THE JOURNAL OF PHILOSOPHY
VOLUME LXXXVIII, NO. 11, NOVEMBER 1991

PLENITUDE OF POSSIBLE STRUCTURES*

OUR chief concern is with actuality, with the way the world is. But inquiry into the actual may lead even to the farthest reaches of the possible. For example, to know what consequences follow from a supposition, we need to know what possibilities the supposition comprehends. Suppose that space is unbounded. Does it follow that space is infinite, as was once generally believed? The possibility of "curved" space demonstrates the opposite. Inquiry is driven by logic, and logical relations hold or fail to hold according to what is logically possible.

Whence come our beliefs about logical possibility? Typically, they derive from the analysis of particular nonlogical concepts. But sometimes we reason in accordance with general principles that are constitutive of logical possibility itself, principles to the effect that, if such and such is possible, then such and so must be possible as well. I shall call these *principles of plenitude;* I divide them into three sorts. First, there are principles that require a plenitude of recombinations. We reason according to such principles when we argue that it is logically possible for there to be a human head attached to the body of a horse. Second, there are principles that require a plenitude of possible contents. We reason according to such principles when we argue that some or all of the actual individuals and properties could be replaced by individuals and properties not of this world: alien individuals and properties. Finally, there are principles that require a plenitude of possible structures. We reason according to such principles when we argue that, if it is logically possible for there to be four or five spatial dimensions, then it is logically possi-

* To be presented in an APA symposium on the Epistemology of Modality, December 30. Joseph Almog will comment. See this JOURNAL, this issue, 620–2, for his contribution.

0022-362X/91/8811/607–19

ble for there to be seventeen, or seventeen thousand. These three sorts of plenitude, taken together, delimit the scope of the possible.

In this paper, I consider only plenitude of possible structures. I take it that there are structures we know to be logically possible, for example, the three-dimensional Euclidean and non-Euclidean spaces of constant curvature. My goal is to uncover the source of that knowledge, and thereby to combat skepticism about modality without appealing to any mysterious faculty of modal intuition. On my account, our knowledge starts from our theorizing about the actual world and is extended, in accordance with the demands of plenitude, by the results of mathematics. I develop and defend a principle of plenitude for structures, and motivate the principle pragmatically by way of the role that logical possibility plays in our inquiry into the world.

First, some preliminary points. A structure is logically possible, on my usage, only if there are or could be concrete entities that instantiate that structure, that is, only if the structure is instantiated by (some or all) of the concrete inhabitants of some possible world.[1] A structure is instantiated by a plurality of inhabitants of a world in virtue of their *natural* properties and relations; otherwise, structures would be too easily instantiated, since instantiation would depend only upon cardinality.[2] I assume that structures exist as abstract entities of some sort. If something more definite is wanted, structures may be represented set-theoretically in ways familiar from model theory for first-order languages.

I shall focus in what follows upon spatial and spatiotemporal structures. Not because I think these are the only sorts of structure to which plenitude applies: worlds have a pattern of instantiation of nonspatiotemporal natural properties and relations; and perhaps some worlds have irreducible causal, or nomological, or probabilistic structure. I focus upon spatial and spatiotemporal structures because they provide substantive examples upon which there is some initial agreement as to possibility.[3]

[1] Some authors use 'metaphysical possibility' for what I call 'logical possibility', and reserve 'logical possibility' for some (prima facie) weaker notion of "mathematical" (or "conceptual") possibility: a putative abstract entity is mathematically possible, roughly, if it can consistently be posited to exist. All structures are possible in this sense.

[2] Not every class of entities at a world is the extension of a *natural* property; belonging to the extension of a natural property may be a matter of shared universals, or duplicate tropes, or primitive naturalness applied to classes of *possibilia;* I need not decide that here. For discussion and comparison of these views, see David Lewis, *On the Plurality of Worlds* (New York: Blackwell, 1986), pp. 59–69.

[3] Beware. I normally use 'space' and 'spatial structure' interchangeably to refer to a "mathematical" entity; but 'space' also has a physical interpretation. Thus,

I

There is one more piece of business before turning to plenitude of structures. A principle of plenitude for structures, on my account, does not by itself determine which structures are possible. It serves rather as a principle of inference for modal reasoning: given that these initial structures are possible, these other structures are possible as well. The possibility of the initial structures must be believed on independent grounds. What might these be?

Consider Newtonian space-time: any two events have an absolute spatial and an absolute temporal separation. I assume we all believe that Newtonian space-time is logically possible. But, thanks to Einstein, we no longer believe it is actual, or even compatible with the actual laws. This suggests that logical possibility is required to encompass, not only actuality and nomological possibility, but our theorizing about actuality and nomological possibility as well. I propose:

(B) We have warranted belief that a structure is logically possible if that structure plays, or has played, an explanatory role in our theorizing about the actual world.

A number of comments are in order. (1) Condition (B) makes warranted belief about logical possibility relative to history and to a community of theorizers, as it should; it does not make logical possibility itself relative. (2) As the case of Newtonian space-time suggests, the historical relativity is asymmetric: the structures believed with warrant to be possible by a community only increase over time. (3) If a bad theory takes hold in a community, positing gratuitous structure that explains nothing, condition (B) does not apply. To 'play an explanatory role' is not just to be *taken* to play an explanatory role by the community. The structure must have genuine explanatory power.[4] (4) Although it is primarily *scientific* theorizing about the world that I have in mind, (B) is not thus restricted. Philosophers and theologians have posited explanatory structures in

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when I say that Euclidean space is instantiated at a world, I do not thereby say that physical space at the world is Euclidean. The latter requires that the structure, Euclidean space, be instantiated by the right entities (e.g., all the points of physical space), and perhaps also in virtue of the right natural relations (e.g., the distance relation at the world).

[4] Perhaps even Newtonian space-time fails this test due to its gratuitous positing of absolute rest; in which case only so-called Neo-Newtonian, or Galilean, space-time, could be warranted by (B). The possibility of Newtonian space-time would then be derived from plenitude. For the distinction between Newtonian and Galilean space-time, and a discussion of the explanatory adequacy of spatiotemporal structures, see Michael Friedman, *Foundations of Space-Time Theories* (Princeton: University Press, 1983), pp. 71–92, 236–63.

their theorizing about the world. However much we mistrust their speculations, we should not exclude these structures without cause. We can eliminate bad philosophy or theology in the same way we eliminate bad science: by requiring genuine explanatory power. (5) It is enough for a theory to be seriously considered by a community; it need not ever be believed. Belief in the possibility of Lobachevskian space (of very small negative curvature) is warranted by (B), because it was seriously considered (in the nineteenth century) whether measurements of stellar parallax supported the Euclidean or Lobachevskian theory of space. (6) Whenever a structure is instantiated at a world, so are all its substructures. For example, a world at which three-dimensional Euclidean space is instantiated is also a world at which one- and two-dimensional Euclidean space is instantiated. Thus, warranted belief in the possibility of a structure passes to all of its substructures. For convenience, I shall interpret 'plays an explanatory role in our theorizing' in such a way that, whenever a structure plays such a role, all of its substructures do so as well.

II

I turn now to plenitude. There are structures we believe possible that neither play, nor have played, any explanatory role in our theorizing. We believe them possible, I suppose, because we believe that the space of logical possibilities must be "filled out" or "completed" in some nonarbitrary way. But what counts as arbitrary here? Can these constraints on logical space be made more precise?

As a first try, we might take the intuitive idea underlying plenitude to be that "there are no gaps in logical space."[5] But what constitutes a gap? Suppose that there are worlds with Euclidean space of six dimensions, and worlds with Euclidean space of eight dimensions, but none with Euclidean space of seven dimensions. Would that be a violation of plenitude, a gap in logical space?

It would, indeed; but one must be cautious in giving the reason. Six-sided regular polyhedra (cubes) are logically possible, as are eight-sided regular polyhedra (octohedra), but not seven-sided regular polyhedra. Yet that does not constitute a gap in logical space. Wherein lies the difference? There *is* a gap in the first case, because mathematical generalizations of three-dimensional Euclidean space to higher dimensions include a seven-dimensional space whenever they include six- and eight-dimensional spaces; and they provide a natural ordering of the spaces according to which the seven-dimensional space falls between the other two. There is *no* gap in the

[5] From Lewis, p. 86.

second case, because mathematics teaches us that a seven-sided regular polyhedron is a contradiction in terms; so in going from six-sided to eight-sided, nothing has been left out. In sum, mathematics provides the backdrop of structures and the natural orderings on structures, without which the notion of a gap in logical space would make no sense.

It is not enough, however, to rule out gaps in logical space; plenitude demands that logical space contain no arbitrary or unnatural boundaries. Suppose that Euclidean spaces of all dimensions up to six were logically possible, but none of greater dimension. That, too, would be a violation of plenitude. The mathematical generalization of three-dimensional Euclidean space to four-, five-, and six-dimensional Euclidean space applies, *mutatis mutandis,* to all finite dimensions; there is no natural stopping point among the finite-dimensional spaces. To allow that some but not all finite-dimensional Euclidean spaces are logically possible would be to assign an unnatural boundary to logical space.

The idea that logical space contain no unnatural boundaries can be taken to supercede and clarify the idea that it contain no gaps. A gap in logical space is formed by two boundaries, one from either side. Call a gap *natural* if both its boundaries are natural; *unnatural* otherwise. A prohibition on unnatural boundaries entails a prohibition on unnatural gaps; natural gaps in logical space, if any there be, need not be a violation of plenitude.

It should be apparent by now that an account of plenitude must rely heavily on a notion of naturalness (or some equivalent). I shall assume that naturalness applies to classes generally, and, in particular, to classes of structures. Talk of natural boundaries in logical space is easily translated into talk of natural classes: any class of logically possible structures determines a boundary in logical space; the boundary is *natural* just in case the class is natural, or is a union of natural classes. Although I have no analysis of naturalness to offer, some words of clarification and illustration are in order.

Naturalness applies both to classes of physical entities and to classes of mathematical entities. In either case, what the natural classes are is not determined by us: it is a matter of objective, noncontingent fact. Examples of natural classes of mathematical entities include: the natural numbers, the real numbers, the ordinal numbers, recursive functions of natural numbers, continuous functions of real numbers. Examples of natural classes of mathematical structures include: groups, vector spaces, topological spaces, Euclidean spaces. Each of these natural classes serves as the principle object of study for some major area of mathematics. If a working criterion for naturalness is wanted, we have here, at least, a sufficient condition. That is not to say, however, that the above-mentioned classes are natural *because* mathematicians have chosen to study them. Rather, mathematicians have chosen to study them, I take it, in part because they are natural classes.

Although I shall speak of classes simply as natural or unnatural, it is clear that naturalness is a matter of degree. The odd natural numbers do not form a natural class in the sense here intended: the study of odd number theory, as opposed to number theory, would be a largely fruitless endeavor. But the odd numbers deviate from naturalness less than the numbers that are odd up to a hundred and even thereafter; and these numbers in turn deviate from naturalness less than some really gruesome class of numbers not even definable within elementary arithmetic. For what follows, I need to assume that classes of structures may be *perfectly* natural, that there is a greatest degree of naturalness; when I say 'natural', I mean 'perfectly natural'.

Naturalness itself imposes a structure on the classes of structures. Some assumptions about this structure will be needed below. I assume that the natural classes exhaust the class of all structures, that is, that every structure belongs to some natural class. I assume that the natural classes are not closed under unions or complements; though it is plausible that they are closed under intersections, that is controversial, and I shall not assume it in what follows. Finally, I assume that the class of all structures is *not* a natural class, on grounds of heterogeneity; but the formulations below could easily be revised to accommodate the contrary judgment.

III

With the notion of naturalness of classes in hand, I turn to formulations of a principle of plenitude for structures. The easiest way to meet the demand that there be no unnatural boundaries is to draw no boundaries at all:

(P1) Every structure is a logically possible structure.

I find (P1) attractive as a principle of plenitude for structures. For one thing, it provides an exceedingly simple account. Once (P1) is accepted, (B) becomes superfluous; mathematics alone—perhaps, mathematical logic alone—determines which structures are possible. Moreover, though the notion of naturalness may play a role in motivating (P1), it plays no role in its formulation. Unfortunately, (P1) goes far beyond anything demanded by the idea that logical space be characterizable in a nonarbitrary way. Perhaps (P1) could be defended by way of the benefits it confers upon our total theory.

In any case, I shall here remain agnostic toward (P1), and go on to develop a (somewhat) more conservative principle that is capable of a stronger defense.

There is another simple way to meet the demand that the space of possible structures contain no unnatural boundaries:

(P2) The class of logically possible structures is a natural class.

(P2) constrains the shape of logical space. It does not by itself tell us whether any particular structure is logically possible. But when combined with (B), it may support inferences to the possibility of particular structures. Thus, let B be the class of structures warranted by (B). Any structure that belongs to every natural class of structures which includes B is warranted by (P2). (I say a structure is *warranted*, for short, if belief in its logical possibility is warranted.) For example, suppose that B contained only the Euclidean spaces of one-, two-, and three-dimensions; then (P2) would warrant the other finite-dimensional Euclidean spaces.

(P2) will not do as a principle of plenitude for structures, however: it is both too strong and too weak. To see that it is too strong, consider the class of logically possible spatiotemporal structures. I take it we believe, based upon (B), that this class includes both continuous and discrete space-times, but I do not believe that any natural class encompasses them both; the mathematics of continuity and the mathematics of discreteness have little in common. Thus, B is not included in any natural class, making the acceptance of (P2) incompatible with (B).

A solution is not far to seek. Although the class of possible space-times is not a natural class, it is a *union* of natural classes; we call them all "space-times" not because they form a natural mathematical kind, but because of some looser family resemblance. This suggests that we weaken (P2) as follows:

(P3) The class of logically possible structures is a union of natural classes.

(P3) still constrains the shape of logical space, assuming, at any rate, that singletons are not in general natural classes. But (P3) is genuinely weaker than (P2) because the natural classes are not closed under unions. Moreover, when combined with (B), it still supports inferences to the possibility of particular structures: given a structure b in B, (P3) warrants any structure that belongs to every natural class containing b. Finally, (P3) is still sufficiently strong to guarantee that the space of possible structures contain no unnatural boundaries.

Nevertheless, I think (P3) is too weak in at least two ways. And if I am right, the condition that logical space contain no unnatural boundaries cannot be sufficient for plenitude. First, there is a problem of *crosswise generalizations*. Suppose that there are two natural ways of generalizing from a structure *b* in *B*, resulting in two natural classes containing *b*. If these generalizations cut crosswise, they may have only the structure *b* in common; in which case, no inference from the possibility of *b* to the possibility of any of the structures that generalize *b* will be supported by (P3). Consider this example. Suppose again that three-dimensional Euclidean space is one of the structures in *B*. One can generalize the number of dimensions to any finite value while keeping the space Euclidean, or generalize the curvature to any constant negative or positive value while keeping the space three-dimensional. Both generalizations, it seems to me, result in natural classes of spaces. It is compatible with (P3) that the spaces from only one of these classes be possible. But that is too weak. I think we have grounds to infer that *all* the spaces in question are possible, grounds that (P3) fails to capture. (P3) allows crosswise generalizations in effect to cancel each other out, without consequence.

One might simply concede that crosswise generalizations on a single structure *b* cancel one another *unless* there are other structures in *B* that, together with *b*, support inferences to the structures that generalize *b*. Thus, plenitude of structures demands that all finite-dimensional Euclidean spaces be possible only because *B* contains, in addition to the three-dimensional Euclidean space, the one-, and two-dimensional Euclidean spaces; and any natural class containing these three spaces contains all finite-dimensional spaces. (Similarly, all three-dimensional spaces of constant curvature are possible because *B* contains three-dimensional spaces of (very small) negative and positive constant curvature.) This suggests it might suffice to enhance (P3) as follows:

(P4) The class of logically possible structures is a union of natural classes. Moreover, suppose *S* is a class of logically possible structures that is included in some natural class. Any structure that belongs to every natural class of structures that includes *S* is logically possible.

(P4) falls midway in strength between (P2) and (P3): unlike (P3), it permits inferences from *classes* of structures, not just from *single* structures; but unlike (P2), it does not require that every class of possible structures be included in some natural class.

Is (P4) strong enough to capture plenitude of structures? I think not. For (P4) as well as (P3), there is a problem of *nested generalizations*. Consider the supposition that there are possible Euclidean spaces with any finite number of dimensions, but no possible Euclidean spaces with infinitely many dimensions. This supposition posits no unnatural boundaries in logical space: the class of finite-dimensional Euclidean spaces is a natural class, an appropriate object of study in mathematics. Thus, the supposition violates neither (P2), (P3), nor (P4). But I claim it is a violation of plenitude nonetheless. The natural generalization of one-, two-, and three-dimensional Euclidean space to other finite dimensions can itself be naturally extended into the infinite. For example, there is a natural generalization of the Euclidean metric to spaces of continuum-many dimensions which makes use of the way that integration generalizes finite summation.[6] Assuming that the Euclidean spaces in B are all finite-dimensional, it follows that they are included in at least two natural classes, one a subclass of the other. (P4) provides no grounds for inferring that any space contained only in the larger of the two subclasses—that is, any infinite-dimensional Euclidean space—is logically possible. But on what grounds does plenitude differentiate between the possibility, say, of a seventeen-dimensional Euclidean space, and the possibility of an infinite-dimensional Euclidean space? What does the size of a spatial structure have to do with the possibility of its instantiation?

One might reply: the seventeen-dimensional space is *closer* to the spaces in B than any infinite-dimensional space, according to the natural ordering of structures. But this reply is incompatible, at least in spirit, with the all-or-nothing approach to logical possibility taken by (P2) through (P4). If a relation of closeness to the structures in B is what differentiates the finite- and infinite-dimensional spaces with respect to possibility, it becomes an utter mystery why a space of seventeen-thousand dimensions should be no less possible than a space of seventeen. The reply in question leads inevitably, I think, to the view that logical possibility is a matter of degree, in which case logical implication becomes a matter of degree as well. That is a truly radical view; I do not reject it out of hand, but it will not be considered further in this paper. I know of no other grounds for favoring the finite-dimensional over the infinite-dimensional Euclidean spaces. I conclude that any principle of plenitude that warrants belief in the possibility of the former, must warrant belief in the possibility of the latter. (P4) fails this test.

[6] A standard example. Let the points of the space be the continuous real-valued functions defined on the real interval [0, 1]. Define the distance between two points, f and g, to be: $\sqrt{\int_0^1 (g(x) - f(x))^2 dx}$.

The same conclusion can be reached by a slightly different route. Suppose again that plenitude requires that there be no arbitrariness in logical space. One way for logical space to be arbitrary, I have said, is to have an unnatural boundary, that is, to not be a union of natural classes. But there is another way. Consider a nested sequence of natural classes representing more and more high-powered generalizations of some structures in *B*; suppose that any member of *B* occurs in the first member of the sequence or in no member at all; suppose further that any natural class that includes every class in the sequence is itself a member of the sequence. If *Z* is the union of all classes in the sequence, then *Z* contains all the structures that are candidates for logical possibility in virtue of the mathematical generalizations of the structures in question in *B*. Now, (P4) permits any division of *Z* into possible and not possible, so long as the possible structures form a natural class (and include the given structures in *B*). But it would be arbitrary for the boundary of logical space to follow one such division over any other. The only way to avoid such arbitrariness in logical space is to impose no division of *Z*. This suggests the following principle of plenitude:

(P5) Suppose *s* is a logically possible structure. Any structure that belongs to any natural class of structures containing *s* is logically possible.

(P5) substantially strengthens (P4). When combined with (B), it supports inferences to the possibility of spaces of any infinite dimensionality, as long as those spaces arise from a natural mathematical generalization of ordinary Euclidean space.

I wish I could in good conscience stop here; but a complication remains. There is a problem of *overhasty generalization*. Consider one-dimensional Euclidean space; that is, the structure of the real numbers with the usual metric: distance $(x, y) = |x - y|$. Is there any natural process of generalization that, when given *only* this structure as input, gives the finite-dimensional Euclidean spaces as output? I think not. The fundamental form of the Euclidean metric —being the square root of a sum of squares—plays no role in the one-dimensional case. Granted, one-dimensional Euclidean space is a *special case* of finite-dimensional Euclidean space; but it is too trivial a special case to support a generalization to higher dimensions. This leads to a problem with (P5). Given the possibility of only the one-dimensional Euclidean space, (P5) supports the inference to the possibility of all the finite-dimensional Euclidean spaces. That inference seems just as overhasty as the generalization upon which it is based.

There is an easy fix that should be resisted. We could say that plenitude of structures only supports inferences based upon generalizations involving *two or more* structures. But that fails to get to the heart of the problem. Natural generalizations can, I think, be based upon a single structure if that structure is not a trivial or degenerate case of the generalization; perhaps three-dimensional Euclidean space is an example. On the other hand, two structures may be no better than one, if both structures are trivial cases of the generalization in question. The number of structures needed to support a generalization is relative both to the type of generalization and to the particular structures chosen; it cannot be specified, once and for all, in advance.

I see no choice, then, but to conclude that the notion of natural class is not by itself sufficient for formulating a principle of plenitude for structures; we need a *relation* that holds between a class of structures and those classes of structures that are *natural generalizations* of it. A natural generalization of a class of structures is always a natural class; but a natural class need not be a natural generalization of all of its subclasses. Switching from natural classes to natural generalizations transforms (P5) into:

(PS) *Plenitude of Structures*. Suppose S is a class of logically possible structures. Any structure belonging to any natural generalization of S is logically possible.

This is the principle of plenitude for structures which I accept. It shares all the virtues of (P5): the logical space of possible structures has no unnatural boundaries, nor arbitrariness in the way boundaries are set.

IV

Thus far I have assumed without argument that logical space should have natural boundaries set in a nonarbitrary way. Can this assumption itself be defended? I think it can. I take it to be constitutive of logical possibility that it provide a suitable framework for our inquiry into the actual world; whoever denied this could not mean what I do by 'logical possibility'. Our inquiry into the actual world involves concepts—such as space, time, and space-time—that have meaningful application beyond the actual world, indeed, beyond the nomologically and the doxastically possible worlds. Since part of that inquiry is inquiry into the nature of these concepts and their logical interrelations, logical possibility must extend at least as far as the meaningful application of these concepts.

Consider the question with which I began this paper: If (physical) space is unbounded, must it also be infinite in extent? Suppose the question had been asked in the eighteenth century, prior to the discovery of non-Euclidean geometry. I think the answer would have been "no" even then: 'space' did not then mean 'Euclidean space', any more than it does now. Thus, questions about the world that might well have been asked in the eighteenth century could only have been answered in the light of mathematical generalizations that were then unknown. The situation is no different today. We do not know in advance which mathematical generalizations of our concepts will turn out to be relevant to our inquiry.[7] If the class of logically possible structures includes some but not all of these generalizations, as is allowed by (P2) through (P4), then logical possibility may be unfit to provide a logical framework for our inquiry into the world. In order to ensure that no relevant structure is left out of logical space, we need to posit a plenitude of possible structures, we need the space of possible structures to be filled out in a nonarbitrary way.

The role that logical possibility plays in inquiry can motivate and justify both (B) and (PS); does it also support (P1), that every structure is logically possible? No; logical possibility must be broad enough to accommodate inquiry into matters of *contingent* truth, not matters of *necessary* truth. I do not require, nor is it customary to require, that logical possibility provide a framework for mathematics. If a structure does not belong to any mathematical generalization of any actual structure, or of any structure warranted by (B), then it is logically irrelevant to inquiry into the actual world.[8] It could safely be excluded from logical space.

V

There is no space to further illustrate my account, or to compare it with what others have said.[9] I conclude by summarizing the implications of my account for the epistemology of modality. I have attempted to steer a course between the Scylla of modal skepticism and the Charybdis of an obscurantist modal epistemology. The skep-

[7] Actually, I hold something stronger, that we know in advance that every generalization is logically relevant, so long as it is compatible with whatever necessary conditions we place on the concept. But that depends upon a theory of content for concepts that I shall not defend here.

[8] Of course, it may be psychologically relevant by suggesting analogies, serving as a heuristic tool, and so on.

[9] Robert Adams appears to reject what I call plenitude of structures altogether. He holds that only the sort of considerations embodied in (B) can warrant belief in the possibility of structures. See "Presumption and the Necessary Existence of God," *Nous*, XXII (1988): 19–32. Lewis believes in a plenitude of possible (spatiotemporal) structures, but his account is based upon some principle weaker than (PS). He would reject (PS) because it leads to there being no *set* of all possible worlds. (I accept the consequence.) Cf. Lewis, pp. 104–8.

tic I have in mind holds that our only grounds for belief in the possibility of structures are the theoretical and explanatory grounds embodied in (B). Such skepticism is belied by ordinary practice, by our ordinary ways of thinking about modality. I take it our role as philosophers is not to challenge ordinary practice—except perhaps in rare cases—but to attempt to account for ordinary practice in a systematic way. I have developed and defended a principle of plenitude, (PS), that I think adequately explains and locates the source of our belief in a plenitude of possible structures. It warrants belief in the possibility of structures that are not ordinarily thought to be possible; but these structures are not ordinarily thought to be possible, I think, only because they are not ordinarily thought of at all. My account does not purport to eliminate all ignorance as to which structures are logically possible. If a structure is not warranted by (PS) together with (B), it may or may not be logically possible, for all I have said; an absence of warranted belief does not warrant belief in the contrary.[10] Moreover, there is ignorance associated with the application of (B) and (PS): ignorance as to which structures are explanatorily adequate to actual phenomena translates into ignorance as to which structures are possible; as does ignorance as to the mathematical generalizations of structures. But although it may sometimes be unclear how my account applies in a particular case, the general grounds of our beliefs are made clear. When we infer that some structure is possible using (B) and (PS), we are guided by science (broadly construed) and by mathematics, not by some mysterious faculty of modal intuition. Nor is any such faculty needed to motivate or defend (B) and (PS). They are motivated and defended, not by modal intuition, but by what we require a theory of modality to do. And there need be nothing obscure about that.

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[10] My account is compatible with the view that *only* the structures warranted by (B) and (PS) are possible. But I would reject that view on grounds of parochialism; it would allow features of *our* inquiry, contingent and accidental though they be, to delimit the scope of the possible.