DISAPPEARANCE AND KNOWLEDGE*

ANDREW D. CLING

Department of History and Philosophy
The University of Alabama in Huntsville

Paul Churchland argues that the continuity of human intellectual development provides evidence against folk psychology and traditional epistemology, since these latter find purchase only at the later stages of intellectual development. He supports this contention with an analogy from the history of thermodynamics. Careful attention to the thermodynamics analogy shows that the argument from continuity does not provide independent support for eliminative materialism. The argument also rests upon claims about continuity which do not support the claim that the continuity of intellectual development is evidence for the elimination of folk psychology. Traditional epistemology and folk psychology should not yet be abandoned.

According to traditional epistemologists, cognitive success is achieved when a subject forms an appropriate belief—a belief that is justified and true, or is true and has the appropriate causal ancestry, or some such thing. If eliminative materialism is true, this entire approach to epistemology is doomed. Eliminative materialists claim (i) that our commonsense descriptions of mental states are part of a larger empirical theory or "folk psychology" (FP), (ii) that FP is so empirically weak as to be in need of total replacement, and (iii) that FP will (or at least should) be replaced by a theory to emerge from completed brain science. Since a central feature of FP is that intelligent behavior is at least sometimes explained in terms of intentional states like beliefs, and since it seems most unlikely that a completed brain science will cast its explanations of behavior in terms of beliefs, it follows that if eliminative materialism is true, there are no such things as beliefs.[1] And if there are no beliefs, it is plainly quixotic to wonder how we should go about forming them.

Paul Churchland is the foremost defender of eliminative materialism. According to his most familiar arguments, FP should be rejected since it is an explanatorily weak, historically stagnating, and conceptually isolated theory whose resources pale in comparison to those being developed in brain science (Churchland 1979, 1981). But Churchland has a less well

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[1]Intentional states are the culprits, really. For convenience I will usually use 'belief' as a stand-in for any states which are individuated by propositional content using 'that' clauses (the belief *that* Bush is President, the desire *that* the Blues win the Stanley Cup, and so on).

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known argument for eliminative materialism which has an interesting twist. According to this argument the continuity of human intellectual development shows that traditional belief-centered epistemology and psychology cannot be adequate and that a complete psychology and epistemology will need to draw their descriptions of cognition from the brain sciences. In short, Churchland thinks that the incompleteness of traditional epistemology—the fact that it describes only a part of this developmental continuum—provides evidence for eliminative materialism and for the claim that traditional epistemology should be abandoned. In what follows, I want to show why we should reject this argument.

My discussion will proceed as follows. I will first provide a detailed interpretation of Churchland's argument from continuity. I will be especially concerned to analyze the various senses of Churchland's claims concerning the continuity of human intellectual development and to explain the relationship between these various claims and materialism. Next I will show how Churchland's defense of the argument from continuity rests explicitly upon his claim that the relationship between folk psychology and brain science is analogous to the relationship between the classical theory of gases and the kinetic-corpuscular theory of gases. If we take this idea seriously, however, it turns out that the argument from continuity is not independent of Churchland's other arguments for eliminative materialism. Unfortunately for Churchland, other philosophers have shown that those arguments are quite dubious. Finally, I will consider the core intuition behind the argument from continuity: the powerful idea that the continuity of a process of development shows that each aspect of that process can only be correctly described or explained using a theory which applies to all stages of the developmental process. I will argue that, in Churchland's case, this core intuition is based on a skein of claims which do not support the elimination of folk psychology or traditional epistemology.

I

Traditional epistemology is sentential. According to Churchland, the distinctive features of traditional epistemology are the assumptions that the most salient stages of cognitive activity—evidential input, cognitive processing, and theoretical output—can be accurately represented as sentences or sets of sentences, and that the norms for evaluating cognitive activity can be characterized in terms of relations between sentences. According to Churchland, traditional epistemology is ideal sentential automation (ISA) epistemology.

> The search for the essence of rationality consists, on . . . [the ISA] approach, in the search for some suitable function or relation *R* that

> maps states and inputs onto or into subsequent states—that is, into other sets with different members and/or differently assigned weights. A given transition, from one set to another, can then be counted as rational just in case it is an instance of the relation R, and a given state can be counted as rational just in case it is the result of a rational transition. (1979, p. 125–126)

In Churchland's view, ISA epistemology is just a natural extension of our folk-psychological habit of supposing that intelligent human behavior is produced by beliefs.

Here is Churchland's *argument from continuity*:

> (1) Rational (healthy, virtuous) intellectual development in an infant cannot be accurately or even usefully represented by a sequence of sets of sentences suitably related. Bluntly, intellectual development at that stage is not ISA-representable.
> (2) Rational (healthy, virtuous) intellectual development in an infant is entirely continuous with—is not different in fundamental kind from, is basically the same kind of activity as—rational development at later stages, even much later (i.e. adult) stages.
> (3) As a general approach to what rational intellectual development consists in, the ISA approach is pursuing what must be superficial parameters. That is, sentential parameters cannot be among the primitive parameters comprehended by a truly adequate theory of rational intellectual development, and the relevance of sentential parameters must be superficial or at best derivative even in the case of fully mature language-using adults. (1979, pp. 127–128)

Although this argument is quite complex, the basic idea is simple. If we cannot describe, explain, or evaluate the intellectual development of infants in terms of beliefs, but the intellectual development of infants does not differ essentially from the intellectual development of adults, then we cannot describe, explain, or evaluate the intellectual development of adults in terms of beliefs either. Folk psychology and ISA epistemology must be replaced by theories which can describe, explain, and evaluate every stage of the continuous process of intellectual development.

Before we can evaluate this argument, we must be much clearer about the central concepts it employs. I take it that 'intellectual development' is intended to be an omnibus term for referring to the processes by which an organism comes to comprehend or represent its environment, without thereby begging the crucial questions about the terms in which such processes are to be described. Premise 1 claims that although infants develop intellectually, there are many stages in which successful intellectual de-

velopment isn't a matter of acquiring the appropriate beliefs, if only because there are many stages in which the infant simply has no beliefs.

Since the argument from continuity concerns the descriptive and explanatory adequacy of ISA theories, the kind of continuity relevant to premise 2 must be continuity with respect to the applicability of the descriptive predicates of ISA theories. A developmental process is continuous with respect to a given theory only if that theory can describe and explain all stages of that process of development using only the predicates on a specified list of primitive predicates.[2] Later stages of such continuous development may involve more complexity, but it will be a complexity describable in terms of the same set of primitive predicates. Put another way, a process is a continuous one only if a single set of explanatory principles employing only a specified set of primitive predicates suffices to account for the events at each stage of the process. Eliminative materialists claim that the list of primitive predicates from a completed brain science—and, ultimately, the set of primitive predicates of completed physics—that suffices to describe and explain human precognitive development also suffices to describe and explain all stages of intellectual development. With respect to FP, human intellectual development is discontinuous since it is only after a certain point that it even seems possible to describe and explain intelligent behavior in terms of beliefs. But, since it is prima facie plausible to suppose that there is an important sense in which the brain events I am currently undergoing are not radically different from those I underwent as an infant, human intellectual development is continuous with respect to brain science.

'Parameters' is more difficult. What does it mean to speak of the 'parameters' of a theory of intellectual development? Churchland does not provide much help on this matter, for though 'parameters' is one of his favorite words, he never subjects it to critical analysis.

The word 'parameter' itself originates in mathematics. In analytic geometry the equation $y = 3x + b$ describes the set of parallel lines on a plane having a slope of 3. Here b is the parameter of the equation, for the assignment of a particular numerical value to b serves to fix or determine a specific member of this set of lines (Karush 1962, p. 190). This is so because fixing the value of b fixes or determines the x and y coordinates of all other points on the line.

This mathematical notion has been extended into non-mathematical domains. Thus, it can be said that the parameters of an object are "the physical properties whose values determine the characteristics or behavior" of that thing (*Webster's New Collegiate Dictionary,* 1974). We might

[2]This way of putting things was suggested to me by an anonymous referee for this journal.

then say, for example, that strength, conditioning and endurance are the parameters of athletic performance if we think that fixing the values of those characteristics for a person determines the properties which characterize that person's athletic performance.

Here, then, we have some clues to use in specifying the various things one might have in mind when speaking of the parameters of intellectual development. First, we might intend merely to refer to the properties which are mentioned in a purely descriptive account of intellectual development or some aspect of intellectual development. Call these the *intellectual parameters*.

On the other hand, parameters might be identified with the properties expressed by the descriptive predicates which occur in the descriptive consequences or presuppositions of a given *normative* theory of intellectual development. In this sense the parameters of a normative epistemology would be those properties expressed by the descriptive predicates which occur in the consequences of the epistemological theory in question: 'belief', for example. Call these the *epistemological parameters*. Note that the epistemological parameters of a given normative theory won't necessarily be the same as the intellectual parameters of any descriptive theory of cognitive behavior, if only because the normative theory may make use of only some of the descriptive resources made available by the descriptive theory.

A third possibility is that the parameters of cognition might be identified with those properties which just suffice to fix or determine the cognitive properties. Put differently, the parameters of a given set of cognitive properties might be identified with the set of descriptive properties upon which the cognitive properties supervene. By 'cognitive properties' I mean those properties which must be mentioned in giving a complete description and explanation of intellectual development, that is, a description and explanation of every stage of that development. Of course, just what these properties are is controversial. Note, however, that we can give a precise sense to this third sense of 'descriptive parameters' without taking a stand on this issue by making use of the concept of supervenience. Thus, where φ and ψ are two sets of property-expressing predicates, ψ supervenes on φ if, and only if, necessarily, things alike in φ respects must be alike in ψ respects. Let us say that the members of a set of properties φ constitute the *determining parameters* of a set of cognitive properties ψ just in case ψ supervenes on φ. The limiting case here is the case where there is no further descriptive theory upon which ψ supervenes. In such a case the determining parameters of the cognitive theory T would just be the properties expressed by the non-logical predicates of T itself. In such a case, T would be, in a certain sense, descriptively basic.

Unless we are antecedently committed to the implausible metaphysical view that all property-expressing predicates must either reduce to or be eliminated by the property-expressing predicates of a very general and comprehensive theory such as physics, we should hold open the possibility that the determining parameters of a descriptive theory *T* of cognitive behavior might not be the properties mentioned by *T* itself. For example, any materialist is committed to the view that the determining parameters of the properties described by any theory, descriptive or non-descriptive, are the properties of completed physics. That is just to say that materialists believe that things alike in physical respects must be alike in non-physical respects as well. But materialists are not thereby committed to the view that all property-expressing predicates which occur in true theories are thereby reducible to or definable in terms of the predicates of physics (Hellman and Thompson 1975, 1977; Post 1987; Kincaid 1987).

Let's examine some of the relationships between these three senses of 'parameter'. I've already noted that the intellectual parameters of a given theory of cognitive behavior might include the epistemological parameters of a given normative theory. Since traditional epistemology concerns itself with the conditions under which beliefs are or can be justified, an important epistemological parameter of traditional epistemology is the property of having beliefs. At least to this extent, traditional epistemology requires the success of FP. The intellectual parameters of folk psychology itself include the properties of having beliefs, having desires, making choices, undergoing sensations and the other salient properties mentioned by everyday folk in their descriptions and explanations of behavior and intellectual development. It is an open question whether the intellectual parameters of folk psychology are the same as the determining parameters of FP. They will be only if there is no other set of descriptive properties upon which FP supervenes. A materialist is committed to the claim that millennium physics, at least, describes the determining parameters of folk psychology, if folk psychology is true. It is also open to the materialist to claim that a higher-level theory like completed neurophysiology might describe the determining parameters of FP, if FP turns out to be true, but this is in no way required. In no sense is it a requirement of materialism that the descriptive predicates of a given theory are reducible to the predicates which express its determining parameters.

What is most significant in all of this is that the intellectual parameters and the determining parameters of FP are not necessarily the same. A materialist can happily concede that the descriptive and explanatory predicates of FP cannot be eliminated from certain sorts of descriptions and explanations and also claim that there is an important respect in which those predicates aren't fundamental or the most basic. Epistemology, for

example, may require the descriptive integrity of some predicates contained in FP which are not themselves reducible to physical predicates. But traditional epistemology is not by that very fact incompatible with materialism.

Note, however, that it is very easy to identify intellectual parameters and determining parameters. They will pick out exactly the same class of properties provided we require that all property-expressing predicates of any true psychological theory be reducible to predicates at the level of physics. It is easy for philosophers who assume such a reducibility requirement to ignore the distinction between intellectual parameters and determining parameters, for on such a view they pick out exactly the same set of properties.

We are now ready to return to the argument from continuity. Premise 1 makes the claim that intellectual development in an infant cannot be described, explained, or evaluated in terms of the categories of FP. Simply put, babes in arms don't have such things as beliefs. Churchland notes that it is possible to resist this premise by claiming that infants have beliefs and desires whose content is inexpressible in our language (Churchland 1979, p. 129). Churchland dismisses this as ad hoc and adds that, anyway, this just pushes the problem back further. According to him,

> even if we are willing to ascribe inarticulable propositional attitudes to the infant, we must still reckon—at some point in the history of the foetus/infant—with the problem of a transition from a period of intellectual development *not* characterized by the manipulation of propositional attitudes to a period of intellectual development that is so characterized. (Churchland 1979, p. 130)

At *some* point in its development, the human being just doesn't have intentional states. At least babes in wombs don't have beliefs.

We may, then, restate premise 1 as follows:

1*. Neither the intellectual parameters of any adequate psychology of infant intellectual development nor the epistemological parameters of any adequate epistemology of infant intellectual development will include intentional properties.

In a similar way, we may recast premise 2 as follows:

2*. The intellectual parameters of an adequate psychology of adult intellectual development or the epistemological parameters of an adequate epistemology of adult intellectual behavior will be the same as the intellectual parameters of an adequate psychology of infant development or the epistemological parameters of infant epistemology.

From 1* and 2* it follows that

3*. Neither the intellectual parameters of an adequate psychology of adult intellectual development nor the epistemological parameters of an adequate epistemology for adults will include intentional properties.

Defenders of FP, then, are apparently presented with an unhappy trilemma. According to Churchland, they must either insist that intellectual development can be described, explained, and evaluated in terms of folk psychological categories from the earliest stages of development, deny that folk psychological categories can describe adult intellectual development, or find an important discontinuity in the process of intellectual development.

II

We are now in a good position to evaluate the argument from continuity. Churchland's defense of the argument depends upon an analogy from the history of thermodynamics. If we take this analogy seriously, however, we can see that the argument from continuity is not independent of Churchland's other argument for eliminative materialism.

Premise 1* is problematic, but we can accept it provided we grant Churchland's assumption that the intellectual development of the infant begins even prior to birth. Whatever descriptive, explanatory, or evaluative power FP has when applied to the adult human is lost on the infant, especially when we include fetuses or even zygotes in the class of infants. It is worth noting, however, that Churchland presents his claim without benefit of any detailed consideration of psychological approaches to cognitive development, such as those of Piaget, which depend on the descriptive and explanatory adequacy of sentential states. Surely this counts against the plausibility of Churchland's claim that FP, or something quite like it, has nothing to offer our understanding of intellectual development.[3] Indeed, I find it deeply ironic that Churchland—a philosopher so impatient with a priori philosophizing about the mind and so convinced that only empirical science can fully comprehend mentality—rests his case for eliminative materialism largely on abstract philosophical considerations. In any case, let's grant premise 1*, at least for the sake of the argument.

Premise 2* is another story. Compare Churchland's original version to my restatement. The original version totters uneasily between the claim that intellectual development is a continuous process and the claim that

[3]This criticism was suggested to me by an anonymous referee for this journal.

infant psychology and adult psychology are the same. Churchland needs the latter claim—a claim about what we might call "explanatory unity"—to sustain his attack on ISA epistemology/psychology, and 2* captures it in a precise way. The success of Churchland's argument, therefore, depends upon the extent to which developmental continuity is good evidence for explanatory unity.

Churchland is not inviting us onto a slippery slope. He supports his claim that there is an important connection between continuity and explanatory unity with an analogy drawn from the history of science. The classical gas law relating the pressure, volume, mass, and temperature of a gas ($PV = mRT$) works very well when applied to relatively dense volumes of gas. Trouble arises with rarefied gases. In such cases there just is no continuous pressure and no well-defined temperature (Churchland 1979, p. 132). According to Churchland,

> the internal activity of an extremely rarefied gas is not accurately represented by the parameters of early classical temperature and pressure, and the classical gas law that uses them is unable to explain and predict the behavior of such a gas. (1979, p. 132)

As the number of gas molecules in the volume of gas is steadily increased, however, the classical law can be applied more and more effectively. But Churchland warns that

> strictly speaking, the body of gas never acquires the classical properties at all, though we get away with the pretence when the particle density is sufficiently high. The crucial parameters of the behavior of the gas were and remain quite distinct from these. They are still precisely what they were in the rarefied case, and they concern the average velocity of the particles, the mass and dimensions of those particles, their angular momenta, their internal oscillations, their number for a given volume, and so forth. And a truly general and successful understanding of what a gas is, what it does, and why it does it simply cannot be had unless it is based on these more penetrating parameters, as many further empirical failures of the classical conception attest. (1979, p. 133)

With the kinetic-corpuscular theory of gases we have a theory which is both more comprehensive and more powerful than the theory containing the classical gas law, and these are among the reasons why the former replaced the latter. Churchland thinks that there is an important analogy between the gas law case and the case of FP.

> The point of . . . [the gas law example] is that the basic parameters of gaseous behaviour are the same whatever the degree of rarefaction

> of the gas, notwithstanding the increasing degree to which that behaviour becomes "comprehensible" in terms of a different set of putative parameters as particle density increases. Analogously, the claim of premiss (2) is that the basic parameters of rational intellectual activity are the same whatever its stage of development, notwithstanding the increasing degree to which that activity becomes "comprehensible" in terms of propositional attitudes as we consider the later stages of its development. (1979, p. 133)

Churchland thinks that this analogy is so close that it is exact. Thus, Churchland:

> [I have already argued] that the framework of propositional attitudes constitutes a theory of intellectual activity, and a noticeably imperfect theory at that. And we also have it from premiss (1) that there is a class of cases, apparently continuous with our own, where the framework of propositional attitudes fails to find descriptive/predictive/explanatory purchase. All we need now to complete the analogy is the not utterly implausible claim of premiss (2) that the case of human infants is more than just 'apparently continuous' with the case of cogitating adults. (1979, p. 133)

We can agree that the gas law analogy shows at least that the continuity of phenomena to be explained can be relevant to explanatory unity, provided that the competing theories in question are related to each other and to the phenomena to be explained in the way the classical theory of gases is related to the kinetic-corpuscular theory of gases and to the behavior of gases. Churchland's argument for premise 2*, therefore, is best understood as an argument which is designed to show that all points of the analogy are exact. Hence, Churchland's emphasis on continuity is not based on the simple claim that the continuity of phenomena is the only feature relevant to explanatory unity, but on the claim that all the other points of his analogy have been or can be established. Before turning specifically to Churchland's arguments about continuity, therefore, it will be essential to focus more clearly on the gas law analogy.

At least six claims must be established in order to show that a particular case of intertheoretical comparison is analogous to the gas law case. First, (i) the case must be a genuine case of intertheoretical comparison. This is to say that the explanations being compared must both comprise or be parts of distinct theories. Also, (ii) the phenomena to be covered by the theories being compared must be on some sort of smooth continuum. In each case (iii) the suspect theory (the one corresponding to the classical theory of gases) should clearly apply at only one end of the continuum. Fourth, (iv) there must be no clear line of demarcation on the continuum

which marks the point at which the suspect theory begins to apply. Fifth, and for our purposes this is the most important point, (v) the suspect theory must be empirically weak even on that part of the continuum to which it does clearly apply. Lastly, (vi) the allegedly superior theory (the one corresponding to the kinetic-corpuscular theory of gases) must have greater explanatory power than the suspect theory at all points on the continuum.

The rest of Churchland's arguments in defense of the argument from continuity are designed to support points (ii) and (iv), claims not clearly distinguished by Churchland. Note, however, the central importance of points (v) and (vi). Unless (v) is established, that is, unless it is shown that the suspect theory, in this case FP, is empirically weak even on that part of the continuum to which it does apply reasonably well, all other points of analogy will be insufficient to support the elimination of the suspect theory. Reduction or supervenience are options. Likewise, unless (vi) is established, we will have no reason to believe that the allegedly superior theory is capable of replacing the suspect theory.

In the case of the argument from continuity, point (v) is crucial. If it is to be supported by the gas law analogy, the argument from continuity can succeed only if we are given strong *independent* reasons for supposing that FP is a weak empirical theory even at the adult end of the cognitive continuum. That is to say that insofar as it depends on the gas law analogy, the argument from continuity cannot provide independent support for eliminative materialism. It depends upon the success of other arguments against the empirical integrity of FP. Specifically, it depends on showing that FP is a weak theory even in the case of adults. It has been persuasively argued, however, that Churchland's other arguments in favor of eliminative materialism and against the empirical integrity of FP are flawed (Horgan and Woodward 1985). This is due, in large part, to the fact that those allegedly empirical arguments depend upon a dubious metaphysical principle to the effect that all theories must either reduce to physics or be eliminated. Inspite, then, of Churchland's intention that his defense of the argument from continuity provide independent support to his case for eliminative materialism, it provides no such support. For it depends upon and, as a result, is just as dubious as his other arguments against the empirical adequacy of FP.

Point (vi) is important too. Point (vi) requires that before there can be a successful replacement of a theory T_1 by a theory T_2, T_2 must be capable of supplanting T_1 at least to the extent that T_2 has greater explanatory power than T_1, taking into consideration all cases to which either T_1 or T_2 is applicable. Neither physical science nor sentential cognitive psychology offers such a theory at present. Of course, it is unfair to make too much of this particular point. Churchland's argument is not in favor

of any particular completed theory but is instead designed to support a kind of psychological research. He is not claiming that physical science does provide us with a particular theory which is superior to FP. He claims only that there are good reasons for believing that physical science will, or at least can, provide us with such a theory and that such a theory will require a revolution in epistemology. Although we cannot rule out such a possibility a priori, Churchland's defense of the argument from continuity does nothing to make such a prospect likely since it depends crucially upon other arguments against the empirical integrity of FP which have been found wanting.

III

Although Churchland's defense of the argument from continuity requires the success of his other attacks on FP and is not, therefore, independent of them, there is a new element here which may make a difference after all: the emphasis on developmental continuity itself. In this section I will consider the powerful intuition according to which the continuity of the process of human intellectual development shows that each aspect of that process can only be correctly described or explained using a single theory which applies at all stages of intellectual development. We cannot fully dismiss the argument from continuity until we have reasons for rejecting this intuition.

The details of the gas law analogy aside, Churchland's intuition that there is an important connection between the continuity of human intellectual development and the eliminability of FP seems to be based on three related but distinguishable claims: (i) the claim that the discontinuity in intellectual development purportedly described by FP is unreflected in any correlative discontinuity in human structural, behavioral, or functional development; (ii) the claim that there is no definite point in intellectual development at which the predicates of FP begin to apply; and (iii) the claim that any discontinuity represented by the intentional properties of FP would be superfluous at best, since whatever they might be used to explain could be explained at least as effectively in terms of the properties which characterize the underlying behavioral, structural, and functional continuities.

Let's begin with claim (i). Churchland says that "if there is any basic change or shift in the infant's mode of intellectual activity during the first year, it does not show itself in any characteristic change in the development of its behavior" (1979, p. 134). I take Churchland here to mean that there is no point of behavioral discontinuity which corresponds to the point at which FP begins to apply. As Churchland puts it,

> the degree to which infant behavior invites the ascription of specific propositional attitudes, and the degree to which such ascriptions are predictively and explanatorily fruitful, falls off continuously as we consider earlier and earlier stages within the first year, and one's awareness of the extent to which those ascriptions are lame projections or plain romancing increases with equal smoothness. One might of course go on credulously projecting several months back into the womb—no behavioral *discontinuities* bar such foolishness—and that is really the point. (1979, p. 134)

Two features are essential to a behavioral discontinuity as Churchland understands it. These features correspond to the distinction between claim (i) and claim (ii) presented above. The first is what we might call a change in the *kinds* of properties manifested in behavior itself. Using semantic ascent we may understand such a change more precisely, as before, in terms of an addition to the list of primitive predicates necessary to describe or explain a particular stretch of behavior. I take it that something like this feature manifests itself in my behavior when I go from driving my truck to playing ice hockey, but not when I go from taking a slap shot to delivering a body check. A unified set of primitive predicates suffices to describe playing hockey ('passes', shoots', 'scores', and so on); additions to this list of predicates are necessary if we want to describe driving, since neither these predicates nor predicates constructible from them suffices to describe driving. The second essential feature of behavioral discontinuities, according to Churchland, is the existence of a definite point at which such a change in the properties of behavior occurs.

Putting these two features together we see that, for Churchland, a behavioral discontinuity must be a point at which there is a change in the kind of properties manifested in behavior. Put a different way, a behavioral discontinuity in intellectual development would be a point at which an addition to a stock of primitive predicates is necessary in order to describe that behavior. This same strategy can be used generally to understand the nature of discontinuities in developmental processes. The challenge to the defender of FP raised by the problem of continuity, as Churchland sees it, is to find an appropriate line of demarcation between the intentional and the non-intentional portions of the axis of intellectual development which can be specified in terms of a change in the primitive properties manifested in the behavior of the developing infant. If such a point cannot be specified, Churchland reasons, FP should be rejected.

Churchland's structural and functional considerations are much more sketchy than his arguments about behavioral continuity, but the underlying strategy is the same. Concerning structure he claims only that the actual details of the development of the central nervous system betray no

point of discontinuity which marks the distinction between the intentional and the non-intentional (1979, p. 136). Churchland's remarks on the relevance of function are also perfunctory. Although he admits that our knowledge is incomplete, he states that

> we do know that the gross structure of . . . [the network of neurons] is of a kind that fits it for the processing of information, and for evolving in the manner in which it does so. . . . And we know that the structural development the brain undergoes fits it for processing information in more and more complex ways. But nervous activity in a network of this kind is a characteristic of the brain at *all* stages of its development, even to some degree of its immature, pre-natal stage. The brain, in short, is a self-modifying information processor from its inception to its death, and should some portion of that information processing capacity be devoted to the execution of linguistic routines during some substantial portion of the brain's existence, that fact appears as almost incidental from this more general point of view. (1979, p. 136)

Churchland's point here is that insofar as we understand brain function at all, it seems that the brain does pretty much the same sort of thing throughout its career: process information. There is no functional discontinuity to correspond to the discontinuity that would be represented by the intentional properties of FP.

One way of responding to these challenges is to deny Churchland's claim that there are no behavioral, structural, or functional discontinuities of the appropriate kind. One initially attractive move is to identify the point at which the predicates of FP begin to apply with the advent of the capacity to speak. On this move, speaking and thinking are so closely tied to one another that even if they aren't quite identical, then at least they are coincidental. Call the claim that the capacity to speak is a behavioral criterion for the applicability of FP the *language criterion*. Churchland has two responses to the language criterion, each of which is important to understanding the force of his views on the elimination of FP.

Churchland's first response to the language criterion is to argue that since infant behavior can be explained and predicted by FP long before the acquisition of speech, the language criterion does not correspond to another important criterion for the application of FP. According to Churchland, "that second criterion is the degree to which the child's continuing behavior yields profitably to systematic explanation and prediction in terms of the familiar propositional attitudes" (1979, p. 135). Call this the *explanation criterion*. Note that the explanation criterion is not the same sort of criterion as the language criterion since the latter, but not

the former, is stated in terms of certain particular features of behavior itself and makes no reference to the explanatory power of a particular theory of behavior. The explanation criterion is vague, but says that intellectual development can be described in FP terms just when quite a lot of that behavior can be explained or rendered intelligible by FP. I think that the explanation criterion is all the defender of FP needs to answer the argument from continuity, but more on this shortly. For now just note that the explanation criterion opens up the possibility of applying FP to behavior without criteria of application stated in terms of the descriptions of a different theory.

Churchland's second objection to the language criterion is more interesting, for it brings us to yet another important thread of the argument skein. Churchland argues that since the capacity to use language is itself acquired during the course of intellectual development, it is a capacity which must itself be explained by a comprehensive psychology of intellectual development. Thus, any theorist who accepts the language criterion must grant that FP is incomplete, at best. This is for the simple reason that beliefs and desires cannot themselves explain the existence of beliefs and desires ad infinitum. If beliefs and desires only come into existence with the advent of language, then beliefs and desires cannot themselves be invoked to explain either the acquisition of linguistic competence or the existence of beliefs and desires themselves. This sort of problem will arise, according to Churchland, no matter where we place the point of discontinuity between the intentional and the non-intentional.

An instructive recipe generates Churchland's argument against the language criterion. I believe this recipe is at the very heart of one of Churchland's claims about the connection between continuity and elimination—claim (iii) above—and should be distinguished from the considerations which are designed only to show that there are no behavioral discontinuities in human intellectual development which correspond to the point at which FP begins to apply. Let's call this important recipe the *novelty-elimination recipe*. Here's how it goes. First, locate some particular intellectual skill or attribute P with the following properties. Make sure (a) that the skill or attribute in question is itself cited in explanations of at least some aspects of behavior, but also ensure (b) that P appears or is invoked only well after intellectual development has begun. It is helpful, but not strictly necessary, if (c) there are no clear criteria statable in terms drawn from some other theory which mark the first appearance of the attribute or skill in question. Step two in the recipe is to conclude that a theory of intellectual development which makes reference only to P will be, at best, incomplete since, after all, the existence or occurrence of P would itself require explanation. Step three is to conclude from step two that P should be eliminated, since the entities and processes which would

have to explain *P* could themselves be invoked to explain whatever it is that *P* explains.

This recipe captures an important intuition behind the argument from continuity itself. If intellectual development is a continuous process, how can an attribute or skill which appears only after the process is already underway have anything more than superficial descriptive or explanatory power? We can see how important this recipe is to Churchland's eliminativist project generally by considering an argument Churchland gives in support of another of his main arguments against the empirical power of FP. According to Churchland,

> One particularly outstanding mystery . . . [not solved by FP] is the nature of the learning process itself, especially where it involves large-scale conceptual change, and especially as it appears in its pre-linguistic or entirely non-linguistic form (as in infants and animals), which is by far the most common form in nature. FP is faced with special difficulties here, since its conception of learning as the manipulation and storage of propositional attitudes founders on the fact that how to formulate, manipulate, and store a rich fabric of propositional attitudes is itself something that is learned, and is only one among many cognitive skills. FP would thus appear constitutionally incapable of even addressing this most basic of mysteries. (1981, pp. 73–74)

I submit that the argument given in this passage, like Churchland's second argument against the language criterion, is an important variant of the argument from continuity itself. All three share a central intuition. The intuition is that there can be no emergence of genuinely novel properties in a continuous process of development. Since intellectual development is a continuous process, the discontinuity reflected in the intentional properties mentioned by FP must be illusory.

In sum, then, Churchland's intuition that there is an important connection between the continuity of intellectual development and the eliminability of FP is based on three qualms. First, the discontinuity that would be represented by FP is not reflected in a discontinuity expressible in the language of a "lower-level" structural, functional, or behavioral account of intellectual development. Second, it is unclear at exactly which point that discontinuity manifests itself. Lastly, such a discontinuity would be eliminable anyway in favor of those theories which describe the full range of intellectual development.

The way out of Churchland's arguments concerning the connection between continuity and elimination is to begin by granting at least some of their premises. There is, for all we know, a continuous story to tell about human intellectual development at the behavioral, structural, and func-

tional level, but this does not rule out a discontinuity in the same process of development expressible in the language of FP. Likewise, it may be hard to specify *the* point at which FP begins to apply, but the search for such a point may be hindered by the search for a lower-level discontinuity which is not to be found, and, anyway, the explanation criterion provides us with the most powerful reason for taking FP seriously in the first place: explanatory power. Lastly, the novelty-elimination recipe shows only that there must be some principled connection between the intentional properties described by FP and the properties described by the other theories which characterize aspects of intellectual development; it does not show that FP is eliminable by or even reducible to an alternative theory of intellectual development. Let's examine these replies in detail.

When we grant the discontinuity of human intellectual development, we grant only that humans manifest psychological states at later stages in their development that they do not have at earlier stages. I now have some beliefs about the structure of the solar system, but there was a time in my development when I had no beliefs at all. The crucial point is that granting this much discontinuity does not require the existence of a corresponding point of discontinuity expressible in behavioral, structural, or even functional terms which can serve as a criterion for the successful application of FP.

To see why psychological discontinuities need not parallel discontinuities at other levels of description, consider the connection between continuity and demarcation. Recall the principle of supervenience introduced above. All materialists must accept, at a minimum, the supervenience of properties expressed by non-physical predicates upon properties expressed by the predicates of completed physics. This is just to say that materialists think that things alike in all physical respects must be alike in all non-physical respects as well. It may be argued that the supervenience of all properties, including psychological properties, on physical properties requires the existence of a point in intellectual development at which FP begins to apply which would also be describable in the language of physical science. After all, another way of saying that the psychological supervenes on the physical is to say that there cannot be a psychological difference between two organisms without there being some physical difference between them. But a consequence of this is that there cannot be a non-physical difference between two points in a single individual's intellectual development without there being some physical difference between those two points. If I now believe that the Blues will win the Stanley Cup and I didn't believe this yesterday, then that psychological fact about me must be reflected in some change in the purely physical facts about me. If there is some point in an infant's intellectual development when it does come to instantiate the intentional properties of FP, then

there must be some physical difference between that point and all the earlier points at which FP fails to apply. Doesn't this show that supervenience alone implies that there must be significant physical differences between the various stages of intellectual development?

Well, of course it does. It shows that those who accept the supervenience of the psychological on the physical—which includes all materialists—are committed to the existence of physical differences whenever they are committed to non-physical differences. But the crucial point is that differences and discontinuities aren't the same. Physical differences between two stages of development can be expressed without expanding the set of primitive physical predicates. But, as I indicated earlier, we have a discontinuity in a process of development only if this stock of primitive predicates must be expanded to describe the new stage of development. We have no reason to suppose, then, that significant psychological discontinuities can just, as it were, be read off of the physical differences which underwrite them. Psychological discontinuities need not parallel physical, functional, or behavioral discontinuities. This is important, for it shows that although a significant psychological discontinuity may characterize the intellectual development of an individual from zygote to zoologist, such a discontinuity requires only that there be corresponding physical differences and not physical, behavioral, or functional discontinuities.

Interestingly enough, even if psychology were reducible to physics, it still needn't be true that there would be psychological discontinuities only if there were corresponding physical discontinuities. The reducibility of psychology to physics would require the definability of psychological predicates in terms of physical predicates, but this might, in principle, be accomplished without adding to the stock of primitive physical predicates needed to describe the non-intentional stages of intellectual development.[4] Since this is so, the absence of discontinuities at the physical, functional, or behavioral levels of description is no evidence against significant psychological discontinuities. I conclude that the physical, functional, or behavioral continuity of the process of intellectual development gives us no reason to think that there are no significant psychological discontinuities in that process.

What about Churchland's claim that there is no definite point in intellectual development at which FP begins to apply? This charge should be taken seriously on its own merits in spite of the fact that Churchland seems to confuse it with the claim about discontinuity. One response would be to claim that this vagueness about the point of applicability is only a function of the fact that FP has not yet developed into a fully articulated

[4]I owe this very important point to an anonymous referee for this journal.

theory of behavior, but that a developed cognitive science built on the ISA paradigm will provide a more precise understanding of the intentional properties dimly comprehended by FP. Another strategy would be to claim that FP might never be absorbed into a scientific theory at all, but that this is no reason to suppose that its descriptions and explanations are false (Graham and Horgan 1988). From this we might argue that the minor vagueness attending the precise point at which FP's intentional predicates begin to apply is just a function of the fact that given everyday purposes and interests it has never been especially important to refine the intentional idiom of FP so that the point of applicability is clearly understood.

A more direct response to the challenge is to claim that it is a mistake to suppose that the very fact of qualitative differences at the extreme ends of a developmental continuum requires that we fully understand the point on that continuum at which those qualitative differences manifest themselves. At what point in the development of his scalp did Don Rickles become bald? This vagueness should not, however, make us suspicious of the descriptive and explanatory integrity of 'bald'. Nor does such vagueness alone suggest that 'bald' is replaceable by a predicate drawn from a lower-level theory. The case of FP may, for all we now know, be similar. I see no reason to suppose that because there is no clear point in their intellectual development at which infants come to have intentional states that there is never any point at which they have them. We can use the explanation criterion given by Churchland himself to mark the fuzzy boundary at which the intentional emerges from the non-intentional. Explanatory power alone gives us a reason to admit the existence of the propositional attitudes. Without a theory which explains everything that FP explains and then some, we have all the reasons we could have for supposing that there really are intentional states.

This response to Churchland invites an instrumentalist reply. Given the vagueness of the point at which the developing intellect begins to manifest intentional states, shouldn't we just accept FP as a convenient fiction, useful for the time being but with no serious claim to represent the actual properties of intellectual development? This challenge is a serious one, for materialists are committed to a principled relation between the physical and the non-physical, which is to be explained at least in terms of the supervenience relation. A materialist simply cannot hold both that FP is true and that the vagueness with which it applies shows that there is simply no fact of the matter about when FP begins to apply. The supervenience of psychological properties upon physical properties presupposes that there is such a fact of the matter at least to the extent that if FP fails to apply in one case it must also fail to apply to all cases which are relevantly similar in physical respects. But I do not see that this commits us to the claim that if we fail to understand completely the point at

which FP begins to apply, then we have good reasons for supposing that the properties described by FP are fictions. The instrumentalist challenge seems to presuppose that we might have some other evidence, apart from explanatory power, for adopting a realistic interpretation of a theory with no current rivals.[5] Admittedly, if we could explain the full range of intelligent behavior without referring to the intentional properties described by FP, then we would be justified, perhaps, in viewing FP as a convenient fiction. But the mere fact that it is not now completely clear just when FP becomes applicable does not support an instrumentalist interpretation.

Churchland's own gas law example is instructive here. The instrumentalist interpretation of the classical gas law suggested by Churchland is plausible only *after* the articulation of the new kinetic-corpuscular theory of gases. Prior to that, the vagueness attending the applicability of the classical law shows, at most, only that there are some phenomena that the classical theory cannot explain, not that it must be eliminated. It may, for all I know, be possible to explain and evaluate human intelligent behavior without reference to the intentional properties of FP. It seems to me that this is a question that can be settled only by a detailed consideration of the explanatory power of FP and its rivals, and not by metaphysical speculations about the continuity of intellectual development.

This brings us to the novelty-elimination recipe. Since the discontinuity of intellectual development that would be represented by FP would itself need to be explained in non-intentional terms, does this show that we might as well get things over with and dispense with FP straight away? No. Notice first that the novelty-elimination recipe is quite implausible as a general strategy for understanding apparently novel properties: applied across the board it would imply that there are never any discontinuities in any sort of development. But I share Churchland's intuition that there must be a principled connection between the intentional and the non-intentional. Churchland overlooks the possibility, however, that the non-intentional can account for the intentional without explaining it away. One possibility is that intentional properties supervene on the non-intentional properties of physics. Admittedly, if we knew from the start that all true theories must reduce to completed physics, then we would know that the intentional *predicates* employed by FP would be dispensable: the properties they express could always be expressed in the language of physics. But this would hardly show that there are no beliefs. Even so, it simply cannot be built in a priori that all theories must either reduce to physics or be eliminated. The properties described by FP might supervene on physical properties without reducing to them. Since there are so many intelligible possibilities, the only way to decide what we should

[5]This reply was suggested to me by an anonymous referee for this journal.

do with FP is to develop and compare the explanatory merits of both intentional and non-intentional approaches to intellectual development.

IV

We are now in a position to sum up our evaluation of Churchland's argument from continuity against traditional psychology and epistemology. It won't work.

For one thing, the argument depends upon establishing an analogy between the FP/neuroscience confrontation and the classical gas theory/kinetic-corpuscular gas theory confrontation. The argument for this analogy must include evidence for the empirical inadequacy of the theory to be replaced and for the empirical power of the replacing theory. To this extent, the argument from continuity depends upon the success of Churchland's other arguments against the empirical adequacy of FP and for the empirical power of neuroscience. Since they have been shown to be weak, they lend scant support to the argument from continuity.

At a deeper level, Churchland's argument depends upon the claim that genuine novelty in a process of continuous development is impossible. If we grant that the propositional attitudes appear only later in the process of intellectual development, as seems reasonable, and we also grant that the process of development is a continuous one and that we can find no definite point at which FP begins to apply, Churchland thinks that we are thereby committed to the disappearance of the intentional. Churchland is like a skeptic at a magic show. When a magician appears to pull a rabbit from the thin air inside a hat, there are two choices. One must either believe that the rabbit was in the hat all along, or else deny that what was pulled from the hat was really a rabbit. Anything else amounts to belief in magic![6] Though this reasoning is sound on the midway, it is misleading in the philosophy of mind. To see through Churchland's own disappearance act, we must not overlook the possibility that novel mental properties emerge in the course of intellectual development on the basis of the gradual articulation of the nervous system and the continuous expansion of the organism's behavioral repertoire. Since none of this requires that psychological discontinuities be describable as discontinuities in physical, functional, or behavioral terms, or that we know of a definite point in development at which FP begins to apply, the continuity of some aspects of intellectual development is no reason to abandon folk psychology or traditional epistemology. To adapt a phrase from Donald Davidson, folk psychology is in need of elaboration, not elimination.[7]

[6]The rabbit example is due to Professor Donald Sherburne. Sherburne accepts the analogy, however, and uses it in the course of an argument for idealism.

[7]My thanks to Professor John Post and to an anonymous referee for their helpful com-

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