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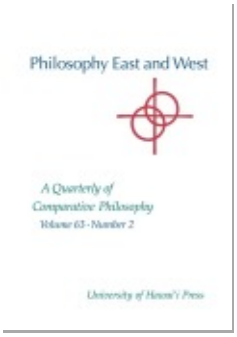

IS INDIAN LOGIC NONMONOTONIC?

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I

In a recent study—a study of considerable length, complexity, and ambition—Claus Oetke put forward the thesis that Indian logic prior to Dharmakīrti, both in the way it was practiced and in the way it was understood by those who reflected on it, was nonmonotonic.[1] Moreover, in this study Oetke presented a grand, systematic interpretation of the development of Indian logic based on this idea. His argument can be summarized in three main points.

1. For Indian logic in the "ancient period"—as evidenced by the examples of inference in the *Nyāyabhāṣya,* the *Ṣaṣṭitantra,* and pre-Diṅnāga Buddhist logical texts—the practice of reasoning, if not the theory of it, was clearly nonmonotonic. Inferences, for example the inference that it will rain because clouds are building up in the sky, were considered good only if normal conditions hold, that is to say, only so long as one is unaware of evidence that directly contradicts the conclusion. Thus, reasoning at this stage is not strictly deductive; an argument can be strong or good so long as the reason leads to or supports the conclusion, without necessarily entailing it.

2. In the "classical period"—roughly that of Diṅnāga and the *Nyāyapraveśa*—a theory of nonmonotonic reasoning was clearly worked out. This theory imposed a stricter normality condition on inference than that of the ancient period, namely that an argument is strong or good if the falsehood of the conclusion, given the reason, would count as a unique exception to our experience, for we have consistently observed the term of the reason, the *hetu,* and the term of the conclusion, the *sādhya,* to be found together in cases other than the one under consideration (the *pakṣa* of the inference). Here, we can say that the reason almost entails the conclusion; but because it is not required that it entail it absolutely, that is, because it is recognized that it is possible for the reason to be true and the conclusion false (although, once again, only as an extraordinary, quite unexpected occurrence), this constitutes a nonmonotonic theory of reasoning. Such a theory—and this is one of Oetke's more important claims—is implicit in the *trairūpya* formula. Moreover, a theory resembling default logic, a specific variety of nonmonotonic logic, seems implicit in the classic five-membered inference of the *Nyāyasūtra* and the *Carakasaṃhitā.*

3. Finally, Dharmakīrti advanced beyond the nonmonotonic model of reasoning by insisting that there be a strict relation of entailment between reason and conclusion: it must not be possible for the reason to be true and the conclusion false. This is ensured by there being an "unrestricted invariable concomitance," *avinābhāva,* between *hetu* and *sādhya;* that is, the *sādhya* is to be found everywhere the *hetu* is

to be found—and not just in the domain of things other than the *pakṣa.* The criterion for there being an *avinābhāva,* in turn, is the existence of an "essential connection," *svabhāvapratibandha,* between *hetu* and *sādhya,* either in the form of causality *(tadutpatti)* or identity *(tādātmya).* Thus, Dharmakīrti represents a significant break with the past.

In the present article I shall take issue with each of these points, suggesting in each case that Oetke's claim, at the very least, stands in need of modification. While impressed with the brilliance and originality of his analyses, I believe nevertheless that he has given a misleading picture of the development of Indian logic. In my view, there was not a shift from one paradigm of reasoning—a nonmonotonic one—to another—a monotonic one. Rather, from the very beginning something like monotonic, that is, deductively valid, reasoning was the ideal or norm, but the conception of that ideal was continually refined, in that the criteria for determining when it is realized were progressively sharpened. I cannot prove this here; perhaps, in fact, it is an ultimately undecidable issue. But in responding to Oetke I can give certain indications as to why I believe it to be the case.

II

In order to understand Oetke's theses and my criticisms of them we must have before us a clear notion of what nonmonotonic reasoning is. Although humans have practiced nonmonotonic reasoning since the beginning of the species, the theory of nonmonotonic logic (at least in the West, allowing for the possibility that the Indians really were the first to discover it centuries ago) is quite new. It was developed only in the last twenty years or so, in the field of computer science, as part of the project to simulate human intelligence, known as Artificial Intelligence (AI). Constantly in daily life the judgments humans make are based on a rough-and-ready kind of reasoning that is not, and has no pretense of being, deductively valid. When I get in my car in the morning and turn the ignition key, I expect the car to start. My judgment is based on an inference: the car will start because I turn the key; for whenever in the past I have turned the key, the car has started (let's say it's a relatively new car). This inference is obviously not a deductively valid one; all kinds of things could happen that would prevent my car from starting even though I turned the ignition key. The premises of my inference—(a) generally, this car starts when you turn the ignition key and (b) I will turn the ignition key—can be true, and the conclusion—the car will start—false. Moreover, if I were presented with information that something has happened that will prevent my car from starting—for example, it was vandalized last night and someone removed the battery—then I am prepared to retract my conclusion.

We resort to this kind of reasoning, referred to in the literature as "default reasoning," continually in everyday life: I turn on the tap expecting water to flow out; I brush my teeth intending to prevent tooth decay; I turn on the stove in order to make one of the burners hot; I put food in my stomach in order to alleviate my hunger and

give me energy, and so forth. Under normal circumstances doing these things will have the intended effects. However, in all of these cases the presentation of new information—for example, the water line has burst, the electricity has been shut off, et cetera—could easily cause me to alter my belief that the action I am about to undertake will have its usual effect.

If I had to rely only on inferences that have deductive validity—which means inferences for which it is not possible that the premises are true and the conclusion false—if, that is, I were not warranted in drawing a conclusion about what will happen if I do X unless it were *guaranteed* that if I do X it will happen, then I would simply be paralyzed. I would never undertake anything. Not only that: I might not even be able to perceive anything or navigate around my environment, for these, and many other cognitive-motor processes, seem to involve the ability to draw conclusions (construct objects) from incomplete information. Thus, in order to build machines that simulate human intelligence, researchers in AI have sought to articulate a theory of nonmonotonic reasoning—reasoning, that is, which looks like classical deductive logic in that it proceeds from premises to a conclusion and may be "good" in the sense that the premises lead to or support the conclusion, but which is utterly different from classical deductive logic in that there is no requirement that the premises entail the conclusion. In fact, one is prepared *not* to affirm the conclusion if presented with certain information. Since this kind of reasoning must somehow be expressed in a computer language in order to be realized by a machine, a "theory" of nonmonotonic reasoning in AI is typically a formalization of nonmonotonic reasoning. (It has proven, however, to be rather difficult to formalize.)[2]

The term 'nonmonotonic' alludes to a generally recognized property of classical deductive logic, namely,

If $X \vdash a$, then $X, Y \vdash a$ (where X and Y are sets of propositions).

This is called the property of dilution or monotony.[3] Strictly defined, a nonmonotonic logic is simply one that does *not* have this property. That means, the conclusion of an argument can be invalidated by the addition of new premises to the original premises; or, the conclusion of an argument does not follow from the original premises *no matter what.* Here, it is important to note that, according to this definition, the new premises do not alter the truth of the original premises; rather, they alter their logical force, so that they no longer imply what they did just by themselves. Since the property of monotony or dilution is known to most philosophers as deductive validity, I shall use 'nonmonotonic' and 'not deductively valid' as interchangeable expressions throughout this essay. However, it should be kept in mind that there are a variety of logics that are nonmonotonic.

Now just this much uncontroversial background already poses a certain problem for Oetke's analysis. We have seen that nonmonotonic reasoning is defined in contrast to monotonic reasoning: it is simply reasoning that is not monotonic or not deductively valid. Indian logicians, then, whether or not they practiced a form of reasoning that was in fact nonmonotonic, would have had a *theory* of nonmonotonic reasoning only if they had the concept of monotony or deductive validity. Did they have that concept? Oetke himself implies that they did not (at least, during the

periods under investigation). Even Dharmakīrti, whose statements imply that in general for an argument to be good it must not be possible for the reason to be true and the thesis or conclusion false, may not have devised a theory that, in its details, fully lives up to this principle. In any case, he certainly never gives clear expression to the notion of deductive validity as such. Thus, although the Indians may well have engaged in nonmonotonic reasoning and considered arguments that are not deductively valid to be good, to say that they had a *theory* of nonmonotonic reasoning seems somewhat problematic. It is sort of like saying that a certain culture that has always naturally lived exclusively on vegetables and has never known anyone to eat meat or even considered that possible thinks of itself as a culture of "vegetarians."

But of course this is a cheap criticism. Surely another tradition might have the same concept we do—or at least something analogous to it—without couching it in quite the same terms.[4] Nevertheless, it seems safe to say that if the Indians did have the concept of nonmonotonicity, they could not have had it in quite the same sense as the modern logician who is working out a specific system of nonmonotonic reasoning—default logic, relevance logic, or whatever—as an alternative to classical deductive logic.[5]

III

We have seen that nonmonotonic reasoning can be characterized informally as reasoning that is "sensitive to new information" or else "sensitive to the addition of new premises."[6] In mathematics—a paradigm of monotonic reasoning—a proof of any theorem, say, $2 + 2 = 4$, will always remain a proof no matter what else we come to know about the world; the truths of mathematics do not change. But in nonmonotonic reasoning the "addition of new premises," that is, the addition of new information to what I already know, can vitiate or defeat my inference. Another way of characterizing nonmonotonic reasoning is that it is reasoning that holds good "only under the assumption of normal circumstances," or, as Oetke frequently puts it, "under the fulfillment of normality conditions." I recognize that certain extraordinary things could occur that would vitiate my reason; therefore, in presenting my inference I make a proviso: I add a *ceteris paribus* clause.

Unfortunately, however, these less formal ways of characterizing nonmonotonic reasoning, as opposed to the more strict definition as reasoning that does not exhibit the property of dilution or monotony, can be misleading, and I aim to show in this and the next section that Oetke is sometimes misled by them. For monotonic reasoning is "sensitive to new information," too. Specifically, it is sensitive to new information *that calls the truth of its premises into question.*[7]

In order to see this, consider virtually any piece of reasoning from philosophy or the natural sciences. I shall take here as my example the well-known Argument from Design for the existence of God in philosophy. The argument goes, roughly: the universe was created by an (infinite) intelligent being (= God), because it shows a "remarkable adjustment of means to ends" (i.e., order and purpose), and we know that things that exhibit order and purpose are the result of the design of intelligent

agents. Now David Hume, in his *Dialogues Concerning Natural Religion,* actually suggests that this is a merely probable, that is, not deductively valid, argument, interpreting it essentially as an argument from analogy: like effects have like causes; to the extent, and only to the extent, that the universe is like a human artifact exhibiting purpose and order, for example a house, can we suppose it to have a similar cause. However, the Argument from Design can also be given deductive form, as follows:

The universe exhibits order and purpose.

All things exhibiting order and purpose are created by intelligent beings.

The universe was created by an intelligent being (= God).

This is a deductively valid argument, a piece of "monotonic" reasoning, for *if* the premises are true the conclusion *must* be true. Does that mean that it is not vulnerable to the presentation of new information, to wit, any of the various empirical considerations Hume raises against the Argument from Design in his *Dialogues*? Of course not. The objection, for example, that the order and purpose we see in nature could very well have come about as a result of the random operation of mechanistic forces on matter over a vast period of time, remains just as damaging as before. But this objection does not call the *validity* of the argument, as formulated here, into question, but only the truth of its major premise, namely that "All things exhibiting order and purpose are created by intelligent beings."

Countless other examples of deductive reasoning that is sensitive to new information can be offered from other fields of knowledge. In geometry, another model of deductive reasoning, the truth of many theorems is affected by the rejection of Euclid's fifth postulate. Newton presented his mechanics in *Principia Mathematica* as a rigorously deductive system, but of course his arguments are called into question by relativity theory. Spinoza presented his metaphysics *more geometrico,* but that does not mean that we cannot raise objections to it based on doubts about his axioms, postulates, and definitions. That a piece of reasoning is "sensitive to new information" has nothing to do with whether it is deductive or nondeductive, monotonic or nonmonotonic; for almost any reasoning can be put in deductive form (or be replaced by reasoning that is deductive in form), so that the new information, instead of exposing the weakness of the relation between premises and conclusion, can instead be taken merely as challenging the truth of the premises.[8] Ultimately, that a piece of reasoning is sensitive to new information has to do with the fact that it is not (however one might attempt to conceal the fact) an instance of *a priori* reasoning but reasoning about the empirical world, hence always subject to revision by further experience.

To point out, then, that certain (empirical) considerations lead us to question whether the conclusion of an argument follows from its premises is not ipso facto to introduce a new logical standard, that is, suggest that one should reason deductively instead of nondeductively. Rather, in most cases it is merely to ask whether the requirements of the relation of entailment between premises and conclusion are satisfied. Relativity theory does not call into question the rigor of Newton's *Principia* or suggest that he did not reason deductively. If anyone ever practiced deductive, monotonic reasoning it was Newton. Rather, relativity theory calls into question

the truth of the premises from which Newton reasoned. The criterion of being "sensitive to new information" identifies a piece of reasoning as nonmonotonic only if it is vitiated by new information *without any of its original premises being called into question.* Thus, returning again to our example of commonsense reasoning about starting the car: my belief that the car will start if I turn the key can be considered to be based on the premise, "Generally, cars start when you turn the ignition key." This premise—because of the qualification 'generally'—is *not* falsified when I am told that my car has been vandalized (for what is generally the case admits of exceptions). In nonmonotonic reasoning, new information does not challenge one's premises but rather draws attention to the fact that one's premises, or one's reason, as stated do not necessitate one's conclusion, *even when they are true.*[9]

Now some of the first evidence Oetke offers in favor of the thesis that there was a transition from a nonmonotonic model of reasoning to (more or less) monotonic reasoning in Indian Logic are passages from Diṅnāga and Dharmakīrti in which they critique the Vaiśeṣika argument for the existence of wind as a separate substance (Oetke, pp. 455 ff.). The argument is—once again, roughly—that the particular quality of touch that we notice all around us must belong to some substance, because it is a quality, and all qualities inhere in substances; yet it cannot be a quality of any of the visible substances earth, water, or fire because it is never perceived together with the other characteristic qualities of these substances (color, coolness, or warmth). Therefore, it must belong to some other, otherwise unknown substance—let that be what the Veda refers to as "wind."[10] Both Diṅnāga and Dharmakīrti point out that the second part of this argument, which excludes other visible substances as the substratum of the tactile quality in question, is not conclusive. For the properties of substances are unpredictable. Dharmakīrti mentions that there are various kinds of earth-substances, for instance, which differ considerably in regard to their tactile properties. Moreover, the properties of substances vary locally. Certain herbs might possess certain tastes or healing powers in one region that they lack in another. Thus, just because we have never perceived the quality of touch in question together with the other qualities characteristic of visible substances does not mean that it cannot be a property of one of them.

Now it seems from this, as Oetke maintains, that both Diṅnāga and Dharmakīrti are rejecting the Vaiśeṣika inference of the existence of wind because, as Oetke puts it, it is "based on certain frame conditions"; that is, it is valid only locally, as far as our rather limited experience extends, not universally.[11] In that case it would seem that both Diṅnāga and Dharmakīrti—although this is less certain for Diṅnāga, who himself seems to accept arguments that are valid only under the assumption of the fulfillment of normality conditions, as we shall see—are recommending a more rigorous form of reasoning, which of course would imply that people before them practiced a less rigorous form of reasoning, namely nonmonotonic reasoning, which is sensitive to new information. But, like the critique of the Argument from Design considered above, their critique of the Vaiśeṣika argument for wind as a separate

substance need not be interpreted in this way. Rather, it can be seen simply as being based on the rejection of one of the (implicit) premises of the argument, namely that a particular quality that is not perceived together with other characteristic qualities of certain substances cannot be a property of those substances. Moreover, they appear to be rejecting this premise out of certain empirical considerations. Touch is, after all, generally a property of visible substances, Diṅnāga points out, and there are a great variety of such substances so that one cannot rule out the possibility that one of them has this peculiar quality. In short, the fact that the argument is shown to be sensitive to new information does not necessarily mean that it is an example of nonmonotonic reasoning. It could just mean that the argument, although deductively valid, involves a faulty premise. Thus, also, Diṅnāga and Dharmakīrti's rejecting the argument in light of "new information" does not mean that they considered it to exemplify a form of reasoning that is less than monotonic.

Of course, Dharmakīrti uses the dubiousness of the premise in question to illustrate the point that a *vyatireka* cannot be established by mere non-perception; hence, one must ascertain a *svabhāvapratibandha* between *hetu* and *sādhya* in order to have a good inference—that is the context of his discussion of this argument (the context for Diṅnāga is quite different).[12] Thus, indeed, insofar as he requires a *svabhāvapratibandha* he can be seen to have a more exacting standard for a good inference. But the demand for a *svabhāvapratibandha* assumes that there should be an invariable concomitance *(avinābhāva)* between *hetu* and *sādhya* to begin with, for it is that which accounts for such a relationship, or that upon which it is founded.[13] The demand for a *svabhāvapratibandha* is not an original declaration that an invariable concomitance between *hetu* and *sādhya* must exist. Surely, the Vaiśeṣika, too, thought that there must be such a relationship in order to have a good argument. Indeed, he probably thought that there is an invariable concomitance between not being perceived together with the characteristic qualities of certain substances and not being a property of those substances—a claim, however, which Diṅnāga and Dharmakīrti obviously dispute, as we have seen. If the Vaiśeṣika, for example, thought that manifest color is an *essential* property of earth, then he would be perfectly justified in believing that earth *must* occur together with color, hence that nothing that occurs *without* color could be a property of earth.[14] My point is: regardless of the disagreement over the truth of this premise, to whatever extent the Vaiśeṣika thought that his inference should be grounded on an *avinābhāva* between *hetu* and *sādhya,* to that same extent did he embrace the same "monotonic" ideal of reasoning that Dharmakīrti, with his *svabhāvapratibandha,* appears to advocate.

Even if Dharmakīrti were right in his implicit criticism of the Vaiśeṣika that the latter erroneously believes that a *vyatireka* can be established by mere *adṛṣṭi* (non-observation of anything that lacks the *sādhya* yet possesses the *hetu*), still, the very fact that the Vaiśeṣika held that inference should be based on both *anvaya* and *vyatireka* would imply that he was thinking of the relation between *hetu* and *sādhya* just as rigorously as Dharmakīrti. He would just have a less exacting—indeed, an incorrect—criterion for determining that such a relation exists.

IV

This, then, is one way in which the characterization of nonmonotonic reasoning as "sensitive to the addition of new information," et cetera, is misleading. But there is another way, and this, too, I think, causes Oetke to go too far in attempting to draw a contrast between nonmonotonic and monotonic reasoning in Indian logic. An argument's "being sensitive to the addition of new information," even in cases where the new information does not call the truth of any premises into question and hence indicates the argument's lack of conclusiveness, is not an all-or-nothing thing. Among inconclusive arguments, some are more inconclusive than others. Or, conversely, when it comes to arguments that are not deductively valid, arguments the premises of which do not entail the conclusion but nevertheless lead to it or support it, some are stronger than others. Moreover, some nondeductive arguments are very strong indeed, so strong as to be almost as good as deductive ones.

We have seen that in relation to matters of fact it is not possible to achieve absolute certainty; all arguments about such matters, whether formulated as deductive ones or not, are vulnerable to further experience. Thus, it would be unreasonable to demand arguments that are perfectly certain in this sphere (see Oetke, pp. 512–514). (In that sense, the tendency in early modern European philosophy to formulate empirical arguments as strictly deductive, instead of probabilistic, can be seen as rather misleading.) What one should expect, rather, are arguments that are as strong as possible under the circumstances. Indeed, this is really all one hopes for in science. Although this is to "settle" for something less than deductive validity, one would be remiss not to note that (1) this is an ideal that comes close to that of deductive validity, and (2) that it is, in any case, a far cry from the sort of "commonsense" reasoning illustrated by my example of the inference about starting the car.

With this in mind let us consider the examples of *anumāna* found in the earliest Indian texts, for example the inference that it will rain because clouds are building up in the sky (*Nyāyabhāṣya* 1.1.5), the inference that it will rain because ants are seen carrying their eggs (*Nyāyabhāṣya* 2.1.37), the inference that it has rained because the river is in flood (*Nyāyabhāṣya* 1.1.5), the inference that all the grains in a pot are cooked because some of them are (Ts'ing Mu's commentary on the *Mūlamadhyamakakārikā*),[15] the inference that there is a peacock in the bushes because one hears a peacock's cry (*Nyāyabhāṣya* 2.1.37), et cetera. Oetke notes that these arguments are obviously not conclusive—it is possible for the reason to be true and the thesis not to hold. Moreover, he points out, this was noted by the Indians themselves, for example in the objection to inference as a valid means of knowledge raised in *Nyāyasūtra* 2.1.37. The rise in the river may be due to its being blocked downstream, not to its having rained; ants running around carrying their eggs could be caused by someone having disturbed their nest, not by the imminence of rain; the noise that sounds like a peacock may be made by a person imitating a peacock, not by an actual peacock, and so forth. Although *Nyāyasūtra* 2.1.38 suggests that the reason can be restated in each case so that it is conclusive, Oetke believes that the discussion of *Nyāyasūtra* 2.1.37–38[16] indicates nevertheless that at some earlier

stage inferences were considered acceptable even when they were *prima facie* inconclusive, that is, even when they were not carefully worded so as to exclude, as much as one could, possibilities other than the conclusion. For in general, and even at the stage of the *Nyāyasūtra,* arguments evidently were considered to hold only under "normal conditions."

Even when the reason is stated so as to be *more* conclusive—for example, "it will rain, because *most* ants over a wide area (not just in one particular place) are carrying their eggs to higher ground, apparently without confusion or fear"—it is still valid only given certain facts, such as that the usual laws of nature hold. Since the presupposition of normal conditions is a hallmark of nonmonotonic reasoning, then, these inferences are examples of nonmonotonic reasoning. And the ancient Indians—unless they were idiots—must have realized it. In declaring such inferences acceptable they were in effect presenting a theory of nonmonotonic reasoning.

Now, granted that all these arguments are strictly inconclusive, invalid arguments, I suggest that the appropriate question to ask is: *how* inconclusive are they? What are the normal conditions that they presuppose, and how likely is it that these conditions might be violated? Here one must note that Oetke has proposed the weakest possible interpretation of these examples. They are taken by him strictly as stated, in which case, of course, most of them are not only inconclusive arguments but very flimsy ones. But, of course, one needn't interpret them in that way; one can see them, rather, as abbreviated formulations, if you will, of more precise, more rigorous arguments. This indeed seems to be the recommendation of *Nyāyasūtra* 2.1.38: we should take these and other inferences *not* strictly as stated, but as they are intended by those who employ them. Surely, no one means to say that it has rained because the river is higher than before, but rather that it has rained because the river has risen in the way it does after it has rained—the water is turgid, flowing rapidly, carrying lots of debris, et cetera. And no one means to say that it will rain just because some ants are running around with their eggs, but rather that it will rain because they are running around everywhere in the peculiar way that they do just before it rains, and so forth. One reasons correctly not from a general reason but from a specific one, says Vātsyāyana. If the arguer fails to make the reason specific enough, so that it strongly supports the conclusion, then the fault lies with him, not with the *anumāna.*[17] If one reads the ancient examples of *anumāna* in this way, that is, as one no doubt would immediately reformulate them were one called upon to make the *hetu* more specific, then they become quite strong arguments which beg to be distinguished from, not assimilated to, the provisional, rough-and-ready type of reasoning we typically think of as "nonmonotonic."

For, granted that even such restated *anumāna*s still hold good only under certain "normal conditions," how likely is it that these normal conditions will be violated? Let us take what at first sight are two of the weakest examples: the inference that it will rain because clouds are building up in the sky (the "precarious" inference from cause to effect that Dharmakīrti, for example, explicitly rejected) and the inference that all the grains in a pot are cooked because some of them are. Suppose that the first inference refers not to the volatile thunderclouds of the American Southwest,

which can either produce a sudden, heavy downpour or dissipate completely, but to the massive buildup of clouds across the horizon that in India signals the onset of the monsoon. When you see that massive wall of black, you *know* it is going to rain. What could prevent it? What new piece of information would block the inference? Well, perhaps if someone were to tell you that a nuclear explosion has occurred—war, God forbid, has finally broken out between India and Pakistan—and the air currents in the upper atmosphere have been disrupted. But, in the grand scheme of things, how likely is that?

Or consider even the inference that all the grains in the pot are cooked because a few of them are. As an experienced cooker of rice I cannot think of any more infallible way of telling that the rice is done than simply to sample a few grains. When cooking rice, first you wash it, then put it in the pot with the proper amount of water (plus salt and a bit of oil), bring it to a boil, cover it and let it simmer for exactly twenty minutes, and only then and not before, lift the lid and test a few grains. If they are done, the whole pot is done—period. I find it difficult to imagine circumstances that would prevent that from happening. Perhaps a few of the grains are brown rice and take longer to cook, but I don't mix white and brown rice! (Who does?!) Perhaps a few grains of brown rice were left in the bottom of the canister and poured into the pot accidentally. Fine, but once again, how likely is that? (I haven't had any brown rice in the house in years.) The inference may presuppose some kind of "normal conditions," but those conditions are such that one has every reason to expect that they are fulfilled. *What seems to characterize these examples of inference, in fact, is that when they are formulated properly, as they were most likely intended, it seems, overall, quite unlikely that the reason could be true and the conclusion false.*

And that is a far cry from the inherently insecure kind of reasoning we typically identify as nonmonotonic, for example my inference that my car will start because I turn the key. I can imagine all kinds of entirely plausible scenarios that would prevent my car from starting in spite of my turning the key. Overall, the likelihood that the reason of my inference is true and its conclusion false is rather high. Therefore—and this, I think, is crucial—when I reason nonmonotonically I typically state my inference together with a proviso: "so long as there is no evidence to the contrary," or "so long as everything is normal," et cetera. *In nonmonotonic reasoning the sensitivity of one's argument to new information is explicit; it is part of the equation.* (This is even reflected by the formalism Oetke cites: A(x): $B_1(x)$ . . . , $B_n(x)/C(x)$, means, "Given A(x), if $B_1(x)$ . . . , $B_n(x)$ cannot be shown, derive C.") But for the examples of *anumāna* in ancient Indian texts there is no sense that the inferences are so shaky as to require a caveat or proviso.[18] On the contrary, they are typically presented as examples of a *pramāṇa,* a reliable means of knowledge about the world. Had the Indian logicians in the most ancient period really intended to include rough commonsense reasoning among the acceptable kinds of inference, they would have mentioned examples that cannot naturally be taken as strong arguments but, in order to be acceptable, do require a proviso; for instance, "A tree will grow here because a seed has been planted" (to which one would like to add: "provided there's enough moisture, that no one digs it up, et cetera"), or "My

cow will give birth to a calf, because she is pregnant" (to which one must add, "provided she is kept healthy," et cetera).

In summary, not all nonmonotonic reasoning (taken in the strict sense as reasoning that is not deductively valid) is the same. Rather than modeling reasoning on the practice of common sense, it seems that the Indians, even quite early on, sought to identify and characterize arguments that are as secure as possible, if not certain. All the old examples can be taken in this way. Thus, also, from the very beginning, *aikāntikatva* or *avyabhicāritva* is understood as a requirement of a good reason—if not already in the *Carakasaṃhitā* then at least in the earliest version of the *Nyāya-sūtra* and in the *Upāyahṛdaya*[19]—a fact that Oetke tends to ignore. What can *avyabhicāritva* mean other than: you can't have the reason without the conclusion, if not absolutely, then for the most part, or as much as one could hope for when reasoning about the real world?[20] The early Indian logicians almost certainly knew that the examples they gave were not strictly conclusive; but they also almost certainly presented those particular examples because they are, on the whole, when taken in a natural way, strong arguments that approximate an ideal of reliability. The expectation that there should be some quite fixed, if not absolutely invariable, connection between *hetu* and *sādhya* seems to have been in place from the very start.[21]

V

I would like to move on to consider other evidence Oetke presents in support of his thesis that the Indians at one stage both practiced and had a theory of nonmonotonic reasoning, namely his analysis of the treatment of the *viruddhāvyabhicārin hetu* and the various *pakṣābhāsa*s in the *Nyāyapraveśa.* A *viruddhāvyabhicārin hetu* is a kind of *hetvābhāsa*: it is a *hetu* that is counteracted by another *anumāna* that establishes the opposite conclusion (hence, *viruddha-avyabhicārin,* "not deviating from the opposite [reason, i.e., a reason that proves the opposite]"[22]). For example, there is the argument "Sound is not eternal, because it is caused," which is offset by the argument "Sound is eternal, because it is audible." The reason for the first argument, "because it is caused," when taken together with the reason of the second argument, "because it is audible"—and vice versa, the reason of the second argument when taken together with the first—becomes an "inconclusive" *(anaikāntika)* reason. This seems to be equivalent to the *satpratipakṣa hetu* of later Nyāya.[23]

The point Oetke makes about this treatment of the *viruddhāvyabhicārin hetu* in the *Nyāyapraveśa* (if I have understood him correctly, for his exposition is not easy to figure out) is as follows. The *Nyāyapraveśa* suggests that a reason becomes invalid when paired with its opposite. But, of course, if it can be defeated when brought together with its opposite, that is, another reason indicating the opposite conclusion, then it was not a strictly valid reason to begin with. Yet the notion that it becomes invalid, that is, a *hetvābhāsa,* when paired with its opposite implies that taken by itself it is acceptable.[24] In short, the *Nyāyapraveśa* seems to be saying that a reason that is perhaps strong but not strictly deductively valid is nevertheless acceptable

(or at least not a *hetvābhāsa*) so long as evidence to the contrary is not brought to light. Thus, the *Nyāyapraveśa* seems to be proposing a model of nondeductive reasoning that is "sensitive to enlargement of information," that is, "defeasible" nonmonotonic reasoning.[25]

This impression is reinforced by the treatment of *pakṣābhāsa*s, "improper theses," in the *Nyāyapraveśa.* Among them are the thesis contradicted by perception *(pratyakṣaviruddha pakṣa),* the thesis contradicted by inference *(anumānaviruddha),* and the thesis contradicted by tradition *(āgamaviruddha).* Once again, it seems that the *Nyāyapraveśa* is putting forward a theory of inference according to which an inference is acceptable unless and until contrary evidence is brought to light. An inference may appear acceptable in isolation, but as soon as someone points out that the thesis of the inference is contradicted, say, by perception, it is defeated. This appears to be a variety of nonmonotonic reasoning that is unable to hold up against the onslaught of further experience.

I believe, however, that Oetke's use of these passages in support of the view that the *Nyāyapraveśa* presents a theory of nonmonotonic logic is inappropriate, because he fails to take sufficient account of the fact that the *Nyāyapraveśa* itself does not consistently distinguish the requirements for a good reason in an inference *(anumāna)* from the requirements for a good reason in a proof *(sādhana).*[26]

An inference is a piece of reasoning that one employs in a proof, but it needn't be employed in a proof. By itself, it is a means of knowledge that enables one to know something about the world.[27] A proof, on the other hand, is a discourse intended to cause another person to adopt a certain belief—"the statement of the *pakṣa* and the other [members of a syllogism]"[28]—that is, the *presentation* of an inference. In a proof an inference is delivered to another person in such a way that it (potentially) becomes a means of knowledge for him or her, too.

Now the requirements of a good inference are different from the requirements of a good proof. The main requirements of a good inference are that there be a strong, if not strictly invariable, connection between reason and conclusion, and that the property identified as the reason really belongs to the minor term or subject about which the conclusion is to be established. In the *Nyāyapraveśa,* of course, these requirements are couched in terms of the "three marks" of the *hetu,* the famous *trairūpya.* But, for a good proof one requires, in addition to a good inference to begin with, which will be presented in the proof in a prescribed way, various other things that are necessary for the opponent to be *persuaded* by the inference and that really have nothing to do with the inference per se. For instance—although as far as I know this is never mentioned in any Indian text—one's opponent must be awake, not asleep. If one's opponent is asleep, then obviously the presentation of an inference will not cause him to accept one's point of view. Or, one's opponent must be basically rational and capable of following an argument. Typically, we can say that features having to do with the state of the opponent pertain to the requirements of a proof—we could call them "dialectical considerations"—not the requirements of an inference; for an inference, an *anumana,* is solely "for one's own understanding."[29]

Although the *Nyāyapraveśa* distinguishes inference from proof in general, it does not carry the distinction through in all the details of its discussion. This may have to do with the fact that it is not primarily concerned with inference in isolation but only insofar as it is employed in a proof. In any case, the requirements for a good proof tend to be imported into the requirements for a good inference. This is true, of course, not only for this text, but for most Indian logic texts; for, as Frauwallner and others have pointed out, dialectic was the main concern of Indian logicians prior to Diṅnāga, not *anumāna* as a means of knowledge in its own right.[30] Thus, when discussing the *hetu* the *Nyāyapraveśa* specifies that it must not be "unestablished" or "unrecognized" *(asiddha);* that is, an unestablished *hetu* is one of the false *hetus (hetvābhasa).* Now for a *hetu* to be established it must be accepted by both the proponent and the opponent of the argument.[31] But this is clearly a requirement for employing an inference in a proof, in the attempt to persuade another of one's own view, not for using an inference as a means of knowledge for oneself—not for inference per se.

Now I would maintain that the two passages to which Oetke refers as support for his thesis that the *Nyayapraveśa* articulates a nonmonotonic model of reasoning are also of this sort: they relate to dialectical considerations, the conditions of a successful proof, not inference. In trying to convince someone of a particular view you don't want to present an argument that is just going to be contradicted by the opponent's counterargument, even if your own argument is a strong one. What you have to do, rather, is destroy your opponent's argument first before you present your own. This is what is expressed by saying that the reason should not be *viruddhāvyabhicārin.* Similarly—what comes to much the same thing—you don't want to argue for a thesis that is directly contradicted by perception, or by an inference of the opponent's own or by revered tradition.[32] That will get you nowhere. What you must do, rather, is remove the apparent counterevidence before setting forth your own argument. This is what is meant by saying that the *pakṣa* must not be *pratyakṣaviruddha,* et cetera. Thus, these requirements, which are presented in the *Nyayapraveśa,* not unnaturally, as desired features of the terms of an inference, the *hetu* and *pakṣa,* in reality pertain only to inference insofar as it is employed in debate. *Hence, they really have nothing to do with inference itself, for one's inference may be perfectly good as such even though one is unable to use it effectively in a proof.* And so it seems incorrect to take these requirements as indications that the *Nyayapraveśa* considers *inference* to be good only provided that there is no evidence that contradicts its conclusion, that is, that it represents a kind of default logic.[33]

Even if one interprets these requirements—that the reason not be directly contradicted by counterevidence in the form of perception, inference, or tradition—as pertaining to an inference as such, they still do not support Oetke's conclusion. For they would then just amount to the assertion that a good inference cannot be obviously fallacious, or even immediately dubious, in these ways. The requirements would not mean that an inference is acceptable so long as it is not vitiated by these

sorts of counterevidence, but that an inference that is contradicted by these sorts of counterevidence doesn't even get off the ground; it is not a good inference at all.[34] The 'inference' that "sound is inaudible because"—what reason could one give?—"it is not tangible, like the self" is just a silly argument without any hint of plausibility, for its thesis is immediately contradicted by experience. It is not a piece of "nonmonotonic" reasoning that has some provisional plausibility that is later removed in light of further experience.

I believe that the discussion of Dharmakīrti in the *Hetubindu,* which Oetke cites on pages 461–466 of his article, is best understood in this connection. In the sixth chapter of the *Hetubindu* Dharmakīrti rejects the addition of further marks to the *trairūpya,* for example that the object of the inference not be "cancelled" *(bādhita)* and that "its uniqueness be intended," that is, that there is not another inference which establishes the opposite conclusion.[35] Does that mean, as Oetke suggests, that Dharmakīrti is rejecting an earlier theory that considered an inference acceptable so long as it is not vitiated by counterevidence? Hardly. Dharmakīrti points out that both of these marks are "redundant on the background of the first three conditions" (Oetke's wording, p. 462). That is to say, if the *hetu* of an argument satisfies the first three marks, it simply won't have the defects that these additional "marks" are supposed to exclude. But another way of saying this is: such defects would prevent an argument from being good in the first place. Dharmakīrti is not rejecting a theory that proposes that an argument can be good but then turn out bad when it runs up against experience, but one that holds that a piece of reasoning is good only if not contradicted by other *pramāṇa*s. He is rejecting that theory because he thinks it is superfluous to say that. For if the *hetu* satisfies the first three marks alone, then, in particular, its object cannot be cancelled by another *pramāṇa;* that is, one cannot know by means of a *pramāṇa* that the *pakṣa* lacks the *sādhya,* for that would be tantamount to saying that the third condition of the *trairūpya,* that the *hetu* cannot be found without the *sādhya,* really *isn't* satisfied![36]

Or else, indeed, Dharmakīrti could be denying the relevance of these additional marks because, as I argued above, they really just pertain to the conditions of proof and not inference per se. (This is not his actual argument, but could have been a motive behind it.) Summing up his discussion of the *Hetubindu* passage, Oetke writes:

> The author of our text [i.e., Dharmakīrti] appears to be reluctant to allow for the possibility that acceptability or validity might be "context sensitive" *in the sense that it depends on the comprehensive argumentative situation* whether some particular argument counts as valid or not. Dharmakīrti depicts as odd the situation that some proof might lose probativeness in view of the fact that some counterargument has been presented. He presupposes a notion of probativeness according to which the maxim: "either always probative or never" holds good. (p. 465; italics added)

But this is just to insist, reasonably enough, on the strict distinction between conditions of proof *(sādhana)* and conditions of inference *(anumāna)* that I previously set out.[37]

VI

I would next like to consider the role that the *trairūpya* supposedly plays in the progression from nonmonotonic to monotonic reasoning in Indian logic. Oetke believes the *trairūpya,* as expounded in Praśastapāda, the *Nyāyapraveśa,* and Diṅnāga, to represent an important transitional position: it calls for a stricter relationship between *hetu* and *sādhya* than that deemed acceptable in the earliest phase, but still does not require the *hetu* to entail the *sādhya.* Specifically, whereas previously an inference was considered good if the *sādhya* would *normally* belong to the *pakṣa* given that it has the *hetu,* now an inference is considered good only if it would be quite extraordinary if the *sādhya did not* belong to the *pakṣa,* given that it has the *hetu.* If you will, in the first phase, as Oetke represents it, one should be mildly surprised if the *sādhya* turns out not to belong to the *pakṣa* (given that it has the *hetu,* of course); in the second, one should be totally shocked. This, believes Oetke, is spelled out by the second and third conditions of the *trairūpya.* Both conditions together define a situation in which the *pakṣa*'s possessing the *sādhya,* given that it has the *hetu,* is "normal in all respects." According to the third condition, for things other than the *pakṣa,* if they lack the *sādhya* then they lack the *hetu.* Thus, if the *pakṣa* had the *hetu* but lacked the *sādhya* it would be a unique exception, different from everything else we know. The second condition, on the other hand, which says that there are some things other than the *pakṣa* that do possess both *hetu* and *sādhya,* tells us that if the *pakṣa* also possesses the *sādhya* (given that it has the *hetu*) then it is not merely not abnormal but also quite normal (for there are other things that possess both *hetu* and *sādhya*) (pp. 472–473).

Nevertheless, although the *trairūpya* tightens the criteria for what counts as "normal" when one specifies that for a good inference something should "normally" possess the *sādhya* if it has the *hetu,* it does not take the crucial step of saying that an inference is good only if something *must* possess the *sādhya* if it has the *hetu.* Thus, it still represents a variety of nonmonotonic reasoning. For, more specifically, both the second and third conditions of the *trairūpya* in Oetke's interpretation only express what must be the case, or be known to be the case, for things *other than the pakṣa;* for the *sapakṣa* consists of things "other than the *pakṣa*" that possess the *sādhya,* and the *vipakṣa* things "other than the *pakṣa*" that lack the *sādhya.* But statements that are true of things *other* than a certain item X cannot entail any truth about X. Thus, the fulfillment of the second and third conditions of the *trairūpya* by the *hetu* does not entail any truth about the *pakṣa,* even if it does possess the *hetu.* So this is nonmonotonic reasoning, in the more precise sense of nondeductively valid.

Oetke's understanding of the role of the *trairūpya* in the development of Indian logic hinges, of course, on his interpretation of the *trairūpya* itself. He has devoted several writings to this problem and I cannot hope to address what he says in all of them here. I shall confine my remarks to this particular article.

His main contention about the *trairūpya,* as I see it, is that it does not imply that a relation of *avinābhāva* should exist between *hetu* and *sādhya,* and that for the reason already noted. Namely, an *avinābhāva* is generally thought to be a relation-

ship that holds universally: *everything* that has the *hetu* has the *sādhya* ((x)(Hx ⊃ Sx)). But since the *trairūpya* excludes the *pakṣa* from the *sapakṣa* and *vipakṣa,* it in effect implies only that everything besides the *pakṣa* that has the *hetu* has the *sādhya* (i.e., (x)(x ≠ p ∧ (Hx ⊃ Sx)). That is to say, since the *sapakṣa* consists of things other than the *pakṣa* that have the *sādhya* and the *vipakṣa* of things other than the *pakṣa* that lack the *sādhya,* to say that the *hetu* must be found in the *sapakṣa* (condition 2) but not in the *vipakṣa* (condition 3) means that it must belong to certain things *other than the pakṣa* that have the *sādhya* and not belong to anything *other than the pakṣa* that lacks the *sādhya.* But this still allows for the possibility that the *pakṣa,* the object about which one wishes to prove something, could possess the *hetu* (as the first condition of the *trairūpya* affirms) and lack the *sādhya.* So the *trairūpya* on Oetke's reading does not imply that, universally, whatever has the *hetu* has the *sādhya,* since the *pakṣa* could be an exception!

Should the *trairūpya* be interpreted in this way? In order to answer this question another consideration must be introduced, namely whether the *trairūpya* should be understood "realistically" or "epistemically." Once again, this is a highly complex problem to which I cannot do justice here. Suffice it to say that there are significant differences in the way the *trairūpya* is formulated in the classical texts. In some versions it is stated simply that the *hetu* should belong to the *pakṣa,* exist in the *sapakṣa,* and not exist in the *vipakṣa;* in others it is stated that the *hetu* should belong to the *pakṣa,* should be found or be "generally known" to be in the *sapakṣa,* and not be found, or be established according to a *pramāṇa* as not occurring, in the *vipakṣa.* The first type of formulation, known as the "realistic version," suggests that the *hetu* really is in the *sapakṣa* and not in the *vipakṣa;* the second, known as the "epistemic version," suggests that *as far as we are able to ascertain from examining things,* it is in the *sapakṣa* and not in the *vipakṣa.*[38] The significance of the difference is that according to the first version *there exists in fact* an invariable concomitance between *hetu* and *sādhya* for all things besides the *pakṣa,* whereas according to the second *we have good evidence for such a concomitance* in that everything we've examined (other than the *pakṣa*) that has the *hetu* also has the *sādhya.*

Now the point I wish to make is that if the *trairūpya* is understood epistemically, as stating the conditions for having good evidence that there is an invariable concomitance between *hetu* and *sādhya,* then it is no longer significant that the *sapakṣa* and *vipakṣa* exclude the *pakṣa.* For even then the second and third conditions of the *trairūpya* will define the conditions for being justified in believing that there is an invariable concomitance between *hetu* and *sādhya universally. For what constitutes good evidence for there being such a relationship between hetu and sādhya for all things other than the single item that is the pakṣa also constitutes good evidence for there being such a relationship for all things including the pakṣa.*[39] If I have examined lots of cases of smoke and found every one of them to be associated with fire, and if, moreover, I have never seen anything that lacked fire that was smoking, then, even though none of those things I examined was this particular mountain that is emitting smoke in the distance, they nevertheless provide the best evidence I could

ever hope for (since I am not able to examine directly the particular mountain in question) that *universally,* for all things even including this mountain, wherever there is smoke there is fire. What I am suggesting, then, is that, under the epistemic interpretation, the *trairūpya* (especially the second and third marks) seems to state the conditions of evidence for the claim that an *avinābhāva* between *hetu* and *sādhya* exists, that is, for everything even including the *pakṣa,* and not just for everything besides the *pakṣa.* (The exclusion of the *pakṣa* from the *sapakṣa* and *vipakṣa* obviously has to do with the fact that the character of the *pakṣa*—whether it actually has the *sādhya* or not—is what is to be established by the inference itself. The *pakṣa*'s having property X cannot be included among the evidence that is intended to establish the generalization that will in turn be used to prove that it has property X!)

In light of this, Oetke's argument that the *trairūpya* represents a theory of nonmonotonic reasoning becomes questionable, because that argument, as we have seen, rests on the premise that the *trairūpya* does *not* imply that a relation of *avinābhāva* between *hetu* and *sādhya* should exist, and hence that the reason of an inference should necessitate the conclusion. But at least as far as epistemic versions of the *trairūpya* are concerned (and I believe that all versions of the *trairūpya,* even those not formulated explicitly in epistemic language, should be understood epistemically—but that is another can of worms[40]), it seems that a *hetu* is considered good only if there is evidence that such a relation exists. Although having evidence for P is not the same as its being the case that P, hence the satisfaction of the second and third conditions of the epistemic version still does not entail that the *pakṣa* has the *sādhya*—although this element of nonmonotonicity remains—nevertheless, at the heart of the epistemic version of the *trairūpya* proposal lies the expectation that there should be an invariable concomitance between *hetu* and *sādhya.* This, indeed, I would maintain, is a demand that was inherited from previous generations of logicians and most clearly enunciated prior to Diṅnāga by Vasubandhu.[41] What the *trairūpya* does (again, in its epistemic version) is simply to set out more rigorous and precise criteria for the existence of an *avinābhāva* than previously articulated.

VII

Finally, we come to Dharmakīrti. Here I can be quite brief. Oetke argues that Dharmakīrti believed that the *hetu* should entail the *sādhya,* insofar as there should be a relation of "unrestricted" invariable concomitance between *hetu* and *sādhya,* that is, not just outside the domain of the *pakṣa* but even including it, so that, given that the *pakṣa* has the *hetu,* it *necessarily* has the *sādhya.* Moreover, Dharmakīrti believed that a *svabhāvapratibandha* between *hetu* and *sādhya,* in the form of either *tādātmya* or *tadutpatti,* is the criterion for the existence of such an invariable concomitance or, specifically, as Oetke puts it, for the fact that the regularity exhibited between *hetu* and *sādhya* in the domain outside the *pakṣa* applies to the *pakṣa* as well.[42] This indeed seems to be a monotonic notion of reasoning—at least in its intent. It seems to appeal implicitly to the idea of deductive validity, that is, the idea that it is im-

possible for the premise (or reason) of an argument to be true and its conclusion false. The question is: is this a radical break from the past; is it significantly different from what went before?[43]

Obviously, since I think that the proponents of the *trairūpya* (Diṅnāga, Śaṅkarasvāmin, and Praśastapāda) implied, prior to Dharmakīrti, that a universal *avinābhāva* should exist between *hetu* and *sādhya,* I believe the answer to this question to be "no." But even prior to the introduction of the *trairūpya* there is every indication that it was accepted that an inference, at least ideally, should have a *hetu* that guarantees the presence of the *sādhya.* The history of Indian logic, as I see it, represents a series of proposals regarding the *criteria* for such a *hetu*—the specific conditions that must be satisfied in order for a *hetu* to be conclusive *(avyabhicārin, aikāntika).* Initially, in the ancient period, it was suggested (implicitly) that it should be akin to the *hetus* of certain paradigm examples of inference. Then, in the *Nyāyasūtra,* it was added that it must be formulated in an appropriately specific way: it is not just from ants carrying their eggs in general that we infer that it will rain, but from ants carrying their eggs in the peculiar way they do just before it rains. Moreover, in the *Nyāyasūtra* and in Vātsyāyana's *Bhāṣya* thereon the citing of an example (whether positive or negative) was considered essential for a proof, because it provides evidence that there is an established *sādhya-sādhana* relationship between the reason and the property to be proved. Other early texts, for example, the *Ṣaṣṭitantra,* proposed that a proper *hetu* will have one of several natural relationships with the *sādhya*: it will be its cause or its effect, its possessor, the whole of which it is a part, et cetera. The proponents of the *trairūpya* (together with early *vyāpti* theorists, such as Kumārila) managed for the first time to characterize a proper *hetu* in formal, extensional terms—a much more precise characterization than previously offered.

Finally, Dharmakīrti characterized a proper *hetu* as having a *svabhāvapratibandha* with the *sādhya*—which actually seems like a throwback to the *Ṣaṣṭitantra* position that there should be some kind of natural relationship between them. All of these proposals can be taken simply as suggestions of criteria for determining when a *hetu* is "non-deviating" or "invariably concomitant" with the *sādhya.* They can all be seen to *presuppose* that such a relation between *hetu* and *sādhya* must exist. In the history of Indian logic, as I view it, there was no real disagreement about whether there should be an invariable concomitance between *hetu* and *sādhya,* but only (implicitly) about how we can tell when we have one.

This may seem a rather naive, pedestrian way of looking at the history of Indian logic compared with Oetke's. But for all its plainness, I believe that it has the virtues of simplicity and straightforwardness. The obvious interpretation, even though apparent to the simpleminded, is not always wrong.

But we can also consider the continuity between Dharmakīrti and his predecessors from the opposite direction. Although Dharmakīrti may have achieved an understanding of the relation between *hetu* and *sādhya* that satisfies the conditions of deductive validity, he still never conceived of a kind of reasoning that is *absolutely certain.* Although he is clear that there should be a universal invariable concomitance between *hetu* and *sādhya,* and even in some places seems to understand

that as a *necessary connection* (i.e., not only is the *hetu* never found without the *sādhya,* but it is *not possible* for it to be found without it), he nevertheless believes that a *svabhāvapratibandha,* the ground of invariable concomitance, is to be established inductively, by means of certain observations.[44] But, of course, an inductive generalization is never certain. Although the conclusion of an inference is certain for Dharmakīrti given the truth of the *vyāpti* between *hetu* and *sādhya,* it would seem that whether such a *vyāpti* really exists, since it is an empirical matter, is always subject to doubt.[45] On the other hand, it is not entirely clear that Dharmakīrti really did succeed in specifying the conditions that determine deductive validity. In identifying *tadutpatti* as one of the types of *svabhāvapratibandha* in particular, he seems to have placed inference on an insecure footing, for it seems possible that a particular kind of phenomenon could have a *svabhāvapratibandha* with more than one kind of cause.[46] This comes up frequently in medical diagnosis, for example. A certain set of symptoms could be caused by two quite distinct sets of causal factors, A and B: on some occasions it is caused by A, on others by B. Thus, doctors frequently misdiagnose diseases, assuming that the symptoms are a manifestation of A when in fact they result from B. In general, the inference from effect to cause isn't always foolproof.[47]

Nor does the relation of *tādātmya,* upon which a *svabhāvahetu* is based, fare any better. It is widely accepted in contemporary philosophy that most, if not all, statements in the natural sciences, including even essential identifications such as "Water is H_2O" or "The atomic number of gold is 79," are subject to revision. For they are *a posteriori* truths, truths we arrive at by investigation and thus susceptible to emendation by further investigation. That means we can discover such statements to be false. Odd as it sounds, it could turn out, upon further investigation and the appropriate revision of scientific theory (although this is hard to imagine), that the liquid found in lakes and rivers that we thought is H_2O is really not H_2O. (We could discover, that is, that our physical theory, including the idea of the molecular and atomic structure of matter, is completely wrong.) It may turn out, in a similar way, that the substance we refer to as gold, out of which we make jewelry and coins, et cetera, and which in the context of current chemical theory we consider to have the atomic number 79, really does not have atomic number 79. Gold does not have atomic number 79 by definition,[48] although once science has established that it does, it becomes a *relatively fixed* truth for us.[49] And odd as it sounds, a *śiṃśapā* could, with continued inquiry and the subsequent revision of biological theory, turn out not to be a tree! (Perhaps we might discover that it is really a large shrub, or else a colony of smaller organisms.)[50] The inference that something is a tree because it is a *śiṃśapā,* based on a *svabhāvapratibandha* between *hetu* and *sādhya* in the form of *tādātmya,* although relatively more certain than the inference that it will rain because clouds are massing in the sky, still is not *absolutely* certain.[51]

In the end, Dharmakīrti and his predecessors were concerned with inference insofar as it pertains to the empirical world; they were not discussing the logic of formal proofs in geometry or mathematics. Thus, it should come as no surprise that they *all* conceived of logic, whether wittingly or unwittingly, as something less than

perfectly certain. Indeed, they all sought to describe the kind of logic that can deliver the highest degree of certainty one can hope for in regard to the sorts of things they were interested in reasoning about.

I have not refuted Oetke's theses here. I have merely called into question some, but by no means all, of the evidence upon which he bases them, and put forward an alternative interpretation of the facts. But Oetke's account remains viable; the data are extensive and complex and admit of a variety of interpretations (as Oetke himself is acutely aware).[52] Perhaps in the end there will be no conclusive considerations that will allow us to decide between them. Above all, one must be grateful to Oetke for raising the issues he has raised, which I believe challenge those engaged in the difficult task of deciphering the texts of Indian logic to pause for a moment and reflect, from a broader perspective, on what they are all about.

Notes

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1 – Claus Oetke, "Ancient Indian Logic as a Theory of Non-monotonic Reasoning," *Journal of Indian Philosophy* 24 (1996): 447–539. A precursor to this essay is "Praśastapāda's Views on the 'Antinomic Reason' and their Consequences for a Theory of Default Reasoning," in *Proceedings of the Panel on Early Vaiśeṣika, Asiatische Studien/Études Asiatiques* 48 (1994): 845–866.

2 – For a useful general introduction to the topic of nonmonotonic logic see the article by D. Perlis, "Reasoning, Nonmonotonic," in *The Encyclopedia of Artificial Intelligence,* 2nd ed., ed. Stuart C. Shapiro (New York: Wiley, 1992). On problems relating to formalization see in particular the articles collected in *Readings in Nonmonotonic Reasoning,* ed. Matthew L. Ginsberg (Los Altos, CA: Morgan Kaufmann Publishers, 1987).

3 – See, for example, Gerhard Brewka, Jürgen Dix, and Kurt Konlige, *Nonmonotonic Reasoning: An Overview* (Stanford: Center for the Study of Language and Information, 1997), p. 24; Richard Cartwright, *Philosophical Essays* (Cambridge, MA: MIT Press, 1987), p. 237; R. Reiter, "A Logic for Default Reasoning," in Ginsberg, *Readings in Nonmonotonic Reasoning,* p. 70.

4 – Oetke suggests, in another important study of Indian logic, that the distinction between *pratijñā,* thesis or assertion, and *nigamana,* conclusion—which is the same statement occurring as part of a "proof," *sthāpanā*—as articulated, for example, in the *Carakasaṃhitā,* implies a distinction between the truth of a statement and (mere) derivability (see his *Vier Studien zum altindischen Syllogismus* [Reinbek: Verlag für Orientalistische Fachpublikationen, 1994], pp.

46–50). But this would be tantamount to a recognition of logical validity only if it did not matter whether the premises of a "proof" are true or not—which is by no means clear. Oetke's further suggestion, namely that the fact that the *Carakasaṃhitā* also states that a proof *(sthāpanā)* may be opposed by a counter-proof *(pratiṣṭhāpanā)* implies just that (i.e., that whether a series of statements is a proof has only to do with the satisfaction of certain formal requirements), is weakened, I believe, by the sorts of considerations I raise in section five of this article.

5 – There is another problem here. Deductive validity for an argument is usually defined as the impossibility of its premises being true and its conclusion false. But, clearly, Indians did not formulate their arguments in terms of premises and conclusion. This applies not just to Dharmakīrti, who thought that the statement of the conclusion in a *parārthānumāna* makes the inference defective (see Tom Tillemans, *Scripture, Logic, Language: Essays on Dharmakīrti and His Tibetan Successors* [Boston: Wisdom Publications, 1999], pp. 69 ff.), but also to earlier thinkers. The classical five-membered inference is best analyzed in terms of a thesis, which is restated as the conclusion, and a reason (together with positive and negative examples)—hence essentially two statements. Nevertheless, for that period we can consider as analogous to our idea of deductive validity the idea, whether explicit or not, that it is impossible for the *reason* to be true and the *thesis* (i.e., conclusion) false. Attempts by scholars such as Schayer to see in the five-membered inference a set of premises that logically entail the thesis as their conclusion are interesting and may well capture the gist of what the early logicians were getting at. However, such proposals, by showing how the Indian syllogism must be *reformulated* in order to meet the requirements of deductive validity, demonstrate in the end that the Indians did not succeed in articulating that concept for themselves. What we don't find in the early texts is anything approaching a discussion of formal validity as such, like the treatment of the different figures and moods of the syllogism in Aristotle's *Prior Analytics.*

6 – See Brewka et al., *Nonmonotonic Reasoning,* p. ix: "Nonmonotonic reasoning, in its broadest sense, is reasoning to conclusions on the basis of incomplete information. Given more information, we are prepared to retract previously drawn inferences."

7 – To be sure, Oetke is aware of the definition of nonomonotonic reasoning as lacking the property of dilution ("Ancient Indian Logic," pp. 452–454), but he does not seem to be aware of all that is implied by this.

8 – Consider even so mundane an argument as "Most dogs bark; Rover is a dog; therefore, Rover barks." This is an invalid, but strong, argument. But it can be made into (or replaced by) an argument that is valid in form, namely "All dogs bark; Rover is a dog; therefore, Rover barks." So long as the information that Rover is a basenji (a breed of dog that doesn't bark) has not been delivered, this

will also appear to be a sound argument. Even when it is delivered, that information defeats the argument by showing the first premise to be false, but the argument of course remains valid in form.

9 – Thus, one can define reasoning to be nonmonotonic if its entailment is such that both of the following can be true:

S entails p (where S is a set of propositions)

S, q does not entail p.

But this is not the same as to say that the reasoning is sensitive to the addition of new information, since for deductive reasoning new information that falsifies a premise can undermine an entailment. That is to say, the following can be true of monotonic, deductive reasoning:

S entails p

S minus q does not entail p.

Thanks to Jonardon Ganeri for this clarification.

10 – See *Vaiśeṣikasūtra,* ed. Muni Śrī Jambuvijayayi (Baroda: Oriental Institute, 1982), 2.1.8–14.

11 – Oetke, "Ancient Indian Logic," pp. 458–461.

12 – The *vyatireka* of an inference is the satisfaction of the third "mark" of the *trairūpya,* namely that the *hetu* is not found in the *vipakṣa;* that is, there is nothing lacking the *sādhya* that possesses the *hetu.*

13 – See E. Steinkellner, "Kumārila, Īśvarasena, and Dharmakīrti in Dialogue: A New Interpretation of Pramāṇavārttika I.33," in *Bauddhavidyāsudhākaraḥ: Studies in Honor of Heinz Bechert,* ed. Petra Kieffer-Pülz and Jens-Uwe Hartmann, Indica et Tibetica, no. 30 (Swisstal-Odendorf, 1997).

14 – See the defense of the argument by Śrīdhara, *Nyāyakandalī,* ed. Durghādhara Jhā (Varanasi: Sampurnanad Sanskrit Vishvavidyalaya Press, 1977), p. 114. Earth *always* has color, he says; and one cannot argue that its color might be unmanifest in this case, because "the perceived touch of earth is seen to be invariably concomitant with *perceived* color" *(upalabhyamānasya pārthivasya sparśasyopalabhyamānarūpeṇaiva sahāvyabhicāropalambhāt)* (ll.8–9).

15 – See Giuseppi Tucci, *Pre-Dignāga Buddhist Texts on Logic from Chinese Sources,* Gaekwad's Oriental Series, no. 49 (Baroda: Oriental Institute, 1929), p. xviii.

16 – Oetke cites the Walter Ruben edition, in which these verses are numbered 2.1.35–36.

17 – *so 'yam anumātur aparādho nānumānasya, yo 'rthaviśeṣeṇānumeyam artham aviśiṣṭārthadarśanena bubhutsata iti* (*NBh* 2.1.38).

18 – Consider the inference that a vehicle seats five because it is a car, or that Nixon is a pacifist because he is a Quaker, or that Nixon is not a pacifist because he is a Republican, et cetera. None of these typical examples of nonmonotonic

arguments is acceptable without the proviso "if things are normal." But the ancient Indian examples of *anumāna,* interpreted naturally, certainly are.

19 – See *Carakasaṃhitā, Vimānasthāna,* ed. Śrī Jayadevavidyālaṅkāra (Delhi: Motilal Banarsidass, 1975), 8.45. *Savyabhicāra* is not explicitly mentioned as an attribute of a reason. The example given is that of a medicine that might be applicable to a certain disease—or might not.

20 – Was *aikāntikatva* a requirement of a good reason for all logicians? In the *Ṣaṣṭitantra* we seem to have the acknowledgment that one of the types of the traditional "threefold *anumāna,*" namely the inference from cause to effect, is not *aikāntika.* But how are we to interpret this? Does this mean that it is acceptable even though it is *anaikāntika,* or that it is not acceptable because it is *anaikāntika*? The text does not say. I would venture to suggest that the fact the *Ṣaṣṭitantra* mentions that the type of reason in question is not *aikāntika* indicates that this was considered to be of some significance, which would indicate in turn that the expectation was that a reason should be *aikāntika.* But there is not sufficient evidence to answer this question. See Erich Frauwallner, "Die Erkenntnislehre des klassischen Sāṃkhya-Systems," *Wiener Zeitschrift für die Kunde Süd- und Ostasiens* 2 (1968): 128.

21 – This also seems to be what the example *(dṛṣṭānta)* in the classic five-membered argument was supposed to secure. See Ernst Prets, "Example and Exemplification in Early Nyāya and Vaiśeṣika," forthcoming.

22 – Following the interpretation of the *Nyāyapraveśavṛtti,* ed. Anandshankar B. Dhruva, Gaekwad's Oriental Series, no. 38 (Baroda: Oriental Institute, 1968), p. 26, ll.15–20, which rejects the analysis *viruddhaś cāvyabhicārī ca.*

23 – See *Tarkasaṃgraha,* ed. Yashwant Vasudev Athalye, Bombay Sanskrit and Prakrit Series, no. 55 (Poona: Bhandarkar Oriental Research Institute, 1974), sec. 55, p. 46.

24 – See *Nyāyapraveśavṛtti,* p. 27, ll.4–7. To the question of whether the *hetu*s of these two inferences are the cause of doubt jointly or separately, the Vṛttikāra answers: jointly. He seems to accept the suggestion of the objector that separately they are correct: *vyastayoḥ samyagdhetutvāt.*

25 – See Oetke, "Ancient Indian Logic," p. 468.

26 – Oetke does note the distinction, for example on page 470: "It is true that some of the subcategories [of *pakṣābhāsas*] appear only applicable to public proofs and not to inferences in general." However, he seems to think that the context sensitivity of proofs that he documents pertains also to inferences; see his discussion of the "acceptability-condition" for arguments in the *Nyāyapraveśa,* in "Ancient Indian Logic," p. 471. Yet he does not consider that it is possible to interpret the text in this way only because the text itself is not careful to differentiate the requirements of a good inference from the requirements of a good proof.

The same problem affects Oetke's earlier essay, "Praśastapāda's Views on the 'Antinomic Reason,'" which he more or less concedes in the following note: "We assume in this context that the relevant features which can be gathered from Praśastapāda's exposition of proof (or *parārthānumāna*) should also be hypostatized *[sic]* for the theory of 'private' inference (or *svārthānumāna*) despite the fact that a number of theoretical notions like that of fallacious assertions, etc., are only explicitly mentioned in the section dealing with proofs. Our following remarks concerning the relationship of Praśastapāda's logical doctrine to Default logic are, however, not essentially dependent on this assumption and could be taken as applying exclusively to his theory of proof if one has qualms about the generalization from (public) proofs to inference in general" (p. 852 n. 6). In that case, however, as I shall argue below, one cannot say that Praśastapāda presents us with a theory of nonomonotonic logic. That our procedure in debate is not monotonic, in the sense that we are always retracting statements in light of counterarguments, et cetera, is hardly controversial.

27 – See Musashi Tachikawa, "A Sixth-Century Manual of Indian Logic" (i.e., the *Nyāyapraveśa*), *Journal of Indian Philosophy* 1 (1971): 144, sec. 4.

28 – Ibid., p. 140, sec. 2.

29 – Ibid., p. 144, sec. 4.

30 – See Frauwallner, *Nachgelassene Werke I,* ed. Ernst Steinkellner (Vienna: Österreichische Akademie der Wissenschaften, 1984), pp. 66–87. See, in particular, the definition of the *viruddha hetu* at *NS* 1.2.6. A *hetu* is *viruddha* if it contradicts an accepted doctrine: *siddhāntam abhyupetya tadvirodhī viruddhaḥ.* This has to do with whether one's argument is consistent with one's overall system of beliefs, and so can be challenged on that ground. It is a dialectical consideration.

31 – Tachikawa, "A Sixth-Century Manual of Indian Logic," p. 141, sec. 3.2.1. Cf. the definition of *asiddha hetu* in the *Tarkasaṃgraha,* sec. 56, pp. 46–47, which makes no reference to acceptance by the opponent.

32 – Cf. the discussions of *satpratipakṣa* and *bādhita hetus* in the *Tarkasaṃgraha,* secs. 55 and 57. The former is a reason counterbalanced by the *hetu* of another argument that alleges to prove the opposite: *yasya sadhyābhāvasādhakaṃ hetvantaraṃ vidyate sa satpratipakṣaḥ.* The latter is one that is conclusively refuted by another *pramāṇa*: *yasya sādhyābhāvaḥ pramāṇāntareṇa niścitaḥ sa bādhitaḥ.* For example, if one were to argue that "Fire is cold, because it is a substance," then one's conclusion would just be contradicted by perception.

33 – In the earliest dialectical manuals, that is, *Carakasaṃhitā, Vimānasthāna* 8 and *Nyāyasūtra* 1.1–2 and 5.2, the concern appears to be solely with debate, not logic as such. Arguments as studied there are just ways of persuading others of

one's point of view; they are not yet means of knowledge, means for attaining truth, even though they must conform to certain formal criteria. Thus, the argument that the soul is eternal because it is not produced, like space, works to persuade others until there is a counterargument *(pratiṣṭhāpanā)*: the soul is not eternal, because it is perceptible by the senses, like a pot (this is the example given in the *Carakasaṃhitā*). It is persuasive so long as it is not contradicted. But that is different from saying that one's argument has the form 'one can derive X from premise Y provided that there is no evidence contrary to X.' The thoroughly dialectical nature of early Indian 'logic' has been well documented in a series of recent articles by Ernst Prets. See, in particular, "Theories of Debate, Proof and Counter-Proof in the Early Indian Dialectical Tradition," in *On the Understanding of Other Cultures, Proceedings of the International Conference on Sanskrit and Related Studies to Commemorate the Centenary of the Birth of Stanislaw Schayer* (Warsaw: University of Warsaw, 2000), pp. 369–382.

34 – One way of putting this is that if a *hetu* is *anumānaviruddha,* for example, then it clearly cannot be *aikāntika,* conclusive. Although one may not directly discern that the *hetu* is inconclusive, that there is something besides the *pakṣa* that possesses the *hetu* but lacks the *sādhya,* the existence of a counterargument suggests that the *pakṣa* could still be an exception to the rule of the *vyāpti* (wherever the *hetu* occurs, so does the *sādhya*). The same would be the case if the *hetu* were *pratyakṣa-* or *āgamaviruddha*: it could not be conclusive. In fact, this suggests a much more adequate account of the *viruddhāvyabhicārin hetu* within the framework of a theory of inference proper than what Oetke proposes. The *hetu* of an *anumāna* for which there is a counterargument—that is, a *viruddhāvyabhicārin hetu*—is *anaikāntika* precisely because the existence of a counterargument suggests that the *pakṣa* may not, after all, fall within the domain of the invariable concomitance of *hetu* and *sādhya* as initially indicated by the satisfaction by the *hetu* of the second and third conditions of the *trairūpya.*

35 – See *Dharmakīrti's Hetubindu,* Teil I, *Tibetischer Text und rekonstruierter Sanskrit Text,* ed. Ernst Steinkellner (Vienna: Österreichische Akademie der Wissenschaften, 1967), pp. 85, l.21—95, l.1. On the interpretation of *vivakṣitaikasāṃkhyatva* as being intended essentially to exclude the *viruddhāvyabhicārin hetu,* see Steinkellner, *Dharmakīrti's Hetubindu,* Teil II, *Übersetzungen und Anmerkungen* (Vienna: Österreichische Akademie der Wissenschaften, 1967), pp. 198–199 n. 26.

36 – That Dharmakīrti understands the view he is attacking in this way is quite evident from the beginning of his discussion (Steinkellner, *Dharmakīrti's Hetubindu*), p. 87, ll.2–8.

37 – Oetke also wants ("Ancient Indian Logic," pp. 481–482) to see an acknowledgement of a provisional kind of reasoning, which would be good only so

long as it is unopposed by counter-reasoning, in the *Carakasaṃhitā (Vimāna-sthāna).* There, a *sthāpanā* consists of the last four of the five *avayava*s, that is, all but the *pratijñā.* What is the difference between a *sthāpanā,* then, and a full argument consisting of all five *avayava*s, including the *pratijñā* (which is not given a name)? Since a *sthāpanā* can be opposed by a *pratiṣṭhāpanā,* apparently a *sthāpanā* is a less rigorous and conclusive argument than a complete five-membered argument, Oetke suggests. (Hence, a *pratijñā* in the context of a five-membered argument constitutes the assertion of a particular statement, whereas the occurrence of the same statement in the context of a *sthāpanā* —namely, as its conclusion, *nigamana*—indicates something less, that it is merely derivable from other statements or facts.) But this seems to be a stretch. Rather than taking the *Carakasaṃhitā* as intending some contrast between a full argument of all five members and a *sthāpanā,* one may simply take *sthāpanā* to be the name given to the last four *avayavas* in a five-membered argument; they are what constitute the proof of the *pratijñā.* The *pratiṣṭhāpanā,* then, is simply the argument the opponent possesses that allegedly proves *his* thesis, his *pratijñā.* That there is a *pratiṣṭhāpanā* to oppose the *sthāpanā* once again has to do with the dialectical situation and does not imply any reservations about the finality of inference per se.

38 – See Oetke, *Studies on the Doctrine of Trairūpya,* Wiener Studien zur Tibetologie und Buddhismuskunde, no. 33 (Vienna: Arbeitskreis für Tibetische und Buddhistische Studien, 1994), esp. pp. 77–107.

39 – Oetke also seems to recognize this when he says of the *trairūpya,* "the principle lying behind this standardization was in all probability that non-existence of exceptions to a rule in [one] domain [namely, the *sapakṣa*] should support conformity to the same rule in another domain [namely, the *pakṣa*]" ("Ancient Indian Logic," p. 496), but I believe he does not follow out the implications of this observation.

40 – Proper consideration of this matter would have to take into account Oetke's analyses of the *trairūpya* formula in his *Studies on the Doctrine of Trairūpya,* which would go well beyond the scope of this study.

41 – Oetke seems willing to consider that Vasubandhu may have had the concept of "unrestricted invariable concomitance"; this, however, does not mean that he thought it was a "necessary condition for the acceptability of proofs or inferences" ("Ancient Indian Logic," pp. 489–490). However, when Vasubandhu defined the reason *(hetu)* of a proof *(sādhana)* as *tādṛgavinābhāvidharmopadarśanam,* it seems obvious that he was thinking of universal invariable concomitance between *hetu* and *sādhya* in precisely that way—as a requirement for a good reason, hence for the acceptability of a proof.

42 – See "Ancient Indian Logic," pp. 490–491 and 493–499. On page 498 Oetke writes, "We should perhaps best consider the theory of *svabhāvapratibandha* as destined to tell us what a person [should be committed to] who takes the fact

that a universal proposition—in particular a proposition of the form 'All H's are S's'—is corroborated or not invalidated in a domain as a criterion for the assumption that this proposition is corroborated and not invalidated also in another domain. . . ."

43 – In fact, Oetke does not really see a *radical* break between Dharmakīrti and his predecessors. On pages 492–504, one of the most interesting passages in his essay, he argues that while Dharmakīrti's *svabhāvapratibandha* proposal can be considered as defining the conditions that must be met for deductive validity, it can more generally be seen as pertaining to the conditions necessary for extrapolating from observations about the concomitance of properties in one domain to the concomitance of those same properties in another. And that is just as relevant for nonmonotonic as for monotonic reasoning. Just as a *svabhāvapratibandha* will account for why the observation of the concomitance of properties among a certain set of examples justifies postulating a universal concomitance of those properties, so there will be some natural circumstance that accounts for why we can move reliably from the observation in regard to one domain, that *for the most part* if something is a bird then it can fly, to believing in regard to another, broader domain, that *for the most part* if something is a bird then it can fly. Thus, Oetke tries to show how Dharmakīrti's theory of *svabhāvapratibandha* in fact originated "on the background of theories of defeasible reasoning" (p. 500).

Nevertheless, he clearly interprets pre-Dharmakīrtian logic as nonmonotonic in spirit, and he also sees Dharmakīrti as taking a decisive step in the direction of conceptualizing deductive validity (although he notes certain flaws in that conceptualization). Thus, for Oetke, there is a continuity between logic before and after Dharmakīrti to the degree that Dharmakīrti can be seen as putting forward a proposal *that evolves out of considerations of nonmonotonic logic.* My own approach, on the other hand, is to see that Indian logic is *monotonic* in orientation from the start. The continuity of Indian logic before and after Dharmakīrti has to do with the steady progression in the understanding of the requirements that must be met for reasoning to be monotonic.

44 – See Tom Tillemans, *Scripture, Logic, Language,* pp. 125–127. He refers to *Pramāṇavārttika* 4.245–258. See also Ernst Steinkellner, "The Logic of the *Svabhāvahetu* in Dharmakīrti's *Vādanyāya,*" in *Studies in the Buddhist Epistemological Tradition,* ed. E. Steinkellner (Vienna: Österreichische Akademie der Wissenschaften, 1991), pp. 311–324, and B. K. Matilal, *The Character of Logic in India* (Albany: State University of New York Press, 1998), pp. 111–113.

45 – See Oetke's discussion in "Ancient Indian Logic," pp. 494–496.

46 – The problem is noted by Oetke, ibid., p. 494.

47 – In various places Dharmakīrti attempts to prove that an effect must have a unique cause. In his article "*Svabhāvapratibandha* and the Types of Reasons"

(in Steinkellner, *Studies in the Buddhist Epistemological Tradition,* pp. 243–268), Oetke points out the fallacies in Dharmakīrti's argument for this thesis in his *Hetubindu* (pp. 259–262). In my view, however, the question of whether an inference based on the *tadutpatti* relationship is not strictly reliable can really only be answered once we have a better understanding of Dharmakīrti's theory of causality.

48 – For it is what is called a "rigid designator," by Kripke. Its meaning is determined by its reference, much like a proper name.

49 – Here I am following Quine, not Kripke, who believes that we can discover that it is part of the very nature of gold that it has atomic number 79, in which case it becomes a *necessary* truth—that is, true in all possible worlds—that it has atomic number 79.

50 – A recent example of this is the planet Pluto being demoted from the status of a planet by astronomers. Thus, the statement "Pluto is a planet," secure for so long, has now been discovered to be false.

51 – It is possible, however, that Dharmakīrti understood the identity of *tādātmya* to be strictly conventional: a *śiṃśapā* is something that is *considered* or *known as* a tree. See, for example, *Pramāṇavārttika* 1.23, together with the autocommentary (Gnoli edition), discussed by Steinkellner in "Wirklichkeit und Begriff bei Dharmakīrti," *Wiener Zeitschrift für die Kunde Südasiens* 25 (1971): 179–211. In that case, the identity would not be subject to empirical disconfirmation. It would, rather, hold strictly and infallibly so long as the convention is accepted, and an inference based on it would be absolutely certain. Thanks to Professor Steinkellner for raising this point in discussion.

52 – Oetke is of course not the only one to question whether Indian logic is meant to describe deductively valid reasoning. In a forthcoming work Jonardon Ganeri suggests that the earliest stage of Indian logic, represented by the *Carakasaṃhitā* and *Nyāyasūtra,* depicts a kind of informal "case-based" reasoning. See "Indian Logic," forthcoming in *Handbook of the History and Philosophy of Logic,* ed. John Woods and Dov Gabbay (Amsterdam, Elsevier Science B.V.).