What is a Body in Kant's System?

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1. The reason for this inquiry.

I think it is my first duty to explain why I have chosen to inquire into the place and meaning of body in Kants' system.

I would like to begin by calling on an essay by Kant entitled "Concerning the Noble Tone of Late Raised in Philosophy." In this essay Kant points to Plato and Pythagoras as the partly unwitting progenitors of those who philosophize in a certain elevated and enthusiastic mode. "The philosophy of Aristotle, on the contrary, is work" he goes on to observe in sober praise. And he calls Aristotle an extremely prosaic philosopher," adding that "at bottom, after all, all philosophy is prosaic." What characterizes Aristotle's philosophical work is that it is an acute and serious analytic and synthetic labor performed by the pure intellect, resulting in a usable product, such as a preliminary table of categories, (B 107), which provides the materials for a later worker to employ systematically (B 107).

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* A: Critique of Pure Reason, First Edition (1781),

B: Critique of Pure Reason, Second Edition (1786).

FMM: Foundations of the Metaphysics of Morals (1785).

MFSN: Metaphysical Foundations of Natural Science (1786), trans. James Ellington (Library of Liberal Arts, 1970).

MFDR: Metaphysical Foundations of the Doctrine of Right (1797).

OP: Opus Postumum, Kant's Gesammelte Schriften, Preussische Akademie (1936) v. 21; (1938) v. 22.

KOP: Kant's Opus Postumum by Erich Adickes (Berlin 1920).

I have begun by citing this essay because my inquiry will unavoidably issue in the question whether philosopy should be prose and work or perhaps something else. And furthermore I feel obliged to set off the spirit of my present undertaking from that of philosophical work. For I came on my question concerning body not at all in the orderly progress of finding and accomplishing a task, but in a most unsystematic or anti-systematic way: by attending to certain particular sections and sequences in Kant's work which struck me with a sense of amazement and revelation as well as a conviction that through these passages there might be access to the unfounded foundations of Kant's edifice. As a result it now seems to me that the marvel of Kant's thought lies in this very circumstance -- that in the name of systematic completeness it throws open depth upon dizzying depth of inquiry.

Let me begin by setting out the items of my conviction and by showing how they all implicate body in the crux of Kant's effort.

2. The ends of the Critique of Pure Reason.

The first of such clues comes out of the very plan and the implied ends of that encompassing systematic edifice, the Critique of Pure Reason.

This first of Kant's three critiques has two great ends. The central end is "critical" in the proper, ordinary sense: human reason is exposed as a faculty for a definite and inevitable system of illusions. In striking these down, Kant makes a

clearing for the possibility of disillusioned human action, performed in the face of the defects of human reason. This possibility is worked out in the second critique, the Critique of Practical Reason.

The encompassing task, however, is Kant's review of the grounds of human knowledge. Such a review is called a "critique" in a sense more peculiar to Kant, and its determined end is the certification of what we call, simply and grandly, "science", and in particular, of physics, as the single truth-producing effort. To say the same thing in other words; the positive critical enterprise is the establishment of "experience." Experience is the joining of the grasp of understanding with some "empirical" matter, meaning something which comes to us, in part, adventitiously, something which is given to us. This product, a grasped given thing, meets precisely Kant's quite traditional notion of truth as "adaequatio intellectus rei," the fitting of thought to thing (B 82). I shall have to return to this definition of truth.

The Critique of Pure Reason, then, not only clears the decks for the practical use of our reason, but also provides the foundations for its theoretical use, and this latter part contains the great positive discoveries of the book. It was in considering this two-fold positive and negative end of the work that I had a first feeling of having come on an enigma. Let me explain.

The first critical system, that which underlies theory, is said to be perfectly complete. Its metaphysical superstructure is a mere work of fleshing out, to be left largely to pupils.

Philosophy is essentially finished (B 884). The second critique, the Critique of Practical Reason, most explicitly contains no new truths nor any promise of new truths; it merely formulates the full meaning of what, according to Kant, we all know even before any philosophical intervention: that we must do as we ought rather than as we want if we are to respect ourselves (FMM, Sec. I). Therefore its effect on our lives is not to give them a content but only a form: whatever we do, we must do it as beings whose reason is a ruler. Hence neither of these two critical systems presents in itself a working project for human reason.

The theoretical enterprise which is founded in the first critique, does, on the other hand, provide our lives with an infinite and legitimate business, namely physical science. Now having expended a truly enormous effort on well-founding such work and on showing that reason has no other, does Kant glory in its beauty, praise its pleasures, demand that its modes inform public and private life? In Plato's Timaeus, for instance, which, anachronistically and inaccurately speaking, also contains a theory of science, the enterprise is accepted by Socrates as "a feast of accounts" (27 b) and a celebration. So completely does Kant omit all comment on the human significance of this single vast permissible use of the human understanding that his omission arouses suspicion of an issue too deep in the foundations of the system for passing explanation.

I shall state right away that I believe there to be evidence, not peripheral and finicking, but bold and central, that in Kant's system physics as the science of bodies does

indeed play a central human role, for it is the one access we have to our own souls, and provides all the self-knowledge we can have. I cannot tell why Kant never explicitly drew attention to this circumstance in all its pathos, except by noting that all great philosophical works that I know have these telling lacunae, junctures too sensitive, deep and dangerous to bring out in words.

3. The grand design for the deduction of physics.

Let me now adduce somewhat more external evidence for the overwhelming importance which the science of bodies has in Kant's system by sketching out the intention not of one work, but of a sequence of three works which largely occupied his later years. This sequence contains a grand design for the deduction of empirical physics, an apparent contradiction in terms, which the setting out of the design will be only partly able to reconcile.

The first of the texts in question is again the Critique of Pure Reason and within it the section called the "Principles of the Understanding." One form of the principal proposition of the understanding is: "The conditions of the possibility of experience in general are at the same time conditions of the possibility of the objects of experience." (B 197). That is to say, the foundations of science are simultaneously the conditions of its objects, namely bodies, so that physics and bodies are established together. Both are the ultimate result of the same long deduction. The "Principles of the Understanding" only establish experience and its objects in general. By "in general" Kant means a priori, "from the first"; objects are a priori insofar as they have from the very first a form of which we ourselves are the source and which precedes any empirical addition.

Such general objects are called things, and in their proper complex of lawful relations, they are called nature.

The next work in the sequence, which is in the grand critical design parallel to the work on the metaphysics of morals named Metaphysical Foundations of the Doctrine of Right and Virtue (5), is called the Metaphysical Foundations of the Science of Nature. In this work the outline of the metaphysics of physics is laid down. By a "metaphysics" Kant means the plan of a completed system of pure rational cognition proceeding by specification from the critical preparation. The metaphysics of nature (or of physics -- again, the object has the same foundation as its science) is therefore the specification of the "general object" established in the first Critique by the introduction of an empirical concept, namely matter understood as the "movable in space". And so we have a "metaphysics of corporeal nature" or a "doctrine of body" (MFSN 469), a pure science resulting from the application of the transcendental principles to an empirical concept. (Here a note on the terms "pure", "a priori", and "transcendental" seems appropriate. All three are privative and mean respectively only this: free of, before, and beyond all sensation.)

I shall give the contents of the Metaphysical Foundations in briefiest outline and return to the work later. In it matter, the movable in space, is treated under four headings: 1. insofar as it is merely movable, 2. insofar as it fills space, 3. insofar as it moves other matter, 4. not as it is an object of experience, but as it is related to a knower, a subject, and his faculties of knowledge.

I should add that the title of this work, of which a reasonable alternative translation is the "Metaphysical Principles of Natural Science," also indicates a corrective purpose beside the positive systematic one. It is intended to oppose the implications of the title Newton gave to the work in which he presented the very physics Kant is grounding: the Mathematical Principles of Natural Philosophy. Kant will contend emphatically that it is not mathematics which furnishes the principles of philosophy, but, in a carefully limited sense, the converse -- mathematics is not usable in natural science without a metaphysical foundation. (OP 21, e.g., 72).

When we come to the third work in the critical design, there is no longer a parallel text dealing with the metaphysics of morals. This is in a most general way quite understandable, for the theory of practice by its very natures comes to an end in deeds, whereas the theory of experience issues in further theory. In any case, in his old age Kant was preoccupied principally with making notes for what he expected to be his most important work (KOP, 3), the completion of the deduction of experimental physics. This enormous agglomeration of notes, including also much other material, became known as the Opus Postumum. Kant called his projected work the "Transition from the Metaphysical Foundation of Natural Science to Physics." His great concern was that there should be no jump or discontinuity in the systematic deduction of the empirical investigation of corporeal nature. (I should note here that the word 'deduction' is mine, not Kant's, and that I am using it, legitimately, I

think, in the sense in which one might speak of the deduction of Euclidean from projective geometry, meaning a specification of general principles to yield a more particular system.)

What Kant intended to provide in this "Transition" was an anticipation of all the possible findings of physics, an anticipation which he considered possible by virtue of its systematic character, and necessary to its preservation.

This is certainly the place to interject the long-deferred expoanation of what Kant means by a "system". Kant's metaphor for a system is that of a work of architecture, in which the foundations, the groundwork, determine a unified superstructure. The non-metaphorical description is in terms of principles and their ruling power; a system is a universe pervasively formed by its fundamental laws, which determine at once the nature of its parts and their relations. I whould add that for Kant thought is such that to think and to make systems are one and the same operation.

To return to the "Transition to Physics". The anticipation of physical inquiry amounts to an exhaustive classification of all conceivable forces, forces being the ultimate concern of physics, as we shall see. Such a "topic" of forces is intended to direct and regulate all future investigation (OP 21, e.g., 640). I shall not go into this classification very far, because there is a sense of failure over the whole unwieldy enterprise, due both to Kant's failing powers and, again as we shall see, to the inherently limitless and self-defeating character of the attempt to direct experimentation a priori.

Aside from corroborating that the impulse and concern of Kant's system really is the science of bodies, the Opus Postumum is most intriquing for the telling glimpses it gives of the motives of this concern. The "critical" aspects of the Opus are dominated by the theme of self-determination, self-affection, and self-knowledge, by the way in which I myself become the "proprietor and originator" of my world. Kant himself makes an elliptical statement concerning this matter well worth quoting (OP 22, 73):

> First the consciousness of oneself as a faculty of representation, second the determination of oneself as a function of oneself, namely a force (vis) of representation. Third the appearance of oneself as a phenomenon, as a manifold of representation: a thoroughgoing determination of oneself, but only as appearance and not as a thing in itself; objectively = x, but as the subject is affected by the understanding: knowledge of oneself through self-determination in space and time." (my italics)

The importance of this passage to my exposition becomes clear if I anticipate myself by stating that self-determination in space and time is precisely physics -- the science of body is the science of self.

I shall however base my argument for this statement not on the Opus Postumum, but on the vigorous and completed works published by Kant himself.

4. The importance of body in the Critique.

Having sketched out in a very external way the deduction of physics through three works, I must now return to the importance of body within the Critique of Pure Reason. To make my argument I must give a very brief review of certain fundamental critical items.

In accordance with the notion of truth set out before, the human soul contains two great faculties. When I say "I think", I mean that I perform a fixed number of definite functions. The system of these operations of thought, which Kant terms "categories", is called the "understanding", which grasps or conceives an object. It is the first faculty. The second faculty is receptive; it provides the form under which what is given to be grasped can be received. It is called the "sensibility" and yields, in Kant's term, "intuitions", sights. This passive faculty is Kant's most crucial critical discovery. It is not strictly speaking a "faculty" at all but a formal receptacle for "sensation", which is Kant's term for whatever is adventitious in human experience. But, again paradoxically, it also contains an a priori given, a "pure intuition" or transcendental material, a pure structure of relations, as it were.

The sensibility, in turn, has two aspects or faces, an outer and an inner sense. I shall leave the outer sense, which Kant terms "space", for later and now describe briefly only the inner, which Kant terms "time".

Time is nothing but our capability for receiving our own original transcendental self, that is, our thinking self, as an appearance. It is "the intuition of ourself and our inner condition".(B 49). "Every act of attention can provide us an example" (B 157) of the act of self-affection in which we appear to ourselves. And when we examine the character of our intuition of ourselves as originators of thought we find it to have the form of a flow of "nows"; consciousness is precisely the

stream we call time; to appear to myself means to activate or determine my sense of time.

Here I must interject a note on the particular text which I am going to deal with. The part of the Critique which is the prime source of what follows is that section called the "Analytic of Principles" of the understanding. Here those two totally disparate faculties, the understanding and the sensibility, are brought together by a third power, hidden and mysterious (B 181), which Kant terms the "imagination."

By means of this faculty the understanding (Categories) grasps, or casts itself (Temporizes) into, the pure formal material available in the sensibility -- but only into its inner sense, only into time. The products of this injection of thought into time are called "schemata". Thus schemata are thought-informed structures of time, or, equally, temporalized operations of thought. The example of a few schemata will make immediately plausible the claim that they are nothing but the pattern under which our thinking appears to ourselves. For instance, our consciousness is understood by us to be fuller or emptier down to vacancy -- here we have the appearance in time of that function of the understanding called the category of reality, which is the thought-function corresponding to a given object; the resultant temporal thought structure is the schema of something insofar as it fills time, the waxing and waning materiality of our consciousness (B 182). So also our consciousness itself subsists: "Time itself does not run out, but in it the existence of what is mutable runs on" (B 183) -- here we have the appearance of the category of substance in time, and the resultant schema is

that of the permanence of something real in time. In a like way those familiar and inevitable patterns of our temporal thinking by which we discover in everything we consider accumulations of moments of attention, namely number, and contemporaneous mutual action, namely simultaneity, and rule-governed succession, namely cause and effect.

Time schema

With the schemata set out, the principles of the understanding are then simply a set of fundamental rules. These rules demand that, and also tell how, these time-involved categories must now in turn be introduced into space, so that an object of "experience", which means of truth or of science, may arise. They are then, in accordance with the principle of principles quoted before, at the same time the rules for the constitution of the objects of experience and for any possible true account of them.

This peculiar sequence, in which the categories are first brought together with time and only then with space, indicates that time is the sense of senses, the primary form in which everything that presents itself to us at all first appears:

> "But since all representations, whether they have outer things as objects or not, belong in themselves, as determinations of the soul, to the inner state, while this inner state belongs...to time, it follows that time is an a priori condition of all appearance in general, that is, the immediate condition of the inner appearance (of soul) and because of this also the mediate condition of outer appearances." (B 50).

And yet there is no science of the soul appearing in time as there is a science of the body appearing in space. Nominally, the science of nature, as the study of all appearances, includes

both, but Kant makes it very clear that there is not now and never can be a science of soul, a psychology. The reason is not merely that other thinking subjects will naturally not submit to, or if they do, will not remain unaffected by, our investigations; rather it is inherent both in the poverty of time itself and of the lawless variability of its contents (A 381).

Kant claims (we shall see later why) that science is such only insofar as there is mathematics in it, preferably geometry. Now the geometric image of time is the flowing line of single dimension, which shows how poor psychology must be mathematically when compared to three dimensional space (MFSN 471). It follows that no self-knowledge of interest can come through the study of soul as it appears. I must add that Kant forcefully proves that it is an illusion of reason to think that the soul can know itself as it is in itself (B 399ff.). Self-knowledge seems to be altogether precluded.

And now we must look at two sections Kant added to the "Analytic Principles" in the second edition of the Critique, the "Refutation of Idealism" and the "General Note to the System of Principles". In these additions Kant endeavors to supply a place where we may look to see ourselves fully and satisfyingly. This place is the outer sense, space.

The outer sense is the second face of our sensibility, a receptive form for all that is other than ourselves, for all that comes from the outside to affect us, for sensation proper. But outer sense is also, in inexplicit but apt reflection of this

purpose, the source of the most telling feature of all the objects within it, which is that they have their parts outside and beside one another and are extended in three dimensions. Thus it is the very structure of the form of outer sense which not only guarantees but even requires that spatial objects shall be subject to geometry -- hence Kant's requirement that natural science be geometric is really the same as his claim that it can only arise in space. (It is of course also numerical, since all the contents of outer sense appear in inner sense or time as well, and number, it will be remembered, is a time schema.)

To return to the additions to the text with which Kant decided to conclude the section on the application of the temporalized categories to space. Here he says that it is noteworthy that "in order to understand the possibility of things according to categories, and so to display the objective reality of the latter, we need not only intuitions, but even always outer intuitions" (B 291). So, for instance, in order to give objective reality to the concept of substance, we need an intuition in space, namely matter, because that alone determines permanence, while time is in constant flux. Even to grasp our own changing consciousness we need to imagine it as a line in space and "the real reason for this is that all alteration presupposes something permanent in the intuition, but that in inner sense no permanent intuition at all is to be met with." (B 292). And Kant concludes: "This whole observation is of great importance... in order to indicate to us the limitations of the possibility of such knowledge whenever there is talk of self-knowledge out of mere inner consciousness and the determination of our nature without the aid of outer empirical intuitions." (B293).

Outer empirical intuitions are, as we shall see, bodies. Kant is therefore saying that bodies are the necessary conditions of our steady presence before ourselves. They are the sole place where we appear to ourselves and in them lies our substance.

* It should be noted that this strange outcome is at least consonant with Kant's peculiar understanding of outer appearance. For when sensation comes to us from what might be called the absolute outside to fill our sensibility, the resulting appearance in no way belongs to the alien source of that sensation and is quite incapable of indicating anything concerning the nature of that source which Kant calls the "thing in itself". It is rather the case that the appearance, the shaped sensation, is entirely formed by us; one might say that sensation itself adds nothing but the fact of our being affected, the mere activation of the subject (B 207). *

5. The use of the term body.

At this point I would like to interject an observation on the word 'body' which I have used in posing my question: What is a body in Kant's system? Kant himself calls the science founded in the Metaphysical Foundations of the Science of Nature a "doctrine of bodies", so the word seems perfectly appropriate. And yet it is not a weighty word, or one of consequence, in the Kantian text. Let me give its definition in the Foundations (MFSN 525): "Body is a matter between determinate boundaries (and such matter therefore has a figure)." A quantity of moving matter is called a mass, and so a mass of determinate shape is

also called a body (537). Body is therefore a mere delimiation of matter; amorphous matter is the basic, pervasive object of interest, whose concept is to be expounded.

Nonetheless I want to hold on to the word body, for the sake of displaying a consequence of the insistence on founding the science of bodies metaphysically. This is the starting, non-plussing disappearance of that inert lump which moves by effort, that shapely solid, that handy repository of trust, that constant object of our most solicitous care, that terminus of an attraction or revulsion (wholly different from the forces of similar name into which Kant will resolve matter), that whole which antecedes all distinction of form and matter, that possible seat of soul which most of us mean when we say 'body' and which first excites the inquiry into bodily nature called physics.

* A note to point up the omission of body in its immediate organic sense from Kant's system. I here mean that body which is a living, sensate center of interpretation of other bodies as alive or dead. Kant never, to my knowledge, treats the relation of such a body as my own to the transcendental outer sense, to space. In a little work in which the relation of body and soul is indeed discussed, the letter on the "Organ of the Soul", he says:

> "For if I am to make the place of my soul, that is, my absolute self, intuitable anywhere in space, I must perceive myself through that very same sense through which I also perceive the matter which surrounds me, just as happens when I want to determine my place in the world as human being, namely that I must observe my body in its relation to other bodies without me. -- Now the soul can perceive itself only through inner sense, but the body, be it internally or externally, only through outer senses and so can simply determine

> no place for itself, because for this purpose it would have to make itself an object of its own outer intuition and would have to place itself outside itself, which is self-contradictory."

Let me first comment on this passage insofar as it seems to contradict the "Refutation of Idealism" in the Critique. For in that too there is no indication that I am to determine myself as a human being in a certain place within outer sense or space, but rather the outer sense as a whole contains the stuff which makes my self-appearance possible.

But further, note the problem which Kant evades: My body as an outer appearance has a very special character -- it is a kind of sink hole of sensation; all sensation streams toward it and all existence or non-existence is controlled from it (as when I close my eyes). This is a difficulty for Kant's outer intuition, since it, like Newton's divine "sensory" of infinite space (Optics, Qu. 28) ought to be homogeneous, isotropic (the same in all directions), and continuous, while my body and its instrument-like sensory organs represent a point of discontinuity, of preference, and a warping of space. Hence it does appear to behave like a seat of soul, and this consideration cannot be accommodated in Kant's system.*

6. The constitution of body.

Let me go on now to describe Kantian body as it is developed from the "Analytic of Principles" of the Critique through the Metaphysical Foundations of the Science of Nature. This genesis is not, of course, temporal, but merely critical.

The functions of the understanding, insofar as they operate on nothing given, enclose in their grasp, that is, conceive, an empty object, a mere X. It is only when, next, these concept functions operate on the pure content of the sensibility that a material object arises, and such an object of pure material is a pure object of experience, a thing in general.

a. "Thing" in the Critique.

Let me briefly recount the principles by which a "thing" is established. There are four of them, in accordance with the number of basic concept functions of thought termed "categories". Two of these are constitutive and are called "mathematical" because they assure that all things shall be so constituted as to be extensively and intensively measurable. The other two are called "dynamic", because they regulate the relations which all things by their very nature as things must have with each other, and they assure that all things whatsoever shall be enmeshed in one dynamic system, a system of mutual influence.

The first principle is called an axiom: it is axiomatic that all things have extension, that all are spatial intuitions and hence measurable.

The second principle is called an anticipation: it is to be anticipated that everywhere in space things will have some degree of perception, that is, measurable intensity of sensation.

Third comes a group of three principles called analogies: we may infer by analogy that even things not immediately available to observation are bound to each other by definite relations,

which are spatial applications of the time schemata, as follows: 1. Time itself as duration is to appear in space as substance so that all things whatsoever will have a steady substrate, a permanent existence. 2. Time as connected succession is to appear in space as cause and effect, so that all things are to be similarly related as causes and effects. 3. Time as simultaneity is to appear in space as the mutual relation of interaction, so that all things are in a like way to affect each other contemporaneously.

The fourth principle is called a postulate and adds nothing to the nature of things objectively but only determines their subjective relation to the faculty of knowledge.

Let me review in a little more detail the nature of a thing as it emerges from the so-called "Anticipations" and the first "Analogy", for these are the principles most directly relevant to the bodily nature of things. They provide, in effect, the foundation of "reality" and "substance" in Kant's system of nature.

In the first analogy, in one of those amazing junctures which make Kant's system so suggestive, substance is established as the spatial representation of consciousness:

> "...There must be in the objects of perception, that is, appearances, that substrate which represents time in general, and in which all alteration or simultaneity can be perceived by means of the relation of appearances to the same. Now the substrate of all that is real... is substance.... It follows that the permanent, in relation to which all time relations of appearance can alone be determined, is substance in appearance, that is, the real in appearance, which, as substrate of all alteration, always remains the same." (B 225).

When we recall that time as the pure content of the inner sense

is myself in appearance, the statement that substance is spatialized self is corroborated. And thus a truly novel meaning has been attached to an old term signifying self-subsisting being. -- Substance is now the three dimensional appearance of soul to itself.

In the "Anticipations" the alterations to be predicated of substance are founded, or rather a guarantee is given that changes in consciousness will occur, even though its qualities cannot be established a priori. That we may anticipate that substance will always be in varying degree sense-activated, that things will always be sensation-filled, that neither time nor space will ever be completely empty -- this is the critical requirement of reality; reality is the determination of a substance as having existence, that is, as being a thing there and then (B 225). Kant's system requires that the things of nature be made quick with sensation, that they materialize.

b. Body in the Metaphysical Foundations of the Science of Nature

In the Metaphysical Foundations the transcendental structure is realized by the introduction of an "empirical concept", the concept of matter. By an "empirical concept" Kant actually means a "concept of something emprical", that is, a concept which is in no way the result of observation (though to claim existence for it would require experience), but rather simply a closer conceptual determination or specification of the transcendental "thing" established in the Critique. The metaphysics of such a concept is nothing but its full explication. Kant presents the concept of matter as if he had chosen one of a number of

possible instances or specifications of a natural thing (470). But in fact, it seems to me, no other choice was possible, since matter turns out to be the unique and necessary first empirical concept of the science of nature.

Matter is the name -- ironically chosen if anyone expects to be presented with some solid stuff -- of the concept of the "movable in space". It is possible to reconstruct the missing reason why the movable in space is the basic concept of the science of nature from this sentence: "The fundamental determination of a something that is to be an object of the external senses must be motion, for thereby only can these senses be affected" (476, my italics). The movable is simply that which can excite sensation, sensation being appropriately understood by Kant as that whose very nature it is to be moving and manifold. It remains to supply another omission by conjecturing what specification of the transcendental Kant is actually performing: the movable appears to be nothing but the real substance of the Critique, but now specifically considered in time and space not separately but at once. At least it is difficult to discover any other, truly new determination in the concept of matter.

The Metaphysical Foundations comes in four parts which are completely parallel to the "Analytic of Principles" and are presented in the form of propositions and proofs following from those principles.

The first part, which derives from the principle of extensive quantity (the Axioms of Intuition), establishes the geometric treatment of point motions. It deals with the composition of motions in terms of moving coordinate systems, or "spaces", and, in refuting Newton's notion of absolute space, provides a

metaphysical foundation for so-called Newtonian relativity. (This is the principle that when bodies interact or are all subject to the same accelerative forces, they constitute a space for which absolute motion or rest are not internally discriminable. Principia, Axioms, Cors. V, VI).

The second part derives from the principle of intensive quantity (the "Anticipations of Perception"), which requires some degree of sensation in things and hence their reality. This part is headed "Dynamics" because it shows that the essential qualities of matter are forces, and dynamis is the Greek word misappropriated by physicists for force. This part is the most important to my purpose precisely because it deals with the most intimate nature of body.

The third part, which derives from the principles governing the relations of things (the Analogies of Experience), is called "Mechanics" since in it are deduced the laws governing the interactions of bodies in systems, those "laws of nature" by which bodies are held in systems. In this part Newton's "Axioms or Laws of Motion" are, with certain suggestive variations, completely deduced as propositions. Here also Kant draws the physical consequence which follows from his understanding of substance as the steady spatial substrate of all alterations -- it is the law of the conservation of matter.

* A note correlating the Propositions of Mechanics of the Metaphysical Foundations with the Axioms of Motion of the Principia Mathematica.

Proposition 2: "First Law of Mechanics", the law of the conservation of matter; proved, as just noted, by an application

to matter of the first Analogy concerning the permanent in space, or substance. It has no explicit counterpart in the Principia but is an implicit consequence of the corpuscular view of matter set out in the "Rules for Philosophizing" which introduce the third book of the Principia and contain the application of the previous mathematical results to the world of matter. For the hard impenetrable atoms there posited can neither come into nor go out of being.

Proposition 3: "Second Law of Mechanics", a form of the law of inertia, namely that every change of matter demands an external cause; proved by an application of the second analogy concerning cause and effect. Its counterpart is Newton's Axiom of Motion I, that every body continues in its state of rest or uniform motion unless forces are applied.

Proposition 4: "Third Mechanical Law", laying down that in all communication of motion action and reaction are always equal to one another; proved by an application of the third Analogy concerning interaction. Corresponds to Newton's Axiom of Motion III, the law of equal and opposite action and reaction of bodies.

Proposition 1 establishes as the operable quantity of Kantian physics the quantity of matter as measured by its "quantity of motion", that is matter compounded with velocity (momentum = mv). This proposition is formally parallel to Newton's Axiom of Mation II, in which the basic operable quantity is defined as force, compounded of mass and acceleration (F=ma). Force as seen in acceleration or change of velocity is simply absent from

Kant's foundation of physics, and this omission constitutes the most significant technical difference between Kantian and Newtonian physics.*

Finally, the fourth part, which derives from the principle concerning the relation of things to the faculty of knowledge (the Postulates of Empirical Thinking) prescribes what propositions of physics are to be asserted as possible or as necessary.

To return to the "Metaphysical Foundations of Dynamics", which deals with matter insofar as it <u>fills space</u>. It is in filling space that matter asserts its "reality", its power to affect the senses. The universal principle of dynamics is: "All that is real in the objects of our external senses... must be regarded as a moving force." (523). "The concept of matter is reduced to nothing but moving forces; this could not be expected to be otherwise, because in space no activity and no change can be thought of but mere motion." (524). Force is the condition of possibility of matter whose possibility is not itself, in turn, explicable and whose concept is not itself derivable from another. As Kant puts it, force itself cannot be made conceivable (513).

Kant proves that matter is in fact nothing but force by showing that all the appearances of spatial objects are accounted for by forces and only by forces. In the course of these proofs he abolishes solidity, understood as the ability of matter to occupy space by reason of mere existence (498) -- an implicit

part, I think, of the ordinary view of body. And he attacks a view he regards as the consequence of positing solidity, Descartes' corpuscular or atomic theory which asserts the mystery of mathematical and mechanical impenetrability, and requires mere blocks of extension to move each other externally (502, 533).

Matter requires two original forces: a repulsive or driving force and an attractive or drawing force, corresponding to the two possible directions of interaction between point centers of force (497).*

The primary repulsive force is the force more intimately associated with our sensing of extended things. "Matter fills space not by its mere existence, but by a special moving force" (497, which in resisting penetration is the cause of palpability. It is, hence, a "superficial" force, a source of surfaces and contacts, which nonetheless constitutes matter throughout so that it is infinitely divisible -- there is always a new surface.

On one force alone, however, matter could not fill space but would, by repelling itself to infinity, become dissipated and vanish. Therefore, in order that body might become concrete, as it were, a countervailing original force it wanted. This second force cannot be immediately sensed or even located in a body, but can only be noticed in its effects. It is a penetrating force which does not need the agency of other matter but acts at a distance even to infinity and precisely where it is not (512). Whereas repulsion provides matter with its outside, so to speak, attraction gives it its inner coherence and keeps the segments

* A philosophical critique of Kant's dynamics is given by Hegel (Science of Logic, Bk I, Sec. I, ch. 3, para. 6, c, Note).

of matter close or dense. It is therefore the force which, as it binds a body to itself, also holds body to body in a system, such as the planetary system.

* These two forces equally and simultaneously constitute matter -- a body is not as in Boscovitch's Theory of Natural Philosophy (1763) a region in space where attractive and repulsive forces alternate, with the repulsive force prevailing and going off to infinity near the center of the body while the attractive force similarly prevails but goes off to zero away from that center. Instead two field-like expanses of force are superimposed and together give rise to regions of various density variously delimited, which correspond to bodies.*

Let Kant himself conclude:

> "If we review all our discussions of the metaphysical treatment of matter, we shall observe that in this treatment the following things have been taken into consideration: first, the real in space (otherwise called the solid) in its filling of space through repulsive force; second, that which with regard to the first as the proper object of our external perception is negative, namely attractive force, by which, as far as may be, all space would be penetrated, that is, the solid would be wholly abolished; third the limitation of the first force by the second and the consequent perceptible determination of the degree of filling of space." (523).

This last "perceptible determination" is matter, while body is but matter shaped between boundaries and therefore nothing but a figure inscribed into the continuous expanse of matter: "A body...is matter between determinate boundaries." (525). Self-determining solid bodies are simply incompatible with Kant's system.

That matter does fill all of space and fills it continuously, so that there is no empty space, is a possibility of such

consequence to physics that Kant concludes the Metaphysical Foundations with its consideration. Within this work the dynamic plenum remains merely a powerful possibility, and the ether as a special pervasive "external" matter which realizes it remains a physical assumption (523, 534, 563 ff.). But it seems to me that the fullness of space is completely deducible metaphysically from the very constitution of appearance. For it follows both from the continuities of nature required by the principles of the understanding (B 281), and from the fact that space, as the receptive form of sensation, can never in itself appear, which is to say that there can be nothing in appearance corresponding to empty space (e.g., B 261). I note here only in passing that if a plenum does require an ether, it may, as an ultimate reference system, well be incompatible with the previously established principle of relativity. But this very inconsistency is proof that Kant's metaphysics of nature does not merely ground Newton's physical results retrospectively -- on the contrary it looks forward not only to a physics of force fields, but also to the great ether debate which ended only with the momentous negative experiments performed just a century after the publication of the Metaphysical Foundations.

Its sequel, the "Transition...to Physics", shows that Kant was also concerned about the loss of independent body in the spread of delimitable stuff. In the very pages in which he now undertakes to show that an ether of some sort is indeed not merely a reasonable assumption but a deductive necessity of the system, he also tries to establish its very contrary, namely natural, organic body (e.g., OP 21, 218). The effort here is to introduce a body

which is not merely, by a regulative fiction of reason, subjectively interpreted as organized to serve an end, but which has an objective principle of self-determination (OP 21, 209 ff.), an "inner force" or proper principle of motion, and may therefore be termed "a self-limiting quantum of matter having a certain figure" (170). Kant regards this task as properly belonging to the "Transition". But he also concedes that such bodies might well be "inconceivable" (570), that is, not derivable in the system; therefore, it seems to me, this effort must fail: the system of well-founded matter called nature cannot, as Kant himself has shown in the letter on the organ of the soul, yield bodies fitted by reason of their self-contained unity to be the seat of life or soul. -- Indeed, how could nature contain such places, being itself the epiphany of soul?

7. The excesses of the system.

Kant considers that the metaphysical foundations of matter and its science have been laid, and the possibility of knowledge understood as experience is forever guaranteed. Henceforth empirical physics may be safely and infinitely pursued -- safely because its principles lie <u>a priori</u> in myself so that all experience is self-experience, and infinitely because all of its occasions are excitations which flow to us, with ever fresh adventitiousness, from an alien source.

But at this juncture a difficulty arises. In order for the systematic character of physics promised by its principles to be preserved throughout the enterprise, a regulative framework of investigation must be laid down. The great preoccupation of

Kant's later years was to assure the "rational coherence" (MFSN 534) of the science of nature by an ever-closer explication and specification of its basic concepts. The representation of the soul as nature seems to require that all assumptions and hypotheses either be soon converted into deductions or discarded. Less and less is left to observation.

To give a prime example: the law of the force of attraction, namely that it varies inversely as the square of the distance between the centers of two bodies, is a specification, by observation, of innumerable mathematical possibilities antecedently set out in Newton's Principia (III, i-viii, particularly i and ii). Kant too states that "no law whatever of attractive or of repulsive force may be risked on a priori conjectures" (534). And yet Kant deduces the inverse square law from the mode of diffusion essential to his attractive force together with a fact of Euclidean geometry, namely that the surfaces of concentric spheres increase as the squares of their radii (519).

This ever-growing regulation of observation insofar as it is attributable to the richness of the system in deductive consequences, might be simply a credit to it. And so it would be, were it the case that nature, when arraigned before Kantian reason, the "appointed judge who compels the witnesses to answer questions which he has himself formulated" (B xiii), always willingly and plausibly responded in the required terms. But the fact of the matter, worth far more consideration than has gone into this passing remark, seems to be that physicists have largely by-passed Kant's "topic" of forces and have super-

ceded his metaphysics -- for example, its constitutionally Euclidean space as well as the categories of causality and simultaneity -- presumably compelled thereto by nature herself.

And yet it is this very excess of doctrinal consequence which makes the study of Kant's metaphysics of physics the indispensable philosophical complement to the study of classical mechanics. For in attempting to account completely for all that is found therein, Kant, even as he fails, unfailingly aids reflection on the terms of physics.

In any case, the failure to preserve the adventitiousness of nature and hence to become a viable guide for experimental physics is only a derivative difficulty of the system. More radical and revealing questions arise about it, beginning with the excessive importance attached to physics as the sole self-study and ending only in questions concerning the nature of philosophy itself.

Let me conclude with the briefest formulation of such questions by returning to the work with which I began, to Kant's essay inveighing against the "noble tone" in philosophy of which Plato is the unwitting progenitor. To one dialogue particularly Kant unmistakably alludes (e.g., in mentioning ektypa, cf. Timaeus 50α) as the embodiment of all that he must disavow in Plato's view of mathematics, of the world of appearances, of truth-telling itself -- the Timaeus. It is almost as if the treatise on the Metaphysical Foundations of the Science of Nature were a specific response to the dialogue -- not, however, in the mode of simple diametric contradiction which Kant reserves for his closer opponents like Descartes, but by way of that most

radical contrariety which characterizes true alternatives. A parallel study of these two texts would raise the aforesaid questions in some such terms:

Kant destroys bodies to preserve the reality of appearances, and gives up the self-determining coherence of individual natures for an assured perceptibility of nature understood as a system of "things". But may not the articulated and distinct beauty of natural bodies and configurations require the intellect to forego sensation-filled dynamic reality as well as ultimate impenetrability in favor of Timaeus' mathematical solidity (53 c ff.)? Does not the inexhaustible originality of this mathematicised nature compel us to reconsider whether our sensibility can possibly be the sole source of her forms?

Kant denies the soul a seat in nature in order to preserve nature herself as the appearance of the soul and the representation of its rational operations. Thus nature becomes a system, an edifice founded on principles and constituted as well as governed throughout by laws derivative from the functions of thought. But may not the curious complex of regularity and irrationality which is the visible world suggest yet a third relation of soul to body, expressed by Timaeus as the girdling of body by soul (36e)? Thus body would arise not as our own outer appearance, but as the inner effects of a world which is indeed intelligible, but not wholly so.

Kant regards the continuing study of palpable nature, the science of body, as the most serious human theoretical activity, and its secure foundation in our own faculties as a completed philosophical labor. But may it not be that the account of the

visible world is, as in Timaeus' phrase, only a "likely story" (eikon mythos, 29 d), and that physics thrives on just those hypotheses, analogies, and likelihoods which Kant disavows in his essay? Then may not this perpetually tentative and open physics be a sort of high amusement with useful effects rather than humanity's central study, and a model-making project -- the "story of likenesses", to which Timaeus' phrase alludes-- rather than a well-grounded system? Hence a metaphysics of physics may finally have to yield to an inquiry into the nature and being of models, which may require the playful poetry of mere philosophy as exemplified in Plato's noble dialogue, rather than the working prose of Kant's systematic philosophy.

Addendum to p. 24, top:

The reason for Kant's substitution of mv for ma is, however, not merely a technical matter. Kant's Proposition 3 begins with the words :"Every change of matter has an external cause" (543). But, as I have noted, this cause is "motion" or "momentum," rather than the force of Newton's Law II. The reason for this substitution is as follows. The two forces Kant has posited in the section on dynamics constitute matter, but do not cause changes of mass, which is to say that they do not affect the motion of "matter in motion." Now for Kant the causes of motions can only be other motions, since a cause is nothing but an appearance which determines another appearance later in time (B 234) and must therefore be of the same kind as its effect. But since effect is a change in space of a mass, the cause must equally be such an "external" change, namely motion. Consequently in the context of the section on mechanics the dynamic forces function only as mediating mechanisms for the communication of motions. These latter momenta alone are Kant's "motive forces."

This explanation was developed by the members of my preceptorial on the Foundations.