Metaphysical Foundations of Natural Science

Immanuel Kant

[Brackets] enclose editorial explanations. Small ·dots· enclose material that has been added, but can be read as though it were part of the original text. Occasional •bullets, and also indenting of passages that are not quotations, are meant as aids to grasping the structure of a sentence or a thought. Every four-point ellipsis . . . . indicates the omission of a brief passage that seems to present more difficulty than it is worth. Longer omissions are reported on, between [brackets], in normal-sized type. Numerals in the margins refer to the pages in the Akademie edition of the work; these numbers are also supplied in both the existing English translations, which can thus easily be correlated with the present version.

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Preface

467 [Kant launches this work by distinguishing two senses of the word 'nature'. There is **(n)** its use in phrases of the form 'the nature of. . . ', where a nature is a quality, and **(N)** its use as a proper name, 'Nature', which signifies not a quality but the sum-total of everything that can be an object of our senses and thus also an object of experience. Kant also lingers on **(n)** in order to distinguish 'the nature of. . . ' from 'the essence of. . . , but this won't concern us in the present work, whose central concern is with **(N)** Nature—the whole world that we can know about through our senses. [Because he was writing in German, Kant had to use a capital 'N' for *Natur* in each of those senses. In English we have a choice; and this version will use 'nature' for the 'nature of . . . ' concept and 'Nature' for the name of a single entity.] Kant continues:] Nature taken in this sense of the word has two main parts, corresponding to the main line through our senses:

> One part contains the objects of the •external senses. Any theory about that will be a doctrine of •body, dealing with extended Nature.
>
> The other part contains the object of the •internal sense. Any theory about it will be a doctrine of •soul, dealing with thinking Nature.

[Kant's *Lehre* has to be translated as 'doctrine', but really that is misleading. He will label as a *Lehre* any disciplined body of fact-and-theory about a given subject; any respectable university department will be dedicated to some *Lehre*; but a *Lehre* can be much too small to support a department—e.g. Kant will speak about 'the doctrine of the properties of a straight line'!] If a doctrine is a *system*—i.e. a knowledge-total ordered according to principles—then it's what we call a *science*. Now, there are two sorts of principles that can
468 connect items of knowledge so that they constitute a *whole*: •empirical principles and •rational principles. This could prompt us to distinguish 'historical natural science' from 'rational natural science'; but it turns out that this is a bad way of stating things. [Kant's explanation of why is confusing: he announces it as focussing on the meaning of 'Nature' but states it in terms of the meaning of 'science'. [We'll see that both items are involved.] The core of the explanation is that *any* natural science, properly so-called, must include principles that rationally hold items of knowledge together. Kant continues:] So the doctrine of Nature—whether extended or thinking—might better be divided into

> **(a)** the historical doctrine of Nature, which contains nothing but the systematically ordered facts about natural things—presenting •Nature as a system of classes of natural things ordered according to similarities, and the •history of Nature as a systematic account of natural things in different times and in different places; and **(b)** natural science.

And natural science *properly* so-called would treat its subject-matter wholly according to *a priori* principles, while natural science *improperly* so-called would treat its subject-matter according to laws of experience.

Nothing counts as science proper unless it is •apodeictically certain, ·i.e. certain because it is absolutely necessary·; any cognitive structure that makes use of merely •empirical certainty is only improperly called 'science'. . . . An example of the latter is chemistry, the basic premises of which are merely empirical; the laws from which the given facts are logically deduced in chemistry are merely laws of experience, which •don't bring with them any consciousness of their necessity and therefore •aren't apodeictically certain. So that entire structure doesn't strictly count as a 'science', and would be better referred to as a systematic art. [This uses 'art', as Kant uses the corresponding word *Kunst*, to mean something like 'disciplined assemblage of skills'.]

So a rational doctrine of Nature deserves the label 'natural science' only when the laws of Nature that underlie it are **(1)** known *a priori* and aren't mere **(2)** laws of experience. Knowledge of Nature of kind **(1)** is called *pure* rational knowledge; knowledge of kind **(2)** is called *applied* rational knowledge. Since the word 'Nature' already carries with it the concept of laws, and since that carries with it the concept
469 of. . . .necessity, it's easy to see •why something can count as natural science only because of the pure part of it, i.e. the part containing the *a priori* principles of all the other explanations of Nature, and •why it's only because of this pure part that it is a *science*. Thus, every discipline dealing with Nature must, according to reason's demands, eventually come to be natural *science*, because the very concept of *Nature* has the necessity of laws inseparably attached to it and required for Nature to be thoroughly understood. [•This removes the confusion mentioned in an earlier note. Kant holds that both the concepts of *Nature* and those of *science* conceptually involve *necessary law*; so any disciplined treatment of Nature must bring in such laws, thereby helping to qualify itself as a science. •Why 'reason's demands'? Because of Kant's doctrine—expounded in his *Critique of Pure Reason* but not here—that reason constantly urges us to interconnect our various items of knowledge, always restlessly trying to get it all into a single rigidly interconnected system.] That is why the most complete explanation of certain phenomena by chemical principles always leaves us dissatisfied, because it has involved only contingent laws learned by mere experience, with no input from anything *a priori*.

Thus all genuine natural science requires a pure part which could be the basis for the apodeictic certainty that reason looks for in such science. And since the principles at work in the pure part make it completely different from the part whose principles are only empirical, there is a lot to be gained from a procedure in which the empirical part is kept out of sight while we expound the pure part on its own, as completely as we possibly can, so as to discover exactly •what reason can accomplish unaided, and •where it starts to need help from principles of experience. . . . ·And now I need to introduce another distinction·:

> •Pure philosophy (= metaphysics) is pure rational knowledge from mere concepts; •Mathematics is pure rational knowledge that is based entirely on the construction of concepts by means of the presentation of the object in *a priori* intuition.

[That account of mathematics comes from a theory of Kant's which is easiest to grasp in application to geometry. Take the proposition that *the total length of any two sides of a triangle is greater than the length of the third side;* how do you know that this is true? Not empirically, by **(1)** measuring the sides of triangular things, or by **(2)** reading it off from the concept *triangle*.

> By method **(1)** we could only get truths known *a posteriori*, i.e. from experience.
> By method **(2)** we could only derive analytic truths—ones knowable through conceptual analysis.

What is remarkable about geometrical truths is that they are known *a priori* and yet are synthetic—i.e. known without appeal to experience but not by being derived purely from concepts. Well, then, how *are* they known? Kant's answer is this: If you *know* that proposition about triangles (and haven't merely taken it on trust from someone else), you must have *constructed a triangle in your mind's eye* and seen from this that the proposition is true. In our present text Kant writes here and below of 'constructing concepts', but that is misleading. He doesn't think that in this process you construct any concept. Rather, you construct, under the guidance of a concept, a mental triangle.] Natural science properly so-called presupposes the metaphysics of Nature, ·i.e. pure rational knowledge from mere concepts·. Why? Because a science properly so-called has to include necessary propositions, and in *this* science they must be necessary truths having to do with the existence of things; so they can't be based on *a priori* intuition, because no such intuition can present anything concerning existence. The necessary propositions involved in natural science, therefore, have to be the concept-based ones that define ‘metaphysics of Nature’. There are two possibilities for what they might be:

(1) The metaphysics of Nature might deal with the laws that make possible the concept of *a thing’s nature*, without bringing in any specific object of experience, and therefore not saying anything specific about any particular kinds of empirical object. The part of the metaphysics of Nature that
470 does this is its transcendental part. [For Kant a ‘transcendental’ principle is one that has to do with the conditions that *make possible* some kind of knowledge.]

(2) The metaphysics of Nature might instead deal with the special nature of this or that kind of thing, of which it has an empirical concept; doing this in such a way it doesn’t look to experience for anything except this concept. (·If it looked to experience for information, it wouldn’t count as ‘metaphysics’·.) For example, it takes as its foundation the empirical concept of *a material thing* or the empirical concept of *a thinking thing*, and searches for anything that reason can teach us *a priori* regarding these things. This science would still count as a ‘metaphysic’ of Nature—specifically, of corporeal or of thinking Nature—but it wouldn’t be a •general metaphysic but rather •a special metaphysical natural science (physics and psychology), in which the transcendental principles mentioned in **(1)** are applied to the two sorts of sense-objects.

In any special doctrine of Nature there is only as much genuine *science* as there is mathematics. As I have explained, a science (properly so-called) of Nature must have a pure part that is the foundation for the empirical part and is based upon *a priori* knowledge of natural things. ·Let us now look very carefully into this notion of *a priori* knowledge of natural things·. To know something *a priori* is to know it from its mere possibility. But the possibility of specific natural things ·such as bodies and minds· can’t be discovered from their mere concepts. ·For example·: from the concept of *body* we can discover the possibility of having a self-consistent thought about a body, but we can’t discover the possibility of a body as a natural thing that could exist outside of the thought of it. So if we are to have knowledge of the possibility of specific kinds of natural things, and hence to know ·truths about· them *a priori*, we’ll need to be given *a priori* an intuition corresponding to the concept, i.e. we need the concept to be constructed. *And rational knowledge through the construction of concepts is mathematical.* It may be possible to dispense with mathematics in developing a •pure philosophy of Nature in general, i.e. one whose only topic is what constitutes the concept of a nature in general; but a pure doctrine of Nature concerning specific natural things (a doctrine of body or a doctrine of soul) is possible only through mathematics. . . .

[That’s why chemistry can’t be a *science*, Kant says. For
it to be a science it would have to derive chemical laws about 471
how different sorts of matter react with one another from an *a priori* intuition—something constructed in our minds. And there is no chance of that. And so, Kant continues,] chemistry can’t be anything more than a systematic art or experimental doctrine, never a science proper, because the principles of chemistry are merely empirical and can’t be presented *a priori* in intuition. . . .

But the empirical study of the soul must always be even further from qualifying as a natural *science* than chemistry is. Why? Because mathematics can’t be applied to the phenomena of inner sense and their laws. (‘But the flow of inner sense’s internal changes is *continuous*, and continuity can be treated mathematically.’ Yes, but •what *that* could add to the content of the doctrine of the soul is vastly less than

•what mathematics can add to the content of the doctrine of body; in about the way that •the doctrine of the properties of a straight line are less than •the whole of geometry! In each case, the tiny doctrine concerns only a single dimension—in the case of the soul it's the single dimension of *time*.) Anyway, if we ·keep mathematics out of the picture and· think of the doctrine of the soul merely as a •systematic art of analysis or as an •experimental doctrine, it still falls wells short of chemistry, ·in three ways·. **(i)** Given any two elements in the complex of events observed through inner sense, I can *think of them separately*, but I can't *separate them* and then bring them together as I choose. **(ii)** I can't investigate the mental events in someone else's mind. **(iii)** With mental events, ·unlike chemical ones·, an observed event can be altered and distorted by the mere fact of being observed. So the doctrine of the soul can't be anything more than . . . . a •natural description of the soul, not a •science of it, and not even a •psychological experimental doctrine. That is why in the title of this work—which really contains only the principles of the doctrine of *body*—I have followed standard usage in employing the general name 'natural science'; for strictly speaking it's only the doctrine of body that is entitled to be called 'science'.

472 But it can't be *natural* science unless mathematics is brought into it, and that can't happen until. . . .a complete analysis of the absolutely general concept of *matter* has been provided. Providing that is the business of pure philosophy. That general concept is an empirical one, but pure philosophy ·in dealing with it· doesn't make use of any particular experiences; it employs only what it finds in the concept of matter that relates to pure space and time. (Such relations come from laws that depend essentially on the concept of *Nature*.) Such a doctrine of body is, therefore, an actual metaphysics of corporeal Nature.

So all natural philosophers who have wanted to proceed mathematically in their work have availed themselves (without realizing it) of metaphysical principles; they *had* to do so, despite their solemn declarations that metaphysics has no claims on their science. No doubt they took 'metaphysics' to be a light-minded activity of •inventing possibilities at will and •playing with concepts which might be incapable of being presented in intuition and have as their only claim to objective reality the mere fact that they aren't self-contradictory! All true metaphysics comes from the essential nature of our thinking faculty, so it's not something we *invent*. The content of metaphysics doesn't come from experience; ·it's nearer the truth to say that experience comes from metaphysics!·. Metaphysics consists in the pure operations of thought—*a priori* concepts and principles whose basic role is to bring the elements of the tangle of empirical representations into lawful connection with one another, thereby turning the tangle into *experience*. That's why those mathematical physicists couldn't do without some metaphysical principles, including the ones that make the concept of their own special object—*matter*—available *a priori* for application to external experience, as with the concepts of motion, of the filling of space, of inertia, and so on. But they rightly held that the apodeictic certainty they wanted their natural laws to have couldn't be had by any merely empirical principles; so they preferred to *postulate* such laws without investigating their *a priori* sources.

In the pure part of natural science as ordinarily conducted, metaphysical and mathematical constructions crisscross with one another; ·and that is very unsatisfactory·. It is enormously beneficial for the sciences to keep principles of different kinds at a distance from each other, putting •each 473
kind into a separate system which constitutes a science of •that kind. If this isn't done, people can confuse them

with one another, failing to see which kind is relevant to a particular problem. . . . That is why I have thought it necessary to segregate •metaphysical principles from the pure part of natural science that has usually been the stamping-ground of metaphysical as well as mathematical constructions, putting •them into a system of their own—a system that will also contain the principles of the construction of those ·mathematical· concepts, and therefore the principles of the possibility of a mathematical doctrine of Nature itself. ·But this system won't contain any mathematics·. . . .

Here is a second advantage of this procedure. In anything that is called 'metaphysics' we can hope for absolute completeness, which can't be expected in any other branch of knowledge; and we can confidently expect such completeness not only for the metaphysics of Nature in general but also for our present topic of the metaphysics of corporeal Nature. Why can we expect this? Because in metaphysics the object—·the item you are studying·—is considered merely as it has to be represented in accordance with the universal necessary laws of thought; this confines the possible results to a definite number of items of knowledge, and it's possible to come to have *all* of these. In contrast with this, in any other science we consider the object as it has to be represented in accordance with data of intuition; there is a limitless web of intuitions, and therefore of objects of thought, so that the science can never achieve absolute completeness, but can be endlessly extended, as in pure mathematics and the empirical doctrine of Nature. [In that sentence, Kant twice specifies that the intuitions he is talking about include pure as well as empirical ones.] I think that ·in the present work· I completely exhaust the metaphysical doctrine of body, extend it as far as you like; but I don't regard that as much of an achievement.

The schema for the completeness of a metaphysical system, whether of Nature in general or of corporeal Nature in particular, is the table of the categories.[1] That is because 474

[1] [In an enormous footnote Kant reports that something published in a recent issue of one of the learned journals expresses doubts relating to his use of his 'table of the pure concepts of the understanding'. He continues:] The doubts aren't aimed at the table itself, but at the conclusions I have drawn from it regarding the limitations of the whole faculty of pure reason and therefore of all metaphysics. . . . These doubts are supposed to touch the main foundation of my system, as set out in the *Critique of Pure Reason*. . . . This main foundation is said ·by my critic· to be my deduction of the pure concepts of the understanding, expounded partly in the *Critique* and partly in the *Prolegomena*. That part of the *Critique* (·says my critic·) should have been the clearest but is actually the most obscure or indeed argues in a circle, and so on. The chief point in these objections is the claim that without a completely clear and adequate deduction of the categories, the system of the *Critique of Pure Reason*, far from being apodeictically certain, would totter on its foundation; and that is what I shall answer here. [Kant's answer is long, dense, difficult, and not needed for present purposes. The gist of it involves his taking his critic to agree •that the categories are forms of thought that we have to use in intellectually dealing with whatever we have to think about, and •that all we can ever have to think about are appearances. These concessions, Kant says, give him his core thesis in the *Critique*, namely that the categories represent the limits to what thoughts we can have, what propositions we can entertain, and so on; and he represents his critic as accepting *that* the categories do this while complaining that Kant hasn't explained *how* they can do it. He replies that his system doesn't need the *how*, which is mere icing on the cake [not his formulation!]. He says that if his account of *how* were a failure, he would still be in good company:] Newton's system of universal gravitation is well established, despite our continuing difficulty about explaining *how* attraction at a distance is possible. Difficulties are not doubts. [And then Kant re-states all this at much greater length, ending up with a slap at his critic, saying that when certain things are made clearer in the second edition of the *Critique*,] that will spare my critic from having to resort to a pre-established harmony because of the surprising agreement of appearances with the laws of the understanding. This 'remedy' is much worse than the evil it is meant to cure. . . . Such a pre-established harmony can't generate the objective *necessity* that characterizes the principles in which pure concepts of the understanding are applied to appearances. For example, it provides no basis for cause-effect connections to be objectively necessary (though it allows subjective necessity (·when we experience C we

this table contains *all* the pure concepts of the understanding that have something to do with the nature of things. It
475 must be possible to bring under the four kinds of category—quantity, quality, relation, and modality—all detailed special
476 cases of the universal concept of *matter*, and therefore everything that

> can be •thought *a priori* concerning matter, •presented in mathematical constructions, or •given in experience as a determinate object of experience.

There's nothing more to be discovered or added; but there may be room for improvements in clearness or thoroughness.

Accordingly, the present work contains four chapters, each dealing with matter brought under one of the four kinds of concepts of the understanding. Something that is present in all the chapters is *motion*. The senses can't be affected by matter unless something moves; so motion is the *basic* fact about anything that is to be an object of the external senses; and the understanding leads all other
477 predicates that express the nature of matter back to motion; so natural science is, *throughout*, either a pure or an applied doctrine of motion. The *Metaphysical Foundations of Natural Science* can therefore be divided into four chapters.

1. Phoronomy: In this, motion is considered as pure quantum—portions of which can be combined in various ways—with no attention being paid to any quality of the matter that moves. [See note on page 17]

2. Dynamics: This treats motion as belonging to the quality of the matter under the label 'basic moving force'. [See note on page 38]

3. Mechanics: This deals with how the movements of portions of matter bring them into ·causal· relations with one another. [See page 58]

4. Phenomenology: In this chapter, matter's motion or rest is handled purely in terms of how it is represented—its modality—and thus in terms of its status as an appearance of the external senses. [See note on page 62]

I have shown the necessity of distinguishing •the metaphysical foundations of the doctrine of body not only from •physics (which employs empirical principles) but even from •physics's rational premises, which concern the employment of mathematics in physics. The reasons for that were internal to metaphysics; but there's also an external reason to deal thoroughly with the doctrine of body as a separate unit, not mixing it up with the general system of metaphysics. This external reason is only accidental—·it depends on a sheer fact about how certain people behave·—but it is important. We can mark the boundaries of a science not merely in terms of •its subject-matter and of •the specific kind of knowledge of that subject-matter, but also in terms of •what those who pursue the science have in mind as a *use* for it. Well, what do all the people who have busied their heads with metaphysics—and will continue to do so —had in mind as a use for it? They have planned for it to

> •extend natural knowledge

(which they could do much more easily and certainly by observation, experiment, and the application of mathematics to external phenomena), and also to

> •give them knowledge of what lies entirely beyond all the boundaries of experience, namely God, freedom, and immortality.

can't help expecting E to follow·). The only possible basis for this objective necessity is the *a priori* principles that lie at the foundation of the possibility of thought itself, these being needed if we are to have knowledge of objects whose appearance is given us, i.e. if we are to be able to have *experience*. And even if there could be no adequate explanation of *how* experience is possible in the first place, it would still be indisputably certain that experience is possible only through those concepts and, conversely, that the only meaningful use for those concepts is in relation to objects of experience.

These things being so, there is a lot to be gained by handling the metaphysics of the doctrine of body in isolation from the rest of metaphysics ·rather than letting it get caught up in that jumble of concerns·. It does in fact grow from general metaphysics, and that shouldn't be forgotten; but it will grow better if we treat it as having been planted in its own ground. This won't affect the completeness of the system of •general metaphysics. It will indeed make it easier for •this science to progress smoothly towards its goal if,
478 whenever it needs to bring in the general doctrine of body, it can call upon the separate system of such a doctrine without having had to include it in its baggage all along. And there's another significant fact (which I can't go into in detail here), namely that general metaphysics, whenever it needs to provide examples (intuitions) to give meaning to its pure concepts of the understanding, always has to take them from the general doctrine of body, i.e. from the form and principles of *external* intuition. And when such examples are not ready at hand, general metaphysics gropes, shaking with uncertainty, among mere meaningless concepts. . . . So a separate metaphysics of corporeal Nature does excellent and indispensable service to general metaphysics . . . . In the present work I have modelled my procedure on the mathematical method —not making my work strictly mathematical (I hadn't time for that), but treating mathematics as something to imitate. This isn't meant as a display of profundity that might earn the work a better reception. Rather, it reflects my belief that a system such as this is quite capable of a mathematical treatment, and that it may some day be completed by someone cleverer than I am. That could happen when mathematical investigators of Nature, stimulated by this sketch of mine, think it worthwhile to extend their studies to the metaphysical portion ·of the doctrine of body· . . . . and to bring it into unison with the mathematical doctrine of motion.

In the preface of his *Principia*, Newton follows up his remark that geometry needs to postulate only two mechanical actions, the ones that trace a straight line and a circle, by saying: 'Geometry is proud of being able to produce so much, with so little taken from elsewhere.' In contrast with that, one might say of metaphysics: It stands astonished that with so much offered to it by pure mathematics, it can achieve 479
so little! Nevertheless, this 'little' is something that mathematics absolutely *has* to have in its application to natural science; and since mathematics must here necessarily borrow from metaphysics, it shouldn't be ashamed to be seen in the company of the latter. [From here on, displayed occurrences of 'Definition' translate Kant's *Erklärung*, which usually means 'explanation'. Kant himself licenses this somewhat loose use of 'definition' in his *Critique of Pure Reason* B 75.]

Chapter 1
Metaphysical Foundations of Phoronomy

Definition 1

I call something '**material**' if and only if it is movable in 480
space. Any space that is movable is what we call 'material' or '**relative**' space. What we think of as the space in which all motion occurs—space that is therefore absolutely immovable—is called 'pure' space or '**absolute**' space.

Remark 1

The *whole* topic of phoronomy is motion; so the *only* property that is here attributed to the subject of motion, i.e. matter, is its *movability*. So we are free to take ·any portion of· matter as a *point*. In phoronomy we set aside all the internal characteristics of matter, thereby setting aside anything involving the quantitative notion of *how much* matter we are dealing with; all we are concerned with is the motion of matter, and the only quantitative notion that we need is not *how much matter* but only *how fast* and *in what direction* the matter moves. [Why does Kant imply that direction-of-movement is *quantitative*? Because he is thinking of 180-degree changes of direction of straight-line movements; an N movement in one direction can be thought of as a minus-N movement in the opposite direction.] If I sometimes use the expression 'body'—·meaning *a body*, not merely undifferentiated *matter*·—that will be because I am deliberately getting ahead of myself, making my discourse less abstract and more comprehensible by bringing into phoronomy some of the more determinate concepts of matter that we shall come to later.

Remark 2

481 If I explain the concept of *matter* not by a predicate that applies to it as object—

> ·i.e. not by saying
> anything of the form 'any item is matter if it has property P.·'

—but only by how it relates to the knowledge-faculty through which it is basically represented to me—

> ·i.e. by saying 'matter is whatever is represented to me by outer sense'·

—then 'matter' is being explained as applying to every object of the external senses; and this would be the mere metaphysical definition of it. But space would be simply the form of all external sensible intuition. . . . [That last phrase refers to the use of our senses in application to the external world; it stands in contrast with *a priori* intuition—see the long note on page 2.] In contrast to this *form*, matter would be what our outer senses give us sensations *of*; so it would be the properly empirical part of external sensory intuition, because matter cannot be given at all *a priori*. In all experience •something must be sensed, and •this is the *real* component in sensible intuition. So the space in which we are to set up experience concerning motions must also be perceptible, i.e. must be indicated by what is perceptible; and this space—

> the sum-total of all objects of experience, and itself an object of experience

—is called 'empirical space'. Now, if such a space is material, it is itself movable. But a movable space, if its motion is to be perceptible, presupposes a larger material space for it to move in, this enlarged space presupposes one larger still, and so on to infinity.

Thus, all motion that is an object of experience is merely relative. We have

> an object x which we perceive to move;
> a space S_1 relative to which we perceive x to move;
> a larger space S_2 relative to which S_1 may move.

It might happen that S_1 does move relative to S_2, and indeed moves in the opposite direction to x ·and at the same speed·; in which case we can describe x as 'moving' in relation to S_1 and at the same time 'motionless' with respect to S_2. These varying accounts of whether and how x moves continue infinitely as we bring in larger and larger relative spaces. [Kant now has a long sentence that is hideously unclear, apparently because it is too compressed. The gist of it seems to be as follows. An absolute space—i.e. a space that isn't material 482
because it isn't movable—is something we assume because it is required for the possibility of experience. But in doing this we are assuming something that can't be perceived •in itself or •in its consequences. (Perceiving it in its consequences would be perceiving something that we knew was a case of some object moving relative to absolute space, and there's no way we can perceive that.) Furthermore, although we need this assumption for the possibility of experience, we

never have any experience in which absolute space plays a part. The whole story of what we perceive can't give any role to absolute space. Kant continues:] So absolute space is in itself *nothing*; it's not any kind of *object*. All it signifies is this: Whenever I am thinking about some object that is moving relative to some space S—·e.g. a leaf blowing through the window and falling onto the carpet in my study·—my thought of 'absolute space' AS is just my thought of every other relative space that I can think of as containing S, the series of such ever-larger spaces running to infinity. This is just a *thought* that I have; I'm not confronted by anything—any matter—that *indicates* this space AS; so my thought represents AS as pure, nonempirical, and absolute. I can compare any empirical space S with AS, representing S as movable in AS, which is therefore always taken to be immovable. If you regard AS as an actual *thing*, you have mistaken

•the *logical* universality that consists in our ability to regard *any* empirical space as being included in it, for
•a *physical* universality that consists in its actually containing *every* empirical space. . . .

[Kant speaks of this mistake as a case of 'misunderstanding reason in its idea', using 'idea' (German *Idee*) as a technical term that he introduced in the *Critique of Pure Reason* and employs just seven times in the present work. (This version will use 'idea' only in translating *Idee*.) For a grasp of how it works, you need to start with the **understanding** and the **concepts** that are its tools. We can have a concept of x only if we could be 'given' an example of x in experience; so we have a concept of *division of a bit of matter* because we can see or feel a bit of matter being cut into two or four or. . . What about •the thought of *division of a bit of matter carried the whole way*? Unless you think that there are 'atoms', smallest bits of matter that can't be further divided, •this thought goes with the thought of an infinitely small bit of matter; that is something we couldn't conceivably encounter in experience; so we have no concept of it; but we do have the idea, this being a thought that takes some concept and subjects it to the thought of *going the whole way* or (in terminology that Kant uses a lot in the *Critique* but not in the present work) the thought of a certain kind of *totality*. It is the role of reason, he holds, to engage in this totalising sort of thought, which is why he links ideas with reason, as he links concepts with understanding. In the use of 'idea' that we have just encountered, Kant speaks of the totalising activity as involving a 'logical universality', and he is referring to the totalising that is involved in the thought of *the whole of space*.] One last remark: An object's movability in space can't be known *a priori*, i.e. without instruction from experience; which is why in the *Critique of Pure Reason* I couldn't count such movability as one of the *pure* concepts of the understanding. The concept of movability, just because it is empirical, can find a place in a natural science only as a bit of *applied* metaphysics, which is where concepts given through experience are dealt with, though according to *a priori* principles.

Definition 2

The **motion** of a thing is the change of its external relations to a given space.

Remark 1

I have based the concept of •matter on the concept of •motion. That's because I wanted to fix the concept of matter without bringing in the concept of •extension, so that I could consider matter as a point, helping myself to the common definition of *motion* as *change of place*. But if we are to define the concept of matter in a comprehensive way that covers moving bodies, that 'change-of- place' definition won't do. The place of any body is a point. The distance of the moon from the earth is given by the shortest line between their places, i.e. between their central points. (That's the only way to get a determinate single distance between them; any other approach will have us measuring from some arbitrarily chosen pair of points—

·say the distance from the lowest point in the Dead Sea to the highest point in the Mare Frigoris·.) Now, taking a body's place to be its central point, *a body can move without changing its place*, as the earth does by turning on its axis. But although the rotating earth doesn't change its place, it does change its relation to external space, because at different times it turns different sides toward the moon, and these differences produce all kinds of different effects on the earth. The equation of 'motion' with 'change of place' holds only for movable *points*, i.e. physical points. [The next bit is awkwardly written, but its content can be made clear. Its point is just that the change-of-place definition omits more things than just rotation; it omits, for example, the
483 movements that go on when beer is fermenting in a cask. What the definition applies to is movement of the cask-and-contents as a unit—movement *of* the cask, not movement *in* the cask.] . . . .

Remark 2

Motions can be divided into two classes. **(1)** Progressive movements, which enlarge their space; straight-line movements and curved-line movements that don't return in on themselves. **(2)** Rotatory movements, which don't enlarge their space, but keep returning in on themselves, staying with the same limited space. And these can be divided in turn, into **(2a)** circular movements like those of the planets around the sun and **(2b)** oscillatory movements like that of a pendulum. . . . I mention these different kinds of motion in phoronomy merely because the word 'speed' is generally used in one sense for movements in class **(1)** and a different sense for movements in class **(2)**, as you will see in a moment.

Remark 3

In any motion we have just two factors to think about—*speed* and *direction*—once we have set aside all the other properties of the moving thing. I am here taking for granted the usual definitions of both of these, but various limitations have to be built into the definition of *direction*. . . .

Consider two snails that are exactly alike in shape and even size, except that one winds to the right and the other to the left. What does this difference rest on? Or the difference between the winding of beans around their pole (like a corkscrew—'against the sun', as sailors would say) and the winding of hops, which go around their pole with the sun? 484
We have here an *internal* difference between the two snails, or between the pole-climbing plants—·it's 'internal' in the sense that we can't make it disappear by re-arranging *other* things in certain ways·. Now, the concept of this internal difference can be *constructed*, but it can't be expressed in general terms. It can happen that two things differ *only* in this way, i.e. without this difference bringing others in its train. Take the rare case of a human being who is found through an autopsy to have all his organs inter-related according to the physiological rules that hold for other human beings except that they are left/right reversed. This can't possibly have made any difference to the internal workings of that person's body. And yet there is a real mathematical and indeed internal difference between two motions that differ only in that way, e.g. two circular motions differing in direction but exactly alike in all other respects. [Kant adds his claim that this left/right matter confirms his view that 'space in general doesn't belong to the properties or relations of things in themselves' but 'belongs merely to the subjective form of our sensible intuition'. He remarks that he has dealt with this elsewhere [in *Prolegomena* section 13]. He continues:] But this is a digression from our present business, in which we *have to* treat space as a property of the things we are considering, namely bodies, because bodies themselves are only

phenomena of the external senses and need to be explained here only as such.—So much for *direction*. As for *speed*: the meaning of this expression also varies in different contexts. We say that the earth rotates on its axis 'faster' than the sun because it completes a rotation in a shorter time, although the motion of the earth in this rotation is *slower* than that of the sun. [Kant gives other examples, without suggesting that this point matters much for his present work. He concludes:] In phoronomy we use the word 'speed' with a merely spatial meaning—the measure of how far a thing travels in a given period of time.

Definition 3

485 **Rest** is time-taking presence in the same place; for something to be **time-taking** is for it to exist throughout a time. [The translation makes this look trivial, but it doesn't in the German.]

Remark

A moving body is momentarily at each point of the line that it traverses. Is it at rest at each point or is it moving? No doubt you'll want to say that it is moving, because it is precisely by *moving* that it came to be at this point. But let's consider what is going on in a movement ·I'll call **Oscillate**·, in which

> a body tracks the line AB, from A to B and then back to A again, doing this with a uniform speed so that the total time is exactly one second—half a second from A to B and half a second for the return journey.

This can't happen unless the body doesn't spend any time—not the smallest portion—at B. Why? Because it is present at B only once in Oscillate; allow its presence there to occupy a tiny period of time and you'll have the problem of which of the two journeys—AB or BA—to assign it to. Either way, the times for the two sub-journeys won't be equal. Now change the example to a movement (·I'll call it **Straight**·) in which

> a body moves exactly as in Oscillate except that instead of switching back at B it continues straight on to a further point C.

In Straight the body is moving at B, not at rest. (Why? Because B is just one point in a continuously moving journey, with nothing special about it except that we have chosen to talk about it. If the body weren't moving at B it wouldn't be moving at any point along the A–C line, which means Straight didn't occur.) But Straight is supposed to be exactly like Oscillate except for the directional difference; so if the body is moving at B in Straight then it is moving at B in Oscillate too—but we have just shown that it can't be! Now consider a third example, of a movement ·that I'll call **Updown**·, in which

> a body rises from A *up* to B which is directly above A, and then—having lost its motion by means of gravity when it reaches B—it falls back again from B to A.

In *this* case is the body moving at B or at rest there? The most plausible answer is this:

> In Updown the body is at rest at point B; because when it is there it has been deprived by gravity of all its upward motion, and the downward motion that gravity will also give to it hasn't yet begun. And something that doesn't have any motion is at rest.

But if that is all right for Updown, why isn't it also all right for Oscillate; for in the latter also the return journey from 486
B to A can't start until the forward journey from A to B has ended; so that in Oscillate also we seem to have to conclude that the body is not, after all, moving at B. But we *can't* draw that conclusion, because something that is moving with a uniform speed can't be at rest anywhere along its journey. What, then, makes the crucial difference between Oscillate and Updown? It is that in Updown the body's motion isn't uniform—it is uniformly decelerated and then uniformly

accelerated, in such a way that its speed at B is reduced not to *nothing* but only to *a speed S that is smaller than any assignable speed.* Keep gravity out of this for a moment, and suppose that the body with speed S in Updown doesn't start to fall at B but keeps moving upwards. ·How far would it get, in how much time, if it stayed at speed S? The answer is this·:

> Take any distance you like, however small, along the line up from B, the body wouldn't cover *that* distance, however long it kept moving with speed S.

This implies that (for any possible experience) the body would remain at B for all eternity. Consequently, it is put into a state of •time-taking presence in the same place, i.e. a state of •rest, although owing to the continuous influence of gravity, i.e. the change of this state,

the rest is immediately abolished. To •be in a time-taking state is conceptually different from •spending time in that state. . . . Thus *rest* can't be defined as *lack of motion*, because that is negative and so can't be constructed. It must instead be defined as *time-taking presence in the same place*. This can be constructed, by representing a motion with *infinitely small speed* through a period of time that is not infinitely short; and because it can be constructed it can be used in applying mathematics to natural science.

Definition 4

To **construct** the concept of a *composite motion* means to present *a priori* in intuition a motion as the result of two or more given motions united in one movable thing.

Remark

In constructing a concept one mustn't make use of any input from experience, e.g. presupposing some force that one 487 knows about only from experience. Putting the point in its most general form: in constructing a concept one mustn't use any concept that can't be given *a priori* in intuition—such as the concepts of cause and effect, and of action and resistance, etc. Don't lose sight of the fact that phoronomy's *only* concern is with the construction of motions in general as *amounts*, so that it takes matter merely as *something movable*, ignoring any facts about *how much* matter is moving in any given case. So phoronomy has from the outset to characterize these motions solely as amounts determined by their speed, their direction and their composition. That much has to be settled entirely *a priori* and indeed through intuition, setting things up for applied mathematics. For the rules governing how motions are inter-connected through physical causes—i.e. forces—can't be properly explained until there's a mathematically constructed basis containing the principles of their composition in general.

Principle

Every motion that could be an object of experience can be viewed either as •the motion of a body in a space that is at rest or as •the rest of a body in a space that is moving in the opposite direction with equal speed. It's a free choice.

Remark

We can experience the motion of a body only if both •the body and •the space in which it moves are objects of external experience—hence, only if they are both material. [Remember that Kant has said that he calls a space 'material' if it can move relative to a larger space.] So an **absolute** motion—i.e. a motion related to an immaterial space—can't possibly be experienced and is hence nothing at all *for us* (even if we allow that absolute space is something *in itself*). But in all **relative** motion the space itself, because it is assumed to be material, can be represented as at rest or as moving. I represent the space as

at rest when it isn't included in some larger space in relation to which I could see it as moving. And I represent the space as moving when it *is* included in some such larger space; an example would be seeing a ball roll along a table in the cabin of a ship, where there is a larger space (including the shore) beyond the space of the cabin, in relation to which •the cabin's space is moving and—it may happen—•the ball
488 is at rest. ·But then the shore's space may be enclosed in a •still larger space relative to which the •shore's space is moving and the •cabin's space is at rest and the •ball is moving after all·! With respect to *any* empirically given space, we can't rule out its being enclosed in a still larger space in relation to which it may be moving or not moving. Thus, for all experience and for every inference from experience, it can't make any difference whether I choose to •consider a body as moving or rather to •consider the body as at rest and the space it is in as moving in the opposite direction with the same speed. The two ways of looking at it are strictly equivalent. You might think that in relation to absolute space one of the accounts is right and the other wrong, but absolute space can't possibly enter into any experience of ours, so we can set it aside. The only difference between body-moving-in-motionless-space and space-moving-around-motionless-body is in how we connect them with other phenomena in our theories.

Also, our experience can't enable us to pick out a fixed point by reference to which we could give sense to a distinction between •absolute motion and •absolute rest. Why not? Because everything we confront in experience is •material, and therefore •movable, and therefore •perhaps actually moving without our being able to perceive this motion. . . . When a body moves in empirical space, I can think of any proportion of the given speed—from *none* to *all*—as belonging to the body, and the remainder—from *all* to *none*—as belonging to the space moving in the opposite direction. There can't be any empirical evidence that would favour any particular distribution. In saying this I am assuming that we are dealing only with motion in a straight line. When other motions are concerned, there isn't the same freedom of choice about what to attribute to the body and what to the space. For example, as between

> •the earth rotates daily on its axis, while the surrounding space (the starry heavens) stay at rest

and

> •the earth remains still while the starry heavens revolve around it,

there are empirically detectable differences. I shall discuss this later on [starting on page 61]. In phoronomy, then, where I consider the motion of a body only in relation to space (upon whose motion or rest the body has no influence at all), it is an arbitrary matter how much (if any) of the speed of a given motion I attribute to the body in question and how much (if any) I attribute to the space that contains it. Later on, ·in mechanics·, where we'll consider how a moving body interacts causally with other bodies in the space of its motion, it will make a discoverable difference how we distribute the speed between the moving body and the space containing it. I'll show this in the proper place [starting at page 53].

Definition 5

The **composition of motion** is the representation of the 489
motion of a point

as identical with two or more motions of the point combined.

Remark

Since in phoronomy I don't have thoughts of any quality of matter other than its movability, I can consider matter itself only as a mere point, and can consider any motion as a track through a space. But that doesn't mean that I am attending only to the space that geometry deals with; because I also bring in the •time involved and hence the •speed of the point's movement through space. So phoronomy is the pure doctrine of the amounts of motions.

what comes next, conservatively translated: The determinate concept of a an amount is the concept of the production of the representation of an object through the composition of the generous.

what Kant seems to have meant: Any *how-much* thought is the thought of a process of mentally assembling something out of parts that are all of the same kind as it. In thinking about (say) *a gallon of water* one is somehow thinking of mentally building up a gallon drop by drop.

Now, nothing is homogeneous with motion except motion, so phoronomy is a doctrine of

> the putting together of different motions of a single point according to their direction and speed,

which is the same as

> the representation of a single motion as comprising within itself two or more motions occurring at the same time.

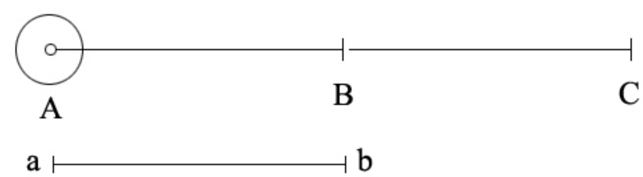
Note that this concerns two or motions that *constitute* one motion; ·all there is to the one motion is those two or more put together·; we are *not* concerned here with two or more motions that *cause* some single motion to occur. In order to find the motion arising from the composition of several motions—as many as you want—you have to proceed piecemeal (as we do with the production of all quantities): start by working out the motion that comes from compounding two of the motions, then compound this with a third. . . and so on. So the doctrine of the composition of *all* motions comes down to the composition of *two*. [Kant goes on to say that there are three different ways in which two motions—whether of equal or unequal speeds—can be happening in a single point at the same time: They may be going **(1)** in a straight line in the same direction, **(2)** in a straight line in opposite directions, or 490
(3) along different lines that are at an angle to one another.]

Proposition

The only way to think of two motions as composing the motion of a single point is by representing •one of the two as occurring in absolute space, and •the other as consisting in the movement of a relative space in the opposite direction.

Proof

First case: A single point undergoes two motions in the same direction along the same line at one time.



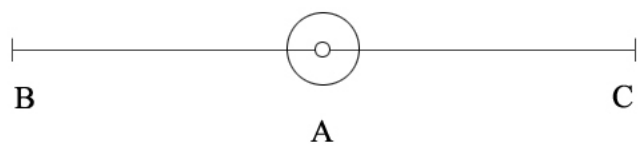
[Kant's presentation of this part of his proof is very hard to follow. It starts with this line of thought: In phoronomy we can equate a speed with a distance/time pair, as we do when we name a speed in terms of 'miles per hour'. Now, suppose that a point is subject to two movements at once, both in a straight line and in the same direction, and think about how we can represent their speeds. If they are equal, then their speeds can be represented by the AB and ab lines in Figure 1. But. . . The preparer of this version of the text is defeated by what comes next. We are threatened with some kind of incoherence or contradiction in representing the speeds of

491 the two movements on the assumption that they are both movements of a single point x relative to a single space.

[The difficulty is solved, Kant tells us, if we take one of the movements to be a left-to-right movement by x from A to B and take the other to be a right-to-left movement of some relative space that also contains x.

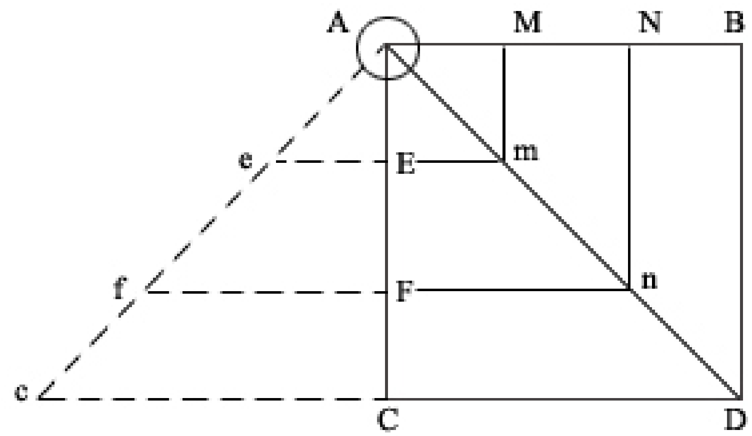
[That is straightforward enough, but the difficulty it is supposed to remedy defeats understanding. The passage in question is presented, closely following the two currently available translations of this work (which differ very little in their handling of this passage) on page 66.]

Second case: Two motions in exactly opposite directions are to be combined at one and the same point.



Let AB be one of these motions and AC the other in the opposite direction (and again let's take the speeds to be equal). In this case the very thought of representing two such motions of a single point x in relation to single space at the same time is plainly impossible. If we are to make sense of the notion of two equal and opposite motions of a single point at the same time, we'll have to think of it as involving a point x that moves in a certain direction relative to absolute space while the relative space that also contains x is moving in the same direction at the same speed. The upshot of this, of course, that relative to the relative space x doesn't move at all. [When in contexts like this Kant speaks of 'the relative space' that is involved, we can take him to mean something like 'the smallest intuitively convenient space' that is involved, out of the possibly infinite series of ever-larger relative spaces that x is contained in.]

492 **Third case:** Two motions of a single point go in different directions—not *opposite* directions but *different* ones that enclose an angle.



·To start with, ignore the dotted lines and attend to the square.· Let the two motions we are concerned with be AB and AC. (The angle BAC could be any non-acute angle; it doesn't have to be a right angle as it is here.) Now, if these two motions occur at the same time in the same space, they will go in the *directions* AB and AC but they won't follow the *lines* AB and AC, but only lines parallel to these. The moving point will go through m; and this will be as though the AB movement had pulled the AC movement over to the line Mm, and the AC movement had pulled the AB movement down to the line Em. [Of course all of that should be said first about •a point between A and m, and before that about a point between A and •that point, and. . . and so on. To draw this properly we would need infinitely many smaller squares within the big one! But jumping across and down to m is sufficient for Kant to make his case.] If the directions are to remain the same, therefore, one of the two motions must be altering the other. [Actually, *each* motion must alter the other.] But the Proposition we are proving is about what the two motions *compose*; and the meaning of that (see Definition

5 on page 13) is that the two will jointly *be* the motion in question, not that by changing one another they'll *produce* it.

On the hand, that our moving point x undergoes motion AC in absolute space while—instead of x's undergoing motion AB—some relative space that x is in undergoes motion BA. Then while x moves AE in absolute space, the relative space moves Ee, that is, moves to the left, so that x's position in the relative space is m. And the same story holds for x's
493 absolute move AF while the relative space moves Ff; and for x's entire absolute move AC while the relative space moves Cc. From the standpoint of the relative space, therefore, x moves smoothly down the diagonal, through m and n ·and of course all the intermediate positions· to D, which is exactly the same result as if it had undergone movements AB and AC. So we get the result we want without having to postulate two motions that affect one another.

Remark 1

•Geometrical construction requires that two amounts when put together **are** a third amount, *not* that they **produce** the third in a causal way—for that would be •mechanical construction. For two items to be completely similar and equal in every way that can be known about in intuition is for them to be **congruous**. All geometrical construction of complete identity rests on congruity. This congruity of two combined motions with a third (as what is composed by the two) can never take place when the two are represented in a single space, e.g. in a single relative space. Hence each attempt to •disprove the Proposition on page 14 has failed because it is come up with merely mechanical solutions—saying how two motions m_1 and m_2 **combine with one another to produce** m_3 a third motion. Such attempts didn't prove that m_1 and m_2 **were identical with** m_3 and that because of this identity they could be presented in pure intuition *a priori*. [Kant wrote 'Each attempt to •prove the Proposition', but that must have been a slip.]

Remark 2

When a speed AC is termed 'double', this can only mean that it consists of two simple and equal speeds AB and BC (see the diagram on page 14). But if a 'double speed' is explained as 'a motion whereby a doubly great space is traversed in the same time', then something is being assumed that shouldn't be taken for granted, namely that two equal speeds can be combined in the same way as two equal spaces. It isn't obvious that a given speed consists of smaller speeds—that a speed is made up of slownesses!—in the way that a space consists of smaller spaces. The parts of the speed aren't external to one another, as the parts of the space are; and if a speed is to be considered as an amount, then the concept of its amount (·'How fast?'·) can't be constructed in the same way as the concept of the size of a space (·'How big?'·), because the former is intensive and the latter extensive. [Except for a passing mention (not included in this version), this is the first time Kant has used 'intensive' in this work. Examples: 'How severe was the pain?' and 'How hot is the water?' 'How fast did the train go?' ask about intensive magnitude, 'How long did the pain last?' and 'How much water is there?' and 'How far did the train go?' ask about extensive magnitude.] But the only way this construction *can* be done is by 494
putting together two equal motions, the motion of the body in one direction and the equal motion of the relative space in the opposite direction. Two equal speeds can't be combined in one body except through external moving causes—e.g. a ship carries the body with one of these speeds while another moving force within the ship gives the body a second speed equal to the first. . . . So much for the *addition* of speeds to one another. But when it's a matter of subtracting one speed from another, it is easy enough to •think of such subtraction

once we

have the notion of a speed as an amount by *addition*; but it's not so easy to •construct the concept of this subtraction. To do this one must combine two opposite motions in one body—and how is that to happen? It can't happen if we work with only one space that doesn't move. 'Isn't the concept of opposite and equal motions of a single body in a single space simply the concept of *rest*?' No, it is not! What we get out of this is not the concept of rest but merely the fact that what we are trying to do is impossible. As I have already shown, the composition that is assumed in the proposition ·on page 14· to be possible has to be done by combining the motion of the body with the motion of the ·relative· space ·that contains it·. Finally, the composition of two motions whose directions enclose an angle: this also can't be thought of in the body by reference to a single space. We *can* make sense of there being a body which is acted on by a northward-pushing force and a westward-pushing one, which between them produce a movement of the body in the north-westerly direction. But that is the •mechanical account of the concept of this kind of composition, not the •mathematical construction of it. A mathematical construction has only to make intuitive what the combined movement *is*, not how it can be *produced* by
495 Nature or art through certain tools and forces. . . .

Remark 3

So there we have phoronomy—a pure doctrine not of •motion but of the •quantity of motion, in which matter is thought of wholly in terms of its mere movability. All it contains is this single proposition—·the one on page 14·—about the composition of motion, applied to the three kinds of cases I have discussed. And it only concerns straight-line motions, not motions along curves; because curved-line motion is continuously changing in direction, and there has to be a cause for this change, a cause that can't be merely space. People usually take the phrase 'composite motion' to refer only to the case where the directions of the motion enclose an angle; this. . . . hasn't done any harm to physics, because in physics all three kinds of combination can be adequately treated as versions of the third case, ·the enclosed-angle· one. If the angle enclosing the two given motions is thought of as infinitely small [i.e. as approaching 0 degrees], it contains the first case; and if the angle is represented as only infinitely little different from a single straight line [i.e. as approaching 180 degrees], it contains the second case. So all three of the cases I have listed can indeed be covered by the single familiar enclosing-an-angle formula. But a proper *a priori* grasp of the quantitative doctrine of motion isn't provided by that formula, and such a grasp is useful for many purposes. [Perhaps that last remark goes with Kant's saying that confining 'composite motion' to the enclosed-angle kind of case is harmful to 'the principle of the classification of a pure philosophical science in general'.]

[Kant ends this chapter with a needlessly difficult paragraph connecting the •three kinds of composition of motion with the •three categories—i.e. pure concepts of the understanding—that he lists under heading 'Quantity' in the *Critique of Pure Reason*. In that work the division is into •unity, •plurality, •totality (corresponding to propositions of the form •'Henry is a tyrant', •'Some husbands are tyrants', •'All weak husbands are tyrants'). Kant hopes to link that with phoronomy by speaking of the latter in terms of •unity of line and direction, the •plurality of directions in one and the same line, and finally the •totality of directions as well as of lines.]

[In that paragraph, the *Critique*'s Quantity trio are labelled first by *Größe* and then by *Quantität*. But in the *Critique* the only label is *Quantität*, whereas *Größe* is regularly used there for 'size' or 'magnitude'. Quite apart from questions of consistency, *Größe* just does mean 'size' or 'amount' or something like it, and has nothing to do with that one/some/all trio of categories; the only two places where Kant writes as though it were the right label for that trio is the paragraph reported above and in the list of category-trios on page 6. —Setting aside issues about the terminology of the *Critique* (which won't concern us much), the present version will mainly translate

> *Größe* by 'size' or 'magnitude' or 'amount' or by phrases using 'how much' or 'how strong' etc., and *Quantität* by 'quantity'.

The standard meanings of the German words are confirmed by Kant's uses of them: *Größe* stands for a universal—bigness, how-much-ness, something that a thing *has*; whereas *Quantität* stands for a particular portion—e.g. the portion of coffee that I drank a moment ago—this being something that a thing *is*. Both *Quantität* and 'quantity' can also be used to name a universal, but they have this other option, which is the one Kant sometimes employs. Quite often he uses *Quantität* to stand for a universal—i.e. as equivalent to *Größe*—and in those cases the relevant English word will have a subscript q, as in 'the amount$_q$ of matter in it' on page 46. Don't think or worry about this; it is put there just for the record. Just twice he uses *Größe* to mean 'quantity' in the non-universal sense.]