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Kant And The Conservation Of Matter

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ABSTRACT

This dissertation is an examination of Kant's rather notorious claim that natural science, or physics, has a *priori* principles, understood as the claim that physics is constrained by rules warranted by the essential nature of thought. The overall direction of this study is towards examining Kant's claim by close study of a particular principle of physics, the principle of the conservation of matter. If indeed this is a principle of physics, and Kant can successfully show that it is a *priori*, then it will be reasonable to conclude, in company with Kant, that physics has a *priori* principles.

Although Kant's proof of the principle of the conservation of matter has been traditionally regarded as a reasonably straightforward consequence of his First Analogy of Experience, a careful reading of his proof reveals that this is not really the case. Rather, Kant's proof of the conservation of matter is a consequence of (i) his schematisation of the category of substance in terms of permanence, and (ii) his identification of matter as substance, by appeal to what he thinks is the empirical criterion of substance, activity.

Careful examination of Kant's argument in defence of the principle of the conservation of matter, however, reveals a

number of deficiencies, and it is concluded that Kant cannot be said to have satisfactorily demonstrated the principle of the conservation of matter or to have convincingly illustrated his claim that physics has a *priori* principles by appeal to this instance.

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INTRODUCTION

This dissertation is a study of Kant's warrant for maintaining that at least some of the foundations and principles of natural science are a priori. In principle one might seek to substantiate the claim that science has a priori principles in, at least, two quite distinct ways: (i) in a global manner by appeal to an argument about the character of either science in general or physics in particular, as Kant does in the Preface to his *Metaphysical Foundations of Natural Science* (henceforth MFNS), or (ii) in a much more localised manner by considering the epistemic status of particular principles of physics with a view to determining whether they are a posteriori and grounded in experience or whether they are indeed, as Kant claims, a priori. Kant actually employed both strategies, although in this dissertation we shall mainly be concerned with his deployment of the second strategy and in particular with his manoeuvres in connection with the principle of the conservation of matter (henceforth PCM). As a contribution to vindicating his views on the nature of science, PCM serves, in Kant's mind, as a telling example or instance of an a priori principle of physics.

In the first chapter I provide an interpretation of what Kant means when he attributes to (some of) the principles of physics the status of being a priori and examine why he thinks that such principles constitute metaphysical

principles of physics. Kant's singular conception of the nature of scientific theories is discussed in order to further accent the need for metaphysical foundations of natural science.

Chapter 2 presents an exposition of Kant's argument in defence of PCM against the backdrop of Newton's physics, the physics for which Kant's **MFNS** was intended to provide metaphysical foundations. Because Kant's argument in support of the principle of the conservation of matter leans heavily on his identification of permanence as the schema of the category of substance and activity as its empirical criterion, chapter 3 presents arguments in support of these claims. The argument given in support of permanence being the schema of the category of substance in turn depends on the principle of the First Analogy of Experience. So in chapter 4, I examine Kant's argument in support of this principle and argue that in the final analysis it is unsatisfactory and fails to demonstrate the principle Kant wants and needs. Chapter 5 studies Kant's conception of substance and urges that although it is not entirely satisfactory, it is by no means as problematic as some commentators and critics have made out. Chapter 6 examines Kant's dynamical view of the nature of matter and argues that it is really quite inadequate for the purposes of mechanics.

CHAPTER ONE: SCIENCE AND METAPHYSICS

[1-1] INTRODUCTION

Kant's claim in the Introduction to the second edition of the Critique of Pure Reason (henceforth **CPR**) that "natural science (physics) contains a priori synthetic judgements as principles" [B17][1] is not a claim which many contemporary philosophers have found very attractive. Nevertheless, it is a claim which deserves careful consideration rather than summary rejection[2]. This dissertation will endeavour to provide a sympathetic examination of Kant's claim and will do so by adopting what I like to call a "localist" methodology, i.e. by subjecting a particular principle, which Kant thinks is an a priori principle of physics, to close scrutiny with a view to determining whether or not it is a priori. If indeed we can identify a particular principle of physics which is a priori then it will be reasonable to conclude that, as Kant claims, physics has a priori principles.

Immediately after announcing in the Introduction to **CPR** that physics is in part a priori, Kant cites two examples of principles of physics which he thinks are synthetic a priori

judgements as evidence and support for his claim. These are the principle "that in all changes of the material world the quantity of matter remains unchanged", PCM, and the principle of the equality of action and reaction, the principle "that in all communication of motion, action and reaction must always be equal". That both principles are indeed a priori, Kant thinks, is sufficiently evidenced by the fact that both of them are necessary and not merely contingent truths. That PCM is a synthetic and not an analytic proposition, Kant thinks, is made clear by the observation that "in the concept of matter I do not think its permanence, but only its presence in the space it occupies. I go outside and beyond the concept of matter, joining to it a priori in thought something I have not thought in it" [B18]. Presumably, then, Kant thinks that the synthetic a priori status of PCM is to be justified by appeal to the permanence of matter, and that the judgement that matter is permanent is not an analytic but a synthetic judgement. It must, indeed, be a synthetic a priori judgement since only as such can it function as a premise for the deduction of PCM as a synthetic a priori judgement. That it indeed has this status in Kant's epistemological scheme is by no means an obviously true claim and is, in fact, a rather more complicated matter than has been generally recognised. Nevertheless, Kant's compressed reasoning in the Introduction to **CPR**, in spite of an important lacuna, (concerning the substantiality of matter) which he repairs in his extended treatment of PCM in his

Metaphysical Foundations of Natural Science, (henceforth **MFNS**), accurately represents (as we will see below) the kind of justification Kant thought could be given for asserting PCM.

Before attempting any evaluation of Kant's claim that physics has synthetic a priori principles however, we ought first to consider what Kant intends when he attributes to (some of) the principles of physics the status of being a priori.

[1-2] THE CHARACTER OF A PRIORI JUDGEMENTS

Kant has a rather large inventory of subjects which can take the term a priori as a predicate, subjects such as knowledge, concept, intuition, proposition and principle. Primarily, however, a priori attaches to judgements, and it attaches specifically to those judgements for which we have a particular kind of warrant or justification. Characterised negatively, this warrant, or justification, is non-empirical warrant. Characterised positively, the warrant for making those judgements which are to be classified as a priori judgements, is what Kant calls the essential nature of

thought[3], i.e. the way that we, and any other beings cognitively equipped like us[4] must think in order for objective knowledge or knowledge of objects to be possible. A priori judgements, we might say, are those judgements which are made because of the essential nature of thought.

A priori judgements are primarily prescriptive rather than descriptive judgements, i.e. judgements about how we ought to interpret and deal with what is given in our encounters with nature or the world, rather than about what is the case in those encounters[5]. As such, a priori judgements are essentially rules[6] and serve to articulate the way we must think in various situations. Like descriptive or declarative judgements, prescriptive judgements require justification or warrant; justification, that is, for why we ought to do whatever it is that a particular rule tells us to do. The warrant for a priori judgements, we have said, is the essential nature of thought, and we can now see that this amounts to saying that we ought to do what a priori judgements tell us to do because that is the way we must think if objective knowledge is to be possible.

Kant's claim that physics has a priori principles is thus to be understood as the claim that physics is governed by rules which are warranted by the essential nature of

thought. The subject of this dissertation is one particular rule which Kant thinks governs physics; the rule captured by what Kant calls the First Law of Mechanics, presented in chapter III, "Metaphysical Foundations of Mechanics", of his MFNS. According to this First Law of Mechanics:

> With regard to all changes of corporeal nature, the quantity of matter taken as a whole remains the same, unincreased and undiminished. [Ak 541][7]

Construed as a rule, this instructs physicists to treat matter as conserved through all changes in motion.

Kant's argument, as we will see in the next chapter, in support of this law of mechanics, is not so much a proof to the effect that it is true that matter is conserved through all changes in its motion as a justification for physicists supposing it to be conserved. The set of rules which govern physics, Kant thought, comprised what he regarded as the metaphysical[8] foundations (Anfangsgründe) or principles of physics. Kant's designation of such principles as metaphysical is intimately bound up with his conception of the nature of metaphysics and his account of the relationship between physics and metaphysics.

[1-3] THE PROPER SUBJECT MATTER OF METAPHYSICS

Notwithstanding the increasing number of intervening years between 1781 and the present, Kant's **CPR** remains the most thorough and comprehensive examination of a priori judgement. On one level the project of **CPR** is to delimit the sphere of such judgement, identifying both what lies within its realm, the realm of pure reason, and what, notwithstanding others' claims to the contrary, lies outside its realm. On the positive side, Kant argues, among other things, that we can know a priori that everything encountered in experience is ordered spatially and temporally; more specifically we know a priori that all objects of experience will have extensive and intensive magnitudes, will be substances and will all be causally interactive. On the negative side, Kant argues that there can be no a priori knowledge of the soul or God, or of the age, size or material composition of the world.

To this description of **CPR** as a study of the limits of a priori judgement we must now add another dimension of the work. The announced project of **CPR** is the establishment of a science of metaphysics[9]. Kant's early attempts to discover the

correct method for metaphysics[10] coalesced in **CPR** into an entirely new conception of the nature of metaphysics. Whereas formerly metaphysics had been understood as, in the Aristotelian formula, the study of being qua being, or the investigation of the nature of reality itself, in Kant's hands the study of metaphysics became the study of the form of nature, where form is to be sharply contrasted with content. The form of nature, Kant came to think in **CPR**, was discovered in nature by epistemic agents in the course of their formulating judgements about nature, where nature is understood as the set of contentful appearances. Epistemic agents, Kant maintained, find themselves confronted with a collection of data which they can render intelligible only by organizing it under certain forms. In a number of texts[11] Kant drew an important distinction between what he called formal and material nature. The concept of material nature, according to Kant, is the concept of the sum total of appearances; material nature is what is given to epistemic agents and what supplies the content for what Kant calls formal nature. The concept of formal nature, Kant maintains, is the concept of "the totality of the rules under which all appearances must come to be thought as connected in an experience" [*Prolegomena* Ak 318] and the "synthetic unity of the manifold of appearances according to rules" [A126]. In the sense in which one speaks of the order of nature or the structure of nature, formal nature is the order of material nature.

It is however, only the "order and regularity in appearances" that "we ourselves introduce" [A125] and not the content. The study of the various ways in which we discover order and regularity in nature or the given content of experience is the study of the essential nature of human thought[12] and, Kant thought, the proper subject matter of metaphysics. In so far as the proper subject matter of metaphysics is the essential nature of thought, the study of metaphysics is the study of the limits or constraints on what is thinkable and judgeable.

The inspiration for Kant's change in perspective was, of course, his "Copernican revolution". In the 1787 Preface to **CPR** Kant suggested that we might have more success in resolving the hitherto interminable metaphysical disputes and that it might prove to be a more profitable strategy for us to "suppose that objects must conform to our knowledge" [Bxvi] rather than vice versa, as had previously implicitly been assumed to be the case. Rather than the mind attempting to mirror nature, Kant proposed that we construe nature as, at least to some extent, namely as far as its form or structure is concerned, mirroring the mind; and it is those respects in which nature mirrors the mind that are, for Kant, the proper subject matter of metaphysics.

For Kant the human mind is a very sophisticated kind of knitting machine[13], although rather than knitting wool the mind synthesises what Kant calls representations. Carrying this metaphor one stage further, in the same way as the knitting machine is designed to knit wool in a variety of different ways or patterns, so the mind is designed to combine or synthesise representations in a number of different forms, and it is precisely these different forms of synthesis which metaphysics studies. Metaphysics is thus the examination of the structure or the cognitive architecture of the human mind. Kant, however, conceives of the study of cognitive architecture much more broadly than contemporary cognitive psychologists are wont to. For, whereas cognitive psychologists are concerned to explain our actual cognitive abilities, Kant is interested in the possibility of any cognitive processes at all[14]. Kant, furthermore, in stark contrast to contemporary cognitive scientists, conceives of the study of cognitive architecture as an a priori study. This last requires some explanation. In particular it needs to be stressed that, like the contemporary approach, Kant does not regard the mind as transparent, its workings (operations) are not open to introspection although its operations are indeed open to a species of logical or transcendental analysis. For the contemporary cognitive psychologist, however, this logical analysis is insufficient and claims, hypotheses or theories, about both particular and

general cognitive operations require experimental and empirical verification. This is, of course, only to be expected since cognitive psychologists are, after all, cognitive scientists and not cognitive philosophers and this distinction is supposed to reflect a distinction between their respective methodologies rather than between their aims or goals[15].

[1-4] SCIENTIFIC THEORIES

According to Kant, scientific theories emerge in the rational attempt to unify and systematise our knowledge or, to use a more Kantian turn of phrase, in the attempt of reason to unify the claims of the understanding. Concerning the exercise of reason, Kant tells us in **CPR** that:

> If we consider in its whole range the knowledge obtained for us by the understanding, we find that what is peculiarly distinctive of reason in its attitude to this body of knowledge, is that it prescribes and seeks to achieve its systematisation, that is to exhibit the connection of its parts in accordance with a single principle. [A645/B673]

Such principles of systematisation, Kant tells us, are always a priori principles. At the highest, or most general, level Kant thinks that these principles are what he calls the ideas of reason and these ideas, he tells us:

> postulate a complete unity in the knowledge obtained by the understanding, by which this knowledge is to be not a mere contingent aggregate, but a system connected according to necessary laws. [A645/B673]

That the laws connecting the parts of the system must be necessary and not merely contingent is required in order to guarantee the mathematisability or applicability of mathematics to the system[16].

Essentially a scientific theory, in Kant's view, is a certain kind of taxonomy or classificatory scheme for nature. As a product of reason, however, rather than the understanding, the kind of taxonomy[17] which is a scientific theory is not so much a representation of the order of nature as a representation of a projected order of nature[18]. But, according to Kant, a scientific theory is not simply any projected order of nature but rather a projected order of nature which satisfies certain constraints. In the Preface to

MFNS Kant draws a distinction between what he calls the historical doctrine of nature, "which contains nothing but the systematically ordered facts regarding natural things (which again would consist of the description of nature as a system of classes of natural things ordered according to similarities...)" [Ak 468], i.e. what we might call a mere taxonomy, and what he refers to as natural science, "either properly or improperly so-called". Natural science "properly so-called" is that science "whose certainty is apodeictic" whereas science "improperly so-called" is that science "that can contain merely empirical certainty". In the latter case, Kant thinks that the science should really be called a "systematic art" rather than a science, and such, he thinks, is the status of chemistry. Kant's explanation of why chemistry has this status and why it fails to rank as a science is particularly instructive:

> So, long, then, as there is for the chemical actions of matter on one another no concept which admits of being constructed, i.e. no law of the approach or withdrawal of the parts of matter can be stated according to which (as, say, in proportion to their densities and suchlike) their motions together with the consequences of these can be intuited and presented a priori in space (a demand that will hardly ever be fulfilled), chemistry can become nothing more than a systematic art or experimental doctrine, but never science proper. [Ak 470-71]

Although Kant was mistaken in his prediction that chemistry would never become a science proper, an error which he sought to rectify in his unfinished work *On the Transition from the Metaphysical Foundations of Natural Science to Physics, (Opus Postumum*[19]), it is, nevertheless, quite clear from his comments on the status of chemistry that what Kant thinks is lacking in chemistry and what precludes it from being a science, properly so-called, is that while chemistry is indeed a taxonomy it is not a taxonomy which generates law-like connections between items in the taxonomy. Kant's insistence that natural science "properly so-called" consists in a taxonomy which permits not merely law-like connections but law-like connections with apodeictic certainty, i.e. connections which can be constructed a priori is just the demand that the law-like connections generated by a taxonomy be mathematisable. Such meta-theoretic constraints are required, Kant thinks, in order for a taxonomy to be more than what we have called a mere taxonomy and to be a scientific theory.

Scientific theories, we have said, are, according to Kant, products of reason and projections of the order of nature. But, for Kant, reason is not, to use a modern turn of phrase, entirely plastic in its projections but is constrained by the principles of the understanding. Beyond

the conditions which must be met in order for a taxonomy to be a scientific theory, any scientific theory is also constrained by what Kant describes as the essential nature of thought, i.e. those principles which in **CPR** he calls the Principles of the Understanding. These principles, the Axioms of Intuition, Anticipations of Perception, Analogies of Experience and Postulates of Empirical Thought specify the various ways in which, in order for knowledge to be possible, Kant claims we must think about what is given to us in experience. Thus, for example, the Axioms of Intuition specify that whatever is given must have extensive magnitude and the Anticipations of Perception tell us that whatever is given must also have intensive magnitude.

Kant's **MFNS** is an explicit application of these constraints to the subject of physics, which is matter. In arguing for the particular metaphysical foundations of physics which he does, Kant is arguing for a set of constraints on physics and, consequently, the investigative activities of physicists. Thus, for example, the second and third laws of mechanics effectively constrain physicists to regard momentum as conserved and the first law instructs them to treat matter as conserved.

The **MFNS** was written at the same time as Kant was making revisions to the first edition (published in 1781) of **CPR** for the second edition (published in 1787). **MFNS** is a surprisingly rich and complex work in which Kant seeks to realise a variety of goals. One of these goals is to provide a critical and, to some extent, corrective examination of the metaphysical presuppositions of the mathematical theory of motion developed by Newton in his Mathematical Principles of Natural Philosophy. Although critical of a number of the metaphysical foundations[20] upon which Newton's theory was constructed, Kant sought to capture the mathematical content of Newton's physics while replacing the unacceptable foundations with more acceptable ones. The metaphysical presupposition of the physics of the *Principia* with which we shall primarily be concerned is Newton's assumption of the conservation of matter. In the *Principia* Newton assumes this without any justification at all[21], and, given the goal of **MFNS** as the critical evaluation of the metaphysical presuppositions of Newton's physics, one might reasonably expect Kant to subject this assumption to some scrutiny. In Kant's view Newton's assumption is right, although, like any good critic, he is not content to leave it as merely an unproven assumption but attempts to demonstrate that the principle of the conservation of matter is justified. Characteristically, Kant attempts to demonstrate that PCM is justified a priori.

Beyond providing a constructive critique of Newton's physics, however, **MFNS** provides a crucially important supplement to the metaphysics or a priori account of the form of nature of **CPR**. In **MFNS** Kant undertakes a study of what he calls special metaphysics, or the metaphysics of corporeal nature, in contrast to the general or universal metaphysics of **CPR**. Whereas general metaphysics, the metaphysics of **CPR**, specifies a set of conditions which must be satisfied in order for something to be an object of experience or empirical knowledge, the special metaphysics of **MFNS** specifies a set of conditions which must be satisfied in order for something to be a physical, material or corporeal object. Now, according to Kant the special metaphysics of corporeal nature is not merely an extension and application of general metaphysics (although in so far as it consists in the application of the categories of the Understanding to the empirical concept of matter, it is indeed an application of general metaphysics) but in an important way completes the general metaphysics. For the metaphysics of corporeal nature is a realisation or instantiation of general metaphysics[22]. As Kant puts it:

> a separate metaphysics of corporeal nature does excellent and indispensable service to general metaphysics, inasmuch as the former provides instances (cases in concreto) in which to realise the concepts and propositions of the latter (properly transcendental philosophy), i.e. to give to a mere form of thought sense and meaning. [Ak 478]

In the Preface to **MFNS** Kant argues that since human receptivity is such that it can be affected by two (radically different) kinds of objects, objects of inner sense and objects of outer sense, i.e. objects ordered spatially and temporally and objects ordered only temporally, it would seem that the general metaphysics of **CPR** is to be supplemented by two special metaphysics, a special metaphysics of objects of inner sense and a special metaphysics of objects of outer sense[23]. This, however, turns out not to be the case and Kant argues that the metaphysical doctrine of body which is the subject matter of **MFNS** is not really one of two possible realizations or instantiations of the general metaphysics, to be complemented by the metaphysical doctrine of soul, but the *only* realization of the transcendental philosophy. The consequences of this position are markedly clear in the B edition of **CPR**, where Kant emphasises the importance of space and the fact that his ontology is one of physical objects located outside us in space. The point is made most explicitly in the section entitled "General Note on the System of the Principles" [B288-294], newly written for the B

[1-5] THE A PRIORI STATUS OF THE PRINCIPLES OF PHYSICS

In saying that the principles and laws of natural science are synthetic a priori judgements it is important to distinguish between the sense in which what Kant calls the principles of the Understanding are a priori and the sense in which the principles of natural science are a priori. Indeed one of the most serious barriers to inclining a sympathetic ear to Kant's claim for the a priori status of the principles of natural science is the failure to identify the correct sense in which the principles of natural science are a priori and the mistaken assumption that they are a priori in the same way as are the principles of the Understanding[24]. But, although Kant was by no means as forthcoming on this issue as one might wish, there are grounds for attributing to Kant a distinction between the sense in which the transcendental principles of **CPR** are a priori and the sense in which the principles of **MFNS** are a priori.

In the B edition Introduction to **CPR**, (section II), having identified the need for a criterion for distinguishing between a priori and empirical knowledge, Kant writes:

> Experience teaches us that a thing is so and so, but not that it cannot be otherwise. First, then, if we have a proposition which in being thought is

> thought as necessary, it is an a priori judgement; and if besides, it is not derived from any proposition except one which has the validity of a necessary judgement, it is an absolutely a priori judgement. [B3]

Kant's point here is that since experience merely yields us knowledge of contingencies, if we have any knowledge of necessity, such knowledge must be non-empirical or a priori. In addition to this, Kant also claims that a judgement which is necessary, and hence a priori, and which also does not presuppose any empirical or non-a priori knowledge, is absolutely a priori. The suggestion is that there are in fact two kinds of a priori knowledge, knowledge which is a priori simplicter and knowledge which is absolutely a priori. Furthermore, Kant tells us on the next page:

> if a judgement is thought with strict universality, that is, in such a manner that no exception is allowed as possible, it is not derived from experience but is absolutely a priori. [B4]

Subsequently, Kant characterises knowledge which is necessary and in the strictest sense, universal, as "pure" a priori knowledge and although he does not discuss whatever is supposed to contrast with "pure" a priori knowledge, which it will be convenient to label "impure" a priori knowledge, the

door is clearly left open for another, weaker, sense in which knowledge might be a priori. "Pure" a priori propositions are necessary and strictly universal propositions, propositions to which there can be no exceptions. By contrast, "impure" a priori propositions are necessary but not strictly universal propositions. The sense of necessity appropriate to the characterisation of "pure" a priori propositions is necessity as it is usually defined in standard modal logic, i.e. a proposition is necessary just in case its negation is not possible. The sense of necessity appropriate to the characterisation of "impure" a priori propositions is a weaker notion of necessity and corresponds to the account of necessity which Kant gives in connection with the category of necessity in the Postulates of Empirical Thought. There Kant defines necessity as follows:

> That which, in its connection with the actual is determined in accordance with the universal conditions of experience, is (that is, exists as) necessary. [A218/B266]

The necessity here, as William Harper has argued in his paper "Kant on the A Priori and Material Necessity",[25] is a conditional necessity such that a proposition is necessary if it is derived from the universal conditions of experience together with something which is actual. Of course, Kant's

concern in the Postulates is with the modalities of objects rather than the modalities of propositions, but it would surely not be unreasonable to extend that account to cover propositions. Now a proposition which is necessary in this sense need not be strictly universal. In line with the distinction between "pure" and "impure" a priori propositions we can now distinguish between the a priori transcendental principles of **CPR** which are "pure" a priori propositions (necessary and universal) and the metaphysical principles of **MFNS** which are "impure" a priori propositions (necessary but not strictly universal)[26]. In the *Critique of Judgement* Kant explicitly tells us that:

> A transcendental principle is one by which we think the universal a priori condition under which alone things can become objects of our cognition in general; on the other hand, a principle is called metaphysical if it is one [by] which [we] think the a priori condition under which alone objects whose concept must be given empirically can be further determined a priori. [Ak 181]

[1-6] METHODOLOGICAL POINTS

In claiming that science has a pure or a priori part, Kant might be claiming merely that science as he knew it has an a priori component. In other words, Kant's philosophy of

science and, in particular, his claim for the a prioricity of part of science might be a commentary on the contemporary science of his time, i.e. Newtonian science. Alternatively, Kant might be claiming that science, not merely de facto but, de jure and necessarily is in part an a priori study. The latter view is clearly a much more daring view than the former, and although neither interpretation of Kant's position has garnered many supporters among philosophers of science, it is significant to note that the former view might be true even if the latter should turn out to be false. Although I am quite sure that Kant wants to make the stronger claim I think he has a more interesting case to make in support of the weaker one[27]; indeed what I take to be the significance of Kant's discussion of PCM is that it attempts to illustrate this in a particularly concrete way.

ENDNOTES

[1] This and all subsequent quotations from **CPR** are from Norman Kemp Smith's translation of *Kritik der reinen Vernunft (Critique of Pure Reason)* in *Kant's Critique of Pure Reason*, MacMillan and Co. Ltd., 1933. I follow the usual practice of referring to the first and second editions of **CPR** as "A" and "B" respectively.

[2] As, for example, Kitcher does ("Kant's Philosophy of Science" in *Midwest Studies* Vol VIII, pp 387-407) when he declares that "Kant does not believe that principles like that of the conservation of matter and that of the equality of action and reaction are fully a *priori*." [p 389] In part, Kitcher's position is motivated by his extremely strong and restrictive characterisation of a *priori* knowledge as knowledge that is obtained by following, what Kitcher calls, an a *priori* procedure. That is, "a type of process such that, given any experience that would be sufficiently r ch to enable someone to entertain the proposition, a process of that type would be available to the agent and, if it were followed, would generate knowledge of the proposition" [p 394].

[3] As Kant says in the Preface to *Metaphysical Foundations of Natural Science*, "All true metaphysics is taken from the essential nature of the thinking faculty itself" [Ak 472].

[4] That is, they are equipped like us insofar as they are furnished with a passive sensibility which receives data in the form of particulars structured in space and time, and an active understanding which produces or invents concepts for ordering and structuring the received particulars.

[5] In his commentary paper "On Buchdahl's and Palter's Papers" (L. W. Beck (ed.), *Proceedings of the Third International Kant Congress 1988-1989),* Robert Butts has noted that:

> Kant's philosophical system appears .... to have been generated in the context of an unresolved tension between two conceptual models, one inherited and deeply embedded in Kant's thought, one created by Kant (it is perhaps the greatest of his philosophical creations) but never really developed by him in sufficient detail. The two models have to do with ways of construing concepts (and judgements, whose ingredients are concepts). The first model regards concepts as subsumers, classes that collect instances. The second model introduces that revolutionary idea that concepts are rules, which means that whatever else concepts are, they are basically invitations to do something, to perform in certain ways. [p 188]

Furthermore, he has suggested that while "analytic judgements may be viewed as something like rules of logic; synthetic a priori judgements may be viewed as rules governing the way in which we formalise talk about experience' [p 189].

[6] This kind of imperativist interpretation of a *priori* judgements can also be found in Stephan Körner's *Kant,* Lewis White Beck's *A Commentary on Kant's Critique of Practical Reason, Cassirer's Kant's Life and Thought* and is argued for

in detail by Robert Butts in his *Kant and the Double Government Methodology: Supersensibility and Method in Kant's Philosophy of Science*.

[7] This and all subsequent quotations from **MFNS** are from James Ellington's translation of *Metaphysische Anfangsgründe der Naturwissenschaft* (Metaphysical Foundations of Natural Science) in *Immanuel Kant: Philosophy of Material Nature*, Hackett, 1985. In order to facilitate cross-references with other translations, page numbers refer to the Prussian Academy edition of *Kant's Gesammelte Schriften*, volume IV, Berlin, 1911.

[8] As Kant announces in the Preface to **MFNS**:

> I have deemed it necessary that from the pure part of natural science (*physica generalis*), where metaphysical and mathematical constructions are accustomed to traverse one another, the metaphysical constructions, and with them als the principles of the constructin of these metaphysical concepts (and hence the principles of the possibility of a mathematical doctrine of nature itself), be presented in one system. [Ak 473]

That "one" system being the system presented in **MFNS**.

[9] These two aspects of **CPR**, the investigation of a *Priori* knowledge and the establishment of the science of metaphysics, interlock quite naturally in so far as metaphysics is supposed by Kant to be a system of a *priori* knowledge.

[10] The *Enquiry Concerning the Clarity of the Principles of Natural Theology and Ethics* (1763), also known as the *Prize*

Essay, Dreams of a Spiritseer (1766), and *On the Form and Principles of the Sensible and Intelligible World*(1770), Kant's Inaugural Dissertation.

[11] Preface to **MFNS** [Ak 467], *Prolegomena* section 36 [Ak 318] **CPR** A126 and B165.

[12] **MFNS** [Ak 472].

[13] The metaphor is suggested by Bennett in *Kant's Analytic*.

[14] Gordon Nagel, *The Structure of Experience* [p 61].

[15] As Nagel (*The Structure of Experience*) has observed "If both approaches are successful, they are complementary despite their differences - Kant supplies a unifying general theory; and cognitive psychology supplies both specificity and, with specificity, a link to the physiological basis of cognition" [p 62].

[16] Okruhlik, "Kant on Realism and Methodology" p 313 in Butts (Ed.), *Kant's Philosophy of Physical Science*.

[17] Kitcher, *"Kant's Philosophy of Science"* [p 392].

[18] "The systematic unity .... is, however, only a projected unity, to be regarded not as given in itself, but as a problem only" [A647/B675].

[19] Michael Friedman, "On The Transition from the Metaphysical Foundations of Natural Science to Physics", unpublished manuscript, [p 4 and pp 50-51].

[20] Principally, Kant objected to (i) Newton's atomistic conception of matter, (ii) Newton's conception of absolute

space and (iii) Newton's denial that gravity is essential to matter.

[21] Although, as we shall examine in the next chapter, Newton did indeed make some moves towards rectifying this omission in the final Query to his *Optics*, Kant would not have found this attempt at all satisfactory.

[22] In 1765, while composing **CPR**, Kant wrote a letter to J. H. Lambert (translated in Zweig, *Kant: Philosophical Correspondence* 1759-99 pp 47-49) in which he reported that "What I am working on is mainly a book on the proper method of metaphysics (and thereby also the proper method for the whole of philosophy)." However, he continues:

> My problem is this: I noticed in my work that, though I plenty of examples of erroneous judgements to illustrate my theses concerning mistaken procedures, I did not have examples to show in *concreto* what the proper procedure should be. Therefore, in order to avoid the accusation that I am merely hatching new philosophical schemes, I must first publish a few little essays, the contents of which I have already worked out. The first of these will be the "Metaphysical Foundations of Natural Philosophy" and the "Metaphysical Foundations of Practical Philosophy". With the publication of these essays, the main work will not have to be burdened excessively with detailed and yet inadequate examples."

Although **MFNS** was not actually published until some twenty years later, it seems clear that Kant did not change his views regarding the relationship of this work to his work on the proper method of metaphysics, i.e. **CPR**.

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[23] In a letter to C. G. Schultz [Zweig, *Kant: Philosophical Correspondence* 1759-99 p 119] of 1785 Kant actually suggests that he will write a metaphysical foundations of the theory of soul as an appendix to the metaphysical foundations of the theory of body.

[24] Brittan, "Metaphysical Foundations of Natural Science" p 63, in Butts (Ed.), *Kant's Philosophy of Physical Science*, and Walker, "The Status of Kant's Theory of Matter" p 155, in Beck (Ed.), *Kant's Theory of Knowledge*.

[25] In Butts (Ed.) *Kant's Philosophy of Physical Science*.

[26] Friedman, "Kant On Causal laws and the Foundations of Natural Science" [p 18].

[27] Brittan, (*Kant's Theory of Science*, p 140), has suggested that although Kant's claim that there is fixed a *priori* component of natural science cannot be sustained, nevertheless, "it is in coming to realise the inadequacy of Kant's claim that a particular set of presuppositions could be guaranteed once and for all that we realise the truth of another claim, that at any given time science consists of a *priori* as well as empirical elements".

CHAPTER TWO: THE CONSERVATION OF MATTER

[2-1] NEWTON AND THE CONSERVATION OF MASS

The physics for which Kant's **MFNS** was intended to provide metaphysical foundations was the physics of Newton's *Mathematical Principles of Natural Philosophy*. In that work Newton merely assumed, without any justification, the conservation of matter. In Kant's view, Newton's assumption is right, although, like any good critic, he is not content to leave it as merely an unproven assumption but attempts to demonstrate that Newton's assumption is indeed justified. In the final Query to his *Optics*, Newton attempted to defend his assumption of the conservation of matter, but his defence, arguing as it does from his conception of the nature of matter which Kant opposed, would have been quite unacceptable to Kant.

Newton's physics as articulated in his Mathematical *Principles of Natural Philosophy* implicitly assumed the conservation of mass[1]. A close inspection, however, of exactly what Newton thereby assumed to be conserved, raises a number of difficulties. Ernan McMullin introduces his study *Newton on Matter and Activity* with the observation that:

> In the story of the concept of matter, Newton plays a paradoxical role. On the one hand he struggled with the intricacies of this concept for sixty years while building his system of the world around it. Yet on the other hand, he provided scientists with a neat and manageable substitute for it, one which would later supplant the older concept in the explicit symbolic systems of modern science. [p 1]

This substitute was, of course, the concept of mass and although today, and indeed for the last two hundred years, it is the concept of mass, understood as the quantity of force required to accelerate a body[2], rather than the concept of a quantity of matter which is the fundamental concept in physics, Newton himself generally prefers to use the term "quantity of matter". This latter concept Newton defines in definition I of the *Principia* as "the measure of the same, arising from its density and bulk conjointly" and adds the following explanation:

> Thus air of a double density, in a double space, is quadruple in quantity; in a triple space, sextuple in quantity. The same thing is to be understood in snow, and fine dust and powders, that are condensed by compression or liquefaction, and of all bodies that are by any causes whatever differently condensed. I have no regard in this place to a medium, if any such there is, that freely pervades the interstices between the parts of bodies. It is this quantity that I mean hereafter everywhere under the name of body or mass. And the same is known by the weight of each body, for it is proportional to the weight, as I have found by

> experiments on pendulums, very accurately made, which shall be shown hereafter.

This definition explicitly identifies the mass of a body with its quantity of matter[3]. In the commentary accompanying definition III, however, we find an implicit definition of an altogether different conception of mass, one approximating much closer to the more modern concept of the quantity of force required to accelerate a body; here Newton writes:

> [vis insita] is always proportional to the body whose force it is and differs nothing from the inactivity of the mass, but in our manner of conceiving it. A body, from the inert nature of matter, is not without difficulty put out of its state of rest or motion. Upon which account this vis insita or force of inactivity may, by a most significant name, be called inertia (vis inertiae) or force of inactivity.

In other words, the inertial force of a body in not merely always proportional to the mass of that body but is indeed nothing other than the mass of a body considered as entirely passive and inactive. Correlatively, the mass of a body is its inertial force, i.e. its "power of resisting, by which every body, as much as in it lies, continues in its present state, whether it be of rest, or of moving uniformly forward in a right line" as defined in definition III of the *Principia*.

In large part Newton inherited this conception of mass from Kepler, although Newton's conception of inertia differs significantly from Kepler's in so far as Kepler regarded the resistance of matter to motion as an inherent tendency of matter for rest, whereas Newton regarded inertia as simply resistance to acceleration or any change in the motion of a body. Kepler had developed the Neoplatonic conception of inertia as a body's passivity and incapacity for spontaneous motion[4] into the conception of inertia as resistance to motion and claimed, in his *De causis Planetarium*[5], that "inertia or opposition to motion is a characteristic of matter; it is stronger the greater the quantity of matter in a given volume".

Having realised that the traditional account of planetary motions in terms of perfect circles had to be abandoned in favour of an account in terms of elliptical orbits, Kepler's search for a dynamical explanation of such elliptical paths led him to develop the idea of physical force from the idea of "motory intelligences, souls or pure forms.... (and the idea of a) factor which, as Kepler discovered, works in opposition to motory force (and which) must necessarily belong to the realm of matter, since it is the nature of matter, according to Neoplatonic tradition, to constitute an impediment to the realisation of form" [Jammer p 53]. This latter idea was the idea of inertia which early

on Kepler explained by analogy with weight. Kepler did not actually distinguish between inertia and weight or even employ the term "inertia" until 1618 in his Epitome astronomaie Copernicae where he wrote that:

> every celestial sphere, because of its materiality has a natural inability to move from place to place, a natural inertia or rest whereby it remains in every place where it is set by itself.

Newton rejected Kepler's idea that bodies have a natural tendency for rest in favour of the idea that bodies persevere in whatever state they happen to be, whether this state be a state of motion or a state of rest. Indeed, Newton made this axiomatic in his system, declaring in his first law of motion:

> Every body continues in its state of rest, or of uniform motion in a right line, unless it is compelled to change that state by forces impressed upon it.

To the account we have developed above of Newton's conception of mass, we must now add consideration of his commitment to atomism. Atomism first makes its appearance in the *Principia* in the scholium accompanying theorem 33 of Book I (Proposition 73), where Newton explains that:

> By the surfaces of which I here imagine the solids composed, I do not mean surfaces purely mathematical, but orbs so extremely thin, that there thickness is as nothing....In like manner, by the points of which lines, surfaces and solids are said to be composed, are to be

> understood equal particles, whose magnitude is perfectly inconsiderable.

Later, in the third of the four rules of reasoning in philosophy which open Book III of the *Principia* the idea of atomism is again introduced in order to explain what Newton takes to be the universal properties of bodies. Newton begins here with the explanation that:

> The qualities of bodies, which admit neither intensification nor remission of degrees, and which are found to belong to all bodies within the reach of our experiments, are to be esteemed the universal qualities of all bodies whatsoever.

And the qualities of bodies which actually are universal, Newton maintains, are hardness, impenetrability, mobility and inertia. Furthermore, Newton claims:

> The extension, hardness, impenetrability, mobility and inertia of the whole, result from the extension, hardness, impenetrability, mobility and inertia of the parts; and hence we conclude the least particles of all bodies to be also extended, and hard and impenetrable, and moveable, and endowed with their proper inertia. [emphasis added]

The picture suggested by this account of bodies as compounded of particles is that for Newton the quantity of matter or mass of a body is proportional to the number of particles or atoms composing the body, whereas the density is the proportion of atoms to interstices or empty spaces in a

body. That this was Newton's view receives some confirmation from his brief account of density given in Book III where in the fourth corollary to proposition 6 he writes "By bodies of the same density, I mean those whose inertias are in the proportion of their bulks". Now, if we read inertias here as masses and remember that by bulk Newton means volume, it becomes clear that the density of a body is the proportion of its mass or quantity of matter, i.e. the number of particles composing the body, to volume, which will, of course, be the proportion of particles to interstices, as we have said. But if this was indeed Newton's view then it involves a vicious circularity, for the mass of a body cannot be determined without previously determining the density of a body and the density of a body cannot be determined without a prior determination of its mass.

Now, although Newton was quite circumspect on this issue and pretty well noncommittal in print, there is evidence for thinking that Newton regarded the particles composing bodies as indestructible and unchangeable and therefore conserved[6]. In the final Query to Book III of the *Optics* Newton gives, albeit in a very tentative and conjectural manner, an argument, in fact two arguments, for this view when he writes:

> ....it seems probable to me that God in the beginning formed matter in solid, massy, hard, impenetrable, moveable particles, of such sizes and figures, and

> with such other properties, and in such proportion to space, as most conduced to the end for which he formed them; and that these primitive particles being solids, are incomparably harder than any porous bodies compounded of them; even so very hard as never to wear or break in pieces; no ordinary power being able to divide what God himself made one in the first creation. While the particles continue entire, they may compose bodies of one and the same nature and texture in all ages; but should they wear away, or break in pieces, the nature of the things depending on them would be changed. Water and earth, composed of old worn particles and fragments of particles, would not be of the same nature and texture now, with water and earth composed of entire particles in the beginning. And, therefore, that nature may be lasting, the changes of corporeal things are to be placed only in the various separations and new associations and motions of these permanent particles; compound bodies being apt to break, not in the midst of solid particles, but where these particles are laid together, and only touch in a few points.

Ignoring the tentative and conjectural character of this observation, Newton's view here appears to be that the particles of which bodies are composed were created by God, created as absolutely hard in the sense that they cannot be worn away or broken apart, although the bodies which they compose, by the "separation broken apart or worn away. In addition to this, Newton also suggests a most remarkable and perhaps surprising, in the context of Newton's writings, transcendental argument for the conclusion that these particles must "continue entire" and exist, as they are (unchanged and unchanging), eternally. The argument is that

such particles must "continue entire" in order that "nature be lasting" i.e. in order that the bodies which these particles compose be the same kinds of bodies today as in the past. For example, if the particles composing such substances as water or earth could break or wear away then bodies of water or earth today "would not be of the same nature" as bodies of water or earth existing at an earlier time, prior to the decay and decomposition of the particles, composed of unbroken and unworn or "entire" particles.

As far as conservation is concerned it seems clear that Newton thought that mass was conserved in the sense that quantity of matter was conserved and not merely in the sense that a body's resistance to change is conserved although in so far as a body's resistance to change is proportional to its quantity of matter it would seem that he regarded mass in this sense as conserved too. At any rate, it seems that the fundamental assumption is the conservation of quantity of matter and that the assumption of the conservation of mass is parasitic on or derivative from this.

[2-2] KANT'S PROOF OF THE CONSERVATION OF MATTER.

Kant's detailed proof of PCM is given in chapter III, The Metaphysical Foundations of Mechanics, of his Metaphysical Foundations of Natural Science. There Kant accords the principle, formulated as "With regard to all changes of corporeal nature; the quantity of matter taken as a whole remains the same, unincreased and undiminished" [Ak 541], the status of the first law of mechanics. The **MFNS** is a work of a priori physics, i.e. an investigation of what we can know a priori about the motion of matter. The first chapter of **MFNS**, The Metaphysical Foundations of Phoronomy, examines what we can know a priori about motion and the second chapter, The Metaphysical Foundations of Dynamics, investigates what we can know a priori of the nature of matter. In the third chapter, The Metaphysical Foundations of Mechanics, Kant undertakes to examine what we can know a priori about the changes in the motion of bodies and in the course of this examination argues for his three Laws of mechanics, i.e. three a priori principles governing changes in the motions of bodies. In the previous chapter we noted that, in the Introduction to the second edition of **CPR**, Kant cites two examples of principles of natural science, which he thinks are known a priori, PCM and the principle of the equality of action and reaction. In **MFNS** these same two principles appear as the first and third laws of mechanics.

Although Kant's three laws of mechanics are significantly different from Newton's three laws of motion[7], it would seem likely that the former principles became laws on the grounds that the role they play in Kant's account is similar to the role that Newton's three laws of motion play in his theory. The second and third laws respectively tell us that all changes in the motions of bodies are communications of motions and reciprocal actions. The claim that all changes of motion are communications of motions rules out the possibility of motion being created ex nihilo and the claim that all changes in motion are reciprocal actions rules out the possibility that motion is ever completely destroyed. These features of motion, Kant thinks, we know a priori and jointly, these two principles about motion would seem to entail the conservation of motion. Although Kant nowhere in **MFNS** asserts explicitly that motion is conserved, there is explicit evidence, in a letter written to Hellwag in 1791, that Kant did indeed consider motion to be conserved and an interesting explanation of why the point is not explicitly made in **MFNS**. Kant writes, in this letter:

> But as for the question, What is the ground of the law that matter, in all its changes, is dependent on outer causes and also requires the equality of action and reaction in these changes occasioned by outer causes? - I could easily have given a priori the universal transcendental grounds of the possibility of these laws as well, in my Metaphysical Foundations of Natural Science. It might be summarised as follows.

> All our concepts of matter contain nothing but the mere representation of outer relationships (for that is all that can be represented in space). But that which we posit as existing in space signifies no more that a something in general to which our imagination can attribute no characteristics but those of an outer thing, in so far as we regard the thing as mere matter, consequently as devoid of any genuinely inner properties such as the power of conception, feeling or desire. From this it follows that, since every change presupposes a cause, and we cannot conceive of an absolutely inner cause producing change in outer, lifeless things (things that are merely material), the cause of all change (from a state of rest to a state of motion and conversely, along with the specification of such changes) must lie in external matter, and without such a cause no change can take place. It follows that no special, positive principle of the conservation of motion in a moving body is required but only a negative one, viz., the absence of any cause of change[8].

When we turn to Kant's first law of mechanics, however, its status as a principle about changes in motion is not as obvious as that of the other two laws since it does not seem to be so much a principle about the nature of motion as a principle about the nature of matter. We can, however, restate the first law of mechanics in such a way that it is indeed explicitly a principle about motion, and thereby bring it in line with the other two laws of mechanics as follows: no change in motion either is, requires or results in a change in the quantity of matter. In the next chapter we will see that Kant maintains that all change is change in motion so it would be entirely plausible to read Kant's claim that

"with regard to all changes of corporeal nature the quantity of matter remains the same" as the claim that in all changes of motion the quantity of matter remains the same. This serves to make explicit how the first law of mechanics, like the other two laws and contrary to first appearances, is indeed a principle governing motions and changes in motion. Kant also has some darker motives for undertaking to demonstrate the conservation of matter: Newton, we have seen, thought that the conservation of matter could be secured simply by appeal to the nature of matter. Kant, however, for reasons we shall explore in chapter 6, thought that Newton's account of the nature of matter could not possibly be right and sought to replace Newton's atomistic conception of matter with an alternative force-based conception of matter[9]. This replacement entailed that the conservation of matter could not be guaranteed simply by appeal to the very nature of matter but, nevertheless, given the significance of PCM for physics, it had to be guaranteed if the alternative conception of matter was to be adequate as the subject matter of physics. Thus, establishing PCM for his own conception of matter was a crucial step in showing that his alternative conception of matter was a genuine alternative.

That Kant regards PCM as an extremely important foundation of physics is made particularly explicit in **MFNS** when he writes in the Observation accompanying the law of inertia that "The possibility of a natural science proper

rests entirely upon the law of inertia (along with the law of the permanence of substance)" [Ak 544] and indeed the conservation of matter was necessary in order to secure the closure of Newton's physics. As Brittan has observed "except on the assumption that such conservation principles hold, there is no way to insure appropriate closure of the physical systems we observe, hence no way to measure changes in them" [Brittan p 144].

In defence of PCM Kant gives the following argument:

> (In universal metaphysics there is laid down the proposition that with regard to all changes of nature, no substance either arises or perishes, and here [in mechanics] there is only set forth what is substance in matter.) In every matter the moveable in space is the ultimate subject of all the accidents inhering in matter, and the number of matter's moveable parts external to one another is the quantity of substance. Hence the quantity of matter according to its substance is nothing but the multitude of substances of which it consists. Therefore the quantity of matter cannot be increased or diminished except by the arising or perishing of new substance of matter. Now, with regard to all change of matter, substance never arises or perishes. Hence the quantity of matter also is neither increased nor diminished thereby but remains always the same, as a whole, i.e. so that somewhere in the world matter continues to exist in the same quantity, although this or that matter may by the addition or subtraction of its parts be increased or diminished. [Ak 541-542]

Essentially, the argument here consists of just two premises: (i) matter and all the parts of matter are substances, and (ii) substances are permanent, sempiternal or perdure. As such, however, the argument is incomplete since it fails to specify how matter is to be quantified[10] and hence that it is the quantity of matter which is conserved or constant. In chapter 6 we shall see that, for Kant, the quantity of matter in nature is the number of volumes of forces or force-filled regions of space. So we can reconstruct this argument as (i) the quantity of matter in nature is the number of force-filled regions of space, (ii) force-filled regions of space are substances and (iii) substances are permanent, from which it follows that the number of force-filled regions of space is constant and hence the quantity of matter in nature is conserved (Q.E.D.).

Kant realised that his identification of the quantity of matter in nature with the number of force-filled regions of space was in a certain way problematic, but we shall defer consideration of this difficulty and Kant's proposal for overcoming this problem until chapter 6 of this dissertation and for the present merely allow Kant's claim that the quantity of matter in nature is the number of force-filled regions of space.

In claiming that substances are permanent, Kant is invoking the schema of the category of substance as

identified in **CPR**. The identification of force-filled regions of space as substances is made by appeal to the empirical criterion of substance, mentioned at the very end of the First Analogy of Experience, and identified towards the end of the Second Analogy, as activity[11]. Both the claim that substances are permanent, and the claim that force-filled regions of space are substances, are a priori claims and, as such, are to be understood as rules or instructions concerning how to regard, in the first case, substances and, in the second case, force-filled regions of space or matter. As a rule, governing the activities of physicists, PCM, we have said, tells physicists to view all changes in motion as not affecting the quantity of matter in nature. On the one hand, neither emerging nor disappearing entities are to be postulated in explaining instances of change in motion, and on the other, neither emerging nor disappearing entities are to be postulated as instances of change in motion. The justification for following such a rule, we can now see, is, essentially, that the quantity of matter in nature is the number of substances in nature and substances are to be thought of as permanent.

Whereas the claim that substances are permanent is, in keeping with the distinction drawn in our previous chapter, a "pure" a priori judgement, the claim that matter or volumes of forces are substances is an "impure" a priori judgement, for this judgement is, we might say, contingent on matter being given. That matter "taken as a whole", i.e. the

totality of matter in a physical system, and every part of matter "taken as a whole", is a substance, is proved by Kant in the Observation accompanying Explication 5 of chapter II (The Metaphysical Foundation of Dynamics) of **MFNS**, [Ak 502-3]. That substances are permanent (and hence that no substance either arises or perishes) Kant appropriately describes as "laid down" in **CPR** rather than "proved" or "demonstrated" for no justification is given for any of the schemata identified for the categories of the understanding, although we will attempt to provide just such a justification in the case of the schema for the category of substance in chapter 3 below.

[2-3] CONCLUSION

By way of conclusion of this chapter I will survey its principal points. I have portrayed Kant as having been motivated in at least three ways to establish and demonstrate PCM. Firstly, in the role of sympathetic critic of Newton, Kant is concerned to make good on what he sees as a shortcoming on Newton's part and he thinks he can prove what Newton merely assumed. In the role of expositor of his own views on the epistemic status of science Kant also thinks that he can both vindicate and illustrate, by example, his claim that science has synthetic a priori judgements as principles. Finally, I have suggested that, because of Kant's

disagreement with Newton over the nature of matter, Kant could not treat the issue of the conservation of matter in quite the way that Newton did, i.e. treat it as merely a consequence following from the nature of matter. Hence the conservation of matter became an issue for Kant in a way in which it really was not an issue for Newton. Beyond this, we have seen that the essential premises in Kant's demonstration of PCM, which also serve to make explicit its status as a synthetic a priori judgement, are the identification of matter as substance and an appeal to what in **CPR** is called the schema of substance, permanence. Kant's warrant for thinking that permanence is the schema of substance or that substances are permanent will be discussed in chapter 3 below and his justification for identifying matter as substance will be examined in chapter 6.

ENDNOTES

[1] In the course of describing the development of the modern concept of mass in the 19th century, Max Jammer, *Concepts of Mass*, comments that "The idea that the quantity of matter is preserved in the course of the history of a material system was, of course, an implicit assumption already in the Principia" [p 85].

[2] This understanding of mass was first explicitly formulated by Leonard Euler in Definition 15 of his *Mechanica sive motus scientia analytice exposita* (1736).

[3] The experiments concerning the proportionality of weight to quantity of matter referred to at the end of Newton's explanation here are described in the course of presenting his proof of proposition 6 in Book III of the *Principia*.

[4] Jammer (*Concepts of Mass*) traces the emergence of the concept of inertia as a body's passivity to the amalgamation of Platonic and Judeo-Christian thought: "In their effort to show that all force and life have their source in the intellect and in God, Neoplatonism and Judeo-Christian philosophy degraded matter to impotence and endowed it with "inertia" in the sense of an absolute absence of spontaneous activity of "form" .... But it was this very notion of inertia which with the rise of classical mechanics in the

seventeenth century, and after being gradually purged of its derogatory emotional connotations, became the characteristic criterion for the dynamic behaviour of matter and thus the foundation for the concept of inertial mass" [pp 30-31].

[5] *Opera Omnia* vol 6 pp 345-6 Cited in translation in Jammer *Concepts of Mass* [p 56].

[6] Although Newton appears to have tried to take some care to distinguish his metaphysical speculations, which appear to have been at best speculations, from the claims to which his theory was committed, namely those propositions which were either deductions from phenomena or inductive generalisations over deductions from phenomena, neither Kant nor any other of Newton's early successors seems to have recognised any clear distinction between newton's physics and metaphysics.

[7] Okruhlik "Kant on the Foundations of Science" in Shea (Ed.) *Nature Mathematised,* [pp 251-268], and "Kant on Realism and Methodology" in Butts (Ed.), *Kant's Philosophy of Physical Science,* [pp 307-329].

[8] Translated in *Kant's Philosophical Correspondence* 1759-99 [p 170].

[9] The nature of matter was an issue of enduring interest to Kant, from his earliest writings through the *Opus Postumum.* Kant's early interest in nature of matter is evidenced in his *Thoughts on the True Estimation of Living Forces* (1747), *Physical Monadology* (1756), *Succinct Exposition Of Some Meditations on Fire* (1755) and *A New Exposition of the First*

Principles of Metaphysical Knowledge (1755). In *Thoughts on the True Estimation of Living Forces* (1747) Kant analyzed the arguments concerning whether the force of motion of a body was to be measured by the quantity of momentum (mv) as advocated by the Cartesians or by the Leibnizian measure of "living force" (mv^2) and urged that the theory of living forces should be understood as the metaphysically correct theory although the Cartesian theory provided the mathematically correct theory. By the time Kant came to write the **MFNS**, however, he rejected the theory of living forces. He also rejected his earlier bifurcation of mathematics and metaphysics and sought to narrow the gap between the two, preserving merely their methodological differences. In the *Physical Monadology*, Kant examined the ontological status of forces and urged that they inhere in matter. Kant further argued for a view very similar to the much better known view Boscovich was to argue for in this *Theory of Natural Philosophy* (1756), according to which monads are non-extended points from which forces of attraction and repulsion are exerted. Kant further opposed Cartesian corpuscularianism in favour of the Leibnizian attribution of fundamental forces to matter in his *Succinct Exposition Of Some Meditations on Fire*, and argued for the conservation of attractive force or gravity and that matter is constituted by such a force in *A New Exposition of the First Principles of metaphysical Knowledge*.

[10] To be sure, Kant tells us that matter is to be quantified in terms of the number of "substances of which it consists" but this is of little help since Kant nowhere tells us how substances are to be quantified.

[11] "But I must not leave unconsidered the empirical criterion of a substance, in so far as substance manifests itself not through permanence of appearance, but more adequately and easily through action" [A204/B249].

CHAPTER THREE: THE PERMANENCE OF SUBSTANCE

[3-1] INTRODUCTION

In the previous chapters we have examined Kant's motivation for undertaking to prove PCM. In this chapter we will begin to consider what can be said in support of the second premise in Kant's proof which asserts that substances are permanent. According to Kant, permanence is the "schema" of substance [A143/B183][1], but he does not supply any explanation or argument in support of this or indeed any of the other schemata which he identifies for the categories. However, drawing on materials provided by Kant in a variety of places, we shall suggest an argument which can be constructed on Kant's behalf in support of his claim that permanence is the schema of substance.

[3-2] THE SCHEMATISATION OF THE CATEGORIES

According to Kant, each of the twelve categories of the understanding require schematisation or supplementation by schemata in order for us to be able to employ them and apply them in experience. Since Kant's "schematisation of the categories of the understanding" has received such bad press from contemporary philosophers[2], it is incumbent on any attempt to take the schematisation and the resultant schemata seriously to explain exactly why the categories need to be schematised.

Kant, unfortunately, introduces the problematic of schematisation in an extremely misleading manner. The problem, we are told, is the heterogeneity of concepts and intuitions:

> In all subsumptions of an object under a concept the representation of the object must be homogeneous with the concept; in other words, the concept must contain something which is represented in the object that is to be subsumed under it. [A137/B176]

To illustrate the kind of thing which a concept can contain and which can be represented in an object, Kant cites the rather notorious example of the roundness which is both intuited in the empirical intuition of a plate and represented in the pure concept of a circle [A137/B176]. Given the homogeneity condition on the subsumption model of concept application, Kant goes on to note the following problem concerning category application:

> But pure concepts of the understanding being quite heterogeneous from empirical intuitions, and indeed from all sensible intuitions, can never be met with in any intuition.... How then is the subsumption of intuitions under pure concepts, the application of a category to appearances possible? [A177/B138]

Thus far the problem of category application appears to be merely a part of a more general problem about concept application. However, despite this appearance to contrary,

the real problem which exercises Kant in the schematism chapter is not a general problem of concept application, of which category application is simply a particular and maybe special case[3], but a problem which is unique to the a priori concepts or categories[4]. Kant is indeed right to point out that there is a certain kind of heterogeneity between categories and empirical intuitions, but he misleads his readers when he treats, as Kemp-Smith aptly puts it, the "relation of categories to intuitional material as analogous to the relation holding between a class concept and the particulars which can be subsumed under it" [*Commentary to Kant's Critique of Pure Reason* p 335]. Indeed it cannot be this latter kind of heterogeneity since this heterogeneity would presuppose that the categories and intuitions are not heterogeneous in the way in which, as we shall see below, they really are.

The real problem to which the schematism is addressed is the problem of supplying content for the categories. Towards the end of the introductory passages preceding the schematism chapter Kant notes that:

> Transcendental philosophy has the peculiarity that besides the rule (or rather the universal condition of rules), which is given in the pure concept of the understanding, it can also specify a priori the instance to which the rule is to be applied. The advantage which in this respect it possesses over all other didactical sciences with the exception of mathematics, is due to the fact that it deals with concepts which have to relate to objects a priori, and the objective validity of which cannot thereby be demonstrated a posteriori, since that would mean the complete ignoring of their peculiar dignity. It must formulate by means of universal but sufficient marks the conditions under which objects can be given in harmony with these concepts. Otherwise the concepts would be void of all content, and therefore mere logical forms, not pure concepts of the understanding. [A136/B175]

The metaphysical deduction has revealed that we are in possession of a set of formal concepts (a set which the transcendental deduction has further attempted to show must be employed in order for experience to be possible), a set, that is, of concepts which specify a syntax or set of rules for generating well-formed judgements or knowledge claims. As such, the twelve categories constitute an (as yet) uninterpreted formalism. But Kant wants the categories to be more than merely syntactical rules specifying the conditions a judgement must satisfy in order to be well-formed. Indeed, at the end of the paragraph just quoted, Kant goes so far as to say that the categories must be more than this if they are really to be "pure concepts of the understanding", Kant's

point here is that if the categories are to be pure concepts of objects, i.e. concepts with objective as well as formal reality, they cannot be merely syntactical concepts but must also have some content, meaning or semantic import. Moreover, the schematisation of the categories as Robert Butts has argued in his paper "Kant's Schemata as Semanitical powers"[5] does indeed do precisely the job of specifying a semantics to supplement this syntax, although, as we shall see, it is a semantics of a very special kind. As Kant says:

> the schemata of the pure concepts of the understanding are thus the true and sole conditions under which these concepts obtain relation to objects and so possess significance (bedeutung). [A146/B185]

The interpretation of the function of the schematisation of the categories as the provision of a semantics[6] for a syntax lends important support to interpreting the schematism as dealing with a special problem about the employment of the categories rather than as attempting to solve a general problem about concept employment. For, quite clearly, empirical concepts are not syntactical concepts which could require the addition of a semantics. Similarly, although less obviously so, this is the case with mathematical concepts. Indeed Kant has an argument, an argument actually exploited by some of his critics[7], to show that there could not be a general problem of concept employment which the schematism could solve. According to Kant, concepts simply are (or as he

says "signify" [A141/B180])[8] rules[9] for recognising and classifying individuals, so that if we:

> sought to give general instructions how we are to subsume under these rules, that is, to distinguish whether something does or does not come under them, that could only be by means of another rule. This, in turn, for the very reason that it is a rule again demands guidance from judgement. [A133/B172]

In other words; given that concepts are rules for classifying individuals, the supposition that concepts require (further) rules for their application or employment would generate an infinite regress and the impossibility of our ever employing any concepts.

With regard to the category of substance, Kant tells us that:

> The schema of substance is permanence of the real in time, that is the representation of the real as a substrate of empirical determination of time in general, and so as abiding while all else changes. [A143/B183]

In the next chapter I will argue that Kant's connection of the category of substance with temporal determinations in general and the empirical representation of time in particular is seriously flawed. So I would abbreviate the claim here to read merely that the schema of substance is permanence[10], which effectively tells us simply that whatever

is a substance is permanent. Now it is important to recognise that the schema here spells out what we might call the a priori content of the concept of substance, it spells out what we (can) know a priori about substances[11]. In the transition from the table of judgements to the table of categories Kant is careful to point out that the only content available for the categories is an a priori content:

> General logic, as has been repeatedly said, abstracts from all content of knowledge, and looks to some other source, whatever that may be, for the representations which it is to transform into concepts by process of analysis. Transcendental logic, on the other hand, has lying before it a manifold of a priori sensibility, presented by transcendental aesthetic, as material for the concepts of pure understanding. In the absence of this material those concepts would be without any content, therefore entirely empty. [A76-77/B102]

As a category or a priori concept, the concept of substance has no empirical content, and, if it has no empirical content, then it contains no specification of what kinds of empirical things are to be subsumed under the concept, i.e. what kinds of empirical things are substances. Now although the schema of substance does indeed spell out a content, permanence, for the concept, it spells out what I have called the a priori content and it does not spell out any empirical content. A comparison of the a priori concept of substance with an empirical concept such as the concept "dog" will demonstrate what is lacking. We can unpack the

concept of "dog" and make explicit the content of that concept, as a set of conditionals of the form

(i) If X is a dog, then X is four-legged.

(ii) If X is a dog, then X barks.

(iii) If X is a dog, then X is covered with fur.

Each of these conditionals tells us to search for a certain empirical characteristic or "mark" in any candidate for being a dog; and a candidate which satisfies a sufficient number of these conditionals is appropriately subsumed under the concept "dog" and proclaimed to be a dog. Unpacking the a priori concept of substance, however, reveals no such conditionals. No conditionals, that is, which make reference to any empirical characteristics or "marks". We can certainly unpack the concept as the conditional: If X is a substance then X is permanent. But being permanent is not an empirical characteristic of substances, since, as Kant recognised [A205/B250], the permanence or existence at all times of something cannot be determined by observation or "comparison of perceptions" [A205/B251]. Indeed the permanence of substances is precisely what we know a priori and not empirically about them. In the Refutation of Idealism Kant points out that:

> we have nothing permanent on which, as intuition, we can base the concept of substance, save only matter; and even this permanence is not obtained from

> outer experience, but is presupposed a priori [B278]

In contrast to the schema of substance, however, what Kant calls the "empirical criterion of substance" purports to give us just such a conditional, namely, if X is a substance then X is active. Being active, according to Kant, means exerting force [A204/B250], and forces, he maintains, can only be known empirically [A207/B252]. So that being active certainly is an empirical property, indeed, not only can it be determined empirically whether or not something is active, but, in fact, this can only be determined empirically and never a priori.

[3-3] THE SCHEMA OF SUBSTANCE

Regrettably, Kant gives no explanation or justification for why permanence is the schema of substance or why substances are permanent. Indeed Kant backs away entirely from providing any justification for any of the particular schemata of the categories which he identifies. At one point he writes:

> This schematism of our understanding, in its application to appearances and their mere form, is an art concealed in the depths of the human soul, whose real modes of activity nature is hardly ever likely to discover, and to have open to our gaze. [A141/B180-81]

And a little further on, he tells us:

> That we may not be further delayed by a dry and tedious analysis of the conditions demanded by transcendental schemata of the pure concepts of the understanding in general, we shall now expound them according to the order of the categories and in connection with them. [A142/B181]

In spite of this, however, I think it is possible to construct an argument, drawing together materials provided by Kant in a variety of places, to justify Kant's claim that the schema of substance is permanence. By providing a schema for the concept of substance, i.e. by specifying a content for the category, we are specifying, a priori, what is to count as a really possible substance. A really possible substance, in contrast to a possible substance simpliciter or a logically possible substance, is a substance of which it is possible for us qua epistemic agents (knowers), constituted in the way Kant thinks we are, with a passive sensibility which receives data in the form of particulars and an active understanding which produces or invents concepts for ordering and structuring the received data, to have knowledge.

In the First Analogy of Experience Kant will attempt to argue that all changes of appearances are alterations (Veränderungen)[12] of substances on the grounds that the only changes we can experience or of which we can have empirical

knowledge are changes which are alterations of substances. Now, if Kant could make a credible case for this, and in the next chapter I will examine to what extent he can, then since all changes of appearances are alterations of substances it would follow that because all really possible changes are changes of appearances, all really possible changes will be alterations of substances. Furthermore, if all really possible changes are alterations of substances, then no really possible change is a change of substance. And if no really possible change is a change of substance, then all really possible substances are unchanging and permanent. This last inference can be further glossed as: If no change of which I can have knowledge is a change of substance, then substances of which I can have knowledge (if, indeed, there are any such) are unchanging or permanent (Q.E.D.).

Now, there may well appear to be something otiose, if not downright circular, about appealing to the results of the First Analogy in order to demonstrate that the chosen schema of substance, permanence, is indeed the correct schema since, in very general terms, the argument of the First Analogy is supposed to reveal the necessity of employing the schematised category of substance in experience. In other words, on the reading in question, the First Analogy starts off under the assumption that permanence is indeed the schema of substance so that any appeal to the First Analogy to justify permanence as the schema of substance, must beg the question. However,

although it is certainly correct to identify Kant's intention in the First Analogy as to demonstrate the necessity of employing the schematised category of substance, the reading of the argument of the First Analogy which we will suggest, in contrast to the reading which we will criticise and reject, in the next chapter, does not turn on the permanence of substance at all and leaves the issue of permanence open and available for inference in the way we have suggested above.

[3-4] THE CATEGORY OF SUBSTANCE

To complete my account of the schema of the category of substance, I need to say something about the pure or unschematised category of substance. In particular, it needs to be shown that the pure category really is a purely syntactical rule and that independent of the schema really is contentless. That it is indeed contentless, and that Kant thinks it is contentless, is by no means obvious from the text, since in a number of places Kant actually seems to tell us what the content of this concept is, in which case it would be absurd to deny that the concept has a content. In the B edition of the transcendental deduction, Kant describes the (pure) category of substance as "meaning something which could exist as subject and never as mere predicate" [B149] and in the Schematism chapter he tells us that:

> substance, for instance, when the sensible determination of permanence is omitted, would mean simply a something which can be thought only as subject, never as predicate of something else. [A147/B186]

Hence it would seem that the category of substance is the concept of something which can only be named by a subject term in a subject-predicate (or categorical) proposition and never by a predicate term, which certainly seems to amount to a specification of the content of the pure category of substance.

Against these pronouncements, however, we must weigh the claim made in the chapter on phenomena and noumena where Kant claims that:

> If I leave out permanence (which is existence in all time) nothing remains in the concept of substance save only the logical representation of a subject - the representation which I endeavour to realise by representing to myself something which can exist only as subject and never as predicate. But not only am I ignorant of any conditions under which this logical pre-eminence may belong to anything; I can neither put such a concept to any use, nor draw the least inference from it. For no object is thereby determined for its employment, and consequently we do not know whether it signifies anything whatsoever. [A242-3/B300-301]

This seems to suggest that, although the pure category might well have a logical meaning, in the absence of the schema it

has no real meaning. Presumably this means that, although the pure category might be a concept of a logically possible object, it is not a concept of a really possible object. But to say that the concept is not a concept of a really possible object is just to say that the concept is empty, a point Kant makes most explicitly in the note accompanying his discussion of the impossibility of an ontological proof of the existence of God:

> A concept is always possible if it is not self-contradictory. This is the logical criterion of possibility, and by it the object of the concept is distinguishable from the nihil negativum. But it may nonetheless be an empty concept, unless the objective reality of the synthesis through which the concept is generated has been specifically proved; and such proof, as we have shown above, rests on principles of possible experience, and not on the principle of analysis (the principle of contradiction). This is a warning against arguing directly from the logical possibility of concepts to the real possibility of things. [A596/B624]

So even if Kant does specify a content for the pure category of substance it might still be the case that the concept is empty in so far as it has no really possible, as opposed to merely logically possible, content.

But the strongest evidence for the interpretation I want to advance is actually to be found by a consideration of the metaphysical deduction itself. Kant introduces his transcendental deduction of the categories of the

understanding with the distinction between questions of fact and question of right:

> Jurists, when speaking of rights and claims, distinguish in a legal action the question of right (quid juris) from the question of fact (quid facti); and they demand that both be proved. Proof of the former, which has to state the right or the legal claim they entitle deduction. [A84/B116]

This distinction is of significance with regard to concepts in so far as:

> ...among the manifold concepts which form the highly complicated web of human knowledge there are some which are marked out for pure a priori employment, in complete independence of all experience; and their right to be so employed always demands a deduction. [A184/B117]

The quid juris, the question of our right to employ the categories is established by Kant on two levels. In the first place, in the transcendental deduction of the categories, Kant establishes our right to employ the set of concepts listed as the table of categories. The argument here, in outline, is that we are entitled to employ this set of a priori concepts when judging because without employing them there would be nothing about which to make judgments. Subsequently, in chapter II of the Analytic of Principles, where he gives detailed arguments in support of each of the

twelve categories[13], Kant endeavors to establish our right to employ each of the categories considered individually[14].

The quid facti is the question of whether we are indeed in possession of a set of a priori concepts, more specifically, whether we are indeed in possession of the set of concepts identified as the twelve categories of the understanding. This question is dealt with by Kant in the so-called metaphysical deduction of the categories, i.e. chapter I of the Analytic of Concepts. The programme of the metaphysical deduction is thus to establish a set of a priori concepts of which we are in possession. Kant's clue for the discovery of this set of concepts is his table of judgements:

> If we abstract from all content of a judgment, and consider only the mere form of understanding, we find that the function of thought in judgment can be brought under four heads, each of which contains three moments. [A70/B95]

In other words, the totality of human judgments (all the judgements we can make) are of four kinds, viz., quantitative, qualitative, relational and modal; and each of these is in turn of three kinds. Quantitative judgments are either universal, particular or singular; qualitative judgments are either affirmative, negative or infinite; relational judgments are either categorical, hypothetical or disjunctive and modal judgments are either problematic, assertoric or apodeictic.

These forms of judgement, Kant thinks, presuppose a set of concepts and this set of concepts is a set of a priori concepts. If indeed, as Kant thinks, all knowledge is judgmental (i.e., obtained and expressed by making judgements) and if indeed there is a set of concepts presupposed by the set of judgement forms, then these concepts will indeed be a priori in so far as they will be logically prior to all empirical knowledge and experience.

The crux of the metaphysical deduction is, of course, Kant's claim that one and the same set of concepts is employed in the unification of representations in a judgement and in the synthesis or unification of the manifold of intuition into an intuition. Now if we consider this claim carefully we can see that such concepts can only be merely syntactical or formal concepts. The table of the forms of judgement, which is Kant's starting point, is a table of the different kinds of judgements we can make or the different ways in which we can make assertions. As a purportedly exhaustive specification of the ways of making assertions, the table of the forms of judgements effectively provides a recursive definition of well-formed assertions. Thus, in order for an assertion P to be a well-formed assertion, P must be either a universal, singular or particular judgement and it must be either affirmative, negative or infinite, and either categorical, hypothetical or disjunctive and either

problematic, assertoric or apodeictic. Now, each of the different ways of making an assertion, Kant thinks, is a different way of unifying or imposing unity on a plurality of representations. As he says, "all judgements are functions of unity among our representations:" [A69/B93]. This unification of representations is achieved, Kant thinks, by the application or employment of a concept and the different kinds of unification reflect the employment of different concepts. But what kind of concepts can these be? Kant tells us that:

> whereas all intuitions as sensible rest on affections, concepts rest on functions. By 'function' I mean the unity of the act of bringing various representations under one common representation. [A68/B93]

He goes on to say:

> The functions of understanding [i.e. the a priori concepts of the understanding] can be discovered in their completeness, if it is possible to state exhaustively the functions of unity [i.e. the forms of relation] in judgements. [A69/B94 parentheses added]

Returning now to the crux of the metaphysical deduction of the categories, Kant's claim is that:

> The same function which gives unity to the various representations in a judgement also gives unity to the mere synthesis of various representations in

> an intuition; and this unity, in its most general expression, we entitle the pure concept of the understanding. The same understanding, through the same operations by which in concepts, by means of analytical unity , it produced the logical form of a judgement, also introduces a transcendental content into its representations, by means of the synthetic unity of the manifold in intuition in general. On this account we are entitled to call these representations pure concepts of the understanding, which apply a priori to objects - a conclusion which general logic cannot establish. [A79/B104-5]

As Allison has stressed[15]:

> (the) central claim of this paragraph is the identity of the understanding and its activity (function) as considered in general and transcendental logic. In short these two disciplines are concerned with one understanding, possessing a single characteristic activity, which they analyse at different levels. This activity consists in the unification or synthesis of representations and this unification occurs in certain determinate ways which can be called 'forms' or 'functions' of unity. In fact it is precisely because general and transcendental logic deal with the same activity at different levels that Kant thinks it possible to move from the determination of forms of functions of the former to those of the latter. [p 123]

Although Allison maintains that the categories "cannot be merely syntactical rules" [p 118], I think his interpretation of what the deduction of the categories consists in admirably indicates why the categories must indeed be syntactical and not semantical rules. According to Allison:

> the pure concepts of the understanding....are nothing other than the logical functions of judgement, viewed in connection with the manifold of intuition....Since they are the same forms of unification, considered from different points of view or at different levels, [and thus] there is no difficulty at all in moving from one to the other. [p 126]

It is not implausible to think that syntactical rules governing the synthesis of intuitions might be derived from syntactical rules governing the unification of representations. Since, however, generally speaking, syntactical systems, or sets of syntactical rules, are not considered to entail semantical systems, or sets of semantical rules[16], it would be implausible to think that semantical rules might be derived from syntactical ones. That the concepts employed in the syntheses of manifolds of intuition into intuitions are indeed identical to the concepts employed in the unifications of representations in judgements is made most explicit by Kant in **CPR** in the second edition version of the transcendental deduction where he writes:

> Now the categories are just these functions of judgement, in so far as they are employed in the determination of the manifold of a given intuition. [B143]

In the General Note on the System of the Principles, added in the B edition, Kant also stated that "the categories are not

in themselves knowledge, but are merely forms of thought for the making of knowledge from given intuitions" [B288]. Similarly, in a footnote to the Preface of **MFNS** Kant emphasised that the categories "are nothing but mere forms of judgement in so far as these forms are applied to intuitions" [Ak 474n].

[3-5] THE EMPIRICAL CRITERION OF SUBSTANCE

In chapter 2 we portrayed Kant's proof of PCM as relying heavily on his identification of matter as a substance and his proof of this latter claim we will see, in chapter 6, turns on an appeal to the empirical criterion of substance. The empirical criterion of substance is introduced in **CPR** at the very end of the discussion of the First Analogy of Experience, almost, it appears, as an afterthought, with the note that:

> We shall have occasion in what follows to make such observations as may seem necessary in regard to the empirical criterion of this necessary permanence - the criterion, consequently, of the substantiality of appearances. [A189/B232]

True to his word, towards the end of the discussion of the second Analogy we find him remembering that:

> I must not leave unconsidered the empirical criterion of a substance, in so far as substance appears to manifest

> itself not through permanence of appearance, but more adequately and easily through action. [A204/B249]

Subsequently we are told that:

> action is a sufficient empirical criterion to establish the substantiality of a subject, without my requiring first go in quest of its permanence through the comparison of perceptions. [A205/B250-1]

This rather coy introduction of the empirical criterion of substance as a means by which substance "more easily" manifests itself and is recognisable unfortunately masks, rather than illuminates, the true significance of this criterion. Thus far we have assumed, plausibly enough, that providing a semantics for a concept at the same time provides a rule for recognising and classifying individuals as being of a certain kind. But this raises a difficulty, which is particularly noticeable and acute in the case of the schema for the category of substance, when we notice that in fact the schema of substance does not and can not provide a rule enabling recognition and classification. The reason for this is that permanence is not an empirical property of objects in the sense that its possession by an object can be discerned by observation or any empirical means. Fortunately the empirical criterion of substance, as we have already suggested above, is eminently suited to play exactly this role.

Having explained the role which the empirical criterion of substance is to play in Kant's epistemological scheme we must now consider why he thinks that it is action which is the empirical criterion of substance. It is indeed, as Paton suggests[17], in large part because Kant's argument in defence of the claim that action is the empirical criterion of substance presupposes the idea of a 'cause' that he deferred consideration of this criterion to the end of the second Analogy. The use which Kant makes of the empirical criterion of substance in **CPR** is to argue that the causes of events are substances rather than, as might more ordinarily be thought to be the case, the states of substances. For Kant, identifying causes of events or, as we will see below, alterations, is a matter of identifying substances and not a matter of identifying states of substances. Thus, for example, when a tomato falls off its stem and bruises, Kant would want to say that the cause of the bruise, the alteration of the tomato, is not any state of the ground below on which it lands, such as the solidity or even repulsive force of the ground but rather, we might say, the ground itself. As Kant says, "Causality leads to the concept of action" [A204/B249] and "action is a sufficient empirical criterion to establish the substantiality of a subject" [A205/B250].

What is at issue in Kant's argument in support of action being the empirical criterion of substance is the

identification of causes of changes, or, more accurately, alterations; the claim Kant wants to make here is that a necessary condition of any x being identified as the cause of an alteration of y is that x be a substance and, hence, given the schema of substance, permanent. Now to say that in order for x to be the cause of an alteration in y, x must be a substance and permanent is not to say that x must itself be unalterable. Kant's distinction between change (Wechsel) and alteration (Veränderung) and, correlatively, between being unchangeable and unalterable is important here. Towards the end of the First Analogy Kant writes:

> Coming to be and ceasing to be are not alterations of that which comes to be or ceases to be. Alteration is a way of existing which follows upon another way of existing of the same object. All that alters persists and only its state changes. [A187/B230]

A little less cryptically in the "Postulates", he writes:

> alteration is combination of contradictorily opposed determinations in the existence of one and the same thing. [B291]

Summarising, we might say that an appearance X changes just in case there is a time t_1 at which X exists and a time t_2 at which X does not exist, or vice versa. In contrast to this an appearance X alters just in case there are times t_1 and t_2 such tha X exists continuously from t_1 to t_2 and X has

property Y at t_1 but not at t_2, or vice versa. Kant reserves change for what might more accurately be termed "ontic-change", a creation or coming into existence and a destruction or passing out of existence and alteration for what we might more commonly recognise as a property change or transformation. We can illustrate the distinction between change and alteration that Kant wants to draw to our attention by considering a ripening tomato. As the tomato passes from being green and firm to being red and soft the tomato alters but does change whereas the properties of the tomato, the redness and greenness and the firmness and softness, all change but do not alter.

In the light of this distinction we can reformulate Kant's claim more accurately as the claim that in order for X to be the cause of an alteration of Y, X must be a substance and hence permanent and unchanging. Now Kant's justification for activity being the empirical criterion of a substance is in fact extremely misleading. He seems to try to present an indirect proof of his claim by constructing a reductio ad absurdum in which the assumption that the cause of an alteration of y is not a substance and hence permanent is shown to result in an infinite regress. Kant tells us that:

> according to the principle of causality actions are always the first ground of all changes of appearances, and cannot therefore be found in a subject which itself changes, because in that case other actions and another subject would

> be required to determine this change. [A205/B250]

Since it is not obvious, and Kant does not tell us why, "other actions and another subject would be required" on the assumption that a cause of an alteration is not a substance, most commentators seem to despair of making any sense of Kant's argument here[18].

But really such an indirect proof is not necessary and Kant can go directly from his distinction between substances and properties or the states of substances, "the ways[s] in which the existence of a substance is positively determined" [A187/B230], in terms of the transient and permanent features of appearances, to showing that identifying causes is indeed a matter of identifying substances. Given this distinction, if X is the cause of an alteration of Y then either X is a substance or it is not. If X is not a substance then X is a state of a substance. But to say that X is a state of a substance is not so much to say that X is a different kind of thing but rather to say that it is a way in which a substance, S, exists, i.e. X is an instance of S being X. Now in this case, in which X is not a substance but a state of a substance, in identifying X as the cause of an alteration of Y we are really identifying S's being X as the cause of the alteration and this is precisely to identify S, a substance (albeit a substance in a particular state), as the cause of the alteration of Y.

What seems to have confused Kant at this point of his discussion, and why he tries to present an indirect argument rather than the direct argument that I have suggested, is his posing the question "How are we to conclude directly from the action to the oermanence of that which acts?" when really he should be addressing the question of how one can move from action to substance or the substantiality of that which acts. The move from there to permanence can then be made by appeal to the schema of substance. That substances are permanent and hence that that which acts is permanent is a synthetic a priori claim and not to be concluded directly from either action or the substantiality of that which acts[19].

What is crucial to the argument I have presented is the recognition that in drawing the distinction between substances and properties, Kant is not a dualist conceiving of the world as composed of two kinds of things. Rather than conceiving of the contents of the world as bifurcated into substances and properties, Kant conceived of the world as composed merely of substances existing in various ways. The distinction between substance and property marks, for Kant, a distinction between two aspects of appearances, the permanent and the "transitory" aspects. The claim that the causes of events are substances rather than states of substances amounts, then, to the claim that it is properly the permanent

rather than the "transitory" aspects of appearances which are to be identified as causes of events.

Having identified action as the empirical criterion of substance, one might well expect that in **MFNS** when Kant argues that matter is substance, he does so by appeal to the causal properties of matter and on the grounds that matter is causally efficacious or active, and therefore substance. But in fact this is not quite the route Kant takes. Instead, Kant, we will see, appeals to the movability of matter and argues for the substantiality of matter in virtue of its movability. If Kant is not to be guilty of equivocating over the empirical criterion of substance then it must be shown that this shift is legitimate.

In **MFNS** Kant claims that the only activity in space is motion [Ak 524] so that whatever is in space and is a cause is a cause of motion. Furthermore, he argues, whatever is a cause of motion must itself be in motion. Clearly whatever is in motion is movable, so that it follows that whatever is a cause of motion must be movable. In other words, being in motion is a necessary condition for being a cause and movability is, trivially, a necessary condition of being in motion. In arguing from the movability of matter to its substantiality, Kant is arguing from the satisfaction of the necessary condition of matter being a cause to its substantiality.

[3-6] CONCLUDING SUMMARY

In addition to presenting arguments in support of Kant's claims that permanence is the schema of substance and activity is its empirical criterion, this chapter has attempted to provide a reconstruction of some of the central doctrines of the epistemology of the "Transcendental Analytic" in **CPR**. Primarily the concern has been to fit together the various components in Kant's theory of judging into a coherent whole. The picture that has emerged is, in outline, one in which the categories of the Understanding are syntactical concepts which require supplementation by schemata or semantical concepts in order for them to be concepts of objects. The schematised category of substance requires, in turn, supplementation by an empirical criterion in order for us to be able to employ it in the recognition and classification of individuals as substances.

ENDNOTES

[1] In the course of cataloguing the respective schemata for the twelve categories, Kant tells us that "the schema of substance is permanence of the real in time" [A143/B183].

[2] Disparagers of Kant's project of schematising the categories include Warnock, "Concepts and Schematism" *Analysis* 9 (1948-9); Bennett, *Kant's Analytic* chapter 10; Wolff *Kant's Theory of Mental Activity* [pp 94-98].

[3] As Gordon Nagel, in his *The Structure of Experience: Kant's system of Principles*, has put it: "(Kant) is not setting out a model of concept application in general, to which, with a bit of fiddling, he hopes to make category-application conform" [p 69].

[4] Paul Guyer, *Kant and the Claims of Knowledge* [p 159].

[5] In *Kant Studies Today* edited by L. W. Beck.

[6] Further indications, with specific reference to the category of substance, that Kant's concern in the schematism chapter is with the content and meaning of concepts is evident in the passage where he claims that the unschematised category of substance is:

> A representation I can put to no use, for it tells me nothing as to the nature of that which is thus to be viewed as primary subject. [A147/B186]

[7] Bennett in *Kant Studies Today* edited by L. W. Beck.

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[8] In the first edition version of the Transcendental Deduction Kant also tells us that a concept is "something universal which serves as a rule" [A106].

[9] As Gordon Nagel has stressed, "Kant does deserve credit for the doctrine of concepts as rules..." [p 69].

[10] Kant's expression for "permanent" is *das Beharrliche* and he uses "permanent" as a noun rather than as an adjective. Since this does not translate at all well into English I think it is best to follow the usual practice of treating "permanent" as an adjective. This is apt, however, to be misleading in so far as it appears to render permanence a property of substances. But, since Kant maintains that properties are transient states of substances, and permanence is not a transient state of substances, permanence cannot strictly speaking be said to be a property.

[11] One reason why it is important to bear in mind that the permanence of a substance is something about substances that can be known *a priori* is that if permanence were an empirical property of substance then the proof of PCM would not be an a Priori proof and PCM would not be shown to be an *a priori* principle.

[12] I discuss Kant's distinction between *Veränderungen* and *Wechseln* in section [3-5] below. Very roughly, *Veränderungen* are property changes whereas *Wechseln* are existence changes.

[13] Kant actually achieves something less than this, giving arguments for the individual categories only in connection

with the relational categories (the Analogies of Experience) and modal categories (the Postulates of Empirical Thought), but not in connection with the categories of quantity or quality.

14 As Kempt Smith has argued, "The proofs of the indispensableness of specific categories are first given in the *Analytic of Principles*." [p 343]. Similarly, Wolff maintains that "the Analytic of Principles is the deduction of the particular categories." [p 224].

15 *Kant's Transcendental Idealism* [p 123].

16 Because a variety of semantical systems would be compatible with one and the same syntactical system.

17 *Kant's Metaphysic Of Experience* [p 214].

18 This comment is really most applicable to Paton, since almost all other commentators merely note Kant's claim that activity is the empirical criterion of substance, and pass over this point without further ado. The only exception to this that I am aware of is Gordon Nagel's discussion of substance and activity in chapter 6 of his *The Structure of Experience: Kant's System of Principles*.

19 Nagel, in his discussion of activity, has suggested a similar to answer to Kant's question: "'How are we to conclude directly from the action to the *permanence* of that which acts?' Easy. *Before* action and change were introduced, permanence was brought in" [p 170].

CHAPTER FOUR: THE FIRST ANALOGY OF EXPERIENCE

[4-1] The Principle of the First Analogy

The First Analogy of Experience is Kant's attempt to provide a transcendental deduction of the category of substance, i.e. to demonstrate that employment of the category of substance is indeed necessary for the possibility of experience or empirical knowledge. The demonstration proceeds by way of a transcendental deduction of a principle employing the concept of substance. The initial problem faced by anyone who would understand the argument of the First Analogy concerns exactly what principle Kant intends to prove. In A the principle given is:

> All appearances contain the permanent (substance) as the object itself and the transitory as its mere determination that is, as a way in which the object exists.

In B, it is revised to read:

> In all change of appearances substance is permanent; its quantum in nature is neither increased nor diminished

Numerous commentators[1] have observed that these principles do not seem to be equivalent, as indeed they are not. The most obvious difference is, of course, the inclusion in the B principle of the clause asserting the conservation of substance. But the additional clause is by no means the only difference between the A and B principles. The A principle

would seem to be a principle about the nature of appearances, a principle to the effect that all appearances are permanent substances with changing properties, whereas the B principle would seem to be a principle about the nature of change, a principle to the effect that all changes of appearances are alterations of substances. Prima facie both principles appear to be principles about the nature of substance, principles asserting the permanence of substance. There are, however, at least two reasons for not reading the principle of the First Analogy as a principle asserting the permanence of substance: firstly, such a reading renders the principle redundant, since it merely reiterates the schema of substance, and, secondly, such a reading actually disrupts Kant's programme in the Analytic of Principles[2], since the demonstration that substance is permanent does not demonstrate that employment of the category of substance is necessary for the possibility of experience, and does not constitute a transcendental deduction of the category of substance. Kant certainly suggests that the principle of the First Analogy is to be understood as a principle about the permanence of substance. In the second edition, he actually titles the principle the "Principle of Permanence of Substance", but if he really means this, then the First Analogy of Experience occupies a quite anomalous position in the Analytic of Principles. A demonstration of the permanence of substance is effectively a demonstration that the schema of substance, identified in the "Schematism" chapter, namely permanence, is indeed the

correct schema. Now, this would certainly be a helpful thing for Kant to provide. But, the programme of the Analytic of Principles is to demonstrate the necessity of employing each of the Categories identified in the Metaphysical Deduction for the possibility of experience or empirical knowledge, and this is simply not to be achieved by demonstrating that permanence is the schema of substance. That substance is permanent, Kant thinks, is a truth of transcendental logic secured by the schematisation of the categories of the Understanding. This is the import of Kant's rather notorious claim in the First Analogy that "Certainly the proposition, that substance is permanent, is tautological" [A184/B227]. By a tautology, Kant here means a truth not of general logic but of transcendental logic; as such it is a synthetic a priori[3] truth and not an analytic truth as it would be if it were a truth of general logic. So we must reject Bennett's objection[4] to the First Analogy of Experience, that Kant sets out in this section of the Analytic of Principles to prove a principle, the principle of the permanence of substance, which is not even a synthetic a priori proposition but is, by his own admission a tautology and analytic.

Pace Kant, we must read the real significance and indeed, intent of the First Analogy as being other than an attempt to prove the permanence of substance. And certainly there is evidence to suggest that Kant too regarded the import of the First Analogy as lying elsewhere; namely as a

demonstration not of a principle about the permanence of substance, but rather of a principle about the nature of change. A principle, that is, which asserts that all changes of appearances are alterations of substances, and which entails that in all changes of appearances substances are unchanging or permanent. In the second edition of the Second Analogy of Experience Kant claimed that, "otherwise expressed", the principle of the First Analogy is the principle that "all change (succession) of appearances is merely alteration" [B233]. In other words, the principle of the First Analogy is, as we have said, not so much a principle about the nature of substance, to the effect that it is permanent, as a principle about the nature of change, to the effect that all change is what Kant calls "alteration". As Kant summarised the conclusion of the First Analogy at the beginning of the (B edition version of the) Second Analogy:

> The preceding principle has shown that all appearances of succession in time are one and all only alterations, that is a successive being and not-being of the determinations of substance which abides; and therefore that the being of substance as following on its not-being, or its not-being as following on its being cannot be admitted. [B232-3]

Here it is important to remember Kant's distinction between change (Wechsel) and alteration (Veränderung) and his technical use of change as existential change, coming into or

going out of existence, and alteration as property or state change. Employing these technical concepts of change (Wechsel) and alteration (Veränderung), now, this principle tells us that all changes of appearances (and here it is changes in the loose everyday sense of the word rather than Kant's technical sense which are at issue) are really alterations, in Kant's technical sense, or Veränderungen and not changes, again in the technical sense, or Wechseln, at all.

Now the import of this characterization of the nature of change as far as appearances are concerned is that alterations require the existence or, we might say, persistence of something throughout the change. Thus if indeed, as Kant claims, all changes of appearances are really alterations, then it follows that in all changes of appearances something persists through those changes. This is not to say that throughout all changes of appearances there is some one thing which persists, or, that one and the same thing persists throughout every change, but merely that in every case of change in appearances there is something which, in that case, persists throughout the change.

Following Kant's lead here the B principle ought to be understood as asserting that:

> all changes of appearances are alterations of substance which does not

> change and since substance does not change its quantum in nature is constant.

The A principle, we said above, would seem to be a principle about the nature of appearances rather than about the nature of change. One might well, however, interpret it as a principle about the nature of change and as asserting that

> All that changes (i.e. what is transitory) are determinations or ways of existing of substance or what is permanent.

And interpreted in this way, which seems to be a perfectly legitimate and by no means implausible reading, the A principle does not differ significantly from the B principle -with the exception, that is, of the inclusion in the B principle and the omission in the A principle of the clause asserting the conservation of substance. Essentially, both principles tells us that:

> All changes of appearances are alterations of substance.

or, less ambiguously:

> Every change is an alteration of a substance.

Most commentators have been quick to point out that the second clause of the B principle, the clause asserting the conservation of substance, is not actually proved in **CPR**[5] although, they claim, Kant does make some moves towards

proving the conservation of substance in **MFNS** and explicitly claims that this has already been "laid down" in the "Universal metaphysics" of **CPR** [Ak 541]. What Kant attempts to prove in **MFNS** is the conservation of matter and, as we have seen in chapter 1, this proof presupposes the conservation or permanence of substance. The conservation of substance, Kant thinks and argues in **CPR**, follows immediately, and indeed trivially, from the fact that substances are permanent. At the end of the proof given in the B edition he writes:

> the substrate of all change remains ever the same. And as it is thus unchangeable in its existence, its quantity in nature can be neither increased nor diminished. [B225]

In other words, the conservation of substance, the constancy of the quantity of substance is, according to Kant, merely a consequence of the schematisation of the category of substance. Allison [p 210] has surely rightly noted that although the point is not explicit in the First edition of **CPR**, it is nevertheless implicit in Kant's account there, given his discussion of the weight of smoke.

[4-2] IN SEARCH OF AN ARGUMENT

Having isolated the task of the First Analogy as that of demonstrating that every change is an alteration of a

substance, we must now examine what Kant has to say by way of proof of this claim. In the Kemp Smith edition of **CPR**, the text of the First Analogy is divided into nine paragraphs. The first paragraph contains the proof Kant added in the B edition of **CPR** (the B proof), the second paragraph is the proof of the First Analogy as given in the A edition (the A proof). Paragraph 3 urges that the principle of the Analogy is not a new and unfamiliar idea but rather a principle which has always been assumed to be true although never proved as such. Further, Kant specifies towards the end of this paragraph how the proof of this principle ought to proceed, i.e. transcendentally and not dogmatically. In paragraph 4 Kant discusses the scholastic principles of *gigni de nihilo nihil* and in *nihilum nil posse reverti* and describes the experiment in which the weight of smoke is calculated by subtracting the weight of ashes from the weight of a piece of wood prior to its being burnt. Paragraph 5 examines the distinction between substances and accidents and paragraph 6 the distinction between alterations and changes. Paragraphs 7 and 8 contain indirect arguments for the permanence of substance and in paragraph 9 Kant articulates his conclusion that:

> Permanence is thus a necessary condition under which alone appearances are determinable as things or objects in a possible experience. [A189/B232]

This in itself is indicative of the degree to which Kant was confused about the First Analogy of Experience. Since the aim of the argument is to demonstrate the necessity of employing the concept of substance, the conclusion here should be that substance, i.e. the category, and not permanence, the schema of the category, is a necessary condition under which alone experience is possible.

Whereas the B edition proof is a reasonably short, single continuous argument, the A edition proof, by contrast, consists of a number of apparently distinct arguments, each of which individually, rather than as a group, seems to be intended to prove the principle of the Analogy. In the A edition proof, at least the following six distinct ideas for proving the principle of the First Analogy are discernible:

1. Substance is necessary for experience of co-existent or simultaneous appearances (as Kant says, "Our apprehension of the manifold of appearance is always successive, and is therefore always changing. Through it alone we can never determine whether this manifold, as object of experience, is co-existent or in sequence. For such determination we require an underlying ground which exists at all times, that is, something abiding and permanent...." [A182/B226]).

2. Substance is required for the empirical representation of time (Kant tells us that "the permanent is the substratum of the empirical representation of time itself" [A183/B226]).

3. Substance is necessary for the possibility of dating appearances ("in it [i.e. the permanent substratum] alone is any determination of time possible" [A183/B226]).

4. Substance is necessary for the possibility of temporal magnitudes and duration ("Only through the permanent does existence in different parts of the time series acquire a magnitude which can be entitled duration" [A183/B226]).

5. Substance is necessary for temporal relations ("Without the permanent there is therefore no time-relation" [A183/B226]).

6. Substance is necessary for the possibility of unified experience ("the permanent in the appearances is therefore the substratum of all determination of time, and, as likewise follows, is also the condition of the possibility of all synthetic unity of perceptions, that is, of experience" [A183/B226]).

Despite this difference in presentation, there is nevertheless a line of reasoning which can be extracted and which appears to be common to both the arguments of the first and second editions. In essence, this argument is that we cannot establish objective temporal relations between appearances merely by reference to time itself; in order to establish such temporal relations, we must employ the concept of substance.

According to the A edition proof:

1. All appearances are in time.

2. Apprehension of the manifold of experience is not sufficient to determine the objective temporal relations between the parts of the manifold.

3. In order to determine the objective temporal relations of the parts of the manifold of appearances we require a permanent substratum.

4. This permanent substratum is the empirical representation of time itself.

5. Time itself does not change but is permanent.

6. Without the permanent there are no temporal relations.

7. Time itself cannot be perceived.

8. Therefore the permanent in appearances, i.e. substance, is that without which there are no temporal relations.

9. All co-existence and succession are thus simply modes of the existence of that which is permanent.

10. Therefore, in all appearances, the permanent is the object itself and everything that changes or can change belongs only to the way in which substance or substances exist, and therefore to their determinations.

and according to the B edition proof:

1. Since all appearances are in time, time is the substratum of all appearances.

2. Since co-existence and succession of appearances are only possible in and as determinations of time, time itself must be permanent.

3. Time cannot be perceived.

4. A perceptible representative of time is required.

5. The substratum of all that is real, i.e. perceivable, is substance.

6. Therefore substance is the perceptible representative of time.

7. Furthermore, since substance is permanent its quantity in nature can be neither increased nor diminished.

The line of reasoning which appears to be common to both these arguments consists of three sub-arguments[6]. The first of these established, or purported to establish, that in order to determine temporal relations between appearances a perceptible representative of time is required. The second sub-argument establishes that substance is the perceptible representative of time and the third establishes that the quantity of substance is constant.

What drives the move from the need for a perceptible representative of time to substance in the second sub-argument, (lines 4-6 in the B edition argument and lines 7-8 in the A edition version) appears to be Kant's conviction that whatever represents time must, because time is permanent, itself be permanent. The idea that the perceptual representative of time must itself be permanent is, however, extremely doubtful. In the footnote to the B edition Preface to **CPR** in which Kant comments on the Refutation of Idealism we are told that:

> The representation of something permanent in existence is not the same as permanent representation. For though the representation of [something permanent] may be very transitory and variable like all our other representations, not excepting those of matter, it yet refers to something permanent. [Bxli]

This implies that the perceptible representative of something permanent (time) need not itself be permanent.

Paton and Kemp Smith have provided almost exactly the same reconstructions of this argument, differing merely on the point of whether substance is the perceptible representative of time because it is the permanent substratum of all appearances (Paton) or substance is the perceptible representative of time because it is in relation to substance that objective temporal relations can be determined (Kemp Smith). In other words, they differ only over why it is that substance is suitable for doing the job which Kant seems to have lined up for it. According to Kemp Smith [pp 359-360], Kant's argument is as follows:

> (1) All our perceptions are in time, and in time are represented as either co-existent or successive.
>
> (2) Time itself cannot change, for only as in it can change be represented.
>
> (3) Time, however, cannot by itself be apprehended, (and) as such it is the mere empty form of our perceptions.
>
> (4) There must be found in the objects of perception some abiding substrate or substance which will represent the permanence of time in consciousness and through relation to which co-existence and succession of events may be perceived.
>
> (5) And, since only in relation to this substrate can time relations be apprehended, it must be altogether unchangeable, and may therefore be called substance.
>
> (6) And being unchangeable it can neither increase nor diminish in quantity.

According to Paton [p 186], the argument is this:

(1) All appearances are in time, and it is only in time as a substratum (or as a permanent form of intuition) that objective succession and simultaneity of appearances can be known.

(2) Therefore time (in which we have to think all objective succession and simultaneity of appearances) abides and does not change because we can know objective succession and simultaneity only as determinations of time.

(3) Time itself cannot be perceived.

(4) Therefore there must be found in the objects of sense-perception (that is, in appearances as appearances of an object) the permanent as a substratum which represents time. All change and simultaneity must be capable of being perceived or apprehended only through the relation of appearances to this permanent.

(5) The permanent substratum of appearances (or of the real) is substance, and appearances (as appearances of objects) can be thought only as determinations of substance. In other words, the permanent by reference to which alone can the objective time relations of appearances be determined is substantia phaenomena (substance in the appearances). It remains always the same and is the substratum of all change.

(6) Since phenomenal substance cannot change in its existence, its quantum in nature can be neither increased nor diminished.

The only real difference between these reconstructions occurs at line (5) which, as we have said, concerns why substance is suitable to be the perceptible representative for time.

Kemp Smith has provided the following helpful gloss on his reconstruction:

> This proof may be stated in briefer fashion. The consciousness of events in time involves the dating of them in time. But that is only possible in so far as we have a representation of the time in which they are to be dated. Time, however, not being by itself experienced, must be represented in experience by an abiding substrate in which all change takes place, and since as the substrate of all change, it will necessarily be unchangeable, it may be called substance. [p 360]

This gloss is particularly important in so far as it fills in a lacuna, in the move from (2) to (3), in Kant's argument as we have reconstructed it above (in the move from (3) to (4) in Kemp Smith's and Paton's reconstructions). The lacuna concerns why, given that time itself cannot be perceived, we need a perceptible representative of time. The explanation is that observation of changes presupposes the dating of appearances and since time cannot be perceived we cannot date appearances by, so to speak, comparing them with time itself. It is the possibility of dating appearances and the observations of changes which this makes possible that, Kemp Smith explains, necessitates a perceptible representative of time. Thus the role substance has to play in the epistemological scheme of things is that of enabling us to date appearances or to fix their relative temporal positions. What makes substance peculiarly suited to this role is its schema of permanence. The salient feature of time which makes the temporal relations of succession and co-existence possible and which must be captured by a perceptual

representative of it, if that perceptual representative is to serve as a means for determining temporal relations and thereby fixing temporal locations or dates, is its numerical unity and the fact that it retains its identity through change. Substance, Kant contends, possesses just this feature and in virtue of this is the perceptual representative of time.

The most detailed study of the role substance plays in determining temporal relations has been given by Arthur Melnick in his *Kant's Analogies of Experience*. As Melnick reads the First Analogy:

> The First Analogy is concerned with the general possibility of determining time magnitude; i.e. determining the lapse of time between events, and determining how long an object remains in a certain state. [p 58]

Fundamental to the possibility of determining temporal magnitudes is the concept of what Melnick calls a "substratum of the determination of the magnitude of a time interval". Of this substratum, Melnick writes:

> According to Kant, there are certain aspects required of anything that is to serve as a substratum of the determination of the magnitude of some time interval. [p 62]

Further, Melnick notes:

> A substance is not defined as that which can serve as a substratum for the determination of time magnitude. [p 62]

There is thus a distinction to be preserved between a substance and a substratum for the determination of a temporal magnitude. The thrust of the First Analogy is that whatever is employed as a substratum of determining a temporal magnitude must be a substance, although the converse does not hold and not every substance must be employed as such a substratum.

Permanence, Melnick stresses, is not a definition of substance but rather a property which Kant (in Melnick's opinion, mistakenly) thinks substances must have in order for them to function as substrata. In addition to the permanence of substance, Melnick argues that the empirical criterion of substance, action, plays a critical role in the proof of the First Analogy, i.e. the proof that all substrata for determining temporal magnitudes are substances. For:

> It seems plausible to say that we determine the magnitude of time intervals in terms of certain actions (like the mechanism of an ordinary face-clock). Something permanent in appearance that does not change at all, can no more serve to determine time magnitude than empty time itself. [p 64]

Thus, Melnick suggests, the permanence of substance and the activity of substance are connected in so far as:

> Only if we take action as a criterion of substance can action serve as a basis for the determination of time magnitude. [p 64]

In other words, Kant's claim that only substances, i.e. what is permanent, can function as substrata for determining temporal magnitudes is to be understood as:

> Only if we take an action to be the action of a thing that persists through a certain time interval (that is, only if action is a criterion of substance), can that action be used to determine the magnitude of that time interval. [p64]

Melnick proceeds to examine more closely what is involved in something persisting through a certain time interval before arguing for a qualified version of this last claim. Melnick distinguishes between two senses of persistence, invariableness or qualitative identity over time and uninterruptedness or numerical identity over time. The relevant sense of persistence, Melnick argues, is numerical identity over time and not qualitative identity. Essentially, using Kant's terminology of Veränderung and Wechsel, an object persists through a temporal interval just in case it does not suffer a Wechsel although it might well undergo a Veränderung. Suitably qualified, the position Melnick is prepared to defend is that:

> Only if we take an action to be the action of a thing that is uninterrupted (though not invariable, for the thing may undergo change) in its existence during a certain time interval can that action be used to determine the magnitude of that time interval. [p 66]

Melnick gives a reductio argument to show that the action must indeed be the action of something which persists through the time interval which the action is being used to measure. Melnick invites us to suppose that the action at issue is the action, i.e. the mechanism, of a face-clock (the swinging of its pendulum or the movement of its clock-work) and the time interval to be measured is the interval between when the clock reads 4:00 a.m. (T_1) and when the clock reads 4:05 a.m. (T_2). The interval between T_1 and T_2 is thus to be measured as the time required for the mechanism to move the hands from reading 4:00 a.m. to reading 4:05 a.m. In order to show that the action must be the action of something that persists through the measured time interval, in this example, that the action must be the action of the clock that persists (uninterrupted although not invariably) through 4:00 and 4:05. Melnick considers what would happen if the clock did not persist. In other words, what would happen if, say, at some time between T_1 and T_2, say time T' the clock, call it clock A, goes out of existence to be replaced at some time between T' and T_2, say time T'', by another clock, clock B, which at T_2 reads 4:05. In such a situation in order to

determine the time interval between T_1 and T_2 we would have to determine the magnitude of the interval between T' and T''. But:

> It will not do in determining this interval to say, e.g. that since the last reading of clock A (at T') was 4:02.25, and the first reading of clock B (at T'') was 4:02.27, that the interval T' to T'' was 2 seconds. For the face readings of the clocks are only significant as the results (the effects) of the mechanical actions of the two clocks. The significance of B reading 4:02.27 vis a vis A reading 4:02.25 is lost, since it is not coordinated with any action during the interval T' to T''. The time between T' and T'' is not marked off by the mechanical process. (p 66)

Hence, Melnick concludes that the action by means of which the interval between T_1 and T_2 is measured must indeed persist through the interval (Q.E.D.). Since, however, Kant does not so much as mention the empirical criterion of substance until the very last paragraph of the discussion of the First Analogy[7], and he does not even tell us what this criterion is until near the end of the Second Analogy, it would seem unlikely that Kant envisaged the proof of the First Analogy as turning on the empirical criterion of substance in anything like the manner claimed by Melnick.

However, although Kant does indeed suggest, in the introduction to the Analogies of Experience, the discussion and proof of the principle that "Experience is possible only

through the representation of a necessary connection of perceptions" [A176/B218], that the First Analogy will deal with temporal duration, i.e. lapse of time, he does not suggest that the First Analogy will deal with the measurement of duration[8]. Moreover, as Guyer has pointed out[9] Kant's only mention of the significance of objects for measuring temporal magnitudes is in a "passing remark" in the second edition version of the Transcendental Deduction, where Kant claims that: "we must derive the determination of lengths of time or of points of time from the changes which are exhibited to us in outer things" [B156]. Guyer goes on to note, however, "that there is no explicit suggestion that it is in virtue of their permanence that external objects play this role" [p 218].

Gordon Nagel has criticised Ralph Walker's interpretation of the First Analogy[10], for being overly concerned with temporal measurement, on the grounds that:

> The setting up of clocks and calendars is an empirical concern that is not essential to experience. There could be people with experience -with a full-fledged system of thought - who had not yet advanced to chronometry. The magnitude of time (which it is Kant's concern to establish in the First Analogy) is distinct from the measure of the magnitude of time (which is not his immediate concern, though the possibility of measuring it does require that it first be established; and, in establishing it, Kant sets out those features - especially causal regularity -

> on which the possibility of measurement rests). [p 138]

These same points, I think, could equally well be directed at Melnick.

[4-3] ANOTHER ATTEMPT

Fortunately Kant presents a much more promising argument towards the end of his discussion of the First Analogy, in paragraph 7, an argument this time from the possibility of experiencing changes to the necessity of employing the concept of substance[11]. We noted above that paragraphs 7 and 8 of the text of the First Analogy, in the Kemp Smith edition of **CPR**, contain two apparently indirect arguments for the principle of the First Analogy. Having explicated the distinction between change (Wechsel) and alteration (Veränderung) (in paragraph 6), Kant now assumes that all changes of appearances are either changes (Wechseln) or alterations (Veränderung). The two arguments we are referring to as the indirect arguments each seek to establish that no change of appearances is a change of substance and therefore all changes of appearances are alterations of substances.

In paragraph 7 Kant writes:

> A coming to be or ceasing to be that is not simply a determination of the permanent but is absolute, can never be a possible perception. For this permanent

> is what alone makes possible the representation of the transition from one state to another, and from not-being to being. These transitions can be empirically known only as changing determinations of that which is permanent. If we assume that something absolutely begins to be, we must have a point of time in which it was not. But to what are we to attach this point, if not to that which already exists? For a preceding empty time is not an object of perception. But if we connect the coming to be with things which previously existed, and which persist in existence up to the moment of this coming to be, this latter must be simply a determination of what is permanent in that which precedes it. Similarly also with a ceasing to be; it presupposes the empirical representation of a time in which an appearance no longer exists. [A188/B231]

Walsh has elaborated on this argument in his study of the First Analogy in his *Kant's Criticism of Metaphysics* [pp 129-135]. As Walsh reads the First Analogy:

> The thesis in which Kant is interested....is that an underlying substance persists through all change, change as such thus being essentially transformation. [p 129]

Stated thus the thesis is seriously ambiguous. On one reading, Kant's thesis is that:

(i) one single substance persists through all change.

On the other reading the thesis is:

> (ii) a plurality of substances persists through all changes.

At the very end of Walsh's discussion, he explicitly endorses reading (i):

> Kant's argument for substance is an argument for a continuing stuff out of which all things are made. [p 134]

However, we shall see that Walsh's arguments really support reading (ii) and not (i).

Walsh charitably describes Kant's direct arguments for the thesis that substance persists through change as "elusive" and, in consequence, concentrates his attention on what he takes to be two indirect arguments suggested rather than actually given by Kant at A186/B229 - "the unity of experience would never be possible if we were willing to allow that new things, that is new substances, could come into existence" - and at A188/B231 - "A coming to be or ceasing to be that is not simply a determination of the permanent but is absolute, can never be a possible perception" where he thinks Kant makes an "impressive, indeed unanswerable" [134] case. In connection with the latter claim Walsh remarks:

> If the coming into being of a new substance .... cannot be witnessed or thought of as part of the objective order of things, considerable doubt is cast on whether these notions could have any application. [p 132]

In defence of the claim that such changes cannot be witnessed, Walsh argues:

> We might suppose that the annihilation of a substance could certainly be observed....but how should we know that it had been annihilated in the required sense of the term?....what would prevent us continuing to ask what became of it? It is not obvious that any combination of facts could logically compel us to agree that the asking of that question was illegitimate. [p 132]

Walsh does not spell out exactly what is the barrier preventing us from knowing that a substance has been annihilated in the required sense of the term. Clearly the barrier is not the inability to specify what conditions must be satisfied in order for a substance to go out of existence or change, in Kant's technical sense of the term. In order for a substance to change, it must be the case there is a time t_1 at which the substance exists and another time t_2 at which the substance does not exist. More plausibly, the barrier concerns our knowing that these conditions have been properly satisfied. Certainly there does seem to be a prima facie problem about knowing that these conditions have been satisfied since one prerequisite for knowing that something

has gone out of existence would be knowing that it has not simply moved out of view, and knowing this would involve searching the whole universe.

Walsh attempts to further reinforce the case by noting that:

> Even if it were agreed that annihilation were witnessable in principle, it would always be possible in any particular case to refuse to allow that it was real on the grounds that there was nothing to distinguish it from illusion. [p 132-3]

But this amounts to nothing more than saying that if we cannot tell whether the annihilation of a substance, X, is real or illusory then the annihilation of X is not real; which is little more than dogmatism.

Walsh further appeals to the argument of paragraph 8 as suggesting a reductio of the idea that we could observe substances being either created or annihilated, i.e. undergoing wechseln. Walsh quotes Kant's claim, in paragraph 5, that "the unity of experience would never be possible if we were willing to allow that new things, that is, new substances, could come into existence" [A187/B320] and suggests that the reason for this is given in paragraph 8 where Kant writes:

> "If some of these substances could come into being and others cease to be, the

> one condition of the empirical unity of time would be removed. The appearances would the relate to two different times, and existence would flow in two parallel streams -which would be absurd." [A188/B231]

Kant's talk of two parallel streams and two times, Walsh thinks, is really too modest since "there would be as many streams as there are unrelated substances" [p 133]. The idea here seems to be that the creation of a substance would not merely be the creation of a single thing but also the creation or initiation, as a consequence of the creation of this single thing, of a causal chain and similarly the destruction of a substance would be a destruction or termination of a causal chain in addition to the destruction of a thing. In so far as the initiated causal chain is causally independent of other causal chains (and presumably it is independent since other causal chains would continue their histories regardless of the creation of the substance and the initiation of the causal chain in question) the created substance is temporally unrelated to other substances, which is to say that it would relate to or be in a different time. Mutatis mutandis the same considerations apply to an annihilated substance. Walsh acknowledges that one might "pursue a policy of maximum liberality, and recognise all time series as real, despite their having no real relation to one another. (But) The difficulty in these conditions is that we should at once encounter too much that

was real and encounter no reality at all." [p 133]. By embracing all time series or at least a plurality of time series as real Walsh thinks we lose the contrast between reality and imagination, between the real and imaginary worlds, and the loss of this contrast entails, as Kant claims, the "total loss of continuity of consciousness and therefore all sense of self" [p 134]. But really we have not been given any reason to think that the acceptance of a plurality of temporal paths would result in the loss of the distinction between reality and imagination, although certainly the acceptance of only one temporal order would provide a convenient if not wholly rigorous means for distinguishing between what is real and imaginary[12]. Moreover, the argument makes an unacceptable appeal to considerations Kant rightly reserved for discussion in the Second and Third Analogies, discussions which Kant claims are grounded by [A187/B230][13] and which presuppose the First Analogy rather than are presupposed by it[14].

In contrast to Walsh's interpretation of the argument of paragraph 7 as an indirect argument to the effect that since Wechseln cannot be experienced and only Veränderungen can, therefore all changes are Veränderungen, Van Cleve and Allison have reconstructed the argument here as showing directly that all changes are Veränderungen.

Van Cleve has, I think, accurately represented this argument as:

(1) We know that X has come into existence.

(2) This knowledge requires that we know that X exists at T_n and did not exist at T_{n-1}.

(3) Since we cannot perceive empty time there must be a Y that existed at T_{n-1}.

(4) X must be a property of Y.

(5) Therefore, if we know that X has come into existence then Y must have altered in respect of X.

He has also noted that step 4 seems to be a non-sequitur [Van Cleve 155]. It is indeed true that, as Kant says, that which comes into existence at a time, T_n, must be attached or temporally related to what exists at a previous time, T_{n-1}, but, Van Cleve claims, there does not seem to be any justification for maintaining that the relationship must be one of predicate to subject or property to substance.

Allison has criticised Van Cleve's reconstruction of the argument in paragraph 8 and proposed an alternative reading. On Allison's reading[15] Kant's reasoning is this:

(1) Time cannot be perceived.

(2) Empty time is not an object of perception.

(3) A single observation is never sufficient to know that any change has occurred.

(4) Experience of change requires at least two successive observations and the noticing of some difference between the two observations.

(5) But this (satisfaction of the conditions specified in (4)) is not sufficient to observe a replacement change (Allison's term for a Wechsel) since I might be having successive observations of a co-existent state of affairs.

(6) If....I experience....a genuine replacement change....then I am constrained to refer the successive states of affairs to some common subject and to view this occurrence as an alteration in this subject.

(7) Therefore, alteration can be perceived only in substances.

Despite Allison's claim to the contrary, his reconstruction is really not significantly different from Van Cleve's except in so far as he gives a considerably more detailed account of what is involved in knowing that something has come into existence. Van Cleve merely specifies that knowing that something has come into existence presupposes knowing that something which exists at a certain time t_n did not exist at a previous time t_{n-1}. More fully, Allison details that knowing that something has come into existence presupposes having two noticeably different perceptions which are not successive perceptions of two qualitatively different co-existent states of affairs. Only in such a situation can I know that something exists at t_n which did not exist at t_{n-1}. The really crucial point is how it is possible for me to know that something which exists at a certain time did not exist at a previous time. As Van Cleve

has stressed, since empty time cannot be perceived, something must have existed previously; and in order for me to know that something has come into existence I must know how it is temporally related to what existed previously. In particular I must rule out the possibility that what I take to have come into existence was co-existent with what existed previously and hence has not really come into existence but existed all along. The only way I can rule out this possibility, according to Allison, is by referring the successive states that I observe to a common subject and regarding them as alterations of this subject. If indeed these are successive and mutually exclusive states then I can rule out the possibility that they are or were co-existent.

The argument here is an argument from the necessary conditions of experiencing or having empirical knowledge of a change. The conclusion that in order for me to experience a change the change must be a change in state or alteration of a substance follows from a consideration of what must be ruled out in order for me to experience a change. Specifically what must be ruled out in order for me to experience a change is the possibility that my successive observations are observations of co-existent objects. The only way I can rule out this possibility is by taking my observations to be observations of successive and mutually exclusive states of a substance. If I have been keeping a caterpillar in a glass jar and one morning on inspecting my

jar, find a butterfly in place of my caterpillar, in order for me to know that the caterpillar has changed into the butterfly I must rule out the possibility that the caterpillar and butterfly are and were co-existent. Perhaps the butterfly was simply invisible all along and now when the butterfly is visible the caterpillar is invisible or perhaps the caterpillar and butterfly merely exchanged places and the caterpillar escaped when the butterfly flew in. Only if the butterfly and the caterpillar, however, are mutually exclusive states of a single subject can I rule out these possibilities and the possibility of their co-existence and hence experience a change.

The upshot of this is that Van Cleve's non-sequitur is really not a non-sequitur at all. His line 4 follows from line 3 by dint of careful analysis of what is presupposed by line 3. X must be a property of Y because it is only if X is a property of Y that I can know that X has come into existence. Nagel, in his account of the First Analogy[16], has put the point most succinctly: "Duration is essential to change; for, unless an object persists throughout the times of its various states, we just have a diversity of objects, not diversity in an (enduring) object" [p 136]. Thus Kant has good grounds for maintaining that all change is indeed alteration for the only changes of which I can have knowledge or experience are those which are alterations.

Kant, however, does not maintain and does not set out to demonstrate in the First Analogy of Experience merely that all change is alteration (simpliciter), but that all change is alteration of substances. In other words, Kant wants to maintain that the subject to which successive observations must be referred must be a particular kind of subject, namely a substance. In the next chapter we shall see that for Kant, a substance is "something which can be thought only as subject, never as predicate of something else" [B186], that is, something which has properties but which cannot itself be a property. Kant, however, does not give, and really there does not seem to be, any good reason for maintaining that the subject to which successive observations must be referred, in order to observe a change, must be this kind of a subject, i.e. a substance. Kant, moreover, really does need the stronger conclusion that all changes are alterations of substances and cannot settle for the weaker conclusion that all changes are merely alterations if the First Analogy is to provide a transcendental deduction of the category of substance and demonstrate the necessity of employing the category of substance for the possibility of experience.

ENDNOTES

[1] Allison *Kant's Transcendental Idealism*, p 200; Kemp Smith *Commentary to Kant's Critique of Pure Reason*, p 358; Bennett, *Kant's Analytic*, p 183; Strawson, *The Bounds of Sense* [p 126].

[2] The programme, that is, which we identified above in chapter 3, section 3-4.

[3] Allison describes this as an instance of a "schema judgement" [p 185], and maintains that such judgements are synthetic a *priori* judgements [p 187].

[4] Bennett *Kant's Analytic* [p 183].

[5] Walker *Kant* chapter VIII p 112, Van Cleve "Substance, Matter and Kant's First Analogy" pp 158-159, Wolff *Kant's Theory of Mental Activity* p 251, Bennett *Kant's Analytic* p 200, Broad "Kant's First and Second Analogies of Experience" *Proceedings of the Aristotelian Society* 1926 [pp 189-210].

[6] Allison too breaks the arguments into three, although rather different, parts. According to Allison:

> The first part .... contends that something at least relatively permanent is required as a substratum or backdrop in relation to which change can be experienced .... The second part .... argues that every "change" (Wechsel) of appearances must be regarded as the change of state of this substratum. The third part .... asserts that this

> substratum must be absolutely, not simply relatively, permanent. [Allison p 201].

On my reading, "relative permanence" does not enter into the picture at all.

[7] Kant does indeed, in the early parts of the First Analogy, talk about an "empirical representative of time" [B225, A183/B226], but this is something quite distinct from the empirical *criterion* of Substance.

[8] Indeed with but one small exception, when Kant gets down to business in the First Analogy, duration and temporal magnitude are hardly even mentioned. The exception is in the A proof, where Kant claims:

> only through the permanent does existence in different parts of the time-series acquire a magnitude which can be entitled duration. For in bare succession existence is always vanishing and recommencing, and never has the least magnitude. [A1283/B226].

[9] *Kant and the Claims of Knowledge* [p 218].

[10] *Kant*, chapter VIII.

[11] More recent studies of Kant's First Analogy (more recent, that is, than Kemp Smith's (1923) and Paton's (1951)) by Allison, Walsh, Bennett, Dryer and Van Cleve have tended to concentrate their attention here in the hopes of discerning a successful argument in defence of the principle of the First Analogy.

[12] Indeed it has been argued (Quinton "Spaces and Time", *Philosophy*, 37 (1962) and Swinburne "Times", *Analysis* 25 (1964)) that a plurality of spaces and times is not only

possible but that there are conceivable situations in which the acceptance of a plurality of times would provide the best explanation of our experience. Although Swinburne has subsequently retracted his claim (Space and Time) and decided that his example of such a situation did not succeed in demonstrating the possibility of a plurality of times, Walker (Kant pp 57-59) has endeavoured to diffuse Swinburne's objections and uphold the possibility of a plurality of times. Falkenstein, however ("Spaces and Times: A Kantian Response", *Idealistic Studies*, 1986), has argued that the possibility of a plurality of times is incoherent on the grounds that the situations which are supposed to demonstrate this possibility, in fact, presuppose the topological connectedness of the "purportedly" unconnected or discrete times.

[13] Nagel ("Substance and Causality"), has pointed out that Kant claims that "the permanence of substance provides a ground for the succession in events" [p 105]. That is, that "there must be found in the objects of perception .... the substratum which represents time in general: and all change or coexistence must, in being apprehended, be perceived in this substratum" [B225].

[14] Specifically, the Second Analogy presupposes that all changes are alterations, as can be seen immediately from both versions of the principle of the Second Analogy, in A:

> Everything that happens, that is, begins to be, presupposes something upon which it follows according to a rule. [A189]

And in B:

> All alterations take place in conformity with the law of the connection of cause and effect. [B232]

[15] In footnote 19 to chapter 9, Allison invites us to compare and contrast his reconstruction with Van Cleve's. He "agree(s) with Van Cleve that the argument which he cites does involve a non-sequitur, (but) I see no reason to accept his reconstruction of the argument" [p 359].

[16] Chapter 5 of *The Structure of Experience: Kant's System of Principles.*

CHAPTER FIVE: KANT'S CONCEPTION OF SUBSTANCE

[5-1] INTRODUCTION

Kant's treatment of the concept of substance has been singled out by a number of commentators as particularly unsatisfactory[1]. The predominant complaint here has been that Kant equivocates over the nature of substance. Although Kant's account of substance is indeed the locus of a certain looseness in his thought, I doubt that this amounts to an equivocation on Kant's part; and certainly the various accusations of equivocation have not accurately targeted any real difficulty with Kant's account.

The accusations of equivocation current in the secondary literature are of two distinct kinds: According to the first kind of accusation[2], the slippage in Kant's account occurs between Kant's conception of substance in the first edition of **CPR**, published in 1781, and his conception of substance in the second edition, published in 1787, after the completion and publication of **MFNS**. According to the second kind of accusation[3], the slippage occurs in Kant's move from the pure or unschematised category to the schematised category in so far as this move involves an illicit conflation of two quite distinct conceptions of substance.

[5-2] KANT'S CONCEPTION OF SUBSTANCE

At the outset it must be recognised that Kant nowhere professes to give a precise statement of what he considers a substance to be. Although Kant, explicitly [A82/B108][4] and understandably, backs away entirely from defining any of the categories [cf A182-3/B108-9][5], we can nevertheless, with sufficient precision, unpack or explicate the category of substance as the concept of something which is a property bearer and which cannot itself be a property borne by anything else. Henceforth we refer to such a property bearer as an ultimate property bearer. Thus in the second edition of the Transcendental Deduction, while stressing that the Categories have no other application than to objects of possible experience, Kant refers to "the concept of substance, meaning something which could exist as subject and never as mere predicate" [B149]. Similarly in the "Schematism" chapter, Kant tells us that:

> substance, for instance, when the sensible determination of permanence is omitted, would mean simply a something which can be thought only as subject, never as predicate of something else. [B186]

As a pure or unschematised category, the category of substance is the concept of a logically possible substance rather than a really possible substance. The concept of a really possible substance is the concept which is revealed by

unpacking the schematised category of substance. A really possible substance is not merely an ultimate property bearer but, Kant maintains, an ultimate property bearer which is permanent. Since it is always really possible rather than merely logically possible concepts which are of interest to Kant, it is this conception of substance as what is permanent which must be recognised as Kant's official conception of substance.

Kant's conception of substance was doubtless influenced by Leibniz, via the writings of Christian Wolff[6] and Alexander Baumgarten[7], who maintained, in his *Discourse on Metaphysics*, that:

> When several predicates can be attributed to the same subject, and this subject can no longer be attributed to any other, we call it an individual substance.

And Leibniz' idea can in turn be traced back to Aristotle, who claimed, in the *Categories*, that

> substance in the truest and primary and most definite sense of the word, is that which is neither predicable of nor present in a subject; for instance the individual man or horse. [2a11-13]

Similarly in Book VII of the *Metaphysics*, we are told:

> We have now outlined the nature of substance, showing that it is that which

> is not predicated of a substratum, but of which all else is predicated. [1029a8-9]

For Leibniz, however, as indeed for Aristotle, this is by no means all there is to being a substance. According to Rescher, in his *Philosophy of Leibniz*:

> The prime features of Leibniz' conception of substance are 1) that a given individual substance is a simple, perduring existent, not in the sense of logical simplicity, but in the absence of spatial parts; and 2) that a given individual substance is capable of functioning as the subject of propositions, the predicates of true propositions concerning the substance standing for attributes of the substance. Speaking generally one can describe Leibniz' individual substance as a spatio-temporal continuant, an existent without spatial parts, but not without attributes, and with a perduring individuality and an inner dynamic of change. [p 59]

Kant accepted the second of Rescher's two prime features of Leibniz' conception of substance, that substances function as the subjects of propositions, although he rejected the idea that the predicates of true propositions name attributes as misleading [A230/B187] and preferred to characterise them as describing the way in which a substance exists. Concerning the first of these features, Kant, we have seen, certainly agreed with Leibniz that substances are perduring existences. However, although Kant nowhere explicitly denied the simplicity of substances, the idea that substances might be simple is surely inconsistent with his idea that substances

are really only possible in space and that substances fill space [B270], so that had Kant squarely faced the question concerning the simplicity of substances he would have denied that they are simple and lack spatial parts.

It is of some importance to note that both the schematised and unschematised categories of substance are neutral with regard to whether the term substance is a general term or a singular term, that is, a mass-noun identifying a kind of stuff or a count-noun identifying a (countable) individual. In other words both ultimate property bearers and permanent ultimate property bearers might be either countable individuals or natural kinds. In the light of this, we can see that our explication of the concept of substance really is an explication or a partial and incomplete definition of the concept. What is lacking in this explication is a precise account of the nature of property bearers. In the First Analogy of Experience, there appears to be some confusion on Kant's part over whether substance is a mass-noun or a count noun and we find him discussing both substance (in the singular) which is indicative of his understanding substance to be a mass term, and substances (in the plural) which is indicative of his understanding substance to be a count noun. Thus we find Kant, in his mass noun mode, telling us that "In all change of appearances substance is permanent;" [B224] and "the substratum of all that is real, that is, of all that belongs to the existence

of things, is substance" [B225]. In his count noun mode, we find him telling us that "The determinations of a substance.... are called accidents" [A186/B229], "Alteration can therefore be perceived only in substances" [A188/B231] and "Substances, in the [field of] appearance, are the substrata of all determinations of time" [A188/B231]. But this vacillation in Kant's writings, and it is a vacillation rather than a rejection or a repudiation of one mode of expression in favour of another, requires explanation rather than condemnation. Kant is not merely taking advantage of the incompleteness and vagueness in his conception of substance, rather Kant is exploiting a peculiar feature of mass terms, terms like water, furniture, substance and matter, in general. In some contexts mass terms function like general terms and in some contexts they function like singular terms. As Quine has observed in *Word and Object* "We shall do best to acquiesce in a certain protean character on the part of mass terms, treating them as singular in the subject and general in the predicate" [p 99]. That is, when occurring as the subject term in subject predicate propositions mass terms function as singular terms whereas when they occur in the predicate position they function as general terms. This accords well with Kant's usage of the term substance although it does not reveal a very satisfactory conception of substance.

[5-3] SUBSTANCE IN THE FIRST AND SECOND EDITIONS OF CPR

Gordon Brittan (*Kant's Theory of Science*) and Robert Paul Wolff (*Kant's Theory of Mental Activity*) have both argued that the differing formulations of the principle of the First Analogy in the two editions of **CPR** belie two quite distinct conceptions of substance. According to Brittan, the first edition principle, the principle that "All appearances contain the permanent (substance) as the object itself, and the transitory as its mere determination that is, as a way in which the object exists", is a principle about an Aristotelian conception of substance such that "substance is the substratum of change, that of which properties can be predicated but which cannot be predicated of anything else" [Brittan p 142]. Whereas the second edition principle, the principle that "In all change of appearances substance is permanent; its quantum in nature is neither increased nor diminished", is a principle about a Cartesian conception of substance, according to which "substance is that which exists in its own right, depending for its existence on itself alone, uncreated and indestructible" [Brittan pp 142-3]. This Aristotelian/Cartesian substance distinction does not correspond to the distinction we have drawn above between substance as a count noun and substance as a mass noun, since both a substratum of change and something which enjoys independent existence could be either a substance in the

sense of a countable individual or in the sense of a kind of stuff.

Brittan acknowledges that one might minimise the differences between the Aristotelian and Cartesian conceptions of substance such that "on the 'Aristotelian' view, substance is the invariant in all change and process (and) on the 'Cartesian' view, substance as the invariant is that which remains eternally the same" [Brittan p 144]. But he argues that even this will not suffice to make the two concepts co-extensive since "The concept of something that has properties, even the substratum of all change, is distinct from the concept of something that is conserved over time" [Brittan p 144]. Now this last might well be true but even in the first edition principle Kant quite clearly regards substance as not merely the concept of something which has properties but the concept of something which is permanent and has properties; and this, surely, is co-extensive with the concept of something which is conserved over time. Henry Allison, (*Kant's Transcendental Idealism*), has also challenged Brittan's charge of equivocation by pointing out that Kant's example of the experiment with the burning wood which clearly presupposes the Cartesian rather than Aristotelian substance was given in the first edition of **CPR** which suggests that Kant might well have had what Brittan describes as Cartesian substance in mind even when writing the first edition of **CPR**.

According to Wolff, the equivocation between the two principles of the First Analogy is really between two senses of permanence which generate two distinct conceptions of substance. In one sense, the permanent in nature is "the familiar Aristotelian notion of the substratum of change, an unchanging base in which attributes succeed one another" [Wolff p 249]. In the second sense, the concept of the permanent in nature is the concept of a closed system. Classical physics assumed the universe to be such that no masses or forces in the system of the universe could ever leave that system and that no "new" masses or forces could ever enter the system. In this sense the system of the universe was said to be a closed system. Now it is this sense of permanence which Wolff thinks is operative in the second edition principle, whereas the Aristotelian sense of permanence is operative in the first edition version.

I am unconvinced that we really have any distinction here at all, any distinction that is between senses of permanence. There is, to be sure, a difference between the kinds of changes possible in (i) nature conceived of as an unchanging base in which alterations succeed one another, and (ii) nature conceived of as a closed system; in the former case all changes are really exchanges whereas this is not necessarily so in the latter case. But this difference is not a difference between senses of "permanence" or between the kinds of permanence exhibited by nature. The idea of a closed

system simply is the idea of a system in which there is "an unchanging base in which attributes succeed one another".

Inspection of the first and second edition principles does not, I think, reveal any changes in the operative conception of substance; and even if it were possible to read the principles such that they bespeak differing conceptions of substance this would surely be an uncharitable and unprofitable way to approach the First Analogy of Experience.

But although it cannot be said that the principles of the First Analogy belie any change in Kant's conception of substance, it might still be thought that Kant did indeed change his view since, as we have observed above, Kant sometimes uses substance as a mass noun and sometimes as a count noun; and the passages which we have quoted above in which Kant's employment of substance as a mass noun is most apparent are all passages which were added in the second edition of **CPR**. But this does not really represent a change in Kant's conception of substance since although the count-noun conception of substance certainly dominates in the first edition version of the First Analogy, the mass-noun account is nevertheless present. In Kant's discussion of how to measure the weight of smoke, having described the procedure of subtracting the weight of the ashes from the weight of the wood prior to burning, Kant observes that it is "presupposed as undeniable that even in fire the matter (substance) does

not vanish, but only suffers an alteration of form" [A185/B228]; which clearly presupposes the conception of substance as a kind of stuff rather than an individual.

In Kant's mind, rather than changing his conception of substance, he thinks he is merely emphasising something not previously emphasised and making explicit something which in the first edition was merely implicit. Kant's move towards emphasising substance as a mass noun in the second edition of **CPR** was undoubtedly motivated by his examination of the nature of matter in **MFNS**, where he argued against the atomistic account of matter, the conception of matter as essentially absolutely dense discrete particles and in favour of matter being a continuum of forces filling space. However, in order to be able to quantify over matter and to be able to talk about quantities of matter, Kant realised that he had to be able to identify units of matter and sought to achieve this by distinguishing between the continuum of matter and the parts into which this continuum could be divided. In the final chapter of this dissertation we shall examine exactly how Kant thought matter could be quantified. For the present all we need to note is that in **MFNS** Kant argued that both the continuum of matter, the stuff composing bodies, and all the parts into which the continuum can be divided, countable individuals, are substances. This supports reading Kant as construing the term substance as ranging over both individuals and natural kinds. In so far as the continuum of

matter filling space is claimed to be substance, substance is a mass noun; and in so far as the parts of the continuum are all claimed to be substances, substance is a count noun.

[5-4] THE PURE AND THE SCHEMATISED CATEGORY OF SUBSTANCE

In *Kant's Analytic* Bennett begins his study of the First Analogy of Experience with an examination of the concept of substance and by drawing a distinction between two conceptions of substance which he believes have traditionally been run together: substance qua bearer of properties, which he calls a substance$_1$, and substance qua "a something which can be neither originated not annihilated by any natural process, i.e. which is, barring miracles, sempiternal" [Bennett p 182], which Bennett calls a substance$_2$. According to Bennett "These two have often been conflated, if not identified; yet it is not obvious that they are even extensionally equivalent" [Bennett p 182]. In Kant's hands, Bennett maintains, the two concepts are run together such that "substance$_2$ is supposed to be derived by schematism from substance$_1$ which is supposed to be derived in its turn from the table of judgments" [Bennett p 184]. But both derivations, in Bennett's opinion, are faulty.

The definition of a substance$_1$ as simply a bearer of properties seems to accord well enough with what Kant says in

the Metaphysical Deduction. Commenting on the Table of Judgments, Kant writes:

> All relations of thought in judgments are (a) of the predicate to the subject, (b) of the ground to its consequence, (c) of the divided knowledge and of the members of the division, taken together, to each other. [A73/B98]

Thus a substance for Kant would appear to be that designated by a subject term in a subject-predicate proposition and a property or accident that designated by a predicate. Similarly the definition of a substance$_2$ seems to be the account of substance Kant advances in the First Analogy, most explicitly at A184/B227 where he claims "Certainly the proposition, that substance is permanent, is tautological".

However, in the "Schematism" chapter Kant describes the pure or unschematised concepts of substance as a concept of "something which can be thought only as subject, never as a predicate of something else" [A147/B186]. This, seemingly quite unjustified, shift in meaning, from that which can be thought as subject to that which can only be thought as subject, is the reason why Bennett does not think that Kant legitimately derives the concept of substance$_1$ from the table of judgments. This, however, is really a most unfair charge since this last concept of substance is not the concept of substance$_1$ at all, although it is indeed, as we have seen, the correct explication of the pure or unschematised category

of substance. The concept of substance$_1$ is the concept of a something which has properties. Clearly not everything which has properties and is thus a substance$_1$ is an ultimate property bearer and something which cannot itself be a property[8].

Kant did indeed, I think, err in his move from the categorical form of judgement to the category of substance although he did not err by attempting to derive Bennett's substance$_1$. On the contrary, the move from the categorical form of judgement to Bennett's substance$_1$ could have been made quite easily and the difficulty only arises because Kant wants to move not to Bennett's substance$_1$, the concept of a property bearer, but to the concept of an ultimate property bearer, a property bearer which cannot itself be a property borne by anything else. In making categorical judgements, which are the source for the category of substance in the Metaphysical Deduction of the Categories [A70/B95-A80/B106], we do indeed employ the concept of a property bearer, but only in a small sub-set of cases do we employ the concept of an ultimate property bearer[9].

Bennett's accusation of equivocation on Kant's part has not passed unchallenged but has been the victim of assault on two fronts. On one front Bennett has been criticised by James Van Cleve[10] on the grounds that his concepts of substance$_1$ and substance$_2$ are indeed coextensive and hence any shifting on

Kant's or anyone else's part between the two is unobjectionable. On the other front, Kant has been defended by Henry Allison on the grounds that he does not illicitly shift between these two senses of substance but consciously develops the concept of substance$_2$ from the concept of substance$_1$.

According to Allison it is really substance$_2$ for which Kant wants to argue in the First Analogy and substance$_1$ plays only a provisional or dialectical role in the argument[11]. Allison, however, has mislocated the problem involved in these changes in meaning and in saving Kant has really only provided grist for Bennett's mill. The significance of the charge of equivocation against Kant is not, or not merely, that it invalidates the argument of the First Analogy, a charge from which Allison is keen to free Kant, but rather that it seriously disrupts the whole programme of the Transcendental Analytic. And it does this by disrupting the relationships which are supposed to hold between the table of judgments and the table of categories and between the unschematised categories and the schematised categories. Officially the twelve categories are supposed to be the a priori concepts employed in the twelve forms of judgement. Officially the schematised categories are supposed to be simply the categories supplemented with temporal determinations. Less cryptically, the schematised categories

are categories supplemented with semantical rules, rules of the form:

> If x is an instance of category C, then x has t.

where t names a temporal characteristic. In the case of the category of substance its semantical rule is:

> If x is a substance, then x is permanent (i.e. exists at all times).

But now it appears that, in the case of substance, the category of substance is not the concept of substance employed in subject-predicate judgments. These employ the concept of substance as something which has properties and the category of substance is, minimally, the concept of substance as something which can only be thought as subject and never as predicate. Similarly the schematised category of substance is not simply the category of substance with a temporal determination. The schematised category is the concept of substance$_2$ and as Bennett points out "perhaps temporal substance$_1$ must have duration but why must it last for ever?" [Bennett p 184].

We mentioned above that Bennett's charge of equivocation has also been challenged on the grounds that his concepts of substance$_1$ and substance$_2$ are, contrary to his claim, indeed co-extensive such that whatever is a substance$_1$ is also a

substance$_2$. The argument that substance$_1$ and substance$_2$ are co-extensive concepts comes from Van Cleve[12]. Van Cleve begins by explicating the distinction between Kant's technical concepts of "change" and "alteration" as follows:

> *x changes* just in case there are times t1 and t2 such that x exists at t1 but not at t2, or vice versa.
>
> *y alters in respect of x* just in case there are times t1 and t2 such that (a) y exists continuously from t1 to t2 and (b) y exemplifies x at t1 but not at t2, or vice versa.

and argues that these imply two principles about alterations:

> (C1) If y alters in respect of x then x is a property.
>
> (C2) If y alters in respect of x then y is a substance$_1$.

Employing these conceptions of "change" and "alteration" and these two principles of alteration Van Cleve presents the following proof of the co-extensionality of substance$_1$ and substance$_2$:

> (1) For any x, if x changes, then there is a y such that y alters in respect of x.
>
> Assume that y* is the y that alters. What must be shown is that y* is a substance$_1$ and a substance$_2$.
>
> (2) y* is a substance$_1$ [from (1) by C2].
>
> (3) Assume y* is not a substance$_2$.

(4) There is a time at which y^* exists and a time at which y^* does not exist [from (1) and (3)].

(5) y^* changes [from (4)].

(6) There is a z which alters in respect of y^* [from(5) and (1)].

(7) y^* is a property [from (6) by C1].

But (7) contradicts(2) and hence(3) is false.

(8) For any x, if x changes, there is a y such that y is a substa· e_1 and a $substance_2$ and y alters in respect of x. [Q.E.D.]

At the end of the day, Van Cleve thinks that line 1 is false; so presumably he would not accept this argument as a satisfactory proof that $substance_1$ and $substance_2$ are indeed co-extensional. But Van Cleve does think that if line 1 were true then this would show that $substance_1$ and $substance_2$ were co-extensive, and the argument is offered by him in that spirit. Kant, however, if the interpretation of the First Analogy which I have advanced in the previous chapter is correct, thinks that line 1 is true. But I very much doubt that Kant would regard $substance_1$ and $substance_2$ as co-extensive.

The Achilles' heel of Van Cleve's proof, seems to me to be his principle C2, since it entails denying that properties can themselves have properties which I think is false and not a claim to which Kant is committed. In the Anticipations of Perception, Kant tells us that "though all sensations as such

are given only a posteriori, their property of possessing a degree can be known a priori" [A176/B218]: which quite clearly implies that properties can themselves have properties and that substances are not the only kinds of thing to be property-bearers.

Van Cleve's error is in fact the adoption of Bennett's identification of a property-bearer as a substance$_1$. In fact a property bearer need not be a substance at all, a property bearer might well itself be a property. In the light of this it is clear why, pace Bennett, the concept of a thing which has properties is not the concept of a substance at all; there are innumerable things which have properties but which are not substances. We should now not be surprised to find that Bennett's substance$_1$ is not Kant's pure or unschematised category of substance. The category of substance, as Kant tells us quite explicitly in several places, is not the concept of a property bearer but rather the concept of what we have called an ultimate property bearer; it is "something which can be thought only as subject, never as predicate of something else" [B186].

Whether or not Kant is entitled to this conception of substance, and I have suggested that, since it is the concept of a property bearer simpliciter rather than the concept of what I called an ultimate property bearer that is employed in making categorical judgements, he is not really entitled to it, it is the account of substance as ultimate

property bearer which Kant wants and needs. Bennett's claim that the schematised category is supposed to be derived from the unschematised one, and Van Cleve's attempt to so derive it, are misguided, in so far as Kant does not think that these are co-extensive concepts any more than are the concepts of substance$_1$ and substance$_2$. To be sure, whatever instantiates the schematised category of substance will also instantiate the pure or unschematised category, but it is not the case that whatever instantiates the unschematised category will also instantiate the schematised category. Substances falling under the schematised category are a sub-set of the substances which fall under the unschematised[13] one.

Although I have rejected a variety of criticisms of Kant's account of substance, I have argued that Kant's treatment of the concept of substance is indeed imperfect in so far as it fails to clarify whether substances are countable individuals or kinds of stuff. But I do not think that any serious conceptual confusions result from this so that the most one might charge Kant with here is insufficient rigour.

ENDNOTES

[1] In particular, Bennett *Kant's Analytic* [pp 182 seq.]; Brittan *Kant's Theory of Science* [pp 142 seq.]; Wolff *Kant's Theory of Mental Activity* [pp 249 seq.] and Wilkerson *Kant's Critique of Pure Reason* [pp 72 seq.].

[2] By Brittan and Wolff.

[3] By Bennett.

[4] "In this treatise, I purposely omit the definitions of the categories" [A82/B108].

[5] In chapter I of the "Transcendental Doctrine of Method", "The Discipline of Reason', Kant explains that to define:

> really only means to present the complete, original concept of a thing within the limits of the concept. [A728/B756]

That is, to define is to specify all and only those things subsumed under the concept. Given this, Kant argues that mathematical concepts (because we have invested them) are the only concepts which can be defined and, in particular, empirical and metaphysical or philosophical concepts can only be explicated or given partial definitions.

[6] Wolff's *Erste Gründe der Gesamten Weltweisheit (Fundamental Principles of Philosophy)* was a significant and extremely

popular vehicle for the dissemination of Leibniz' views in German universities during the 1730's.

[7] Kant regularly used Baumgarten's *Metaphysica* (1739) as a text book for his lectures.

[8] Yet another concept of substance emerges when Bennett finally gets down to the business of assessing the truth and falsity of Kant's claims. In order to assess Kant's alteration thesis Bennett proposes to consider the question:

> Could there not be an existence-change of substancel, i.e. of an objective item which had a substantival rather than an adjectival status in everyone's conceptual scheme? [p 188]

For Kant the distinction between substances and properties as spelled out at the end of the "Schematism" is a matter of necessity. A substance qua something which cannot be a property is something which logically and necessarily cannot be a property. In contrast to this Bennett proposes to understand the concept of substance as the concept of something which, contingently rather than necessarily, always plays a substantival rather than an adjectival role in our conceptual scheme: it is something which could play an adjectival role but which, for, typically, pragmatic reasons, does not.

[9] For example, judgements about paradigmatically Aristotelian substances, such as the individual man or the individual horse.

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10 "Substance, matter and Kant's First Analogy" *Kant-Studien* 70 (1979), [pp 149-61].

11 *Kant's Transcendental Idealism* [p 214].

12 Van Cleve [p 153].

13 In the same way as the set of really possible objects is a sub-set of the set of logically possible objects (Brittan *Kant's Theory of Science* [p 21].

CHAPTER SIX: THE SUBSTANTIALITY OF MATTER

[6-1] KANT'S CRITIQUE OF NEWTON'S MATTER THEORY

We suggested at the end of chapter 2 that in part Kant was motivated to prove PCM by his disagreement with Newton over the nature of matter. Specifically, Kant thought that Newton was wrong to think of matter, in the style of Democritus, as composed of immutable atoms and that the right way to think of matter is, in the style of Leibniz, as composed of forces.

That Kant disagreed with Newton at the level of matter theory has been disputed by Michael Friedman in his paper "The Metaphysical Foundations of Newtonian Science"[1], where he claims that "it is far from clear that Kant himself had Newton in mind as a representative of the 'mathematical-mechanical' conception of matter" [p 28], and argues that Kant's "primary disagreement" with Newton concerns:

> the spatio-temporal framework of Principia; specifically, the notions of Absolute Space and Absolute Time that are fundamental to Newton's presentation of his theory. These notions, as employed by Newton, can of course find no place in the critical philosophy, and Kant is therefore faced with the problem of capturing the content of Newton's theory without such metaphysically suspect notions. [p 30]

However, although Kant did indeed consider Newton's notions of Absolute Space and Absolute Time objectionable, these are

by no means the only points of contention between Kant and Newton. It would be no more correct to identify these points as the central points of disagreement between Kant and Newton than it would be to identify the theory of matter as the fundamental bone of contention. As Friedman himself observes, Kant criticised Newton for denying that gravity is an essential property of matter. Kant also objected to Newton's account of inertia and, correlatively, mass. Furthermore, although Kant did indeed only mention Descartes and Democritus, in **MFNS**, as representatives of the "mathematical-mechanical" conception of matter [Ak 533], in **CPR**, in the discussion of the Anticipations of Perception, Kant describes "Almost all natural philosophers" [A173/B214] as subscribing to the "mathematical-mechanical" account.

In the General Observation on Dynamics which concludes chapter II (The Metaphysical Foundation of Dynamics) of **MFNS**, Kant describes the atomistic account of matter, which he labels the mathematical-mechanical account, as conceiving of matter as the combination of the absolutely full with the absolutely empty. Kant derides the ideas of absolute fullness and absolute emptiness claiming that:

> Absolute emptiness and absolute density are in the doctrine of nature approximately what blind chance and blind fate are in metaphysical science, namely, a barrier for the investigating reason, with the result that either fiction occupies the place of reason or else

> reason is lulled to sleep on the pillow of occult qualities. [Ak 532]

In other words, absolute emptiness and absolute density are, like the concepts of blind chance and blind fate, empty concepts which hinder rather than foster the advance of science. Essentially, Kant tells us, the mathematical-mechanical view of matter:

> consist(s) in the assumption of the absolute impenetrability of the primitive matter, in the absolute homogeneity of this matter, differences only being allowed in the shape and in the absolute unconquerability of the cohesion of the matter in these fundamental particles themselves. Such were the materials for the production of specifically different matters in order not only to have at hand an unchangeable and yet variously shaped fundamental matter for the unchangeability of species and kinds, but also to explain mechanically nature's various actions as arising from the shape of these primary parts as machines (to which nothing more was wanting than an externally impressed force). [Ak 533]

Matters or parts of matter, are composed of particles of matter and empty spaces. The particles of matter are uniformly and absolutely dense and the empty spaces are absolutely empty.

Crucial to this account of matter, Kant continues, was the necessity of postulating (absolutely) empty spaces in order to explain the varying densities of matter; density was a function of the proportion of absolutely empty spaces to

absolutely filled spaces. However, the mathematical-mechanical account's postulation of absolute impenetrability Kant regards as "indeed nothing more or less than a qualitas occulta" [Ak 502]:

> For one asks, what is the reason why matters cannot penetrate one another in their motion? He receives the answer, because they are impenetrable. The appeal to repulsive force is free of this reproach. For although this force likewise cannot be further explicated according to its possibility and hence must be admitted as a fundamental one, it nevertheless yields the concept of an active cause and of the laws of this cause in accordance with which the effect, namely, the resistance in the filled space can be estimated according to the degrees of this effect. [Ak 502]

Kant's point here would seem to be that whereas absolute impenetrability is inexplicable, what Kant calls "relative impenetrability" [Ak 502], which he thinks is an essential property of matter, is not and can be explained in terms of the fundamental forces constituting matter. Now although indeed these fundamental forces are not further explicable - for, if they were, they would not be fundamental - Kant at this point seems to think that they are not on a par with absolute impenetrability since they have explanatory and predictive value. The fundamental force of repulsion, Kant thought, explains variations in density [Ak 517]. Furthermore, given that repulsive force is a force which varies in proportion to other, compressive, forces [Ak 521],

we can predict the extent to which a body will resist the compressive force of another and the degree to which it will be changed by that other body.

What further tells against the mathematical-mechanical account of the nature of matter and in favour of his own metaphysical-dynamical account, in Kant's mind, is that on the former in contrast to the latter account, matter is not really possible and is not an object of possible experience. Matter is not really possible on the mathematical-mechanical conception of matter because the absolute emptiness presupposed by this account is not really possible, i.e. not an object of possible experience. Although Kant claims, in the Transcendental Aesthetic of **CPR**, that "we can quite well think it [space] as empty of objects" [A24/B39], so that empty space is logically possible, these empty spaces cannot be really possible if indeed, as Kant also claims, "space is nothing but the form of all appearances of outer sense" [A26/B42]. Were empty space really possible, then space would not be the form of outer appearances, but would itself be an appearance. In place of the mathematical-mechanical account of the nature of matter, Kant presents what he calls the metaphysical-dynamical account.

[6-2] THE METAPHYSICAL-DYNAMICAL ACCOUNT OF MATTER.

Matter, according to Kant, is the movable in space. As such, matter occupies space and since, Kant maintains, there are no voids or absolutely empty spaces[2], the whole of space, and every space or every part of space, is occupied by matter and what is in space forms a plenum or seamless whole. This plenum, Kant argues, is essentially a continuum of forces, a continuum of dynamical forces of attraction and repulsion. Matter, Kant claims, does not merely have extensive magnitude and does not only have location in space or "occupy" space but fills it and does so in varying degrees of intensity, thereby giving matter intensive as well as extensive magnitude. Now, matter fills space, according to Kant, by exerting moving forces. In the first Explication of the "Metaphysical Foundation of Dynamics" Kant tells us that:

> To fill a space means to resist everything movable that strives by its motion to press into a certain space. [Ak 496]

Such resistance, since it diminishes motion (even to the point of changing it into rest) and is thus a cause of motion, Kant argues, must be a moving force. Hence it is, as Kant claims in Proposition 1 of the Dynamics, that matter fills space by exerting a moving force.

The fundamental moving forces of matter, i.e. those moving forces in virtue of which matter is possible, Kant claims, are the forces of attraction (gravity) and repulsion (elasticity) and he explicates these forces as follows:

> Attractive force is that moving force whereby a matter can be the cause of the approach of other matter to itself (or, equivalently, whereby it resists the withdrawal of other matter from itself).
>
> Repulsive force is that whereby a matter can be the cause of making other matter withdraw from itself (or, equivalently, whereby it resists the approach of other matter to itself). [Ak 498]

These two forces, Kant argues, are the only forces that can be conceived, for, all motion must be regarded as imparted along a straight line and the only possible motions along a straight line are those whereby two points in the line approach one another and withdraw from one another.

We have seen Kant's argument for maintaining that the force of repulsion is necessary for the possibility of matter - without it matter cannot fill space. We must now consider his argument for maintaining that, in addition to the force of repulsion, the possibility of matter requires the force of attraction. According to Kant:

> (m)atter by its repulsive force alone (which contains the ground of its impenetrability), and if no other moving force counteracted this repulsive one, would be held within no limits of

> extension, i.e., would disperse itself to infinity, and no assignable quantity of matter would be found in any assignable space. Consequently, with merely repulsive forces of matter, all spaces would be empty; and hence, strictly speaking, there would be no matter at all. Therefore, forces which are opposed to the extensive ones, i.e. compressive forces, are required for the existence of all matter [Ak 508-509]

In other words, if matter had merely repulsive and no attractive force then matter would disperse to infinity and would not fill space.

Mutatis mutandis a similar line of reasoning is advanced in the proof of proposition 6, "By mere attraction, without repulsion, no matter is possible" [Ak 510], to show that matter could not be endowed only with attractive force and no repulsive force. Prima facie, these arguments appear to be rather weak since they do not explain why, in the case of repulsive force, the limits must be set by attractive force and cannot be set by other repulsive forces, and in the case of attractive force, why the limits must be set by repulsive force and not other attractive forces. In fact, Kant appears to consider just this, in connection with repulsive forces, and argues that the forces limiting repulsive forces "cannot in turn be sought for originally in the opposition of another matter, for this other itself requires a compressive force in order that it may be matter" [Ak 509]. The idea that repulsive forces might be limited by other repulsive forces,

Kant thinks, leads to an infinite regress since the limiting repulsive force must be itself limited, and, if this is limited by yet another repulsive force, then this last, too, would have to be limited by still another repulsive force, and so on ad infinitum. It must be borne in mind, here, that what Kant is concerned with is not merely the real possibility of this or that part of matter, but, rather, the possibility of matter in general or matter taken as a whole. Kant vacillates throughout the whole of **MFNS** between discussing what he sometimes refers to as matter taken as a whole, the plenum of matter, and what he calls the parts of matter[3], regions of the plenum; fortunately, the context usually makes it clear which Kant has in mind and no serious confusion seems to result.

Thus far in the analysis of matter it looks rather as though the forces exerted by matter are distinguishable and to be distinguished from matter itself. This, however, is misleading, for, according to Kant "the concept of matter is reduced to nothing but moving forces" [Ak 524] and, he immediately adds, "this could not be expected to be otherwise, because in space no activity and no change can be thought of but mere motion". Presumably the reasoning here is that since all change and activity in space is motion, and nothing is required for motion but moving forces, we need assume the existence in space of nothing but moving forces. Matter is thus, not to be distinguished from the forces it

exerts but in fact is identical to those very forces and is nothing but those forces. Hence, Kant claims that:

> all that is real in the objects of our external senses and is not merely a determination of space (place, extension and figure) must be regarded as moving force. [Ak 523]

The idea that matter is a continuum of force must be carefully distinguished from a common, and in my view mistaken, interpretation of Kant's conception of matter as a set of centres of force. This latter was indeed the view Kant articulated in his Physical Monadology and was the view articulated by Boscovich[4] with whom Kant is frequently, and again I think mistakenly, compared in some of the secondary literature[5] but, in spite of his scattered references to centres of force in **MFNS**, this is not Kant's understanding of the nature of matter in that work[6]. The references to centres of force in **MFNS**, (in the discussions of the infinite divisibility of matter, proposition 4 of the Dynamics, and the two Observations accompanying the proof of the infinite extent of attractive force, proposition 8) one and all occur in the context of constructions or, more accurately, comments on constructions and Kant sternly warns us not to attribute to the object of a concept "what necessarily belongs only to the process of the construction of the concept" [Ak 505]. Kant's point being, I take it, that although in constructions or attempts to render the fundamental forces intuitable one

must represent the forces as radiating from point-like centres, we are not to infer from this the existence of material points. It is important to remember that although Kant seems to waver on this point, the forces constituting matter, the fundamental forces, are not constructable and as such cannot be rendered intuitable.

Given this conception of matter, as a continuum of repulsive and attractive forces, Kant argues for a number of properties of repulsive force; principally that it is a superficial rather than a penetrative force (Note on Explication 7), which is governed by an inverse cube law (Observation 1 accompanying Proposition 8 [Ak 521]) and which has no least or greatest degrees (Proposition 2). Kant further argues for various properties of attractive force, principally that attractive force, in contrast to repulsive force is a penetrative force, that the action of attractive force is an immediate action (Proposition 8) and that attractive force is governed by an inverse square law. Beyond this, and much more significantly for our concerns, Kant also argues for four properties of matter, i.e. properties of the continuum of forces, viz., its impenetrability, infinite divisibility and infinite compressibility and, finally, its substantiality. Concerning the substantiality of matter, Kant argues that both matter taken as a whole, the plenum of forces, is a substance and that each of the parts into which

matter taken as a whole, or the plenum of matter, can be divided is itself a substance.

[6-3] FOUR PROPERTIES OF MATTER

The impenetrability and compressibility of matter are reasonably straightforward, so we will deal with them first. That matter is impenetrable was a commonly held view in classical physics, but Kant takes some pains to distinguish the impenetrability which he wants to attribute to matter, and which he describes as a relative impenetrability, from the absolute impenetrability more commonly attributed to matter. Kant distinguishes between the two kinds of impenetrability as follows:

> The impenetrability of matter resting on resistance, which increases proportionally to the degree of compression, I term relative; but that which rests on the assumption that matter, as such, is capable of no compression at all is called absolute impenetrability. The filling of space with absolute impenetrability may be called mathematical; that with merely relative impenetrability, dynamical. [Ak 502]

He attempts to demonstrate the relative impenetrability of matter as a consequence of the impossibility of infinitely great compressive forces.

According to Kant, matter or the forces which fill space can be compressed into ever smaller spaces and there is no limit, in the sense of a smallest space, beyond which matter cannot be compressed. It is in this sense, that Kant thinks there is no limit to compressibility and that matter is infinitely compressible.

In addition to being infinitely compressible, Kant claims that the repulsive force exerted by a part of matter increases proportionally to the degree of its compression, specifically in an inverse cubic proportion [Ak 522], and he argues on the basis of this, in conjunction with the impossibility of infinitely great compressive forces, for the impenetrability of matter. Penetration of one part of matter by another, we are told, occurs when one part of matter "by compression, completely abolishes the space of .... (another's) extension" [Ak 500] and presupposes the compression of a part of matter "into an infinitely small space, and hence an infinitely compressive force would be required; but such a force is impossible" [Ak 501] and so penetration is impossible. The compressive force must be infinitely great, Kant thinks, because the repulsive force which it must overcome increases proportionally to the degree of compression and an infinitely great compressive is impossible because, as Kant tells us in **CPR** and reiterates in **MFNS** [Ak 506], "a determinate yet infinite quantity is self-contradictory" [A527/B555].

So much then for the compressibility and impenetrability of matter. In claiming that matter is infinitely divisible Kant intends to maintain that matter is a continuum and not an aggregate of discrete parts or atomic simples. It is important to appreciate here that Kant is not claiming that matter has infinitely many actual parts. Rather, as Kant puts it:

> one can only say of appearances whose division goes on to infinity that there are as many parts of the appearance as we give, i.e. as far as we want to divide. [Ak506-7]

This is not to say that the number of parts of matter is an arbitrary affair but rather that the number of parts into which we divide matter is relative to the metric or scale of measure we employ in making our divisions. Thus the number of parts into which we can divide matter will differ if our metric is cubic millimetres, say, from the number of parts into which we can divide matter if we employ a more fine-grained metric. The crucial point, though, is that, as Kant argues in connection with the Antinomies of Reason in **CPR**, it is we who do the dividing and thus matter will have as many parts as we divide it into.

In the second of the four Antinomies of **CPR**, Kant pitted the thesis "Every composite substance in the world is made up of simple parts, and nothing anywhere exists save the simple

or what is composed of the simple" [A434/B462] against the antithesis that "No composite thing in the world is made up of simple parts, and there nowhere exists in the world anything simple" [A435/B463] The thesis encapsulates what Kant in MFNS calls the mechanical-mathematical view of matter and the antithesis, his own metaphysical-dynamical view. This antinomy of reason arises, Kant thinks, because both of these apparently contradictory views can be proved to be true. But, the antinomy can be resolved, Kant claims, once one recognises that in fact the thesis and antithesis are not contradictories at all but sub-contraries and as such may both be false. All four Antinomies of Reason Kant tells us, rest on the following dialectical argument:

> If the conditioned is given, the entire series of all its conditions is likewise given; objects of the senses are given as conditioned; therefore etc., [A497/B525]

But from the standpoint of transcendental idealism, Kant explains, the major premise is false, for:

> If....what we are dealing with are appearances....I cannot say in the same sense of the terms, that if the conditioned is given, all its conditions (as appearances) are likewise given, and therefore cannot in any way infer the absolute totality of the series of its conditions. [A498-9/B527]

According to transcendental idealism, appearances are merely empirical syntheses of properties in space and time and as

such do not presuppose the synthesis of their conditions so that, contra the major premise, appearances are given independently of the appearances of their conditions. The synthesis of the conditions of an appearance, Kant tells us, "first exists in the regress, and never exists without it" [A499/B527], it is not something given but something which we undertake to construct, and "(w)hat we can say is that a regress to the conditions, that is, a continued empirical synthesis, on the side of the conditions, is enjoined or set as a task and that in this regress there can be no lack of given conditions" [A499/B527].

Applying these considerations now directly to the second antinomy, the dialectical argument tells us that if the divisible is given then the entire series of its divisions is given. This we now know to be false from the standpoint of transcendental idealism. The divisible is given without all its divisions or parts being given, although the construction of such a series of divisions can be carried out without any limit.

What the **MFNS** aims to add to the discussion in **CPR** is a demonstration that matter, understood as a continuum of forces satisfies the requirements of **CPR** in so far as there is no lack of possible divisions of matter. Kant's demonstration of this is as follows:

> ....the space that matter fills is mathematically divisible to infinity, i.e. its parts can be differentiated to infinity, although they cannot be moved and, consequently, cannot be separated (according to demonstrations of geometry). But in a space filled with matter every part of the space contains a repulsive force to counteract on all sides all remaining parts, and hence to repel them and likewise be repelled by them, i.e. to be moved at a distance from them. Hence every part of a space filled by matter is of itself movable and is therefore separable by physical division from the remaining parts, in so far as they are material substance. Consequently, as far as the mathematical divisibility of space filled by a matter reaches, thus far does the possible physical division of the substance that fills the space likewise reach. But the mathematical divisibility extends to infinity, and consequently also the physical, i.e. all matter is divisible to infinity and indeed is divisible into parts each of which is itself in turn material substance. [Ak 503-4]

The parts into which matter is divisible are volumes of force or volumes of space in which forces are active. But the infinite divisibility of matter does not follow immediately from the infinite divisibility of the space which it fills, for the infinite divisibility of the latter is only a mathematical and not a physical divisibility. That is, although one can differentiate infinitely small spaces one cannot separate or move such spaces. In contrast to this, the infinite divisibility of matter yields infinitely small separable or movable parts of matter or, as we will see below, material substances. This, Kant thinks, is because of the way matter fills space, i.e. by exerting repulsive force.

Now the physical divisibility or movability of matter, Kant thinks, is entailed by the way matter fills space i.e. by exerting moving force and the inference to the physical divisibility of matter is an inference from its exertion of repulsive force. But the inference from the exertion of repulsive force to movability, I take it, is not simply that if a part of matter exerts moving force then it is movable, or that if a part of matter exerts moving force over another part of matter then the latter is movable but rather that if two parts of matter both exert repulsive force on one another then at least one of those parts must be movable. Since it is arbitrary which part we regard as mover and which we regard as moved, we can in fact infer that both parts are movable and by generalisation infer that all parts of matter are movable.

Finally, we can turn to consider the substantiality of matter. Explication 5 of the Dynamics tells us that:

> Material substance is that in space which of itself, i.e. separable from all else existing outside it in space, is movable. The motion of a part of matter whereby it ceases to be a part is separation. The separation of the parts of matter is physical division. [Ak 502-3]

Then in the Observation on this Explication, which is really the proof of the substantiality of matter, Kant argues that both matter taken as a whole, the plenum filling space, and

all the parts into which matter as a whole can be physically divided are substances. Now the argument which Kant gives here is really very puzzling. Kant tells us that:

> The concept of substance signifies the ultimate subject of existence, i.e. that which does not itself in turn belong merely as predicate to the existence of another. Now matter is the subject of everything in space that can be counted as belonging to the existence of things; for, besides matter no subject would otherwise admit of being thought of except space itself, which is, however, a concept that does not contain anything at all existent but contains merely the necessary conditions of the external relations of possible objects of the external sense. Therefore, matter as the movable in space is substance therein. [Ak 503]

Furthermore:

> ....just in the same way, all parts of matter, will likewise be substances in so far as one can say of them that they are themselves subjects and not merely predicates of other matters, and hence these parts themselves will in turn have to be called matter. They are themselves subjects if they are of themselves movable.... [Ak 503]

From these considerations Kant draws the surprising conclusion that "Therefore, the proper movability of matter or any part thereof is at the same time a proof that this movable thing, and every movable part thereof, is a substance" [Ak 503]. What makes this conclusion surprising is that Kant is introducing an entirely new idea here. Kant's

point at the end of the argument is that matter is a substance because matter is movable but earlier in the argument, his point is that matter is a substance because matter is "the ultimate subject of existence".

Now, it is the idea that matter is a substance because it is movable which is expressed in Explication 5, to which this Observation is an accompanying commentary. Kant's introduction, in the Observation, of the idea that matter is a substance because it is "the ultimate subject of existence" seems to be an unfortunate distraction. As a distraction it is unfortunate because the suggestion that since a substance is a subject which cannot be a predicate of anything else and matter is a subject which cannot be a predicate of anything else, so matter is a substance is an entirely illegitimate and unacceptable suggestion for Kant to make. This idea is unacceptable because it is in conflict with one of the major doctrines of **CPR**, the doctrine of the Schematism. As we saw, in chapter 3 above, the pure or unschematised category of substance is the concept of an "ultimate property bearer", i.e. a bearer of properties which cannot itself be borne by any other subject. In contrast to this the schematised category of substance is the concept of a perduring ultimate subject of existence. Now these two concepts are not co-extensive and, more importantly, according to Kant in the **CPR** the unschematised category is a concept of which we can make no use. According to **CPR** it is only the schematised

categories, and not the unschematised ones, that we can employ and apply in experience. And yet, the suggestion here seems to be precisely that matter is to be identified as substance in space by appeal to the unschematised category of substance.

Fortunately, though, there is the other, much more appropriate line of thought according to which matter is the movable in space and is a substance in virtue of its movability. In chapter 3 we saw that activity is the empirical criterion of substance, and above we noted that the only activity in space is motion [Ak 542] so that, since substance is only possible in space, strictly speaking movability is the empirical criterion of substance. Now matter is indeed movable and hence, by appeal to the empirical criterion of substance, we can legitimately conclude that matter is a substance. Moreover, as we saw in connection with the infinite divisibility of matter, every part of matter, part in to which matter can be divided, is itself movable so that every part of matter will itself be a substance.

[6-4] THE QUANTITY OF MATTER

In chapter II of **MFNS**, the "Metaphysical Foundations of Dynamics", Kant tells us that:

> the first application of our concepts of quantity to matter whereby there first becomes possible for us the transformation of our external perceptions into the experiential concept of matter as object in general is founded only on matter's property of filling space. [Ak 510]

From this it would appear that by a quantity of matter Kant has in mind a certain intensive magnitude, namely the intensity of forces filling a space. In chapter III of **MFNS**, the "Metaphysical Foundations of Mechanics", however, Kant tells us that:

> The quantity of matter is the number of its movable [parts] in a determinate space. [Ak 537]

For the purposes of mechanics, a concept of the quantity of matter is required which will allow a body's moving force or momentum to vary in proportion to its quantity of matter. From this perspective, Kant thinks, what must be estimated in estimating the quantity of matter in a body is the number of a body's movable or external parts. As Kant stresses in the Observation accompanying the proof of Proposition 1 of the "Mechanics":

> That the quantity of matter can only be thought of as the number of movable parts (external to one another), as the definition expresses it, is a remarkable and fundamental statement of universal mechanics. For thereby is indicated that matter has no other quantity than that which consists in the multitude of its manifold parts external to one another.

> Consequently, matter has no degree of moving force with given velocity such that this degree might be independent of the aforementioned multitude and might be regarded merely as intensive quantity. [Ak 539]

As far as mechanics is concerned it is only the quantity of matter qua number of movable parts which is relevant. Matter, we have seen, is, according to Kant, a continuum of forces filling space. This continuum, he further maintains, is divisible into movable parts, each of which is a volume of forces and, because of its movability, a substance. The position Kant wants to maintain in the "Mechanics" is that matter is to be quantified in terms of the number of its parts, i.e. the number of substances or volumes of forces of which it is composed, and that a quantity of matter, as far as mechanics is concerned, is a number of substances or volumes of forces. Kant, however, realised that the quantification of matter in terms of the number of its parts was not straightforwardly forthcoming, given his Mathematical-Dynamical conception of matter. For matter, on this account, is not merely divisible into parts, but is infinitely divisible. As infinitely divisible, there is no limit to the number of parts into which matter can be divided and the number of parts of matter is, strictly speaking, indeterminate. Unlike the Mathematical-Mechanical account of matter, the Metaphysical-Dynamical account provides no natural metric for the quantification of matter in terms of parts.

Furthermore, since Kant maintains that the divisibility of matter extends as far as the divisibility of space, the number of parts of matter in a body, and hence its quantity of matter, will be proportional to its volume. It is in order to avoid this proportionality, to divorce the quantity of matter in a body from its volume, and to avoid the indeterminacy of quantities of matter, that Kant introduces his mechanical procedure for measuring quantities of matter.

To this end, Kant specifies that:

> The quantity of a matter can be estimated in comparison with every other matter only by its quantity of motion at a given velocity. [Ak 537]

In other words, Kant is suggesting that the momentum, or moving force, of a body should be treated as "operationally" prior to its quantity of matter and that the quantity of matter in a body should be determined in the light of its momentum[7]. If we treat momentum as fundamental, then when the velocities are constant, we can measure the quantity of matter in one body, A, relative to another body, B, and determine that, say, the quantity of matter in A is greater than the quantity of matter in B. When the momentum of A is twice the momentum of B and the velocities of A and B are equal, then the quantity of matter in A will be twice the quantity of matter in B. Such determinations of quantities of matter will, of course, only be relative determinations of

quantities of matter, that is, a determination of the quantity of matter in one body relative to the quantity of matter in another body. The determination of such relative quantities of matter will, furthermore, require the ability to compare the moving forces of bodies moving at the same velocities. Kant unfortunately gives no indication of how such moving forces are to be compared.

Momentum, or quantity of motion, Kant maintains, is to be measured in terms of mv, the product of quantity of matter and velocity. Kant acknowledges that there does indeed seem to be a circularity involved in maintaining that quantity of matter is to be determined by appeal to momentum and that momentum is measured by the product of quantity of matter and velocity but seeks to evade the circularity by claiming that while the former is indeed the explication of the concept of quantity of matter, the latter is not the explication of the concept of momentum but rather "the explication of the application of the concept (of the quantity of matter) to experience" [Ak 540 parentheses added]. In other words, it is by appeal to a body's momentum that its matter can be quantified:

> The quantity of the movable in space is the quantity of the matter, but this quantity of the matter (the multitude of the movable) manifests itself in experience only by the quantity of the motion at equal velocity. [Ak 540]

Quite rightly, Kant here intends that what we encounter in experience are not multitudes of substances or multitudes of movable parts but bodies and bodies causing changes in one another. This is the given about which we endeavour to construct a theory. The first step in our theory construction, construction of a mechanical theory, is to quantify over the changes bodies cause. This gives us the concept of moving force or quantity of motion. Given the momenta of bodies we can then extrapolate the quantities of matter in those bodies by dividing the momenta by the velocities. But if such an account is to be even remotely plausible, some indication must be given for how the momenta of bodies are to be determined. And this, we have noted above, is conspicuously absent in Kant's account.

[6-5] THE CONSERVATION OF MASS

It is frequently charged against Kant that in establishing the conservation of matter Kant does not succeed in establishing the conservation of mass, although he seems to think that he does. This suggests on the one hand an inconsistency or incoherence in Kant's account, and on the other hand a serious deficiency, since Kant really ought to establish the conservation of mass. Kant ought to establish the conservation of mass, it is thought, because since the advent of Newton's Principia it is mass and not quantity of

matter which occupies centre stage in physics. Furthermore Newton thought that mass was conserved and if the a priori physics of **MFNS** is to underwrite Newton's physics then it must legitimate Newton's espousal of the conservation of mass.

It is certainly true enough that Kant's demonstration of the conservation of matter neither demonstrates the conservation of mass nor entails the conservation of mass, where mass is understood in the way Newton understood it, that is, as a body's force of resistance to changes in motion. But Kant is under no illusions on this point. Although **MFNS** is indeed intended to underwrite Newton's physics, it is intended to do this, in part, by replacing unacceptable metaphysical presuppositions with acceptable ones. One of these presuppositions we have seen to be the atomistic conception of matter. Another unacceptable, in Kant's eyes, Newtonian presupposition was that mass is a force of resistance. Kant rejected entirely the idea of inertial force, declaring that:

> The designation force of inertia (vis inertiae) must....in spite of the famous name of its originator, be entirely dismissed from natural science. [Ak 550]

For, Kant argued:

> Nothing but the opposite motion of another body can resist a motion, but

> this other's rest can in no way resist a motion. Here, then, inertia of matter, i.e., mere incapacity to move of itself, is not the cause of a resistance. A special and entirely peculiar force merely to resist, but without being able to move a body, would under the name of a force of inertia be a word without any meaning. [Ak 551]

Worse still, Kant argued, the postulation of the force of inertia "would result in the fact that the motion in the world would be consumed, diminished, or destroyed" [Ak 550] since, in any communication of motion, a body must expend and lose some of its motion in overcoming the inertial force of the other body. The inertia of matter, according to Kant, "is and signifies nothing but its lifelessness" [Ak 544], that is, its incapacity to move itself.

In so far as Newton identified the concept of mass with that of inertial force, Kant rejected Newton's conception of mass and did not seek to demonstrate its conservation. Furthermore, Kant, unlike Newton, attempted to distinguish between the quantity of matter in a body and its mass. In the Observation accompanying Proposition 1 of the "Mechanics", Kant tells us that:

> As to what concerns the concept of mass in the same Explication (i.e. Explication 2) it cannot, as is usually done, be taken to be the same as the concept of quantity (of matter). [Ak 540 parentheses added]

All that Kant tells us by way of explanation of the distinction between the concepts of mass and quantity of matter is that:

> The quantity of matter is the number of its movable [parts] in a determinate space. This quantity, in so far as all its parts in their motion are regarded as simultaneously active (moving), is called the mass, and one says that a matter acts in mass when all its parts move in the same direction and at the same time exercise their moving force externally. [Ak 537]

In other words, the concept of mass is the concept of a quantity of matter in motion, or a body with moving force[8].

[6-6] CONCLUDING OBSERVATION

Although Kant clearly conceives of his "Dynamics" as grounding and making possible his "Mechanics", he really tells us almost nothing about how dynamical laws are presupposed by mechanical ones [Ak 537]. Indeed the dynamical character of matter is barely invoked at all in the discussions of the three laws of mechanics.

This is perhaps not surprising given, the inadequacy of the dynamical account of matter for mechanics. But this does give rise to a particularly awkward tension in Kant's position. On the one hand, Kant has argued strenuously in

chapter II of **MFNS** that the dynamical account of matter provides the only really possible subject matter for mechanics. Dynamism was more than merely Kant's preferred ontology and more than a mere hypothesis which rivalled the atomists' hypothesis[9]. Mechanics is essentially the study of the communication of motion and, hence, the causal relations between bodies. On the dynamical account of matter these communications of motions and causal relations are between bodies which are nothing more than volumes of attractive and repulsive forces. On the other hand, as we have seen above, and as Kant himself at least realised in part, the dyna ical conception of matter put forward by Kant is really quite unsuitable for mechanics.

ENDNOTES

[1] In Butts (Ed.), *Kant's Philosophy of Physical Science* [pp 25-60].

[2] At the very end of the Dynamics chapter, Kant acknowledges that the (logical although not real) possibility of empty spaces cannot be disputed but maintains that:

> no experience, inference from experience, or necessary hypothesis for explicating empty spaces can justify us in assuming them as actual. [Ak 535]

[3] Kant also talks about "matters" and sometimes "a matter" by which, again, he sometimes means matter taken as a whole and sometimes parts of matter.

[4] *A Theory of Natural Philosophy* (1758).

[5] For example L. W. Beck in his Introduction to his translation of Kant's *Physical Monadology* in Beck (Ed.), *Kant's Latin Writings* and C. D. Broad in "Kant and Psychical Research" in his *Religion, Philosophy and Psychical Research.*

[6] In **MFNS** Kant conceives of matter as a continuum of forces rather than an aggregate as he maintained in the *Physical Monadology.* A comparison of proposition II of the *Physical Monadology* with the last sentence of Observation 1 accompanying Proposition 4 in **MFNS** is instructive on this point: in the *Monadology* Kant writes "Bodies consist of monads .... A body, therefore, consists of absolutely simple

primitive parts, i.e. monads." [Ak 477] whereas in the **MFNS** he says ".. as regards something infinitely divisible, there can be assumed no actual distance of parts, which always constitute a continuum as regards all expansion of the space of the whole, although the possibility of this expansion can be made intuitable only under the idea of an infinitely small distance" [Ak 505].

[7] Kant does actually suggest another way for determining the quantity of matter in a body, namely by appeal to attractive force or gravity: "original attraction, as the cause of universal gravitation can indeed provide a measure of the quantity of matter and its substance (as actually happens int he comparison of matter by weighing)" [Ak 541]. But this account, although it receives more treatment in the *Opus Postumum*, is completely undeveloped by Kant in **MFNS** and seems to be only mentioned in order to stress that, contrary to first impressions, even on this account the determination of the quantity of matter in a body is a mechanical and not a dynamical concern [Ak 541]. Many of the details of what a developed version of this account would look like, and how Kant's account differs from Newton's, are worked out by Michael Friedman in his "Metaphysical Foundations of Newtonian Science".

[8] Whether or not Kant's attempted separation of the concepts of mass and quantity of matter is judged to be acceptable (and it has been argued by Okruhlik, "Ghosts in the World

Machine: A Taxonomy of Leibnizian Forces", that it is not) the point still stands that Kant did not intend to establish the conservation of Newtonian mass.

[9] As suggested by Brittan in *Kant's Theory of Science* [p 153] and "Kant's Two Grand Hypotheses" [p 85] and Martin in *Kant's Metaphysics and Theory of Science* [pp 56-60].

CHAPTER SEVEN: CONCLUSIONS

This dissertation has endeavoured to present a case study in Kant's account of the a priori foundations of natural science, in order to evaluate his claim that natural science has such principles as foundations. Our case study has focused on PCM, the principle of the conservation of matter, and we have assumed that if this particular principle is indeed a principle of physics, and it can be shown to be a priori, then it will be reasonable to conclude, in company with Kant, that physics does indeed have a priori principles.

Although PCM is not a principle of contemporary physics, in our examination of Newton's physics in chapter 2 above, we saw that it was indeed a principle of what we now refer to as classical physics. In other words, PCM was indeed a principle of the physics with which Kant was acquainted and the physics which he thought and attempted to argue had a priori foundations. Kant's claim that PCM is an a priori principle, we saw in chapter 1, amounted to the claim that the warrant or justification for judging matter to be conserved is of a certain kind, i.e. an appeal to the essential nature of thought. In bare outline the warrant for maintaining that matter is conserved is that matter and all the parts of matter are substances and substances are permanent.

Because the claim that PCM is a priori amounts to the claim that it is warranted or justified in a certain kind of way, an assessment of whether PCM really is a priori, and

whether Kant's identification of it as a priori is correct or not, requires an examination of the justification which Kant provides for it. In so far as Kant provides a sound argument in support of PCM, the strength of the claim that PCM is a priori will depend on the strength of the a priori status of that argument's premises. However, in so far as the justification and argument which Kant provides in defence of PCM is inadequate and does not satisfactorily demonstrate PCM, Kant really cannot appeal at all to PCM in order to support the claim that physics has principles which are a priori.

In claiming that PCM is an a priori principle, Kant, we saw, was not committed to assimilating this and other principles of physics to the principles of the Understanding articulated in **CPR** and according them exactly the same a priori status. In addition to the textual evidence we adduced in chapter 1, for attributing to the principles of the Understanding the status of "pure" a priori principles, and the status of "impure" a priori to the principles of physics, it is clear from the warrant for PCM that we have sketched above that PCM cannot be on a par with the principles of the Understanding. For, the warrant for PCM contains an irreducibly empirical element, viz., the reference to matter, which would be quite inadmissible in the case of principles of the Understanding. Similarly, although we must regard substances as permanent, the necessity which attaches to our

regarding substances as permanent is not the same as the necessity which attaches to our treating matter and the parts of matter as substances.

Kant's argument in defence of PCM, we have seen, is really quite disappointing and falls far short of establishing his conclusion. In chapter 2, we analysed Kant's argument in defence of PCM as an argument from (i) the quantification of matter in terms of the number of force-filled regions of space, (ii) the substantiality of matter and (iii) the permanence of substances. Kant's Metaphysical-Dynamical conception of matter, we saw in chapter 6, was really quite inadequate for the purposes of providing a metaphysical foundation for Newtonian mechanics in so far as it did not provide an account of matter which could be quantified in such a way that a body's moving force would vary in proportion to its quantity of matter. Although Kant attempted to get around this difficulty by specifying an "operational" procedure for quantifying matter, dynamically conceived, his suggestion there is too incomplete to be judged as successful.

In chapter 3 we constructed an argument, on Kant's behalf, in defence of his claim that substances are permanent and perdure throughout time. This argument took the principle of the First Analogy of Experience, the principle that all changes are alterations of substances, as a premise, and in

chapter 4 we examined what grounds Kant provides for believing this premise to be true. Although Kant was seen to have good grounds for maintaining that all changes are alterations, he was not seen to have good grounds for maintaining the stronger claim that all changes are alterations of substances. Consequently, it cannot be said that Kant's insistence that substances are permanent, i.e., exist at all times, is warranted.

The upshot of this is that Kant's appeal to PCM as an instance of an a priori principle of physics and as illustrating that physics does indeed have a priori principles, must be rejected as unpersuasive and unconvincing. From the failure to illustrate the a priori character of PCM, one cannot, of course, conclude that therefore physics does not have a priori principles. One cannot even conclude that therefore PCM is not an a priori principle. The most one might conclude is that the case for physics having a priori principles and the case for PCM being such an a priori principle was not satisfactorily made by Kant.

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