefly reviewing the interrelations between Kuhn's and Cassirer's thought. There are some deep and undeniable differences: Crucially, Kuhn's historicism is indebted to the irrationalism of Koyré's and Meyerson's to a much greater degree than the Neokantianism of the Marburg school, and Kuhn was explicit about Cassirer's "profound limitations". Yet, the commonalities are obvious. As Ferrari notes, following Friedman, both thinkers are committed to a roughly dynamical account of Kantian categories in their analysis of scientific knowledge (Cassirer from the very start, and Kuhn later on in his life). Ferrari then notes that Friedman's developmental picture of science is close to Kuhn's but without the relativism. Instead Friedman proposes that Habermas' theory of communicative rationality may provide just the right account of the means scientists employ in choosing among competing paradigms: Philosophy thus mediates between otherwise incommensurable paradigms. Ferrari then goes on to take issue with Friedman's account of Cassirer's relativized a priori, and in particular its ability to account for such an inter-paradigmatic rationality. In particular the bulk of Ferrari's paper is devoted to showing that Cassirer followed his teacher and mentor Cohen in providing a rich account of the relativized a priori that was both regulative and constitutive. Ferrari argues that Cassirer's late philosophy of culture is of a piece with this, and cannot be assimilated to Hegelianism. Thus, according to Ferrari, Cassirer provided all the right ingredients for inter-paradigmatic rationality.

The third paper in the symposium (entitled "A Place for Pragmatism in the Dynamics of Reason") is Thomas Mormann's extended argument in favour of a pragmatic a priori. Mormann again begins by reviewing Friedman's account of the development of science in *Dynamics of Reason*, which he presents as a synthesis between three main influences, namely Cassirer's Neokantianism, Carnap's logical empiricism, and Kuhn's historicism. The main thesis of the paper is that Friedman's synthesis underestimates the pragmatic elements in the development of science. In particular, Mormann argues that by focusing on the development of mathematical physics, Friedman's account leaves out of the picture the crucial contribution to scientific progress provided by the experimental sciences. Mormann suggests that Friedman's appeal to Kuhn is

incomplete without reference to the pragmatic elements contributed by the experimental sciences, and he urges us to take into account C. I Lewis's pragmatic a priori in order to appropriately complete the picture. In particular Mormann invites us to reconsider science as a system of activities as opposed to a system of theoretical knowledge. Rather than appeal to any philosophical theory of communicative rationality as an explanation of the progress of science, Mormann refers us to some relevant literature in cognitive science developing a theory of the "epistemic activities of an embodied subject".

The fourth contribution to the symposium ("Another Parting of the Ways: Intersubjectivity and the Objectivity of Science"), by Alfred Nordmann, provides yet a new angle. After a review of Friedman's synthesis, Nordmann takes the novel route of considering issues related to the development of technology. He argues that from the perspective of the philosophy of technology, the notion of an objective shared world is unnecessary in order to account for progress. Moreover there is a distinct account of scientific objectivity, which does not require intersubjective agreement upon the shared ontology of accepted theoretical propositions. It instead "somehow derives from the technological infrastructure" that supports new experimental and instrumental capabilities. In an attempt to deal with these important features of the scientific practice revealed by closer attention to technology, Nordmann turns to Heidegger's philosophy of technology. He first notes that Heidegger is no stranger to Friedman, who already dealt with his transcendental phenomenology, and its relation to both Cassirer's Neokantianism and Carnap's logical empiricism in a previous book (Friedman, 2000). He then goes on to characterise the main difference in terms of two competing accounts of truth and objectivity, namely "disclosure of what is" versus "securing thought by giving it certainty". From Nordmann's and Heidegger's perspective, science begins as applied science and therefore by conception responds to objectivity as "disclosure of what is". It then becomes a question of philosophical and historical interest why in its development science goes on to acquire a self-image in which only the representational notion of objectivity as propositional certainty plays a role. In Heidegger's thought this is linked with modern science's ambition to overcome the finitude of *Dasein*, the concrete experience of the existing being. Nordmann then argues that Heidegger is only critical of modern science as the sort of technology

deployed by the Newtonian-Cartesian paradigm, not as technology in general. This move paves the way, according to Nordmann, for a philosophy of technology as the disclosure of affordances or powers of complex and hybrid “apparatus-world” systems, which Nordmann suggests may be necessary to complement Friedman’s developmental Kantianism.

4. The Diversity of the Sciences and the A Priori

In the previous section I provided what I take to be a neutral summary of the claims in the four contributions to the symposium. Michael Friedman responds in his own final paper (“Reconsidering the Dynamics of Reason”). Although his response is inspired by the contributions to the symposium, it does not address their concerns individually, providing instead a general and programmatic statement of work to come. In this section I aim to provide a brief commentary on some of the interlocking themes in the symposium, together with my own rendition of the dialectics between the diverse papers.

I have been referring to Friedman’s view in *Dynamics of Reason* as “developmental Kantianism”. This is then the view according to which there is progress in science and it is to be understood as a succession of ever improving frameworks endowed with a distinct array of empirical and constitutive elements. The constitutive elements retain their a priori character in virtue of not being testable within their frameworks – yet they are changeable, and typically change in the development of science. Their substitution is not an irrational or random event, but it is rather an achievement – the result of the application of a form of communicative rationality at the meta-level. As I read them, the gist of each of the contributions is to suggest that “developmental Kantianism” may need further elaboration and extension. But the sense of incompleteness they suggest is slightly different, and so are the extensions suggested.

In addition, as we already saw, each author engages in a comparison of developmental Kantianism with a different philosophical school or tradition. Thus Thomas Uebel’s paper suggests that the left Vienna circle’s conception of scientific philosophy

(Neurath's and Carnap's view *circa* 1935) may have the resources to provide at least as accurate or complete picture of the progress of science. Massimo Ferrari's contribution suggests that Cassirer's Neokantianism suffices all by itself to account for space-time theory, and in addition may provide a good account of the so-called moral sciences (*geisteswissenschaft*). Thomas Mormann's paper urges that the practices and activities characteristic of experimental science are well served by the notion of the a priori within the pragmatist tradition. Finally, Alfred Nordmann offers Heidegger's phenomenological philosophy of technology as a needed complement to developmental Kantianism.

There are, I suggest, interesting connections between the two sorts of claims. The part of science that, it is firstly claimed, has been left out of the picture, is also the part of science that, it is secondly claimed, is best promoted by, and best exemplifies, the alternative philosophical tradition at hand. Let me try to make the case for each of the four papers in turn.

Thomas Uebel provides arguments in favour of what he calls the left Vienna Circle's bipartite metatheory conception, a combination of the pragmatic conventionalism regarding linguistic frameworks advocated by Carnap and Neurath's naturalistic approach to scientific practice which, according to Uebel, offers a plausible alternative to Friedman's synthetic relativized a priori. Carnap's *Logical Syntax* unified higher order logic (including set theory) and mathematics (including the coordinating principles as of mathematical physics), by treating all their true statements as similarly analytical a priori (this is what Friedman refers to as Carnap's attenuated logicism). Uebel's contribution suggests that that this view may suffice to account for the relevant function of the a priori in the mathematical natural sciences. Much hinges here on what we take 'analytic' to mean. Uebel argues that although it is evident that Carnap's sense of it must differ from Quine's – and Kant's for that matter – there is no reason why the latter must be preferred, on the application of Carnap's own principle of tolerance. But then note that as regards the empirical sciences no distinction in kind was drawn by the Vienna Circle and especially Neurath between the social and the natural sciences. Now developmental Kantianism is committed to structured frameworks and paradigms, which at least Kuhn seems to have thought to be

characteristic of mature sciences only (by which it is typically understood the natural sciences and, in particular, physics). Except for economics, however, social science to this day has resisted widespread mathematicisation. Hence Uebel's critique invites the thought that either developmental Kantianism needs to be developed further in order to characterise the relativized a priori in precisely those areas of science that for Neurath had been unduly neglected by his Vienna Circle colleagues, or that its sophistication is wasted on the social sciences until they reach a stage of maturity where its tools are properly applied to them.

Turning now to the second contribution, by Massimo Ferrari, the emphasis is on Cassirer's account of the moral sciences. According to Friedman, Cassirer's brand of Neokantianism not only adopts the Marburg school emphasis upon the regulative use of reason in the trans-theoretical development of the a priori, but it in fact makes the constitutive part of the relativized a priori altogether redundant.⁷ Friedman's own suggestion is rather to combine the Marburg emphasis on regulative reason in the trans-theoretical development of science with a strong commitment to the constitutive nature of the a priori. Now, as noted already, Ferrari disagrees with this interpretation of Cassirer's work. He argues instead that Cassirer's relativized a priori must be understood as simultaneously constitutive and regulative, in line with the Marburg school Neo-Kantian interpretation.⁸ He then goes on to argue that Cassirer's rendition of the a priori is particularly suited to the moral sciences, and to the development of culture in general. In particular Cassirer's momentous *Philosophy of Symbolic Forms* may be interpreted as the attempt to extend the transcendental method characteristic of the Marburg school to the study of the conditions of the diverse manifestations of culture – scientific and humanistic alike. Thus Ferrari's paper suggests that developmental Kantianism must be further developed to account for the moral sciences (*geisteswissenschaft*), and the diverse manifestations of human culture in general.

⁷ Friedman, 2001, p. 65; also Friedman, 1999b, chapter 7.

⁸ Cassirer departs from Cohen, always according to Ferrari, mainly only on account of his distinctive 'universal invariant' theory of experience.

Thomas Mormann's essay discusses the a priori in relation to an altogether different philosophical school, namely American pragmatism. An important part of Friedman's *Dynamics of Reason* is devoted to an application of the relativized a priori to Kuhn's thought, and in particular to Kuhn's notion of paradigm. Mormann argues by contrast that Lewis' pragmatic a priori may be more appropriately suited to Kuhn's views, and in particular to Kuhn's later conception of paradigms as disciplinary matrices. Along with a theoretical framework, a disciplinary matrix involves a large number of practical activities and skills, including experimental activities and skills. Since C.I. Lewis' notion of the a priori is designed to fit in with activities and skills, it seems appropriate for disciplinary matrices as a whole. Mormann's paper suggests that Friedman's developmental Kantianism, as it is, may be leaving out some of the most essential practices in scientific inquiry, namely those pertaining to experimentation and the building of instruments. Following Chang (2008) Mormann defends a notion of pragmatic a priori as the set of metaphysical principles underlined by a particular activity. Thus the activity of counting requires the metaphysical principle of discreteness. Without the assumption of the principle, the activity as such is impossible (I say "as such" because an action superficially resembling counting could still conceivably take place in a meaningless automatic fashion – but such an action would not be an instance of the activity in question, i.e. it would not be genuine counting). The pragmatism is injected in virtue of the voluntary nature of partaking into such an activity. By contrast, developmental Kantianism as it stands seems, *prima facie*, too inflexible to account for such cases of pragmatic activities, other perhaps than the sort of scientific theorising characteristic of mathematical physics.

Finally, Alfred Nordmann argues that Heidegger's alternative phenomenological interpretation of Kant, when properly understood, provides a fitting account of both technology and applied science. Heidegger's conception of objectivity, which results from his very different notion of truth in science, is much more appropriate for a full understanding of the roles and functions of technology and applied science. In an earlier book (Friedman, 2000) Friedman had studied in careful detail the disputation at Davos between Cassirer and Heidegger in 1929, and sided with Cassirer while also being sympathetic to Heidegger's "breathtakingly original exploration of the spiritual

and philosophical predicament of the early twentieth century”.⁹ Nordmann’s paper is therefore not in anyway directed at any lack of appreciation of Heidegger’s accomplishments on Friedman’s part. Rather, in line with the other contributions to the volume, it raises some questions regarding the domain of application of developmental Kantianism and, in doing so, suggests a further extension. This may be another area of inquiry where the relativized a priori betrays its origin in discussions surrounding the significance of modern mathematical theories of space-time. In the realm of the techno-sciences, as revealed by Nordmann’s discussion of Heidegger’s views, may be no a priori propositional knowledge plays any significant role at all.

5. Developing Developmental Kantianism

In his response Friedman outlines what the main features of the *Dynamics of Reason* would be when extended to other domains of science, whether the social sciences, the experimental sciences, or technology and instrumentation. It is an extraordinary programmatic statement that gives a full picture of Friedman’s philosophical ambitions and work to come.

As regards the experimental sciences and technology, Friedman proposes to follow Helmholtz’s programme to extend Kant’s faculty of sensibility to these areas by considering Helmholtz’s insight regarding the idea of space as the result of our practical experience of bodily motion. This would provide Friedman with a relevant anchor to activities well beyond theoretical deductive inference and would hopefully allow him to incorporate into this extended version of the workings of Kant’s faculty of sensibility all the embodied cognition that goes on in experimental science. Further still, Friedman aims to extend the faculty of sensibility to the interplay between experiment and instrument by considering the development of technology that results

⁹ Friedman (2000, p. 152). The relevant paragraph contains Friedman’s strongest praise of Cassirer yet: “And it is in this respect, in particular, that Cassirer here emerges as a quite central twentieth century figure. For he alone attempts to do justice, once again, to both sides of Kant’s original philosophical synthesis. And he alone is thus in a position to mediate the increasing intellectual tension between the now notorious ‘two cultures’ – between the *naturwissenschaftliche* and *geisteswissenschaftliche* intellectual orientations”.

from this experimental practice (here he mentions in particular, electromagnetic optics, and interferometry).

But this is not all. And even more ambitious development of developmental Kantianism is forthcoming. In the final part of his contribution, Friedman announces that he plans to explore the application of developmental Kantianism to other significant elements of culture that, without constituting scientific knowledge, nonetheless impinge in significant ways upon its generation. It is at this point that Friedman invokes the advent of the Gregorian calendar, and its deep entanglement with the institutional nature and social function of the Catholic Church. In other words, he is claiming that the social history of science itself can be made to fall under the remit of developmental Kantianism. What other elements of culture may be interpreted via this extended and sophisticated Kantian stance? Friedman suggests daringly that developmental Kantianism may have application in the sphere of the moral and political sciences as well, including in particular the development of political philosophy (here he mentions his intent to be able to apply it to the theories of Marx, Habermas, and Rawls).

Now, for the relativized a priori to have such a major role in these areas of inquiry and domains of discourse, developmental Kantianism would need to be extended from what Kant referred to as the realm of theoretical reason and into that of practical reason. Kant thought that practical reason resulted from the sole application of the faculty of understanding, without any contribution from the faculty of sensibility that characterises empirical knowledge. It is hence obvious that such an extension of Friedman's developmental view of knowledge (from the domain of empirical science where it originates to domains of human knowledge and rationality where empirical evidence is at best fortuitous) is an astonishingly ambitious endeavour that requires, for a start, a reconfiguration of several Kantian categories. Yet, it is a fitting ambition for one of the most extraordinary lucid and profound philosophers of science of our time.

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